Assessment and Synthetization of Extension Needs Encompassing the Economic and Ecological Impacts of Wild Pigs Among Young Pine Plantations

by

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Abstract

The southeastern United States has recently seen its first increases in Longleaf pine (*Pinus palustris* Mill.) acreage after more than four centuries of decline thanks to ongoing restoration efforts. Connecting existing longleaf landscapes across this species' native range depends largely on the successful establishment of plantations on non-industrial private lands. As in Alabama, the majority of forest lands in southeastern states are owned by non-industrial private landowners. Seedling depredation by wild hogs (*Sus scrofa*) poses a threat to longleaf restoration efforts especially in young forest plantations. Improving the knowledge base about wild hogs among young forest plantations will help guide better management decisions for non-industrial private landowners and resource professionals. This dissertation addresses extensions needs for information regarding wild hogs and explores the relationship between wild hogs and young forest plantations from two perspectives.

First, an extension publication was created to synthesize and organize resource material pertaining to wild hogs in order to supplement the nine year gap since the last published bibliography. Second, a mail survey was conducted among non-industrial private landowners in Alabama to gain an understanding about wild hog damage and control in forest plantations. Findings were used to further explore the economics of wild hog damage and control for a stand level model utilizing longleaf. Third, a field study

was performed to determine wild hog’s preference among seedling species and to observe ecological factors influencing seedling depredation.

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CHAPTER 1

Introduction

The longleaf pine (*Pinus palustris* Mill.) species has endured numerous anthropogenic hardships over the past four centuries, the last century alone has proved the most taxing. Irresponsible logging practices, tapping for pitch, fire suppression, the spread of agriculture, and the introduction of wild hogs are a few factors contributing to the major reduction of a once numerous resource (Frost 1993). During the first half of the 20^{th} century, concern escalated over why longleaf regeneration was not succeeding. Along with fire suppression, wild hogs (*Sus scrofa*) were one of the main factors driving regeneration failure in longleaf pine forests (Frost 1993, Hopkins 1947, Wakeley 1954).

Present in over 44 states, wild hogs are receiving more attention than ever as the problems stemming from their presence become more evident (Mayer 2009a). The deleterious effects of wild hogs on longleaf regeneration both directly and indirectly result from a number of the animals' daily activities. The result of rooting activities can often lead to complete crop failure in forest operations (Campbell and Long 2009, Mayer 2009b, Wakeley 1954). Rooting can also indirectly affect longleaf regeneration by altering the vegetation structure.

Longleaf pine restoration efforts have the potential to be affected by growing wild hog population which currently has proved difficult to manage. This review of the history, ecology, and related research regarding longleaf pine and wild hogs will help bring understanding to an issue centuries in the making.

History and Ecology of Longleaf Pine

The historical range of virgin longleaf forests dominated a belt of land along southeastern states stretching from Virginia to Texas (Schwarz 1907). This 92 million acre expanse of forest was primarily dominated by longleaf pine (Frost 1993). Over thousands of years the landscape afforded ideal growing conditions for this species alone due to the frequent fire interval sparked by lightning (Frost 1993). In addition to lightning, Native Americans started fires in these forests to drive game species towards hunters (Frost 1993).

The understory of historic longleaf forests were comprised primarily of various types of grasses; the most common of which were wire-grass (*Aristida stricta* Michx.) and broomsedge bluestem (*Andropogon virginicus* L.) (Schwarz 1907). One unique aspect of longleaf pine is the canopy structure which allows ample sunlight to reach the forest floor facilitating the growth of grasses (Means 2007). Along with longleaf, grasses were another common species able to grow on a landscape subject to such frequent fire return intervals. Grasses served as an important ignition source for the low intensity fires longleaf require for proper growing conditions (Landers et al. 1995). The lack of natural land barriers allowed fire to burn unimpeded across the Southeast (Chapman 1932). The savannah-like conditions resulting from the longleaf landscape exposed to frequent fire created a unique ecosystem capable of sustaining a high diversity of species richness (Peet 2007, Means 2007). Nearly 900 plants species exist in association with longleaf pine ecosystems, along with 100 bird, 36 mammal, and 170 reptile and amphibian species (NRCS 2011). A comprehensive list of the flora and fauna associated with longleaf pine ecosystems has been described further by Means (2007). Over one-third of the bird species and 69 percent of the mammalian species forage on or near the ground, and rely on the ground cover associated with landscapes maintained by fire (Van Lear et al. 2005). The key to these ecosystems sustaining such a high diversity of species richness is the open-canopied grasslands maintained by frequent fire (Means 2007).

Chapman (1932) explained the many fire adaptations of longleaf allowing it to thrive in the Southeast. First, during the initial growth period longleaf seedlings concentrate growth to the root rather than the stem. Second, nutrients are stored in the roots allowing it to put out new needles after the preexisting needles are burned off. Third, the thick, long needles unique to longleaf may protect the scaly bud from damage by fire. Fourth, longleaf put on thick, fire resistant bark when it commences stem growth. Lastly, young saplings lack many branches discouraging crown fires. Fire was also critical for successful germination and establishment through the elimination of competition. Longleaf have large seeds with limited dispersal range and seedlings are slow growing, remaining in the stemless grass stage for years (Landers et al. 1995). Additionally, fire is critical in reducing damage from brown spot needle blight. Brown spot needle blight is caused by a fungus which grows on the underside of dead grasses and spreads onto the needles of the seedlings by rain splash (Greene 1931). The survival of the saplings is unaffected by this disease as long as fire burns off the needles harboring the fungus.

It did not take long for the first settlers to recognize the valuable resource spread across the southeastern landscape. Roland Harper (1913), a field botanist of the early 20th century, described longleaf as having more uses than any other tree in the world. Frost (1993) documented the historic events which brought about the drastic reduction of longleaf forests. Prior to the 1700's, impacts to longleaf by early European settlers were limited to coastal regions along navigable waterways. Commercial logging began to have a more serious impact on the longleaf population when water-powered sawmills were constructed beginning in 1714. Over the next 50 years, hundreds of these mills materialized over the Southeast but were still limited to areas accessible by rivers.

The naval store industry is responsible for much of the disappearance of longleaf during the 19^{th} century. The sap collected from pine trees was used to produce tar, pitch, rosin, and turpentine and collectively referred to as naval stores. Early records indicate naval stores existed in Virginia some 200 years before the industry peaked in North Carolina. The practice of boxing longleaf for crude turpentine left the trees damaged beyond repair. With the invention of the copper still in 1834, turpentine distillation was made vastly more efficient and profitable. The copper still allowed for the commercial exploitation of longleaf from North Carolina to Texas. Advances in steam technology and logging railroads during the period of 1870-1920 devastated the last remaining expanses of virgin forest in the South. By this point longleaf was being shipped around the world because of its value as a superior lumber product.

Frost (1993) postulated the failure of longleaf to regenerate itself was driven by three factors. First, around the turn of the 19th century, much of the southern landscape had been converted to open pastureland or agricultural fields. Longleaf, limited by the short range of seed dispersal, could not restock these open areas. Also, historic longleaf sites were being restocked with faster growing pine species like loblolly (*Pinus taeda*) and slash pine (*Pinus elliottii*). Second, there was a period during 1910-1930 where prescribed or intentional burning was outlawed due to the misconstrued belief that fire was harmful to southern forests. Fire suppression from the southern forest system proved detrimental to longleaf's ability to regenerate itself and allowed competition to take over the understory. Third, the open grazing of livestock was practiced up until the end of the 19th century. These free ranging livestock would have significantly impacted longleaf regeneration, especially the hog (Frost 1993).

Currently, the small numbers of longleaf forests resembling pre-settlement conditions are second-growth forests (Landers et al. 1995). Costa and DeLotelle (2007) describe most longleaf forests found scattered across the South as more even-aged structured and with denser understories composed primarily of shrub cover. According to Costa and DeLotelle (2007), this alteration of forest structure and loss of herbaceous cover has resulted in a reduction in faunal diversity and extirpation of many vertebrate species. Numerous species of plants and animals are now listed as endangered, threatened, and under conservation concern as a result of the disappearance of longleaf pine habitat (Means 2007, Van Lear et al. 2005). These at-risk species are described in more detail by Means (2007). Two endangered keystone species who have received the most public attention are the red-cockaded woodpecker (*Picoides borealis*) and the gopher tortoise (*Gopherus polyphemus*) (Costa and DeLotelle 2007, Means 2007, Van Lear et al. 2005).

There are many who would regard the longleaf species as one of the most treasured forest resources in the southern United States (US) (Alavalapati et al. 2007). Longleaf restoration efforts have become considerably more commonplace due to a rising public preference for their valuable market outputs (timber and non-timber products) and non-market outputs (biodiversity, ecological services, and aesthetics) The US Forest Service, Department of the Interior, and US Department of Agriculture's (USDA) Natural Resources Conservation Service (NRCS) are highly involved in the restoration of longleaf pine to its historic range (Alavalapati et al. 2007, LPC 2017). More comprehensive details concerning the policies and cost-share programs created to incentivize landowners to plant more longleaf are described by Alavalapati et al. (2007). Private landowners play a critical role in the future of longleaf pine and with a unified effort perhaps this species will once again become a substantial component of southern forests.

History and Ecology of Wild Hogs

Mayer (2009a) composed the most complete historical account of wild hogs in the US to date. The origins of wild hogs are widespread and varied, for this reason it is nearly impossible to narrow down what species were introduced and when. There were essentially two types of *S. scrofa* introduced to the US, the Eurasian wild boar and domestic swine. It is commonly accepted among scientists and professionals that *S.*

scrofa encompasses the Eurasian wild boar, domestic swine, feral hogs, and any hybrids found in the US.

Spanish explorers Hernan Cortes and Hernado De Soto hold the first documented introduction of hogs to the continental US in the 1500's (Mayer 2009a). Hogs were an important food source to early explorers making them an essential commodity to bring on expeditions. Pigs were also a highly sought-after food source for Native Americans, who frequently traded or stole pigs from the Spaniards. Many other Spanish, French, and English explorers and colonists came after De Soto bringing with them more hogs. Native Americans would later provide colonist with salted pork and corn proving critical for their survival during their initial establishment. Free-ranging hogs proved to be the most economical way to raise pigs. Over the ensuing centuries open range practices of early settlers, farmers, and Native Americans would facilitate the establishment of feral populations (West et al. 2009).

It was during the 19th century that the Eurasian wild boar was introduced to the US by wealthy sportsmen (Mayer 2009a). Though the animals were kept in fenced hunting preserves, they would inevitably escape. The first of these hunting reserves was in New Hampshire, followed by more in North Carolina and Texas. These marked the most notable populations of escaped hogs who would later make up the populations currently seen in the US. The continued expansion of wild hogs across the country has been primarily manmade through the translocation by hunters favoring this game species. Interbreeding has occurred between the Eurasian boar and the feral pigs producing many of the hybrids currently found in the wild.

In addition to illegal translocation and release, the expansion of wild hog populations in North America is largely due to a prolific reproductive ability (Mayer 2009a). Once introduced to an area, the reproductive potential and adaptable biology of these animals enables them to quickly become established (Seward et al. 2004, West et al. 2009). Male wild hogs become sexually mature as young as 4-5 months and reach puberty within their first year (Comer and Mayer 2009). They are capable of breeding year round, though most breeding is done by larger, older males. Females are sexually mature as young as 3-4 months old and also reach puberty within their first year. The average litter size is 5-6 piglets and females can become pregnant within a month after giving birth (Comer and Mayer 2009, Graves 1984). Gestation periods last 112 to 120 days and females typically reproduce once a year, though they are capable of producing nearly two litters a year (Comer and Mayer 2009).

Most of the damage relating to wild hogs comes from aggressive foraging behaviors, specifically rooting (Mayer 2009b). Rooting often takes place in the winter or early spring when above-ground resources are scarce (Ballari and Barrios-Garcia 2014). These animals root to obtain food by breaking up and loosening soil in a search for roots, tubers, fungi, and burrowing animals (Mayer 2009b). Wild hogs are opportunistic omnivores (or generalist feeders), with food selection being influenced by energy requirements, food availability, and seasonal and geographic variations (Ballari and Barrios-Garcia 2014). Ballari and Barrios-Garcia (2014) synthesized scientific literature pertaining to wild hog diet and found a number of studies showed diet varied based on seasonally available foods. The study concluded that wild hogs consume above-ground vegetable parts in the spring, fruits year-round except the spring, and hard mast during autumn and winter. Plant matter makes up 90 percent of wild hog's diet while invertebrates play a small but important role. Invertebrates are eaten throughout the year and research suggests they are a required food source for wild hogs.

As ecosystem engineers, wild hogs are capable of impacting forest communities on a number of different levels (Campbell and Long 2009, Crooks 2002). Many studies have examined how the activities of this species affect forest ecosystems by disturbing soils, mainly by rooting, ultimately changing the understory composition (Arrington et al. 1999, Bratton 1975, Chavarria et al. 2007, Engeman et al. 2003, Fagiani et al. 2014, Howe et al. 1976, Ickes et al. 2001, Lacki and Lancia 1986, Wirthner et al. 2012, Wood and Roark 1980). The majority of studies show rooting in introduced ranges has a negative effect on plant communities suggesting that plants are not adapted to wild hog disturbance (Ballari and Barrios-Garcia 2014). Other studies emphasized the wild hog's ability to reduce forest regeneration (Bruinderink and Hazebroek 1996, Hanson and Karstad 1959, Ickes et al. 2005, Siemann et al. 2009, Sweitzer and Van Vuren 2002).

Direct and Indirect Impacts of Wild Hogs on Longleaf Forests

Wild hogs have had a notable impact on forestry and timber resources (Campbell and Long 2009, Mayer 2009b, Mayer et al. 2000). The direct impacts most often involve pine species and include: girdling mature trees through rubbing, damaging the lateral roots by rooting or chewing, and damaging the bark by tusking (Mayer 2009b). Another direct impact of wild hogs, and the most economically costly, is their predation of planted pine seedlings (Mayer 2009b, Mayer et al. 2000). This primarily involves longleaf in its grass stage, but has also been observed with other southern pines like loblolly pine, slash pine, and pitch pine (*P. rigida*) (Wakeley 1954). A single hog is reportedly capable of rooting up to six longleaf pine seedlings a minute, destroying an estimated 400-1000 seedlings a day (Hopkins 1947, Wakeley 1954).

Lipscomb (1989) showed wild hogs have a profound effect on longleaf pine regeneration. In South Carolina, he observed after two growing seasons, only eight of 845 longleaf pine seedlings survived hog predation in an unfenced area, versus 64 percent of seedlings surviving in fenced-in sites. Wood and Roark (1980) concluded the hogs are not actually consuming the pine saplings, but instead are chewing on the roots to access the sap and starches, then discarding the woody tissue. The damage done to the rootstock and lower portion of the stem result in seedling mortality and repeated over a large enough area can cause regeneration failure (Mayer 2009b).

Rooting indirectly affects longleaf regeneration by creating environments that favor pioneer and exotic species (Barrios-Garcia and Ballari 2012). Similarly, Singer et al. (1984) found rooting in deciduous forests can reduce as much as 80 percent of the understory and result in a change in vegetation composition. Siemann et al. (2009) found a significant increase in woody exotic species took place in areas where rooting occurred. Increasing the amount of exotic and pioneer species would cause longleaf seedlings to remain in the grass stage for a longer period of time and extend the period of vulnerability to wild hogs. Additionally, Singer et al. (1984) found wild hog activities can expose anywhere from 560-1130 tree roots per acre by rooting. Though many of the roots were not broken, they were exposed and vulnerable to the environment.

Wallowing often takes place in conjunction with rooting (Mayer 2009b). Though wallowing does not disturb as large of an area as rooting activities, it can indirectly cause mortality in longleaf seedlings by crushing, trampling, or pulling up trees within a wallowing pit. Wallow pits and rooted areas become fire barriers which can affect how efficiently a prescribed burn (or natural fire) carries through a stand.

There are many research topics of wild hogs in forest settings, but very few pertain to longleaf. Wild hogs affinity for longleaf pine seedlings has been documented over the past century but little research has been done other than showing that excluding wild hogs improves longleaf seedling survival (Lipscomb 1989). Additional research is needed in the future to better understand the connection between wild hogs and longleaf. Such an understanding could lead to better trapping and management techniques. Currently, the best option for protecting forest stands from wild hogs is to use a combination of available management techniques including exclusion fencing, general hunting, hunting with dogs, and trapping (Campbell and Long 2009). Managing wild hogs is helpful on a short term basis while longleaf seedlings are in the grass stage but an efficient long term wild hog management solution has yet to be found.

Dissertation Synopsis

This dissertation was created to meet research and extension needs concerning the impact of wild hogs on young forest plantations. Though there is a strong emphasis on wild hog damage to longleaf pine, the trends and topics discussed in the following chapters have broader implications. The research objectives defined below are a positive step towards increasing the knowledge base on wild hogs in the areas of economics, ecology, and extension. The first research objective was to address the need for an updated bibliography of recent published resource material pertaining to wild hogs. The second research objective was to estimate and examine the economic impacts of wild hogs in non-industrial privately owned forests within Alabama. The third research objective was to determine wild hog's preference among seedling species and to observe ecological factors influencing seedling depredation. By achieving these research objectives, a greater understanding about wild hogs will contribute to improving the management of this species. To achieve the research objectives, this dissertation presents the results of three separate projects:

1. The first project (Chapter 2) built on the previous works of Wolf and Conover (2003) and Mayer and Shedrow (2007). This chapter synthesizes and organizes a number of different resource materials pertaining to wild hogs into a single searchable online document. Materials in the updated bibliography include selected journal articles, books, extension publications, conference proceeding articles, Internet publications, and academic theses. This bibliography was created to supplement the nine year gap since the last bibliography of works concerning wild hogs. Subject categories are included with each entry that best describe the nature of the material and how it applies to wild hogs. When available, the country where the work originated was included. Along with being included as the second chapter of this dissertation, the bibliography has been published by the Alabama Cooperative Extension System and is available at the following link: http://www.aces.edu/pubs/docs/F/FOR-2047/FOR-2047.pdf.

2. The second project (Chapter 3) involved a survey sent to non-industrial private landowners across Alabama. The survey was designed to simultaneously capture information related to wild hog presence on private lands, damage to forested areas, forest types, control methods, and hunting. Descriptive statistics were used on the survey data and the results were organized by major physiographic region. Survey results revealed the level and cost of wild hog damage and control taking place in Alabama. This information was then used to build a stand level economic model of a longleaf pine stand in order to explore the potential economic implications of landowner responses to wild hog damage. Sensitivity analyses were performed on the costs of damage and control to observe how prices fluctuated when exposed to a range of potential discount rates and amounts of damage.
3. The third project (Chapter 4) involved a field study where wild hogs preference towards pine and hardwood seedlings were observed at two sites. Five tree species were planted at each site and observational visits were made monthly throughout the study period. One site received a heavy amount of hunting pressure while the other site did not. Site conditions were recorded so ecological inferences could be made about wild hog damage to planted seedlings.

CHAPTER 2

Wild Pig (*Sus scrofa*): An Update Bibliography

2.1. Introduction

This bibliography is a compilation of selected journal articles, books, extension publications, conference proceeding articles, Internet publications, and academic theses and dissertations from 2007 to present. This bibliography was created to supplement the nine year gap since the last bibliography of works concerning wild hogs published by John J. Mayer and C. Barry Shedrow "Annotated Bibliography of the Wild Pig (Sus Scrofa)" (2007). Information on wild hogs from works published before 2007 can be found in Wolf and Conover's (2003), "Feral pigs and the environment: an annotated bibliography". As with Mayer and Shedrow's bibliography, the purpose of this document is to provide a readily accessible summary of literature on wild hogs. Only works pertaining specifically to wild hog research and management were selected for this bibliography. The author did not include entries which mentioned wild hogs in a general/minimal manner; nor did the author include references concerning all species in genus *Sus*. References comparing domestic pigs to their wild counterparts were included. In a few cases, general studies with wild hogs as a primary focus or sample group were included.

Due to the broad nature of work being done around the world regarding wild hogs, it should be noted that this bibliography does not include every article related to the species, but is merely a starting point for those interested in learning more about *Sus* species. Sources were identified using a computer database through Auburn University Libraries, and on the Internet's World Wide Web. The entries are followed by subject categories to assist the users of this bibliography to find the appropriate references they may need. Topics pertaining to subject categories are defined in Mayer and Shedrow's (2007) bibliography; those topics include, archaeological/paleontology, behavior, contamination, control/management, damage, diseases/parasites, domestication, ecology, economics, folklore/fiction, food habits, genetics, history, hunting, morphology, physiology, population biology, predation, radioecology, reproduction, and taxonomy. For most studies, the country where the study was conducted is noted in parenthesis after the subject categories associated with each entry. This bibliography will continue to be updated in the future. Please forward suggestions for the articles that were not included or published after 2016 to:

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2.2. Bibliography

A

Abe, M., Ito, N., Sakai, K., Kaku, Y., Oba, M., Nishimura, M., Kurane, I., Saijo, M., Morikawa, S., Sugiyama, M. and Mizutani, T. 2011. **A novel sapelovirus-like virus isolation from wild boar.** *Virus Genes*, 43(2): 243-248.

Key words: Diseases/Parasites (Japan)

Acevedo, P., Quirós-Fernández, F., Casal, J. and Vicente, J. 2014. **Spatial distribution of wild boar population abundance: basic information for spatial epidemiology and wildlife management.** *Ecological Indicators*, 36: 594-600.

Key words: Population Biology (Spain)

Acevedo, P., Vicente, J., Höfle, U., Cassinello, J., Ruiz-fons, F. and Gortázar, C. 2007. **Estimation of European wild boar relative abundance and aggregation: a novel method in epidemiological risk assessment.** *Epidemiology and Infection*, 135(03): 519-527.

Key words: Population Biology (Spain)

Ahn, K.S., Ahn, A.J., Kim, T.H., Suh, G.H., Joo, K.W. and Shin, S.S. 2015. **Identification and prevalence of *Globocephalus samoensis* (Nematoda: Ancylostomatidae) among wild boars (*Sus scrofa coreanus*) from southwestern regions of Korea.** *The Korean Journal of Parasitology*, 53(5): 611-618.

Key words: Diseases/Parasites (Korea)

Ahn, K.S., Oh, D.S., Ahn, A.J., Suh, G.H. and Shin, S.S. 2013. **First record of *Bourgelatia diducta* (*Nematoda*: Chabertiidae) from wild boars in the Republic of Korea.** *The Korean Journal of Parasitology*, 51(4): 441-448.

Key words: Diseases/Parasites (Korea)

Albarella, U., Dobney, K. and Rowley-Conwy, P. 2009. **Size and shape of the Eurasian wild boar (*Sus scrofa*), with a view to the reconstruction of its Holocene history.** *Environmental Archaeology*, 14(2): 103-136.

Key words: Archaeological/ Paleontology, Morphology

Albayrak, H., Ozan, E. and Cavunt, A. 2013. **A serological survey of selected pathogens in wild boar (*Sus scrofa*) in northern Turkey.** *European Journal of Wildlife Research*, 59(6): 893-897.

Key words: Diseases/Parasites (Turkey)

Albayrak, İ. and Inci, S. 2007. **The karyotype of the wild boar *Sus scrofa* Linnaeus, 1758 in Turkey (Mammalia: Artiodactyla).** *Turkish Journal of Zoology*, 31(1): 65-68.

Key words: Genetics, Taxonomy (Turkey)

Albiach-Serrano, A., Bräuer, J., Cacchione, T., Zickert, N. and Amici, F. 2012. **The effect of domestication and ontogeny in swine cognition (*Sus scrofa scrofa* and *S. s. domestica*).** *Applied Animal Behaviour Science*, 141(1): 25-35.

Key words: Domestication, Physiology (Germany)

Alexandri, P., Triantafyllidis, A., Papakostas, S., Chatzinikos, E., Platis, P., Papageorgiou, N., Larson, G., Abatzopoulos, T.J. and Triantaphyllidis, C. 2012. **The Balkans and the colonization of Europe: the post-glacial range expansion of the wild boar, *Sus scrofa*.** *Journal of Biogeography*, 39(4): 713-723.

Key words: Genetics, Population Biology, Taxonomy (Greece)

Alves, P. C., Pinheiro, Í., Godinho, R., Vicente, J., Gortázar, C. and Scandura, M. 2010. **Genetic diversity of wild boar populations and domestic pig breeds (*Sus scrofa*) in south-western Europe.** *Biological Journal of the Linnean Society*, 101(4): 797-822.

Key words: Domestication, Ecology, Genetics, Taxonomy (France/Austria)

Amaral, A.J., Megens, H.J., Crooijmans, R.P., Heuven, H.C. and Groenen, M.A. 2008. **Linkage disequilibrium decay and haplotype block structure in the pig.** *Genetics*, 179(1): 569-579.

Key words: Domestication, Genetics

Amici, A., Cifuni, G.F., Contò, M., Esposito, L. and Failla, S. 2015. **Hunting area affects chemical and physical characteristics and fatty acid composition of wild boar (*Sus scrofa*) meat.** *Rendiconti Lincei*, 26(3): 527-534.

Key words: Hunting, Morphology (Italy)

Amici, A., Serrani, F. and Adriani, S. 2016. **Somatic variability in wild boar (*Sus scrofa* L.) in different areas of central Italy.** *Italian Journal of Animal Science*, 9(1): 39-44.

Key words: Ecology, Morphology (Italy)

Amici, A., Serrani, F., Rossi, C.M. and Primi, R. 2012. **Increase in crop damage caused by wild boar (*Sus scrofa* L.): the "refuge effect".** *Agronomy for Sustainable Development*, 32(3): 683-692.

Key words: Damage, Hunting (Italy)

Amills, M., Ramírez, O., Galman-Omitogun, O. and Clop, A. 2013. **Domestic pigs in Africa.** *African Archaeological Review*, 30(1): 73-82.

Key words: History (Africa)

Amos, W. and Acevedo-Whitehouse, K. 2009. **A new test for genotype–fitness associations reveals a single microsatellite allele that strongly predicts the nature of tuberculosis infections in wild boar.** *Molecular Ecology Resources*, 9(4): 1102-1111.

Key words: Diseases/Parasites, Genetics

Anderson, L.G., Gortázar, C., Vicente, J., Hutchings, M.R. and White, P.C. 2013**.** **Modelling the effectiveness of vaccination in controlling bovine tuberculosis in wild boar.** *Wildlife Research*, 40(5): 367-376.

Key words: Diseases/Parasites (Spain)

Andersson, A., Äänismaa, R., Huusko, J. and Jensen, P. 2011. **Behaviour of European wild boar (*Sus scrofa*) in connection with farrowing in an enclosure.** *Mammalian Biology-Zeitschrift für Säugetierkunde*, 76(3): 332-338.

Key words: Behaviour (Sweden)

Andersson, A., Valros, A., Rombin, J. and Jensen, P. 2011. **Extensive infanticide in enclosed European wild boars (*Sus scrofa*).** *Applied Animal Behaviour Science*, 134(3): 184-192.

Key words: Behavior (Finland/Sweden)

Andraszek, K., Gryzińska, M., Ceranka, M. and Larisch, A. 2015. **Structure of nucleoli in first-order spermatocytes of selected free-living animal species.** *Animal Reproduction Science*, 161: 16-22.

Key words: Morphology

Anezaki, T. 2007. **Pig exploitation in the southern Kanto region, Japan.** *International Journal of Osteoarchaeology*, 17(3): 299-308.

Key words: Archeological/Paleontology (Japan)

Anezaki, T. 2009. **Estimating age at death in Jomon Japanese wild boar (*Sus scrofa leucomystax*) based on the timing of molar eruption in recent comparative samples.** *Mammal Study*, 34(2): 53-63.

Key words: Archeological/Paleontology, Morphology (Japan)

Antolová, D., Reiterová, K. and Dubinsky, P. 2007. **Seroprevalence of *Toxoplasma gondii* in wild boars (*Sus scrofa)* in the Slovak Republic.** *Annals of Agricultural and Environmental Medicine*, 14(1): 71-73.

Key words: Diseases/Parasites (Slovakia)

Aoun, O., Lacour, S.A., Levieuge, A., Marié, J.L., Vallée, I. and Davoust, B. 2012. **Screening for *Trichinella britovi* infection in red fox (*Vulpes vulpes*) and wild boar (*Sus scrofa*) in southeastern France.** *Journal of Wildlife Diseases*, 48(1): 223-225.

Key words: Diseases/Parasites (France)

Aravena, P., Skewes, O. and Gouin, N. 2015. **Mitochondrial DNA diversity of feral pigs from Karukinka Natural Park, Tierra del Fuego Island, Chile**. *Genetics and Molecular Research*, 14(2): 4245-4257.

Key words: Genetics, Taxonomy (Chile)

Arenas-Montes, A., García-Bocanegra, I., Paniagua, J., Franco, J.J., Miró, F., Fernández-Morente, M., Carbonero, A. and Arenas, A. 2013. **Blood sampling by puncture in the cavernous sinus from hunted wild boar.** *European Journal of Wildlife Research*, 59(2): 299-303.

Key words: Physiology

Arslan, A. and Albayrak, I. 2009. **C-banded karyotype and nucleolar organizer regions (NORs) of wild boar, *Sus scrofa* (Artiodactyla: Suidae) from Anatolia.** *Turkish Journal of Biology*, 33(1): 29-33.
Key words: Genetics (Turkey)

B

Babayev, E.A., Magomedov, M.R., Akhmedov, E.G. and Yarovenko, Y.A. 2010. **Specific features of the wild boar (*Sus scrofa*) population structure in Piedmont Daghestan.** *Zoologichesky Zhurnal*, 89(3): 371-377.
Key words: Population Biology (Russia)

Bacchetta, R., Mantecca, P., Lattuada, L., Quaglia, F., Vailati, G. and Apollonio, M. 2007. **The carpal gland in wild swine: functional evaluations.** *Italian Journal of Zoology*, 74(1): 7-12.
Key words: Morphology (Italy)

Bagamian, K.H., Skrypnyk, A., Rodina, Y., Bezymennyi, M., Nevolko, O., Skrypnyk, V. and Blackburn, J.K. 2014. **Serological anthrax surveillance in wild boar (*Sus scrofa*) in Ukraine.** *Vector-Borne and Zoonotic Diseases*, 14(8): 618-620.
Key words: Diseases/Parasites (Ukraine)

Balasse, M., Evin, A., Tornero, C., Radu, V., Fiorillo, D., Popovici, D., Andreescu, R., Dobney, K., Cucchi, T. and Bălăşescu, A. 2016. **Wild, domestic and feral? Investigating the status of suids in the Romanian Gumelniţa (5th mil. cal BC) with biogeochemistry and geometric morphometrics.** *Journal of Anthropological Archaeology*, 42: 27-36.
Key words:Archaeological/Paleontology, Morphology (Romania)

Balkaya, I., Utuk, A.E., Babur, C., Beyhan, Y.E., Piskin, F.C. and Sozdutmaz, I. 2015. **Detection of *Toxoplasma gondii* and *Neospora caninum* antibodies in wild boars (*Sus scrofa*) in eastern Turkey.** *Israel Journal of Veternairy Medicine*, 70: 28-31.
Key words: Diseases/Parasites (Turkey)

Ballari, S.A. and Barrios-García, M.N. 2014. **A review of wild boar *Sus scrofa* diet and factors affecting food selection in native and introduced ranges.** *Mammal Review*, 44(2): 124-134.

Key words: Food Habits

Ballari, S.A., Cuevas, M.F., Cirignoli, S. and Valenzuela, A.E. 2015. **Invasive wild boar in Argentina: using protected areas as a research platform to determine distribution, impacts and management.** *Biological Invasions,* 17(6): 1595-1602.

Key words: Control/Management, Damage, Population Biology (Argentina)

Ballari, S.A., Cuevas, M.F., Ojeda, R.A. and Navarro, J.L. 2015. **Diet of wild boar (*Sus scrofa*) in a protected area of Argentina: the importance of baiting.** *Mammal Research*, 60(1): 81-87.

Key words: Control/Management, Food Habits (Argentina)

Ballesteros, C., Carrasco-García, R., Vicente, J., Carrasco, J., Lasagna, A., de la Fuente, J. and Gortázar, C. 2009. **Selective piglet feeders improve age-related bait specificity and uptake rate in overabundant Eurasian wild boar populations.** *Wildlife Research*, 36(3): 203-212.

Key words: Control/Management (Spain)

Ballesteros, C., Garrido, J.M., Vicente, J., Romero, B., Galindo, R.C., Minguijón, E., Villar, M., Martín-Hernando, M.P., Sevilla, I., Juste, R. and Aranaz, A. 2009. **First data on Eurasian wild boar response to oral immunization with BCG and challenge with a *Mycobacterium bovis* field strain.** *Vaccine*, 27(48): 6662-6668.

Key words: Diseases/Parasites (Spain)

Ballesteros, C., Gortázar, C., Canales, M., Vicente, J., Lasagna, A., Gamarra, J.A., Carrasco-García, R. and De la Fuente, J. 2009. **Evaluation of baits for oral vaccination of European wild boar piglets.** *Research in Veterinary Science,* 86(3): 388-393.

Key words: Control/Management (Spain)

Ballesteros, C., Vicente, J., Carrasco-García, R., Mateo, R., de la Fuente, J. and Gortázar, C. 2011. **Specificity and success of oral-bait delivery to Eurasian wild boar in Mediterranean woodland habitats.** *European Journal of Wildlife Research,* 57(4): 749-757.

Key words: Contorl/Management (Spain)

Bancerz-Kisiel, A., Platt-Samoraj, A., Szczerba-Turek, A., Syczyło, K. and Szweda, W. 2015. **The first pathogenic *Yersinia enterocolitica* bioserotype 4/O: 3 strain isolated from a hunted wild boar (*Sus scrofa*) in Poland.** *Epidemiology and Infection*, 143(13): 2758-2765.

Key words: Diseases/Parasites (Poland)

Bankovich, B., Boughton, E., Boughton, R., Avery, M.L. and Wisely, S.M. 2016. **Plant community shifts caused by feral swine rooting devalue Florida rangeland.** *Agriculture, Ecosystems & Environment*, 220: 45-54.

Key words: Food Habits (Florida-USA)

Barasona, J.A., Latham, M.C., Acevedo, P., Armenteros, J.A., Latham, A.D.M., Gortazar, C., Carro, F., Soriguer, R.C. and Vicente, J. 2014. **Spatiotemporal interactions between wild boar and cattle: implications for cross-species disease transmission.** *Veterinary Research*, 45(122): 1-11.

Key words: Diseases/Parasites (Spain)

Barbisan, F., Savio, C., Bertorelle, G., Patarnello, T. and Congiu, L. 2009. **Duplication polymorphism at MHC class II DRB1 locus in the wild boar (*Sus scrofa*).** *Immunogenetics*, 61(2): 145-151.

Key words: Genetics (Italy)

Barrios-Garcia, M.N. and Ballari, S.A. 2012. **Impact of wild boar (*Sus scrofa*) in its introduced and native range: a review.** *Biological Invasions*, 14(11): 2283-2300.

Key words: Damage

Barrios-Garcia, M.N. and Simberloff, D. 2013. **Linking the pattern to the mechanism: how an introduced mammal facilitates plant invasions.** *Austral Ecology*, 38(8): 884-890.

Key words: Food Habits (Argentina)

Barrios-Garcia, M.N., Classen, A.T. and Simberloff, D. 2014. **Disparate responses of above-and belowground properties to soil disturbance by an invasive mammal.** *Ecosphere*, 5(4): 1-13.

Key words: Damage (Argentina)

Baubet, E., Servanty, S. and Brandt, S. 2009. **Tagging piglets at the farrowing nest in the wild: some preliminary guidelines.** *Acta Silvatica Lignaria Hungarica*, 5: 159-166.

Key words: Behavior (France)

Baums, C.G., Verkühlen, G.J., Rehm, T., Silva, L.M., Beyerbach, M., Pohlmeyer, K. and Valentin-Weigand, P. 2007. **Prevalence of *Streptococcus suis* genotypes in wild boars of northwestern Germany.** *Applied and Environmental Microbiology*, 73(3): 711-717.

Key words: Diseases/Parasites (Germany)

Beasley, J., Webster, S.C., Rhodes, O.E. and Cunningham, F.L., 2015. **Evaluation of Rhodamine B as a biomarker for assessing bait acceptance in wild pigs.** *Wildlife Society Bulletin*, 39(1), pp.188-192.

Key words: Control/Management (South Carolina-USA)

Beasley, J.C., Grazia, T.E., Johns, P.E. and Mayer, J.J. 2014. **Habitats associated with vehicle collisions with wild pigs.** *Wildlife Research*, 40(8): 654-660.

Key words: Damage (South Carolina-USA)

Belkin, V., Panchenko, D., Tirronen, K. and Danilov, P. 2012. **Semi-free ranging ungulates in European taiga.** *Zoology and Ecology*, 22(1): 1-8.

Key words: Reproduction (Russia)

Beltrán-Beck, B., Ballesteros, C., Vicente, J., De la Fuente, J. and Gortázar, C. 2012. **Progress in oral vaccination against tuberculosis in its main wildlife reservoir in Iberia, the Eurasian wild boar.** *Veterinary Medicine International*, 1-11.

Key words: Diseases/Parasites (Iberia)

Beltrán-Beck, B., Romero, B., Boadella, M., Casal, C., Bezos, J., Mazariegos, M., Martín, M., Galindo, R.C., de la Lastra, J.M.P., Villar, M. and Garrido, J.M. 2014.

Tonsils of the soft palate do not mediate the response of pigs to oral vaccination with heat-inactivated *Mycobacterium bovis*. *Clinical and Vaccine Immunology*, 21(8): 1128-1136.

Key words: Diseases/Parasites

Bengsen, A.J., Gentle, M.N., Mitchell, J.L., Pearson, H.E. and Saunders, G.R. 2014. **Impacts and management of wild pigs *Sus scrofa* in Australia.** *Mammal Review*, 44(2): 135-147.

Key words: Control/Management, Damage (Australia)

Beral, M., Rossi, S., Aubert, D., Gasqui, P., Terrier, M.E., Klein, F., Villena, I., Abrial, D., Gilot-Fromont, E., Richomme, C. and Hars, J. 2012. **Environmental factors associated with the seroprevalence of *Toxoplasma gondii* in wild boars (*Sus scrofa*), France.** *EcoHealth*, 9(3): 303-309.

Key words: Diseases/Parasites (France)

Bergagna, S., Zoppi, S., Ferroglio, E., Gobetto, M., Dondo, A., Giannatale, E.D., Gennero, M.S. and Grattarola, C. 2009. **Epidemiologic survey for *Brucella suis* biovar 2 in a wild boar (*Sus scrofa*) population in northwest Italy.** *Journal of Wildlife Diseases*, 45(4): 1178-1181.

Key words: Diseases/Parasites (Italy)

Bergman, I.M., Edman, K., Ekdahl, K.N., Rosengren, K.J. and Edfors, I. 2012. **Extensive polymorphism in the porcine toll-like receptor 10 gene.** *International Journal of Immunogenetics*, 39(1): 68-76.

Key words: Genetics (Czech Republic)

Bergman, I.M., Rosengren, J.K., Edman, K. and Edfors, I. 2010. **European wild boars and domestic pigs display different polymorphic patterns in the toll-like receptor (TLR) 1, TLR2, and TLR6 genes.** *Immunogenetics*, 62(1): 49-58.

Key words: Domestication, Genetics, Taxonomy

Beskardes, V., Yilmaz, E. and Oymen, T. 2010. **Evaluation on management of wild boar (*Sus scrofa* L.) population in Bolu-Sazakici hunting ground.** *Journal of Environmental Biology*, 31: 207-212.

Key words: Control/Management (Turkey)

Bevins, S., Blizzard, E., Bazan, L. and Whitley, P. 2013. ***Neospora caninum* exposure in overlapping populations of coyotes (*Canis latrans*) and feral swine (*Sus scrofa*).** *Journal of Wildlife Diseases*, 49(4): 1028-1032.
Key words: Diseases/Parasites (USA)

Bevins, S.N., Pedersen, K., Lutman, M.W., Gidlewski, T. and Deliberto, T.J. 2014. **Consequences associated with the recent range expansion of nonnative feral swine.** *BioScience*, 1-9.
Key words: Control/Management, Damage, Diseases/Parasites (USA)

Bianco, E., Nevado, B., Ramos-Onsins, S.E. and Pérez-Enciso, M. 2015. **A deep catalog of autosomal single nucleotide variation in the pig.** *PLOS ONE*, 10(3): 1-21
Key words: Genetics, Taxonomy

Bianco, E., Soto, H.W., Vargas, L. and Pérez-Enciso, M. 2015. **The chimerical genome of Isla del Coco feral pigs (Costa Rica), an isolated population since 1793 but with remarkable levels of diversity.** *Molecular Ecology*, 24(10): 2364-2378.
Key words: Genetics, Taxonomy (Costa Rica)

Bilandžić, N., Sedak, M., Vratarić, D., Perić, T. and Šimić, B. 2009. **Lead and cadmium in red deer and wild boar from different hunting grounds in Croatia.** *Science of the Total Environment*, 407(14): 4243-4247.
Key words: Contamination (Croatia)

Bilska-Zając, E., Różycki, M., Chmurzyńska, E., Marucci, G., Cencek, T., Karamon, J. and Bocian, Ł. 2013. **Trichinella species circulating in wild boar (*Sus scrofa*) populations in Poland.** *International Journal for Parasitology: Parasites and Wildlife*, 2: 211-213.
Key words: Diseases/Parasites (Poland)

Binois, A., Bridault, A., Pion, G. and Ducrocq, T. 2014. **Dental development pathology in wild artiodactyls: two prehistoric case studies from France.** *International Journal of Paleopathology*, 4: 53-58.
Key words: Archaeological/Paleontology (France)

Blackwell, P.G., Niu, M., Lambert, M.S. and LaPoint, S.D. 2015. **Exact Bayesian inference for animal movement in continuous time.** *Methods in Ecology and Evolution*, 7: 184-195.

Key words: Behavior

Bleier, N., Lehoczki, R., Újváry, D., Szemethy, L. and Csányi, S. 2012. **Relationships between wild ungulates density and crop damage in Hungary.** *Acta Theriologica*, 57(4): 351-359.

Key words: Damage (Hungary)

Boadella, M., Acevedo, P., Vicente, J., Mentaberre, G., Balseiro, A., Arnal, M., Martínez, D., García-Bocanegra, I., Casal, C., Álvarez, J. and Oleaga, Á. 2011. **Spatio-temporal trends of Iberian wild boar contact with *Mycobacterium tuberculosis* complex detected by ELISA.** *EcoHealth*, 8(4): 478-484.

Key words: Diseases/Parasites (Spain)

Boadella, M., Barasona, J.A., Pozio, E., Montoro, V., Vicente, J., Gortazar, C. and Acevedo, P. 2012. **Spatio-temporal trends and risk factors for Trichinella species infection in wild boar (*Sus scrofa*) populations of central Spain: a long-term study.** *International Journal for Parasitology*, 42(8): 739-745.

Key words: Diseases/Parasites (Spain)

Boadella, M., Díez-Delgado, I., Gutiérrez-Guzmán, A.V., Höfle, U. and Gortázar, C. 2012. **Do wild ungulates allow improved monitoring of flavivirus circulation in Spain?.** *Vector-Borne and Zoonotic Diseases*, 12(6): 490-495.

Key words: Diseases/Parasites (Spain)

Boadella, M., Gortázar, C., Vicente, J. and Ruiz-Fons, F. 2012. **Wild boar: an increasing concern for Aujeszky's disease control in pigs?.** *BMC Veterinary Research*, 8(1):1-7.

Key words: Diseases/Parasites (Portugal)

Boadella, M., Ruiz-Fons, J.F., Vicente, J., Martín, M., Segalés, J. and Gortazar, C. 2012. **Seroprevalence evolution of selected pathogens in Iberian wild boar.** *Transboundary and Emerging Diseases*, 59(5): 395-404.

Key words: Diseases/Parasites (Portugal)

Boadella, M., Vicente, J., Ruiz-Fons, F., de la Fuente, J. and Gortazar, C. 2012. **Effects of culling Eurasian wild boar on the prevalence of *Mycobacterium bovis* and Aujeszky's disease virus.** *Preventive Veterinary Medicine*, 107(3): 214-221.
Key words: Diseases/Parasites (Spain)

Bobek, B. 2014. **Use of a line intercept snow track index and plot sampling for estimating densities of wild boar (*Sus scrofa*) in southwestern Poland.** *Wildlife Biology in Practice*, 10(3): 7-16.
Key words: Population Biology (Poland)

Boqvist, S., Bergström, K. and Magnusson, U. 2012**. Prevalence of antibody to six Leptospira servovars in Swedish wild boars.** *Journal of Wildlife Diseases*, 48(2): 492-496.
Key words: Diseases/Parasites (Sweden)

Borji, H., Sadeghi, H., Razmi, G., Pozio, E. and La Rosa, G. 2012. **Trichinella infection in wildlife of northeast of Iran.** *Iranian Journal of Parasitology*, 7(4): 57-61.
Key words: Diseases/Parasites (Iran)

Boros, Á., Nemes, C., Pankovics, P., Kapusinszky, B., Delwart, E. and Reuter, G. 2012. **Porcine teschovirus in wild boars in Hungary.** *Archives of Virology*, 157(8): 1573-1578.
Key words: Diseases/Parasites (Hungary)

Borza, C., Neghina, A.M., Dumitrascu, V., Tirnea, L., Calma, C.L. and Neghina, R. 2012. **Epizootiology of trichinellosis in pigs and wild boars in western Romania, 1998–2011.** *Vector-Borne and Zoonotic Diseases*, 12(8): 712-713.
Key words: Diseases/Parasites (Romania)

Bosch, J., De La Torre, A., Alexandrov, T., Iglesias, I., Miteva, A. and Munoz, M.J. 2014. **Can habitat suitability predict the presence of wild boar? Suitable land uses vs. georeferenced data in Bulgaria.** *Folia Zoologica*, 63(3): 194-205.
Key words: Population Biology (Bulgaria)

Bosch, J., Mardones, F., Pérez, A., De la Torre, A. and Muñoz, M.J. 2014. **A maximum entropy model for predicting wild boar distribution in Spain.** *Spanish Journal of Agricultural Research*, 12(4): 984-999.

Key words: Population Biology (Spain)

Bosch, J., Peris, S., Fonseca, C., Martinez, M., De La Torre, A., Iglesias, I. and Muñoz, M.J. 2012. **Distribution, abundance and density of the wild boar on the Iberian Peninsula, based on the CORINE program and hunting statistics.** *Folia Zoologica*, 61(2):138-151.

Key words: Population Biology (Portugal, Spain)

Bosse, M., Madsen, O., Megens, H.J., Frantz, L.A., Paudel, Y., Crooijmans, R.P. and Groenen, M.A. 2015. **Hybrid origin of European commercial pigs examined by an in-depth haplotype analysis on chromosome 1.** *Frontiers in Genetics*, 5:1-9.

Key words: Domestication

Bosse, M., Megens, H.J., Frantz, L.A., Madsen, O., Larson, G., Paudel, Y., Duijvesteijn, N., Harlizius, B., Hagemeijer, Y., Crooijmans, R.P. and Groenen, M.A. 2014. **Genomic analysis reveals selection for Asian genes in European pigs following human-mediated introgression.** *Nature Communications*, 5: 1-8.

Key words: Domestication

Bosse, M., Megens, H.J., Madsen, O., Frantz, L.A., Paudel, Y., Crooijmans, R.P. and Groenen, M.A. 2014. **Untangling the hybrid nature of modern pig genomes: a mosaic derived from biogeographically distinct and highly divergent *Sus scrofa* populations.** *Molecular Ecology*, 23(16): 4089-4102.

Key words: Taxonomy

Bosse, M., Megens, H.J., Madsen, O., Paudel, Y., Frantz, L.A., Schook, L.B., Crooijmans, R.P. and Groenen, M.A. 2012. **Regions of homozygosity in the porcine genome: consequence of demography and the recombination landscape.** *PLOS Genetics*, 8(11): 1-15.

Key words: Genetics

Braga, C., Alexandre, N., Fernández-Llario, P. and Santos, P. 2010. **Wild boar (*Sus scrofa*) harvesting using the espera hunting method: side effects and management implications.** *European Journal of Wildlife Research*, 56(3): 465-469.

Key words: Control/Management (Portugal)

Brook, R.K. and van Beest, F.M. 2014. **Feral wild boar distribution and perceptions of risk on the central Canadian prairies.** *Wildlife Society Bulletin*, 38(3): 486-494.

Key words: Population Biology (Canada)

Bruinderink, G.G. and Lammertsma, D.R. 2008. **Aspects of wild boar management on the Veluwe.** *De Levende Natuur*, 109(4): 176-180.

Key words: Control/Management (Netherlands)

Brunet, J., Hedwall, P.O., Holmström, E. and Wahlgren, E. 2016. **Disturbance of the herbaceous layer after invasion of an eutrophic temperate forest by wild boar.** *Nordic Journal of Botany*, 34: 120-128.

Key words: Food Habits (Sweden)

Bueno, C.G. and Jiménez, J.J. 2014. **Livestock grazing activities and wild boar rooting affect alpine earthworm communities in the central Pyrenees (Spain).** *Applied Soil Ecology*, 83: 71-78.

Key words: Food Habits (Spain)

Bueno, C.G., Alados, C.L., Gómez-García, D., Barrio, I.C. and García-González, R. 2009. **Understanding the main factors in the extent and distribution of wild boar rooting on alpine grasslands.** *Journal of Zoology*, 279(2): 195-202.

Key words: Ecology (Spain)

Bueno, C.G., Barrio, I.C., García-González, R., Alados, C.L. and Gómez-García, D. 2010. **Does wild boar rooting affect livestock grazing areas in alpine grasslands?.** *European Journal of Wildlife Research*, 56(5): 765-770.

Key words: Damage (Spain)

Bueno, C.G., Barrio, I.C., García-González, R., Alados, C.L. and Gómez García, D. 2011. **Assesment of wild boar rooting on ecological and pastoral values of alpine pyrenean grasslands.** *Pirineos. Revista de Ecología de Montaña*, 166: 51-67.

Key words: Food Habits, Ecology (Spain)

Bueno, C.G., Reiné, R., Alados, C.L. and Gómez-García, D. 2011. **Effects of large wild boar disturbances on alpine soil seed banks.** *Basic and Applied Ecology*, 12(2): 125-133.

Key words: Food Habits (Spain)

Burgos-Paz, W., Souza, C.A., Castelló, A., Mercadé, A., Okumura, N., Sheremet'Eva, I.N., Huang, L.S., Cho, I.C., Paiva, S.R., Ramos-Onsins, S. and Pérez-Enciso, M. 2013. **Worldwide genetic relationships of pigs as inferred from X chromosome SNPs.** *Animal Genetics*, 44(2): 130-138.

Key words: Taxonomy

Burgos-Paz, W., Souza, C.A., Megens, H.J., Ramayo-Caldas, Y., Melo, M., Lemús-Flores, C., Caal, E., Soto, H.W., Martínez, R., Alvarez, L.A. and Aguirre, L. 2013. **Porcine colonization of the Americas: a 60k SNP story**. *Heredity*, 110(4): 321-330.

Key words: Taxonomy

Burrascano, S., Copiz, R., Del Vico, E., Fagiani, S., Giarrizzo, E., Mei, M., Mortelliti, A., Sabatini, F.M. and Blasi, C. 2015. **Wild boar rooting intensity determines shifts in understorey composition and functional traits.** *Community Ecology*, 16(2): 244-253.

Key words: Food Habits (Italy)

Burrascano, S., Giarrizzo, E., Bonacquisti, S., Copiz, R., Del Vico, E., Fagiani, S., Mortelliti, A. and Blasi, C. 2015. **Quantifying *Sus scrofa* rooting effects on the understorey of the deciduous broadleaf forests in Castelporziano Estate (Italy).** *Rendiconti Lincei*, 26(3): 317-324.

Key words: Food Habits (Italy)

Burri, C., Vial, F., Ryser-Degiorgis, M.P., Schwermer, H., Darling, K., Reist, M., Wu, N., Beerli, O., Schöning, J., Cavassini, M. and Waldvogel, A. 2014. **Seroprevalence of hepatitis E virus in domestic pigs and wild boars in Switzerland.** *Zoonoses and Public Health*, 61(8): 537-544.

Key words: Diseases/Parasites (Switzerland)

Bywater, K.A., Apollonio, M., Cappai, N. and Stephens, P.A. 2010. **Litter size and latitude in a large mammal: the wild boar *Sus scrofa*.** *Mammal Review*, 40(3): 212-220.

Key words: Reproduction

C

Cadar, D., Cságola, A., Lőrincz, M., Tombácz, K., Kiss, T., Spînu, M. and Tuboly, T. 2011. **Genetic detection and analysis of porcine bocavirus type 1 (PoBoV1) in European wild boar (*Sus scrofa*).** *Virus Genes*, 43(3): 376-379.

Key words: Diseases/Parasites (Transylvania)

Cadar, D., Cságola, A., Lőrincz, M., Tombácz, K., Spînu, M. and Tuboly, T. 2012. **Detection of natural inter-and intra-genotype recombination events revealed by cap gene analysis and decreasing prevalence of PCV2 in wild boars.** *Infection, Genetics and Evolution*, 12(2): 420-427.

Key words: Diseases/Parasites (Transylvania)

Cadar, D., Cságola, A., Spinu, M., Dán, Á., Ursu, K., Lőrincz, M. and Tuboly, T. 2010. **Prevalence of porcine circoviruses in Transylvanian wild boars, detected by real-time PCR—short communication.** *Acta Veterinaria Hungarica*, 58(4): 475-481.

Key words: Diseases/Parasites (Transylvania)

Cadar, D., Dán, Á., Tombácz, K., Lőrincz, M., Kiss, T., Becskei, Z., Spînu, M., Tuboly, T. and Cságola, A. 2012. **Phylogeny and evolutionary genetics of porcine parvovirus in wild boars.** *Infection, Genetics and Evolution*, 12(6): 1163-1171.

Key words: Diseases/Parasites (Transylvania)

Cahill, S., Llimona, F., Cabañeros, L. and Calomardo, F. 2012. **Characteristics of wild boar (*Sus scrofa*) habituation to urban areas in the Collserola Natural Park (Barcelona) and comparison with other locations.** *Animal Biodiversity and Conservation*, 35(2): 221-233.

Key words: Behavior, Ecology (Spain)

Cai, J., Jiang, Z., Zeng, Y., Li, C. and Bravery, B.D. 2008. **Factors affecting crop damage by wild boar and methods of mitigation in a giant panda reserve.** *European Journal of Wildlife Research*, 54(4): 723-728.

Key words: Damage (China)

Calenge, C. and Rossi, S. 2014. **Bayesian modelling of hunting data may improve the understanding of host–parasite systems: wild boar diseases and vaccination as an example.** *Journal of Theoretical Biology*, 343: 32-43.

Key words: Diseases/Parasites (France)

Calero-Bernal, R., Gómez-Gordo, L., Saugar, J.M., Frontera, E., Pérez-Martín, J.E., Reina, D., Serrano, F.J. and Fuentes, I. 2013. **Congenital toxoplasmosis in wild boar (*Sus scrofa*) and identification of the *Toxoplasma gondii* types involved.** *Journal of Wildlife Diseases*, 49(4): 1019-1023.

Key words: Diseases/Parasites (Spain)

Campbell, T.A. and Long, D.B. 2008. **Mammalian visitation to candidate feral swine attractants.** *The Journal of Wildlife Management*, 72(1): 305-309.

Key words: Control/Management (Texas-USA)

Campbell, T.A. and Long, D.B. 2009. **Feral swine damage and damage management in forested ecosystems.** *Forest Ecology and Management*, 257(12): 2319-2326.

Key words: Control/Management

Campbell, T.A. and Long, D.B. 2009. **Strawberry-flavored baits for pharmaceutical delivery to feral swine.** *The Journal of Wildlife Management*, 73(4): 615-619.

Key words: Control/Management (Texas-USA)

Campbell, T.A. and Long, D.B. 2010. **Activity patterns of wild boars (*Sus scrofa*) in southern Texas.** *The Southwestern Naturalist*, 55(4): 564-567.

Key words: Behavior (Texas-USA)

Campbell, T.A., Long, D.B. and Massei, G. 2011. **Efficacy of the Boar-Operated-System to deliver baits to feral swine.** *Preventive Veterinary Medicine*, 98(4): 243-249.

Key words: Control/Management (Texas-USA)

Campbell, T.A., Long, D.B., Bazan, L.R., Thomsen, B.V., Robbe-Austerman, S., Davey, R.B., Soliz, L.A., Swafford, S.R. and VerCauteren, K.C. 2011. **Absence of *Mycobacterium bovis* in feral swine (*Sus scrofa*) from the southern Texas border region.** *Journal of Wildlife Diseases*, 47(4): 974-978.

Key words: Diseases/Parasites (Texas-USA)

Campbell, T.A., Long, D.B., Lavelle, M.J., Leland, B.R., Blankenship, T.L. and VerCauteren, K.C. 2012. **Impact of baiting on feral swine behavior in the presence of culling activities.** *Preventive Veterinary Medicine*, 104(3): 249-257.

Key words: Control/Management (Texas-USA)

Cano-Gómez, C., García-Casado, M.A., Soriguer, R., Palero, F. and Jiménez-Clavero, M.A. 2013. **Teschoviruses and sapeloviruses in faecal samples from wild boar in Spain**. *Veterinary Microbiology*, 165(1): 115-122.

Key words: Diseases/Parasites (Spain)

Cano-Manuel, F.J., Lopez-Olvera, J., Fandos, P., Soriguer, R.C., Pérez, J.M. and Granados, J.E. 2014. **Long-term monitoring of 10 selected pathogens in wild boar (*Sus scrofa*) in Sierra Nevada national park, southern Spain.** *Veterinary Microbiology*, 174(1): 148-154.

Key words: Diseases/Parasites (Spain)

Canu, A., Costa, S., Iacolina, L., Piatti, P., Apollonio, M. and Scandura, M. 2014. **Are captive wild boar more introgressed than free-ranging wild boar? Two case studies in Italy.** *European Journal of Wildlife Research*, 60(3): 459-467.

Key words: Behavior (Italy)

Canu, A., Scandura, M., Merli, E., Chirichella, R., Bottero, E., Chianucci, F., Cutini, A. and Apollonio, M. 2015. **Reproductive phenology and conception synchrony in a natural wild boar population.** *Hystrix, The Italian Journal of Mammalogy*, 26(2): 77-84.

Key words: Reproduction (Italy)

Caratti, S., Rossi, L., Sona, B., Origlia, S., Viara, S., Martano, G., Torre, C. and Robino, C. 2010. **Analysis of 11 tetrameric STRs in wild boars for forensic purposes.** *Forensic Science International: Genetics*, 4(5): 339-342.

Key words: Genetics (Italy)

Carbonero, A., Paniagua, J., Torralbo, A., Arenas-Montes, A., Borge, C. and García-Bocanegra, I. 2014. **Campylobacter infection in wild artiodactyl species from southern Spain: occurrence, risk factors and antimicrobial susceptibility.** *Comparative Immunology, Microbiology and Infectious Diseases*, 37(2): 115-121.

Key words: Diseases/Parasites (Spain)

Castro-Hermida, J.A., García-Presedo, I., González-Warleta, M. and Mezo, M. 2011. **Prevalence of Cryptosporidium and Giardia in roe deer (*Capreolus capreolus*) and wild boars (*Sus scrofa*) in Galicia (NW, Spain).** *Veterinary Parasitology*, 179(1): 216-219.

Key words: Diseases/Parasites (Spain)

Célio Alves, P., Pinheiro, Í., Godinho, R., Vicente, J., Gortázar, C. and Scandura, M. 2010. **Genetic diversity of wild boar populations and domestic pig breeds (*Sus scrofa*) in south-western Europe.** *Biological Journal of the Linnean Society*, 101(4): 797-822.

Key words: Taxonomy

Cellina, S., Schley, L., Krier, A., and Roper, T. J. 2007. **Influence of supplementary feeding on wild boar *Sus scrofa*.** *Beitraege zur Jagd- und Wildforschung*, 32: 373-378.

Key words: Control/Management

Centner, T.J. and Shuman, R.M. 2015**. Governmental provisions to manage and eradicate feral swine in areas of the United States.** *Ambio*, 44(2): 121-130.

Key words: Control/Management (USA)

Cha, S.H., Choi, E.J., Park, J.H., Yoon, S.R., Kwon, J.H., Yoon, K.J. and Song, J.Y. 2007. **Phylogenetic characterization of classical swine fever viruses isolated in Korea between 1988 and 2003.** *Virus Research*, 126(1): 256-261.

Key words: Diseases/Parasites (Korea)

Charoensook, R., Brenig, B., Gatphayak, K. and Knorr, C. 2011. **Further resolution of porcine phylogeny in southeast Asia by Thai mtDNA haplotypes.** *Animal Genetics*, 42(4): 445-450.

Key words: Taxonomy (Thailand)

Chatfield, J., Milleson, M., Stoddard, R., Bui, D.M. and Galloway, R. 2013. **Serosurvey of leptospirosis in feral hogs (*Sus scrofa*) in Florida.** *Journal of Zoo and Wildlife Medicine*, 44(2): 404-407.

Key words: Diseases/Parasites (Florida-USA)

Chen, C.H., Huang, H.L., Yang, H.Y., Lai, S.H., Yen, N.T., Wu, M.C. and Huang, M.C. 2013. **Mitochondrial genome of Taiwan pig (*sus scrofa*).** *African Journal of Biotechnology*, 10(13): 2556-2561.

Key words: Genetics (Taiwan)

Chen, K., Baxter, T., Muir, W.M., Groenen, M.A. and Schook, L.B. 2007. **Genetic resources, genome mapping and evolutionary genomics of the pig (*Sus scrofa*).** *International Journal of Biological Sciences*, 3(3): 153-165.

Key words: Genetics

Chen, L., Jin, L., Li, M., Tian, S., Che, T., Tang, Q., Lan, J., Jiang, Z., Li, R., Gu, Y. and Li, X. 2014. **Snapshot of structural variations in the Tibetan wild boar genome at single-nucleotide resolution.** *Journal of Genetics and Genomics*, 12(41): 653-657.

Key words: Genetics (China)

Chen, S., Gomes, R., Costa, V., Rocha, I., Zsolnai, A., Anton, I., Charneca, R., Santos, P., Nunes, J.L., Buzgó, J. and Varga, G. 2012. **Novel coding genetic variants of the GBP1 gene in wild and domestic pigs (*Sus scrofa*).** *Livestock Science*, 146(1): 1-4.

Key words: Genetics (China)

Chen, S., Gomes, R., Costa, V., Santos, P., Charneca, R., Zhang, Y.P., Liu, X.H., Wang, S.Q., Bento, P., Nunes, J.L. and Buzgó, J. 2013. **How immunogenetically different are domestic pigs from wild boars: a perspective from single-nucleotide polymorphisms of 19 immunity-related candidate genes.** *Immunogenetics*, 65(10): 737-748.

Key words: Taxonomy (China)

Chiari, M., Cortinovis, C., Bertoletti, M., Alborali, L., Zanoni, M., Ferretti, E. and Caloni, F. 2015. **Lead, cadmium and organochlorine pesticide residues in hunted red deer and wild boar from northern Italy.** *Food Additives & Contaminants: Part A*, 32(11): 1867-1874.

Key words: Contamination (Italy)

Chiari, M., Ferrari, N., Bertoletti, M., Avisani, D., Cerioli, M., Zanoni, M., Alborali, L.G., Lanfranchi, P., Lelli, D., Martin, A.M. and Antonio, L. 2015. **Long-term surveillance of Aujeszky's disease in the Alpine wild boar (*Sus scrofa*).** *EcoHealth*, 12(4): 563-570.

Key words: Diseases/Parasites (Italy)

Chiari, M., Ferrari, N., Zanoni, M. and Alborali, L. 2014. ***Mycoplasma hyopneumoniae* temporal trends of infection and pathological effects in wild boar populations.** *European Journal of Wildlife Research,* 60(2): 187-192.

Key words: Diseases/Parasites (Italy)

Chiari, M., Zanoni, M., Tagliabue, S., Lavazza, A. and Alborali, L.G. 2013. **Salmonella serotypes in wild boars (*Sus scrofa*) hunted in northern Italy.** *Acta Veterinaria Scandinavica*, 55(42): 1-4.

Key words: Diseases/Parasites (Italy)

Cho, I.C., Han, S.H., Fang, M., Lee, S.S., Ko, M.S., Lee, H., Lim, H.T., Yoo, C.K., Lee, J.H. and Jeon, J.T. 2009. **The robust phylogeny of Korean wild boar (*Sus scrofa coreanus*) using partial D-loop sequence of mtDNA.** *Molecules and Cells*, 28(5): 423-430.

Key words: Taxonomy (Korea)

Cho, Y., Lim, S., Jeoung, H., Kim, Y. M., Song, J., Lee, J., and An, D. 2015. **Serological evidence for influenza virus infection in Korean wild boars.** *The Journal of Veterinary Medical Science*, 77(1): 109-112.

Key words: Diseases/Parasites (Korea)

Choi, S.K., Lee, J.E., Kim, Y.J., Min, M.S., Voloshina, I., Myslenkov, A., Oh, J.G., Kim, T.H., Markov, N., Seryodkin, I. and Ishiguro, N. 2014. **Genetic structure of wild**

boar (*Sus scrofa*) populations from East Asia based on microsatellite loci analyses. *BMC Genetics*, 15(85): 1-10.
Key words: Genetics

Closa-Sebastià, F., Casas-Díaz, E., Cuenca, R., Lavín, S., Mentaberre, G. and Marco, I. 2011. **Antibodies to selected pathogens in wild boar (*Sus scrofa*) from Catalonia (NE Spain).** *European Journal of Wildlife Research*, 57(4): 977-981.
Key words: Diseases/Parasites (Italy)

Cocca, G., Sturaro, E., Dal Compare, L. and Ramanzin, M. 2010. **Wild boar (*Sus scrofa*) damages to mountain grassland. A case study in the Belluno province, eastern Italian Alps.** *Italian Journal of Animal Science*, 6(1s): 845-847.
Key words: Food Habits (Italy)

Coelho, C., Gomes, J., Inácio, J., Amaro, A., Mesquita, J.R., Pires, I., Lopes, A.P. and Vieira-Pinto, M. 2015. **Unraveling *Sarcocystis miescheriana* and *Sarcocystis suihominis* infections in wild boar.** *Veterinary Parasitology*, 212(3): 100-104.
Key words: Diseases/Parasites (Spain)

Coelho, C., Lopes, A.P., Mesquita, J.R., Cardoso, L. and Vieira-Pinto, M. 2015. ***Toxoplasma gondii* infection in hunted wild boars (*Sus scrofa*): heart meat juice as an alternative sample to serum for the detection of antibodies.** *EcoHealth*, 12(4): 685-688.
Key words: Diseases/Parasites (Spain)

Coelho, C., Vieira-Pinto, M., Faria, A.S., Vale-Gonçalves, H., Veloso, O., das Neves Paiva-Cardoso, M., Mesquita, J.R. and Lopes, A.P. 2014. **Serological evidence of *Toxoplasma gondii* in hunted wild boar from Portugal.** *Veterinary Parasitology*, 202(3): 310-312.
Key words: Diseases/Parasites (Spain)

Cohen, M., Costantino, S.N., Calcagno, M.A., Blanco, G.A., Pozio, E. and Venturiello, S.M. 2010. **Trichinella infection in wild boars (*Sus scrofa*) from a protected area of Argentina and its relationship with the presence of humans.** *Veterinary Parasitology*, 169(3): 362-366.
Key words: Diseases/Parasites (Argentina)

Cole, R.J. and Litton, C.M. 2014. **Vegetation response to removal of non-native feral pigs from Hawaiian tropical montane wet forest.** *Biological Invasions*, 16(1): 125-140.

Key words: Food Habits (Hawaii-USA)

Colino–Rabanal, V.J., Bosch, J., Muñoz, M.J. and Peris, S.J. 2012. **Influence of new irrigated croplands on wild boar (*Sus scrofa*) road kills in NW Spain.** *Animal Biodiversity and Conservation*, 35(2): 247-252.

Key words: Damage (Spain)

Contzen, M., Sting, R., Blazey, B. and Rau, J. 2011. ***Corynebacterium ulcerans* from diseased wild boars.** *Zoonoses and Public Health*, 58(7): 479-488.

Key words: Diseases/Parasites (Germany)

Cooper, S.M., Scott, H.M., De la Garza, G.R., Deck, A.L. and Cathey, J.C. 2010. **Distribution and interspecies contact of feral swine and cattle on rangeland in south Texas: implications for disease transmission.** *Journal of Wildlife Diseases*, 46(1): 152-164.

Key words: Diseases/Parasites (Texas-USA)

Cooper, S.M. and Sieckenius, S.S. 2016. **Habitat selection of wild pigs and northern bobwhites in shrub-dominated rangeland.** *Southeastern Naturalist*, *15*(3): 382-393.

Key words: Behavior (Texas-USA)

Corn, J.L., Cumbee, J.C., Barfoot, R. and Erickson, G.A. 2009. **Pathogen exposure in feral swine populations geographically associated with high densities of transitional swine premises and commercial swine production.** *Journal of Wildlife Diseases*, 45(3): 713-721.

Key words: Diseases/Parasites (North Carolina, South Carolina-USA)

Costa, D.S., Macedo, D.B., Santos, M.D., Paula, T.A. and Faria, F.J. 2011. **Intrinsic rate of spermatogenesis in free-ranging feral pigs (*Sus scrofa* sp).** *Animal Reproduction Science*, 125(1): 165-169.

Key words: Reproduction (Brazil)

Costa, G.M., Campos-Junior, P.H., Lacerda, S.M.S., Rezende-Neto, J.V., Guimarães, D.A. and França, L.R. 2011. **Comparative testis structure and spermatogenic efficiency in three suiform species: the domestic pig *(Sus domesticus*), the wild boar (*Sus scrofa scrofa*) and the collared peccary (*Tayassu tajacu*).** *Asian Wild Pig News*, 10(2): 23-31.

Key words: Taxonomy (Brazil)

Costa, V., Pérez-González, J., Santos, P., Fernández-Llario, P., Carranza, J., Zsolnai, A., Anton, I., Buzgó, J., Varga, G., Monteiro, N. and Beja-Pereira, A. 2012. **Microsatellite markers for identification and parentage analysis in the European wild boar (*Sus scrofa*).** *BMC Rresearch Notes*, 5(479): 1-6.

Key words: Taxonomy

Cowled, B. and Garner, G. 2008. **A review of geospatial and ecological factors affecting disease spread in wild pigs: considerations for models of foot-and-mouth disease spread.** *Preventive Veterinary Medicine*, 87(3): 197-212.

Key words: Diseases/Parasites

Cowled, B.D., Garner, M.G., Negus, K. and Ward, M.P. 2012. **Controlling disease outbreaks in wildlife using limited culling: modelling classical swine fever incursions in wild pigs in Australia.** *Veterinary Research*, 43(3): 1-16.

Key words: Control/Management (Australia)

Cowled, B.D., Lapidge, S.J., Smith, M.L. and Staples, L.D. 2008. **Vaccination of feral pigs (*Sus scrofa*) using iophenoxic acid as a simulated vaccine.** *Australian Veterinary Journal*, 86(1-2): 50-55.

Key words: Diseases/Parasites (Australia)

Cowled, B.D., Ward, M.P., Laffan, S.W., Galea, F., Garner, M.G., MacDonald, A.J., Marsh, I., Muellner, P., Negus, K., Quasim, S. and Woolnough, A.P. 2012. **Integrating survey and molecular approaches to better understand wildlife disease ecology.** *PLOS ONE*, 7(10): 1-8.

Key words: Diseases/Parasites (Australia)

Cságola, A., Kecskeméti, S., Kardos, G., Kiss, I. and Tuboly, T. 2006. **Genetic characterization of type 2 porcine circoviruses detected in Hungarian wild boars.** *Archives of Virology*, 151(3): 495-507.

Key words: Diseases/Parasites (Hungary)

Cubric-Curik, V., Atlija, M., Šprem, N. and Curik, I. 2011. **Mitochondrial DNA diversity in wild boars from the Istria and Cres Island.** *Agriculturae Conspectus Scientificus (ACS)*, 76(4): 321-324.

Key words: Taxonomy (Croatia)

Cucchi, T., Dai, L., Balasse, M., Zhao, C., Gao, J., Hu, Y., Yuan, J. and Vigne, J.D. 2016. **Social complexification and pig (*Sus scrofa*) husbandry in ancient China: a combined geometric morphometric and isotopic approach.** *PLOS ONE*, 11(7): 1-20.

Key words: Archaeological/Paleontology, Domestication (China)

Cucchi, T., Fujita, M. and Dobney, K. 2009. **New insights into pig taxonomy, domestication and human dispersal in Island South East Asia: molar shape analysis of Sus remains from Niah Caves, Sarawak.** *International Journal of Osteoarchaeology*, 19(4): 508-530.

Key words: Archaeological/Paleontology, Domestication, Taxonomy (Malaysia)

Cucchi, T., Hulme-Beaman, A., Yuan, J. and Dobney, K. 2011. **Early Neolithic pig domestication at Jiahu, Henan Province, China: clues from molar shape analyses using geometric morphometric approaches.** *Journal of Archaeological Science*, 38(1): 11-22.

Key words: Archaeological/Paleontology, Domestication (China)

Cuevas, M.F., Mastrantonio, L., Ojeda, R.A. and Jaksic, F.M. 2012. **Effects of wild boar disturbance on vegetation and soil properties in the Monte Desert, Argentina.** *Mammalian Biology-Zeitschrift für Säugetierkunde*, 77(4): 299-306.

Key words: Food Habits (Argentina)

Cuevas, M.F., Novillo, A., Campos, C., Dacar, M.A. and Ojeda, R.A. 2010. **Food habits and impact of rooting behaviour of the invasive wild boar, *Sus scrofa*, in a**

protected area of the Monte Desert, Argentina. *Journal of Arid Environments*, 74(11): 1582-1585.

Key words: Food Habits (Argentina)

Cuevas, M.F., Ojeda, R.A. and Jaksic, F.M. 2013. **Multi-scale patterns of habitat use by wild boar in the Monte Desert of Argentina.** *Basic and Applied Ecology*, 14(4): 320-328.

Key words: Behavior, Ecology (Argentina)

Cuevas, M.F., Ojeda, R.A., Dacar, M.A. and Jaksic, F.M. 2013. **Seasonal variation in feeding habits and diet selection by wild boars in a semi-arid environment of Argentina.** *Acta Theriologica*, 58(1): 63-72.

Key words: Feeding Habits (Argentina)

Cutillas, C., de Rojas, M., Ariza, C., Ubeda, J.M. and Guevara, D. 2007. **Molecular identification of *Trichuris vulpis* and *Trichuris suis* isolated from different hosts.** *Parasitology Research*, 100(2): 383-389.

Key words: Diseases/Parasites (Spain)

Cutini, A., Chianucci, F., Chirichella, R., Donaggio, E., Mattioli, L. and Apollonio, M. 2013. **Mast seeding in deciduous forests of the northern Apennines (Italy) and its influence on wild boar population dynamics.** *Annals of Forest Science*, 70(5): 493-502.

Key words: Food Habits (Italy)

Cuttell, L., Cookson, B., Jackson, L.A., Gray, C. and Traub, R.J. 2012. **First report of a *Trichinella papuae* infection in a wild pig (*Sus scrofa*) from an Australian island in the Torres Strait region.** *Veterinary Parasitology*, 185(2): 343-345.

Key words: Diseases/Parasites (Australia)

Cuttell, L., Gómez-Morales, M.A., Cookson, B., Adams, P.J., Reid, S.A., Vanderlinde, P.B., Jackson, L.A., Gray, C. and Traub, R.J. 2014. **Evaluation of ELISA coupled with western blot as a surveillance tool for Trichinella infection in wild boar (*Sus scrofa*).** *Veterinary Parasitology*, 199(3): 179-190.

Key words: Diseases/Parasites (Australia)

Cvetnić, Z., Spicić, S., Toncić, J., Majnarić, D., Benić, M., Albert, D., Thiebaud, M. and Garin-Bastuji, B. 2009. ***Brucella suis* infection in domestic pigs and wild boar in Croatia.** *International Office of Epizootics*, 28(3): 1057-1067.
Key words: Diseases/Parasites (Croatia)

D

da Silva, D. and Müller, G. 2013. **Parasites of the respiratory tract of *Sus scrofa scrofa* (wild boar) from commercial breeder in southern Brazil and its relationship with *Ascaris suum*.** *Parasitology Research*, 112(3): 1353-1356.
Key words: Diseases/Parasites (Brazil)

da Silva, D. and Müller, G. 2013. **Parasitic helminths of the digestive system of wild boars bred in captivity.** *Revista Brasileira de Parasitologia Veterinária*, 22(3): 433-436.
Key words: Diseases/Parasites (Brazil)

da Silva, E.C., de Jager, N., Burgos-Paz, W., Reverter, A., Perez-Enciso, M. and Roura, E. 2014. **Characterization of the porcine nutrient and taste receptor gene repertoire in domestic and wild populations across the globe.** *BMC Genomics*, 15(1057): 1-16.
Key words: Genetics, Taxonomy

Danieli, P.P., Serrani, F., Primi, R., Ponzetta, M.P., Ronchi, B. and Amici, A. 2012. **Cadmium, lead, and chromium in large game: a local-scale exposure assessment for hunters consuming meat and liver of wild boar.** *Archives of Environmental Contamination and Toxicology*, 63(4): 612-627.
Key words: Contamination (Italy)

Danilov, P.I. and Panchenko, D.V. 2012. **Expansion and some ecological features of the wild boar beyond the northern boundary of its historical range in European Russia.** *Russian Journal of Ecology*, 43(1): 45-51.
Key words: Ecology (Russia)

Darfour-Oduro, K.A., Megens, H.J., Roca, A.L., Groenen, M.A. and Schook, L.B. 2016. **Evolutionary patterns of Toll-like receptor signaling pathway genes in the Suidae.** *BMC Evolutionary Biology*, 16(33): 1-11.
Key words: Genetics

Darinot, F. 2014. **Impact of wild boar (*Sus scrofa*) and carrion crow (*Corvus corone*) on meadows and ground nesting birds in the Reserve naturelle nationale du Marais de Lavours (Ain).** *Bulletin Mensuel De La Societe Linnennee De Lyon*, 260-270.
Key words: Food Habits (France)

De La Lastra, J.M.P., Galindo, R.C., Gortázar, C., Ruiz-Fons, F., Aranaz, A. and De La Fuente, J. 2009. **Expression of immunoregulatory genes in peripheral blood mononuclear cells of European wild boar immunized with BCG.** *Veterinary Microbiology*, 134(3): 334-339.
Key words: Diseases/Parasites, Genetics (Spain)

De Vargas, A.C., Monego, F., Gressler, L.T., de Avila Botton, S., Lazzari, A.M., Da Costa, M.M., Ecco, R., Ribeiro, M.G., Lara, G.H.B. and Takai, S. 2013. **Bronchopneumonia in wild boar (*Sus scrofa*) caused by *Rhodococcus equi* carrying the VapB type 8 plasmid.** *BMC Research Notes*, 6(111): 1-4.
Key words: Diseases/Parasites (Brazil)

Deberdt, A.J. and Scherer, S.B. 2007. **The wild boar: occurrence and management of the species in Brazil.** *Natureza & Conservação*, 5(2): 101-114.
Key words: Control/Management (Brazil)

Deksne, G. and Kirjušina, M. 2013**. Seroprevalence of *Toxoplasma gondii* in domestic pigs (*Sus scrofa domestica*) and wild boars (*Sus scrofa*) in Latvia.** *The Journal of Parasitology*, 99(1): 44-47.
Key words: Diseases/Parasites (Latvia)

del Rey, V.S., Fernández-Garayzábal, J.F., Mentaberre, G., Briones, V., Lavín, S., Domínguez, L., Gottschalk, M. and Vela, A.I. 2014. **Characterisation of *Streptococcus suis* isolates from wild boars (*Sus scrofa*).** *The Veterinary Journal*, 200(3): 464-467.

Key words: Diseases/Parasites (Spain)

Delgado, R., Fernandez-Llario, P., Azevedo, M., Beja-Pereira, A. and Santos, P. 2008. **Paternity assessment in free-ranging wild boar (*Sus scrofa*)–Are littermates full-sibs?.** *Mammalian Biology-Zeitschrift für Säugetierkunde*, 73(3): 169-176.
Key words: Reproduction (Portugal)

Delgado-Acevedo, J., Zamorano, A., DeYoung, R.W., Campbell, T.A., Hewitt, D.G. and Long, D.B. 2011. **Promiscuous mating in feral pigs (*Sus scrofa*) from Texas, USA.** *Wildlife Research*, 37(7): 539-546.
Key words: Reproduction (Texas-USA)

Deng, T.P., Zhang, H.X. and Zeng, G.S. 2008. **Feeding habitats of wild boars on northern slope of Funiu Mountain, Henan Province.** *Sichuan Journal of Zoology*, 27: 747-750.
Key words: Feeding Habits (China)

Denzin, N. and Borgwardt, J. 2012. **Occurrence and geographical distribution of antibodies to hepatitis E virus in wild boars of Saxony-Anhalt, Germany (2011).** *Berliner und Munchener Tierarztliche Wochenschrift*, 126(5-6): 230-235.
Key words: Diseases/Parasites (Germany)

Denzin, N., Borgwardt, J., Freuling, C. and Müller, T. 2013. **Spatio-temporal analysis of the progression of Aujeszky's disease virus infection in wild boar of Saxony-Anhalt, Germany.** *Geospatial Health*, 8(1): 203-213.
Key words: Diseases/Parasites (Germany)

Di Francesco, A., Donati, M., Morandi, F., Renzi, M., Masia, M.A., Ostanello, F., Salvatore, D., Cevenini, R. and Baldelli, R. 2011. **Seroepidemiologic survey for *Chlamydia suis* in wild boar (*Sus scrofa*) populations in Italy.** *Journal of Wildlife Diseases*, 47(3): 709-712.
Key words: Diseases/Parasites (Italy)

Di Nicola, U., Scacchia, M. and Marruchella, G. 2015. **Pathological and serological findings in wild boars (*Sus scrofa*) from Gran Sasso and Monti della Laga National Park (Central Italy).** *Large Animal Review*, 21(4): 167-171.
Key words: Diseases/Parasites (Italy)

Ditchkoff, S.S., Jolley, D.B., Sparklin, B.D., Hanson, L.B., Mitchell, M.S. and Grand, J.B. 2012. **Reproduction in a population of wild pigs (*Sus scrofa*) subjected to lethal control.** *The Journal of Wildlife Management*, 76(6): 1235-1240.

Key words: Constol/Management, Reproduction (Alabama-USA)

Do, T.D., Park, C., Choi, K., Jeong, J., Vo, M.K., Nguyen, T.T. and Chae, C. 2015. **Comparison of pathogenicity of highly pathogenic porcine reproductive and respiratory syndrome virus between wild and domestic pigs.** *Veterinary Research Communications*, 39(1): 79-85.

Key words: Diseases/Parasites (Vietnam)

Dobney, K., Cucchi, T. and Larson, G. 2008. **The pigs of Island Southeast Asia and the Pacific: new evidence for taxonomic status and human-mediated dispersal.** *Asian Perspectives*, 59-74.

Key words: Archaeological/Paleontology, Taxonomy

Dobrowolska, A. and Melosik, M. 2008. **Bullet-derived lead in tissues of the wild boar (*Sus scrofa*) and red deer (*Cervus elaphus*).** *European Journal of Wildlife Research*, 54(2): 231-235.

Key words: Contamination, Hunting (Poland)

dos SL Hohl, L., Sicuro, F.L., Azorit, C., Carrasco, R., Rocha-Barbosa, O., Hohl, L., Sicuro, F., Azorit, C., Carrasco, R. and Rocha-Barbosa, O. 2014. **Age and sex-related geometrical variation of Ramus mandibulae of *Sus scrofa's* (Mammalia: Artiodactyla) jaws.** *International Journal of Morphology*, 32(4): 1282-1288.

Key words: Morphology (Brazil)

Dovrat, G., Perevolotsky, A. and Ne'eman, G. 2014. **The response of Mediterranean herbaceous community to soil disturbance by native wild boars.** *Plant Ecology*, 215(5): 531-541.

Key words: Food Habits (Israel)

Dovrat, G., Perevolotsky, A. and Ne'eman, G. 2012. **Wild boars as seed dispersal agents of exotic plants from agricultural lands to conservation areas.** *Journal of Arid Environments*, 78: 49-54.

Key words: Food Habits (Israel)

Dubey, J. 2015. **In the United States, negligible rates of zoonotic sarcocystosis occur in feral swine that, by contrast, frequently harbour infections with *Sarcocystis miescheriana*, a related parasite contracted from canids.** *Parasitology*, 142: 549-556.

Key words: Diseases/Parasites (USA)

Durkalec, M., Szkoda, J., Kolacz, R., Opalinski, S., Nawrocka, A. and Zmudzki, J. 2015. **Bioaccumulation of lead, cadmium and mercury in roe deer and wild boars from areas with different levels of toxic metal pollution.** *International Journal of Environmental Research*, 9(1): 205-212.

Key words: Contamination (Poland)

E

Ebert, C., Huckschlag, D., Schulz, H.K. and Hohmann, U. 2010. **Can hair traps sample wild boar (*Sus scrofa*) randomly for the purpose of non-invasive population estimation?.** *European Journal of Wildlife Research*, 56(4): 583-590.

Key words: Population Biology (Germany)

Ebert, C., Knauer, F., Spielberger, B., Thiele, B. and Hohmann, U. 2012. **Estimating wild boar *Sus scrofa* population size using faecal DNA and capture-recapture modelling.** *Wildlife Biology*, 18(2): 142-152.

Key words: Population Biology (Germany)

Ebert, C., Kolodziej, K., Schikora, T.F., Schulz, H.K. and Hohmann, U. 2009. **Is non-invasive genetic population estimation via faeces sampling feasible for abundant mammals with low defecation rates? A pilot study on free ranging wild boar (*Sus scrofa*) in south-west Germany.** *Acta Silvatica et Lignaria Hungarica*, 5: 167-177.

Key words: Population Biology (Germany)

Efstathios, P.T. and Hadjisterkotis, E. 2009. **Current distribution and population status of wild boar (*Sus scrofa* L.) in Greece.** *Acta Silvatica and Lignaria Hungarica*, 5: 153-157.

Key words: Population Biology (Greece)

Eglezos, S., Stuttard, E., Huang, B., Dykes, G.A. and Fegan, N. 2008. **A survey of the microbiological quality of feral pig carcasses processed for human consumption in Queensland, Australia.** *Foodborne Pathogens and Disease,* 5(1): 105-109.

Key words: Contamination (Australia)

Elledge, A.E., McAlpine, C.A., Murray, P.J. and Gordon, I.J. 2013. **Modelling habitat preferences of feral pigs for rooting in lowland rainforest.** *Biological Invasions*, 15(7): 1523-1535.

Key words: Damage (Australia)

Elsey, R.M., Mouton Jr, E.C. and Kinler, N. 2012. **Effects of feral swine (*Sus scrofa*) on alligator (*Alligator mississippiensis*) nests in Louisiana.** *Southeastern Naturalist*, 11(2): 205-218.

Key words: Food Habits (Louisiana-USA)

Elston, J.J. and Hewitt, D.G. 2010. **Intake of mast by wildlife in Texas and the potential for competition with wild boars.** *The Southwestern Naturalist*, 55(1): 57-66.

Key words: Food Habits (Texas-USA)

Engeman, R., Cattaruzza, R., Cattaruzza, M. and Fischer, J. 2016. **Photographic estimation of wild boar damage to alpine grazing pastures in the Carpathian Mountains of central Romania.** *Environmental Science and Pollution Research,* 1-4.

Key words: Damage (Romania)

Engeman, R.M., Constantin, B.U., Schwiff, S.A., Smith, H.T., Woolard, J., Allen, J. and Dunlap, J. 2007. **Adaptive and economic management methods for feral hog control in Florida.** *Human-Wildlife Conflicts* 1(2):178-185.

Key words: Economics, Control/Management (Florida-USA)

Engeman, R.M., Massei, G., Sage, M. and Gentle, M.N. 2013. **Monitoring wild pig populations: a review of methods.** *Environmental Science and Pollution Research*, 20(11): 8077-8091.

Key words: Population Biology

Erster, O., Roth, A., Pozzi, P.S., Bouznach, A. and Shkap, V. 2015. **First detection of *Sarcoptes scabiei* from domesticated pig (*Sus scrofa*) and genetic characterization of *S. scabiei* from pet, farm and wild hosts in Israel.** *Experimental and Applied Acarology,* 66(4): 605-612.
Key words: Diseases/Parasites (Israel)

Ervynck, A., Lentacker, A., Müldner, G., Richards, M. and Dobney, K. 2007. **An investigation into the transition from forest dwelling pigs to farm animals in medieval Flanders, Belgium.** *Pigs and Humans,* 10: 171-193.
Key words: Archaeological/Paleontology, Domestication (Belgium)

Escribano-Romero, E., Lupulović, D., Merino-Ramos, T., Blazquez, A.B., Lazić, G., Lazić, S., Saiz, J.C. and Petrović, T. 2015. **West Nile virus serosurveillance in pigs, wild boars, and roe deer in Serbia.** *Veterinary Microbiology,* 176(3): 365-369.
Key words: Diseases/Parasites (Serbia)

Estrada-Peña, A., Acevedo, P., Ruiz-Fons, F., Gortázar, C. and de la Fuente, J. 2008. **Evidence of the importance of host habitat use in predicting the dilution effect of wild boar for deer exposure to Anaplasma spp.** *PLOS ONE*, 3(8): 1-10.
Key words: Diseases/Parasites (Spain)

Evin, A., Cucchi, T., Cardini, A., Vidarsdottir, U.S., Larson, G. and Dobney, K. 2013. **The long and winding road: identifying pig domestication through molar size and shape.** *Journal of Archaeological Science*, 40(1): 735-743.
Key words: Archaeological/Paleontology, Domestication

Evin, A., Cucchi, T., Escarguel, G., Owen, J., Larson, G., Vidarsdottir, U.S. and Dobney, K. 2014. **Using traditional biometrical data to distinguish West Palearctic wild boar and domestic pigs in the archaeological record: new methods and standards.** *Journal of Archaeological Science*, 43: 1-8.
Key words: Archaeological/Paleontology, Taxonomy

Evin, A., Dobney, K., Schafberg, R., Owen, J., Vidarsdottir, U.S., Larson, G. and Cucchi, T. 2015. **Phenotype and animal domestication: A study of dental variation between domestic, wild, captive, hybrid and insular Sus scrofa.** *BMC Evolutionary Biology*, 15(16): 1-16.

Key words: Morphology, Taxonomy

Evin, A., Flink, L.G., Bălăşescu, A., Popovici, D., Andreescu, R., Bailey, D., Mirea, P., Lazăr, C., Boroneanţ, A., Bonsall, C. and Vidarsdottir, U.S. 2015. **Unravelling the complexity of domestication: a case study using morphometrics and ancient DNA analyses of archaeological pigs from Romania.** *Philosophical Transactions of the Royal Society of London B: Biological Sciences,* 370(1660): 1-8.

Key words: Archaeological/Paleontology, Domestication (Romania)

F

Fabisiak, M., Sapierzynski, R., Salamaszynska-Guz, A. and Kizerwetter-Swida, M. 2010. **The first description of gastric Helicobacter in free-ranging wild boar (*Sus scrofa*) from Poland.** *Polish Journal of Veterinary Sciences,* 13(1): 171-174.

Key words: Diseases/Parasites (Poland)

Fabisiak, M., Szczotka, A., Podgórska, K. and Stadejek, T. 2012. **Prevalence of infection and genetic diversity of porcine circovirus type 2 (PCV2) in wild boar (*Sus scrofa*) in Poland.** *Journal of Wildlife Diseases*, 48(3): 612-618.

Key words: Diseases/Parasites (Poland)

Fagiani, S., Fipaldini, D., Santarelli, L., Burrascano, S., Del Vico, E., Giarrizzo, E., Mei, M., Taglianti, A.V., Boitani, L. and Mortelliti, A. 2014. **Monitoring protocols for the evaluation of the impact of wild boar (*Sus scrofa*) rooting on plants and animals in forest ecosystems.** *Hystrix, the Italian Journal of Mammalogy*, 25(1): 31-38.

Key words: Food Habits

Fajardo, V., González, I., Martín, I., Hernández, P.E., Garcı, T. and Martín, R. 2008. **Differentiation of European wild boar (*Sus scrofa scrofa)* and domestic swine**

(***Sus scrofa domestica***) **meats by PCR analysis targeting the mitochondrial D-loop and the nuclear melanocortin receptor 1 (MC1R) genes.** *Meat Science*, 78(3): 314-322.

Key words: Genetics, Taxonomy (Spain)

Fang, M., Larson, G., Ribeiro, H.S., Li, N. and Andersson, L. 2009. **Contrasting mode of evolution at a coat color locus in wild and domestic pigs.** *PLOS Gentics*, 5(1): 1-6.

Key words: Gentics, Taxonomy

Faria, A.S., das Neves Paiva-Cardoso, M., Nunes, M., Carreira, T., Vale-Gonçalves, H.M., Veloso, O., Coelho, C., Cabral, J.A., Vieira-Pinto, M. and Vieira, M.L. 2015. **First detection of *Borrelia burgdorferi sensu lato* DNA in serum of the wild boar (*Sus scrofa*) in northern Portugal by nested-PCR.** *Ecohealth*, 12(1): 183-187.

Key words: Diseases/Parasites (Portugal)

Fenati, M., Monaco, A. and Guberti, V. 2008. **Efficiency and safety of xylazine and tiletamine/zolazepam to immobilize captured wild boars (*Sus scrofa* L. 1758): analysis of field results.** *European Journal of Wildlife Research*, 54(2): 269-274.

Key words: Control/Management (Italy)

Ferreira, E., Souto, L., Soares, A.M. and Fonseca, C. 2009. **Genetic structure of the wild boar population in Portugal: evidence of a recent bottleneck.** *Mammalian Biology-Zeitschrift für Säugetierkunde*, 74(4): 274-285.

Key words: Genetics (Portugal)

Ferretti, F., Fattorini, L., Sforzi, A. and Pisani, C. 2016. **The use of faeces counts to estimate relative densities of wild boar in a Mediterranean area.** *Population Ecology*, 1-6.

Key words: Population Biology (Italy)

Ferretti, F., Sforzi, A., Coats, J. and Massei, G. 2014. **The BOS™ as a species-specific method to deliver baits to wild boar in a Mediterranean area.** *European Journal of Wildlife Research*, 60(3): 555-558.

Key words: Control/Management (Italy)

Ferretti, F., Storer, K., Coats, J. and Massei, G. 2015. **Temporal and spatial patterns of defecation in wild boar.** *Wildlife Society Bulletin*, 39(1): 65-69.

Key words: Population Biology (Italy)

Ficetola, G.F., Bonardi, A., Mairota, P., Leronni, V. and Padoa-Schioppa, E. 2014. **Predicting wild boar damages to croplands in a mosaic of agricultural and natural areas.** *Current Zoology*, 60: 170-179.

Key words: Damage (Italy)

Fischer, J. and Wüst, M. 2012. **Quantitative determination of the boar taint compounds androstenone, skatole, indole, 3α-androstenol and 3β-androstenol in wild boars (*Sus scrofa*) reveals extremely low levels of the tryptophan-related degradation products.** *Food Chemistry*, 135(4): 2128-2132.

Key words: Morphology (Germany)

Florijančić, T., Ozimec, S., Bošković, I., Bilandžić, N., Jelkić, D., Vukšić, N. and Gross-Bošković, A. 2015. **Assessment of heavy metal content in wild boar (*Sus scrofa* l.) hunted in eastern Croatia.** *In International UAB-B. EN. A Conference Environmental Engineering and Sustainable Development*, 16(2): 630-636.

Key words: Contamination (Croatia)

Focardi, S., Gaillard, J.M., Ronchi, F. and Rossi, S. 2008. **Survival of wild boars in a variable environment: unexpected life-history variation in an unusual ungulate.** *Journal of Mammalogy*, 89(5): 1113-1123.

Key words: Behavior, Ecology (Italy)

Focardi, S., Morimando, F., Capriotti, S., Ahmed, A. and Genov, P. 2015. **Cooperation improves the access of wild boars (*Sus scrofa*) to food sources.** *Behavioural Processes*, 121: 80-86.

Key words: Behavior (Bulgaria, Italy)

Fonseca, C. 2008. **Winter habitat selection by wild boar *Sus scrofa* in southeastern Poland.** *European Journal of Wildlife Research*, 54(2): 361-366.

Key words: Ecology (Poland)

Fonseca, C., Da Silva, A.A., Alves, J., Vingada, J. and Soares, A.M. 2011. **Reproductive performance of wild boar females in Portugal.** *European Journal of Wildlife Research*, 57(2): 363-371.

Key words: Reproduction (Portugal)

Fonseca, C., Kolecki, M., Merta, D. and Bobek, B. 2007. **Use of line intercept track index and plot sampling for estimating wild boar, *Sus scrofa* (Suidae), densities in Poland.** *Folia Zoologica*, 56(4): 389-398.

Key words: Population Biology (Poland)

Fontanesi, L., Scotti, E. and Russo, V. 2008. **Differences of the porcine amelogenin X and Y chromosome genes (AMELX and AMELY) and their application for sex determination in pigs.** *Molecular Reproduction and Development*, 75(11): 1662-1668.

Key words: Genetics

Fornazari, F., Langoni, H., da Silva, R.C., Guazzelli, A., Ribeiro, M.G. and Chiacchio, S.B. 2009. ***Toxoplasma gondii* infection in wild boars (*Sus scrofa*) bred in Brazil.** *Veterinary Parasitology*, 164(2): 333-334.

Key words: Diseases/Parasites (Brazil)

Frackowiak, W., Gorczyca, S., Merta, D. and Wojciuch-Ploskonka, M. 2013. **Factors affecting the level of damage by wild boar in farmland in north-eastern Poland.** *Pest Management Science*, 69(3): 362-366.

Key words: Damage (Poland)

Frantz, A.C., Bertouille, S., Eloy, M.C., Licoppe, A., Chaumont, F. and Flamand, M.C. 2012. **Comparative landscape genetic analyses show a Belgian motorway to be a gene flow barrier for red deer (*Cervus elaphus*), but not wild boars (*Sus scrofa*).** *Molecular Ecology*, 21(14): 3445-3457.

Key words: Population Biology (Belgium)

Frantz, A.C., Cellina, S., Krier, A., Schley, L. and Burke, T. 2009. **Using spatial Bayesian methods to determine the genetic structure of a continuously distributed population: clusters or isolation by distance?.** *Journal of Applied Ecology*, 46(2): 493-505.

Key words: Population Biology (Luxemburg)

Frantz, A.C., Massei, G. and Burke, T. 2012. **Genetic evidence for past hybridisation between domestic pigs and English wild boars.** *Conservation Genetics*, 13(5): 1355-1364.

Key words: Genetics, Taxonomy (England)

Frantz, A.C., Zachos, F.E., Kirschning, J., Cellina, S., Bertouille, S., Mamuris, Z., Koutsogiannouli, E.A. and Burke, T. 2013. **Genetic evidence for introgression between domestic pigs and wild boars (*Sus scrofa*) in Belgium and Luxembourg: a comparative approach with multiple marker systems.** *Biological Journal of the Linnean Society*, 110(1): 104-115.

Key words: Genetics, Taxonomy (Luxemburn, Belgium)

Frantz, L.A., Schraiber, J.G., Madsen, O., Megens, H.J., Bosse, M., Paudel, Y., Semiadi, G., Meijaard, E., Li, N., Crooijmans, R.P. and Archibald, A.L. 2013. **Genome sequencing reveals fine scale diversification and reticulation history during speciation in Sus.** *Genome Biology*, 14(9): 1-12.

Key words: Genetics, Taxonomy

Franzetti, B., Ronchi, F., Marini, F., Scacco, M., Calmanti, R., Calabrese, A., Paola, A., Paolo, M. and Focardi, S. 2012. **Nocturnal line transect sampling of wild boar (*Sus scrofa*) in a Mediterranean forest: long-term comparison with capture–mark–resight population estimates.** *European Journal of Wildlife Research*, 58(2): 385-402.

Key words: Population Biology (Italy)

Frauendorf, M., Gethöffer, F., Siebert, U. and Keuling, O. 2016. **The influence of environmental and physiological factors on the litter size of wild boar (*Sus scrofa*) in an agriculture dominated area in Germany.** *Science of The Total Environment*, 541: 877-882.

Key words: Ecology, Reproduction (Germany)

Frémondeau, D., Cucchi, T., Casabianca, F., Ughetto-Monfrin, J., Horard-Herbin, M.P. and Balasse, M. 2012. **Seasonality of birth and diet of pigs from stable isotope**

analyses of tooth enamel (δ 18 O, δ 13 C): a modern reference data set from Corsica, France. *Journal of Archaeological Science*, 39(7): 2023-2035.

Key words: Morphology (France)

Fujinuma, J. and Harrison, R.D. 2012. **Wild pigs (*Sus scrofa)* mediate large-scale edge effects in a lowland tropical rainforest in Peninsular Malaysia.** *PLOS ONE*, 7(5): 1-7.

Key words: Food Habits (Malaysia)

Fujita, Y., Yoshihara, Y., Sato, I. and Sato, S. 2014. **Environmental radioactivity damages the DNA of earthworms of Fukushima Prefecture, Japan.** *European Journal of Wildlife Research*, 60(1): 145-148.

Key words: Radioecology (Japan)

Fukuda, M., Otsuka, Y., Uni, S., Bain, O. and Takaoka, H. 2010. **Genetic evidence for the presence of two species of Onchocerca from the wild boar in Japan.** *Parasite*, 17(1): 33-37.

Key words: Disease/ Parasites, Genetics (Japan)

Fukuda, M., Otsuka, Y., Uni, S., Bain, O. and Takaoka, H. 2010. **Molecular identification of infective larvae of three species of Onchocerca found in wild-caught females of *Simulium bidentatum* in Japan.** *Parasite*, 17(1): 39-45.

Key words: Disease/ Parasites, Genetics (Japan)

Fulgione, D., Rippa, D., Buglione, M., Trapanese, M., Petrelli, S. and Maselli, V. 2016. **Unexpected but welcome. Artificially selected traits may increase fitness in wild boar.** *Evolutionary Applications*, 769-776.

Key words: Domestication, Taxonomy (Italy)

G

Galindo, R.C., Muñoz, P.M., De Miguel, M.J., Marin, C.M., Labairu, J., Revilla, M., Blasco, J.M., Gortazar, C. and De la Fuente, J. 2010. **Gene expression changes in spleens of the wildlife reservoir species, Eurasian wild boar (*Sus scrofa*),**

naturally infected with *Brucella suis biovar* 2. *Journal of Genetics and Genomics*, 37(11): 725-736.

Key words: Diseases/Parasites, Genetics (Spain)

Gallardo, M.T., Mateos, L., Artieda, J., Wesslen, L., Ruiz, C., García, M.A., Galmés-Truyols, A., Martin, A., Hernández-Pezzi, G., Andersson, Y. and Gárate, T. 2007. **Outbreak of trichinellosis in Spain and Sweden due to consumption of wild boar meat contaminated with *Trichinella britovi*.** *Eurosurveillance*, 12(11).

Key words: Diseases/Parasites (Sweden, Spain)

Galván, I., Alonso-Alvarez, C. and Negro, J.J. 2012. **Relationships between hair melanization, glutathione levels, and senescence in wild boars.** *Physiological and Biochemical Zoology*, 85(4): 332-347.

Key words: Morphology (Spain)

Gamelon, M., Besnard, A., Gaillard, J.M., Servanty, S., Baubet, E., Brandt, S. and Gimenez, O. 2011. **High hunting pressure selects for earlier birth date: wild boar as a case study.** *Evolution*, 65(11): 3100-3112.

Key words: Reproduction (France)

Gamelon, M., Focardi, S., Gaillard, J.M., Gimenez, O., Bonenfant, C., Franzetti, B., Choquet, R., Ronchi, F., Baubet, E. and Lemaître, J.F. 2014. **Do age-specific survival patterns of wild boar fit current evolutionary theories of senescence?.** *Evolution*, 68(12): 3636-3643.

Key words: Behavior (Italy)

Gamelon, M., Gaillard, J.M., Baubet, E., Devillard, S., Say, L., Brandt, S. and Gimenez, O. 2013. **The relationship between phenotypic variation among offspring and mother body mass in wild boar: evidence of coin-flipping?.** *Journal of Animal Ecology*, 82(5): 937-945.

Key words: Reproduction (France)

Gamelon, M., Gaillard, J.M., Servanty, S., Gimenez, O., Toïgo, C., Baubet, E., Klein, F. and Lebreton, J.D. 2012. **Making use of harvest information to examine alternative management scenarios: a body weight-structured model for wild boar.** *Journal of Applied Ecology*, 49(4): 833-841.

Key words: Control/Management (France)

Gamito-Santos, J.A., Gómez, L., Calero-Bernal, R., Rol-Díaz, J.A., González-Ruibal, L., Gómez-Blázquez, M. and Pérez-Martín, J.E. 2009. **Histopathology of trichinellosis in wild boar.** *Veterinary Parasitology*, 165(1): 165-169.

Key words: Diseases/Parasites (Spain)

Gantchoff, M.G. and Belant, J.L. 2015. **Anthropogenic and environmental effects on invasive mammal distribution in northern Patagonia, Argentina.** *Mammalian Biology-Zeitschrift für Säugetierkunde*, 80(1): 54-58.

Key words: Food habits (Argentina)

García, G., Vergara, J. and Lombardi, R. 2011. **Genetic characterization and phylogeography of the wild boar *Sus scrofa* introduced into Uruguay.** *Genetics and Molecular Biology*, 34(2): 329-337.

Key words: Genetics, Taxonomy (Uruguay)

Garcia, M., Gingras, B., Bowling, D.L., Herbst, C.T., Boeckle, M., Locatelli, Y. and Fitch, W. 2016. **Structural classification of wild boar (*Sus scrofa*) vocalizations.** *Ethology*, *122*(4): 329-342.

Key words: Morphology (France)

García-González, Á.M., Pérez-Martín, J.E., Gamito-Santos, J.A., Calero-Bernal, R., Alonso, M.A. and Carrión, E.M.F. 2013. **Epidemiologic study of lung parasites (*Metastrongylus* spp.) in wild boar (*Sus scrofa*) in southwestern Spain.** *Journal of Wildlife Diseases*, 49(1): 157-162.

Key words: Diseases/Parasites (Spain)

García-Jiménez, W.L., Benítez-Medina, J.M., Fernández-Llario, P., Abecia, J.A., García-Sánchez, A., Martínez, R., Risco, D., Ortiz-Peláez, A., Salguero, F.J., Smith, N.H. and Gómez, L. 2013. **Comparative pathology of the natural infections by *Mycobacterium bovis* and by *Mycobacterium caprae* in wild boar (*Sus scrofa*).** *Transboundary and Emerging Diseases*, 60(2): 102-109.

Key words: Diseases/Parasites (Spain)

García-Jiménez, W.L., Benítez-Medina, J.M., Martínez, R., Carranza, J., Cerrato, R., García-Sánchez, A., Risco, D., Moreno, J.C., Sequeda, M., Gómez, L. and

Fernández-Llario, P. 2015. **Non-tuberculous Mycobacteria in wild boar (*Sus scrofa*) from southern Spain: epidemiological, clinical and diagnostic concerns.** *Transboundary and Emerging Diseases*, 62(1): 72-80.

Key words: Diseases/Parasites (Spain)

García-Jiménez, W.L., Fernández-Llario, P., Benítez-Medina, J.M., Cerrato, R., Cuesta, J., García-Sánchez, A., Gonçalves, P., Martínez, R., Risco, D., Salguero, F.J. and Serrano, E. 2013. **Reducing Eurasian wild boar (*Sus scrofa*) population density as a measure for bovine tuberculosis control: effects in wild boar and a sympatric fallow deer (*Dama dama*) population in central Spain.** *Preventive Veterinary Medicine*, 110(3): 435-446.

Key words: Control/Management, Diseases/Parasites (Spain)

García-Presedo, I., Pedraza-Díaz, S., González-Warleta, M., Mezo, M., Gómez-Bautista, M., Ortega-Mora, L.M. and Castro-Hermida, J.A. 2013. **Presence of *Cryptosporidium scrofarum, C. suis* and *C. parvum* subtypes IIaA16G2R1 and IIaA13G1R1 in Eurasian wild boars (*Sus scrofa*).** *Veterinary Parasitology*, 196(3): 497-502.

Key words: Diseases/Parasites (Spain)

García-Sánchez, A., Gómez, L., Fernández-Llario, P., Parra, A. and de Mendoza, J.H. 2007. ***Tuberculous meningoencephalitis* in a wild boar.** *Journal of Wildlife Diseases*, 43(4): 780-783.

Key words: Diseases/Parasites (Spain)

García-Sánchez, R.N., Nogal-Ruiz, J.J., Manzano-Lorenzo, R., Díaz, J.A., Lopez, G.P., Ruano, F.S., Casas, A.R., Bascon, C.C., Bolás-Fernández, F. and Martínez-Fernández, A.R. 2009. **Trichinellosis survey in the wild boar from the Toledo mountains in south-western Spain (2007–2008): molecular characterization of Trichinella isolates by ISSR-PCR.** *Journal of Helminthology*, 83(02): 117-120.

Key words: Diseases/Parasites (Spain)

Garrido, J.M., Sevilla, I.A., Beltrán-Beck, B., Minguijón, E., Ballesteros, C., Galindo, R.C., Boadella, M., Lyashchenko, K.P., Romero, B., Geijo, M.V. and Ruiz-Fons,

F. 2011. **Protection against tuberculosis in Eurasian wild boar vaccinated with heat-inactivated *Mycobacterium bovis*.** *PLOS ONE*, 6(9): 1-10.
Key words: Diseases/Parasites

Gaskamp, J.A., Gee, K.L., Campbell, T.A., Silvy, N.J. and Webb, S.L. 2016. **Pseudorabies virus and *Brucella abortus* from an expanding wild pig (*Sus scrofa*) population in southern Oklahoma, USA.** *Journal of Wildlife Diseases*, 52(2): 383-386.
Key words: Diseases/Parasites (Oklahoma-USA)

Gasparik, J., Dobias, M., Capcarova, M., Smehyl, P., Slamecka, J., Bujko, J. and Gasparik Jr, J. 2012. **Concentration of cadmium, mercury, zinc, copper and cobalt in the tissues of wild boar (*Sus scrofa*) hunted in the western Slovakia.** *Journal of Environmental Science and Health, Part A*, 47(9): 1212-1216.
Key words: Contamination (Slovakia)

Gassó, D., Feliu, C., Ferrer, D., Mentaberre, G., Casas-Díaz, E., Velarde, R., Fernández-Aguilar, X., Colom-Cadena, A., Navarro-Gonzalez, N., López-Olvera, J.R. and Lavín, S. 2015. **Uses and limitations of faecal egg count for assessing worm burden in wild boars.** *Veterinary Parasitology*, 209(1): 133-137.
Key words: Diseases/Parasites (Spain)

Gassó, D., Rossi, L., Mentaberre, G., Casas, E., Velarde, R., Nosal, P., Serrano, E., Segales, J., Fernandez-Llario, P. and Feliu, C. 2014. **An identification key for the five most common species of Metastrongylus.** *Parasitology research*, 113(9): 3495-3500.
Key words: Diseases/Parasites (Spain)

Gassó, D., Serrano, E., Castillo-Contreras, R., Aguilar, X.F., Cadena, A.C., Velarde, R., Mentaberre, G., López-Olvera, J.R., Risco, D., Gonçalves, P. and Lavín, S. 2016. **Coprological tests underestimate *Macracanthorhynchus hirudinaceus* burden in wild boar.** *Parasitology Research,* 115(5): 2103-2105.
Key words: Diseases/Parasites (Spain)

Gayet, T., Devillard, S., Gamelon, M., Brandt, S., Say, L. and Baubet, E. 2016. **On the evolutionary consequences of increasing litter size with multiple paternity in wild boar (*Sus scrofa scrofa*).** *Evolution, 70(6): 1386-1397*.

Key words: Reproduction (France)

Gentle, M., Speed, J. and Marshall, D. 2015. **Consumption of crops by feral pigs (*Sus scrofa*) in a fragmented agricultural landscape.** *Australian Mammalogy*, 37(2): 194-200.

Key words: Damage (Australia)

Georgescu, S.E., Manea, M.A., Dudu, A. and Costache, M. 2012. **Phylogenetic relationships of the Mangalitsa swine breed inferred from mitochondrial DNA variation.** *International Journal of Molecular Sciences*, 13(7): 8467-8481.

Key words: Genetics, Taxonomy (Romania)

Gerveno, J.M.C., Pérez, D.R., Blanco, P.G., Jiménez, W.L.G., Molino, M.G., Fernandez-Llario, P., de Mendoza Salcedo, J.H. and Gordo, L.J.G. 2013. **Fatal infection due to *Haemophilus parasuis* in a young wild boar (*Sus scrofa*).** *Journal of Veterinary Diagnostic Investigation*, 25(2): 297-300.

Key words: Diseases/Parasites

Gethöffer, F., Sodeikat, G. and Pohlmeyer, K. 2007. **Reproductive parameters of wild boar (*Sus scrofa*) in three different parts of Germany.** *European Journal of Wildlife Research*, 53(4): 287-297.

Key words: Reproduction (Germany)

Giménez-Anaya, A., Herrero, J., Rosell, C., Couto, S. and García-Serrano, A. 2008. **Food habits of wild boars (*Sus scrofa*) in a Mediterranean coastal wetland.** *Wetlands*, 28(1): 197-203.

Key words: Food Habits (Spain)

Goedbloed, D.J., Megens, H.J., Van Hooft, P., Herrero-Medrano, J.M., Lutz, W., Alexandri, P., Crooijmans, R.P.M.A., Groenen, M., Van Wieren, S.E., Ydenberg, R.C. and Prins, H.H.T. 2013. **Genome-wide single nucleotide polymorphism analysis reveals recent genetic introgression from domestic pigs into**

northwest European wild boar populations. *Molecular Ecology*, 22(3): 856-866.

Key words: Genetics, Taxonomy (Germany, Netherlands)

Goedbloed, D.J., van Hooft, P., Lutz, W., Megens, H.J., van Wieren, S.E., Ydenberg, R.C. and Prins, H.H. 2015. **Increased *Mycoplasma hyopneumoniae* disease prevalence in domestic hybrids among free-living wild boar.** *EcoHealth*, 12(4): 571-579.

Key words: Diseases/Parasites (Germany, Netherlands)

Goedbloed, D.J., van Hooft, P., Megens, H.J., Bosch, T., Lutz, W., van Wieren, S.E., Ydenberg, R.C. and Prins, H.H.T. 2014. **Host genetic heterozygosity and age are important determinants of *porcine circovirus* type 2 disease prevalence in European wild boar.** *European Journal of Wildlife Research*, 60(5): 803-810.

Key words: Diseases/Parasites (Germany, Netherlands)

Goedbloed, D.J., van Hooft, P., Megens, H.J., Langenbeck, K., Lutz, W., Crooijmans, R.P., van Wieren, S.E., Ydenberg, R.C. and Prins, H.H. 2013. **Reintroductions and genetic introgression from domestic pigs have shaped the genetic population structure of northwest European wild boar.** *BMC Genetics*, 14(43): 1-10.

Key words: Genetics, Population Biology (Germany, Netherlands)

Gómez, J.M. and Hódar, J.A. 2008. **Wild boars (*Sus scrofa*) affect the recruitment rate and spatial distribution of holm oak (*Quercus ilex*).** *Forest Ecology and Management*, 256(6): 1384-1389.

Key words: Food Habits (Spain)

Gómez-Morales, M.A., Ludovisi, A., Amati, M., Bandino, E., Capelli, G., Corrias, F., Gelmini, L., Nardi, A., Sacchi, C., Cherchi, S. and Lalle, M. 2014. **Indirect versus direct detection methods of Trichinella spp. infection in wild boar (*Sus scrofa*).** *Parasites & Vectors*, 7(171): 1-8.

Key words: Diseases/Parasites (Italy)

Gonçalves, P., Risco, D., Fernández-Llario, P., Barquero-Pérez, O., Serrano, E., Hermoso-de-Mendoza, J. and Mateos, C. 2015. **A new method for ageing wild boar using dental measures.** *Ecological Indicators*, 62: 328-332.
Key words: Morphology (Spain)

González-Barrio, D., Martín-Hernando, M.P. and Ruiz-Fons, F. 2015. **Shedding patterns of endemic Eurasian wild boar (*Sus scrofa*) pathogens.** *Research in Veterinary Science*, 102: 206-211.
Key words: Diseases/Parasites (Spain)

González-Rodríguez, V. and Villar, R. 2012. **Post-dispersal seed removal in four Mediterranean oaks: species and microhabitat selection differ depending on large herbivore activity.** *Ecological Research*, 27(3): 587-594.
Key words: Food Habits (Spain)

Gortazar, C., Beltrán-Beck, B., Garrido, J.M., Aranaz, A., Sevilla, I.A., Boadella, M., Lyashchenko, K.P., Galindo, R.C., Montoro, V., Domínguez, L. and Juste, R. 2014. **Oral re-vaccination of Eurasian wild boar with *Mycobacterium bovis* BCG yields a strong protective response against challenge with a field strain.** *BMC Veterinary Research*, 10(96): 1-7.
Key words: Diseases/Parasites

Gortázar, C., Torres, M.J., Vicente, J., Acevedo, P., Reglero, M., De la Fuente, J., Negro, J.J. and Aznar-Martín, J. 2008. **Bovine tuberculosis in Donana Biosphere Reserve: the role of wild ungulates as disease reservoirs in the last Iberian lynx strongholds.** *PLOS ONE*, 3(7): 1-8.
Key words: Diseases/Parasites (Spain)

Gortazar, C., Vicente, J., Boadella, M., Ballesteros, C., Galindo, R.C., Garrido, J., Aranaz, A. and De La Fuente, J. 2011. **Progress in the control of bovine tuberculosis in Spanish wildlife.** *Veterinary Microbiology*, 151(1): 170-178.
Key words: Diseases/Parasites (Spain)

Grajewski, J., Twaruzek, M. and Kosicki, R. 2012. **High levels of ochratoxin A in blood serum and kidneys of wild boars *Sus scrofa* in Poland.** *Wildlife Biology*, 18(3): 272-279.

Key words: Contamination (Poland)

Groenen, M.A. 2016. **A decade of pig genome sequencing: a window on pig domestication and evolution.** *Genetics Selection Evolution*, 48(23): 1-9.

Key words: Domestication, Genetics

Groenen, M.A., Archibald, A.L., Uenishi, H., Tuggle, C.K., Takeuchi, Y., Rothschild, M.F., Rogel-Gaillard, C., Park, C., Milan, D., Megens, H.J. and Li, S. 2012. **Analyses of pig genomes provide insight into porcine demography and evolution.** *Nature*, 491(7424): 393-398.

Key words: Domestication, Genetics

Große-Brinkhaus, C., Jonas, E., Buschbell, H., Phatsara, C., Tesfaye, D., Jüngst, H., Looft, C., Schellander, K. and Tholen, E. 2010. **Epistatic QTL pairs associated with meat quality and carcass composition traits in a porcine Duroc× Pietrain population.** *Genetics Selection Evolution*, 42(39): 1-13.

Key words: Genetics (Germany)

Guan, L., Hu, Y., Tang, Z., Yang, Y., Dong, Y., Cui, Y. and Wang, C. 2007. **Stable isotopic analysis on sus bones from the Wanfabozi site, Tonghua, Jilin.** *Chinese Science Bulletin*, 52(24): 3393-3396.

Key words: Archaeological/Paleontology, Taxonomy (China)

Guiry, E.J., Noël, S., Tourigny, E. and Grimes, V. 2012. **A stable isotope method for identifying transatlantic origin of pig (*Sus scrofa*) remains at French and English fishing stations in Newfoundland.** *Journal of Archaeological Science*, 39(7): 2012-2022.

Key words: Archaeological/Paleontology (Newfoundland)

Gulakov, A.V. 2014. **Accumulation and distribution of 137 Cs and 90 Sr in the body of the wild boar (*Sus scrofa*) found on the territory with radioactive contamination.** *Journal of Environmental Radioactivity*, 127: 171-175.

Key words: Radioecology (Ukraine)

Gun, S.B. and Fu, Y.K. 2007. **Study on population characteristics of the wild boars in Ziwuling forest grassland in Gansu Province.** *Pratacultural Science*, 9.

Key words: Population Biology (China)

Gunduz, A., Turedi, S., Nuhoglu, I., Kalkan, A. and Turkmen, S. 2007. **Wild boar attacks.** *Wilderness & Environmental Medicine*, 18(2): 117-119.
Key words: Damage (Turkey)

H

Haas, C., Origgi, F.C., Akdesir, E., Batista Linhares, M., Giovannini, S., Mavrot, F., Casaubon, J. and Ryser-Degiorgis, M.P. 2015. **First detection of sarcoptic mange in free-ranging wild boar (*Sus scrofa*) in Switzerland.** *Schweiz Arch Tierheilk*, 157: 269-275.
Key words: Diseases/Parasites (Switzerland)

Haas, C., Rossi, S., Meier, R. and Ryser-Degiorgis, M.P. 2015. **Evaluation of a commercial ELISA for the detection of antibodies to *Sarcoptes scabiei* in wild boar (*Sus scrofa*).** *Journal of Wildlife Diseases*, 51(3): 729-733.
Key words: Diseases/Parasites (France)

Haaverstad, O., Hjeljord, O. and Wam, H.K. 2014. **Wild boar rooting in a northern coniferous forest–minor silviculture impact.** *Scandinavian Journal of Forest Research*, 29(1): 90-95.
Key words: Damage (Norway)

Hafeez, S., Abbas, M., Khan, Z.H. and Rehman, E.U. 2011. **Preliminary analysis of the diet of wild boar (*Sus scrofa* L., 1758) in Islamabad, Pakistan.** *Turkish Journal of Zoology*, 35(1): 115-118.
Key words: Food Habits (Pakistan)

Hafeez, S., Ashfaq, M., Hafeez, T., Ahsan, M. and Tiwana, U. 2012. **Preliminary analysis of the diet of wild boar (*Sus scrofa* L., 1758) in an agroecosystem of central Punjab, Pakistan.** *Turkish Journal of Zoology*, 36(5): 676-681.
Key words: Food Habits (Pakistan)

Hajji, G.E.M. and Zachos, F.E. 2011. **Mitochondrial and nuclear DNA analyses reveal pronounced genetic structuring in Tunisian wild boar *Sus scrofa*.** *European Journal of Wildlife Research*, 57(3): 449-456.
Key words: Genetics (Tunisia)

Halley, D.J. and Rosvold, J. 2014. **Stable isotope analysis and variation in medieval domestic pig husbandry practices in northwest Europe: absence of evidence for a purely herbivorous diet.** *Journal of Archaeological Science*, 49: 1-5.

Key words: Archaeological/Paleontology, Domestication

Hälli, O., Ala-Kurikka, E., Wallgren, P. and Heinonen, M. 2014. ***Actinobacillus pleuropneumoniae*** **seroprevalence in farmed wild boars in Finland.** *Journal of Zoo and Wildlife Medicine*, 45(4): 813-818.

Key words: Diseases/Parasites (Finland)

Halouzka, J., Juricova, Z., Jankova, J. and Hubalek, Z. 2008. **Serologic survey of wild boars for mosquito-borne viruses in south Moravia (Czech Republic).** *Veterinarni Medicina*, 53(5): 266-271.

Key words: Diseases/Parasites (Czech Republic)

Hamilton, J., Hedges, R.E. and Robinson, M. 2009. **Rooting for pigfruit: pig feeding in Neolithic and Iron Age Britain compared.** *Antiquity*, 83(322): 998-1011.

Key words: Archaeological/Paleontology (Britian)

Han, S.H., Lee, S.S. and Cho, I.C. 2007. **SINE-like sequence insertion on zinc finger-Y gene and sexual dimorphism in wild boars.** *Journal of Applied Animal Research*, 32(2): 165-168.

Key words: Genetics (Korea)

Hanson, L.B., Mitchell, M.S., Grand, J.B., Jolley, D.B., Sparklin, B.D. and Ditchkoff, S.S. 2009. **Effect of experimental manipulation on survival and recruitment of feral pigs.** *Wildlife Research*, 36(3): 185-191.

Key words: Reproduction (Georgia-USA)

Hara, Y., Terada, Y., Yonemitsu, K., Shimoda, H., Noguchi, K., Suzuki, K. and Maeda, K. 2014. **High prevalence of hepatitis E virus in wild boar (*Sus scrofa*) in Yamaguchi Prefecture, Japan.** *Journal of Wildlife Diseases*, 50(2): 378-383.

Key words: Diseases/Parasites (Japan)

Hartley, M. 2010. **Qualitative risk assessment of the role of the feral wild boar (*Sus scrofa*) in the likelihood of incursion and the impacts on effective disease**

control of selected exotic diseases in England. European *Journal of Wildlife Research*, 56(3): 401-410.

Key words: Diseases/Parasites (England)

Hayes, R., Riffell, S., Minnis, R. and Holder, B. 2009. **Survival and habitat use of feral hogs in Mississippi.** *Southeastern Naturalist*, 8(3): 411-426.

Key words: Behavior, Ecology (Mississippi-USA)

Hearn, R., Watkins, C. and Balzaretti, R. 2014. **The cultural and land use implications of the reappearance of the wild boar in north west Italy: a case study of the Val di Vara.** *Journal of Rural Studies*, 36: 52-63.

Key words: Animal geography; Hunting; Agriculture

Hebeisen, C., Fattebert, J., Baubet, E. and Fischer, C. 2008. **Estimating wild boar (*Sus scrofa*) abundance and density using capture–resights in Canton of Geneva, Switzerland.** *European Journal of Wildlife Research*, 54(3): 391-401.

Key words: Population Biology (Switzerland)

Hegel, C.G.Z. and Marini, M.Â. 2013. **Impact of the wild boar, *Sus scrofa,* on a fragment of Brazilian Atlantic Forest.** *Neotropical Biology and Conservation*, 8(1): 17-24.

Key words: Damage, Ecology (Brazil)

Herrero, J., García-Serrano, A. and García-González, R. 2008. **Reproductive and demographic parameters in two Iberian wild boar *Sus scrofa* populations.** *Acta Theriologica*, 53(4): 355-364.

Key words: Reproduction (Spain)

Herrero-Medrano, J.M., Megens, H.J., Groenen, M.A., Ramis, G., Bosse, M., Pérez-Enciso, M. and Crooijmans, R.P. 2013. **Conservation genomic analysis of domestic and wild pig populations from the Iberian Peninsula.** *BMC Genetics*, 14(106): 1-13.

Key words: Genetics, Taxonomy (Spain)

Hess, S.C. and Jocobi, J.D. 2014. **How much land is needed for feral pig hunting in Hawai ‘i?.** *Pacific Conservation Biology*, 20(1): 54-56.

Key words: Hunting (Hawaii-USA)

Hidalgo-Mihart, M.G., Perez-Hernandez, D., Perez-Solano, L.A., Contreras-Moreno, F., Angulo-Morales, J. and Hernandez-Nava, J. 2014. **First records of wild pigs in the Términos Lagoon area, Campeche, Mexico.** *Revista Mexicana de Biodiversidad*, 85(3): 990-994.

Key words: Economics (Mexico)

Hill, D.E., Dubey, J.P., Baroch, J.A., Swafford, S.R., Fournet, V.F., Hawkins-Cooper, D., Pyburn, D.G., Schmit, B.S., Gamble, H.R., Pedersen, K. and Ferreira, L.R. 2014**. Surveillance of feral swine for Trichinella spp. and *Toxoplasma gondii* in the USA and host-related factors associated with infection.** *Veterinary Parasitology*, 205(3): 653-665.

Key words: Diseases/Parasites (USA)

Hinić, V., Brodard, I., Thomann, A., Holub, M., Miserez, R. and Abril, C. 2009. **IS 711-based real-time PCR assay as a tool for detection of Brucella spp. in wild boars and comparison with bacterial isolation and serology.** *BMC Veterinary Research*, 5(22): 1-8.

Key words: Diseases/Parasites (Switzerland)

Hirata, D., Doichev, V.D., Raichev, E.G., Palova, N.A., Nakev, J.L., Yordanov, Y.M., Kaneko, Y. and Masuda, R. 2015. **Genetic variation of the East Balkan Swine (*Sus scrofa*) in Bulgaria, revealed by mitochondrial DNA and Y chromosomal DNA.** *Animal Genetics*, 46(2): 209-212.

Key words: Genetics (Bulgaria)

Hirose, K., Mikawa, S., Okumura, N., Noguchi, G., Fukawa, K., Kanaya, N., Mikawa, A., Arakawa, A., Ito, T., Hayashi, Y. and Tachibana, F. 2013. **Association of swine vertnin (VRTN) gene with production traits in Duroc pigs improved using a closed nucleus breeding system.** *Animal Science Journal*, 84(3): 213-221.

Key words: Genetics (Japan)

Hoelzle, K., Engels, M., Kramer, M.M., Wittenbrink, M.M., Dieckmann, S.M. and Hoelzle, L.E. 2010. **Occurrence of *Mycoplasma suis* in wild boars (*Sus scrofa* L.).** *Veterinary Microbiology*, 143(2): 405-409.

Key words: Diseases/Parasites (Germany)

Hohloch, C., Reiner, G., Bronnert, B., Willems, H. and Reinacher, M. 2014. **Detection of *porcine circovirus* type 2 and its association with PMWS in wild boars and domestic pigs in Germany: a histopathological, immunohistochemical and molecular biological study.** *Berliner und Munchener tierarztliche Wochenschrift*, 128(5-6): 200-203.

Key words: Diseases/Parasites (Germany)

Holá, M., Ježek, M., Kušta, T. and Košatová, M. 2015. **Trophic discrimination factors of stable carbon and nitrogen isotopes in hair of corn fed wild boar.** *PLOS ONE*, 10(4): 1-12.

Key words: Physiology (Czech Republic)

Holland, E.P., Aegerter, J.N. and Smith, G.C. 2007. **Spatial sensitivity of a generic population model, using wild boar (*Sus scrofa*) as a test case.** *Ecological Modelling*, 205(1): 146-158.

Key words: Population Biology (United Kingdom)

Holland, E.P., Burrow, J.F., Dytham, C. and Aegerter, J.N. 2009. **Modelling with uncertainty: introducing a probabilistic framework to predict animal population dynamics.** *Ecological Modelling*, 220(9): 1203-1217.

Key words: Population Biology (United Kingdom)

Honda, T. and Kawauchi, N. 2011. **Methods for constructing a wild boar relative-density map to resolve human-wild boar conflicts.** *Mammal Study*, 36(2): 79-85.

Key words: Control/Management, Population Biology (Japan)

Honda, T. and Sugita, M. 2007. **Environmental factors affecting damage by wild boars (*Sus scrofa*) to rice fields in Yamanashi Prefecture, central Japan.** *Mammal Study*, 32(4): 173-176.

Key words: Ecology, Damage (Japan)

Honda, T., Hayashi, Y. and Sato, Y. 2008. **Habitat selection of wild boar (*Sus scrofa*) captured near the forest edge.** *Honyurui Kagaku/Mammalian Science*, 48(1): 11-16.

Key words: Behavior, Ecology (Japan)

Honda, T., Kuwata, H., Yamasaki, S. and Miyagawa, Y. 2011. **A low-cost, low-labor-intensity electric fence effective against wild boar, sika deer, Japanese macaque and medium-sized mammals.** *Mammal Study*, 36(2): 113-117.

Key words: Control/Management (Japan)

Honda, T., Miyagawa, Y., Ueda, H. and Inoue, M. 2009. **Effectiveness of newly-designed electric fences in reducing crop damage by medium and large mammals.** *Mammal Study*, 34(1): 13-17.

Key words: Control/Management (Japan)

Hongo, H., Anezaki, T., Yamazaki, K., Takahashi, O. and Sugawara, H. 2007. **Hunting or management? The status of Sus in the Jomon period in Japan.** *Pigs and Humans 10,000 Years of Interaction*: 109-130.

Key words: Archaeological/Paleontology (Japan)

Hou, X.D., Sheng, G.L., Yin, S., Zhu, M., Du, M., Jin, C.Z. and Lai, X.L. 2014. **DNA analyses of wild boar remains from archaeological sites in Guangxi, China.** *Quaternary International*, 354: 147-153.

Key words: Archaeological/Paleontology, Domestication (China)

Hu, Y., Luan, F., Wang, S., Wang, C. and Richards, M.P. 2009. **Preliminary attempt to distinguish the domesticated pigs from wild boars by the methods of carbon and nitrogen stable isotope analysis.** *Science in China Series D: Earth Sciences*, 52(1): 85-92.

Key words: Archaeological/Paleontology, Domestication (China)

Hua, X., Yan, J., Li, H., He, W. and Li, X. 2016. **Wildlife damage and cultivated land abandonment: findings from the mountainous areas of Chongqing, China.** *Crop Protection*, 84: 141-149.

Key words: Damage (China)

Huckschlag, D. 2008. **Development of a digital infrared video camera system for recording and remote capturing**. *European Journal of Wildlife Research*, 54(4): 651-655.

Key words: Control/Management

Huh, J., Ha, H., Kim, D., Cho, B. and Kim, H. 2007. **Transient transfection analysis of long terminal repeats of porcine endogenous retroviruses in *Sus scrofa coreanus*.** *Korean Journal of Genetics*, 29(3): 403-407.
Key words: Diseases/Parasites (South Korea)

I

Iacolina, L., Scandura, M., Bongi, P. and Apollonio, M. 2009. **Nonkin associations in wild boar social units.** *Journal of Mammalogy*, 90(3): 666-674.
Key words: Behavior (Italy)

Iacolina, L., Scandura, M., Goedbloed, D.J., Alexandri, P., Crooijmans, R.P.M.A., Larson, G., Archibald, A., Apollonio, M., Schook, L.B., Groenen, M.A. and Megens, H.J. 2016. **Genomic diversity and differentiation of a managed island wild boar population.** *Heredity*, 116(1): 60-67.
Key words: Genetics, Population Biology

Ilie, D.E., Bacila, V., Cean, A., Toma, L. and Cziszter, S.N. 2014. **Screening of RYR1 genotypes in swine population by a rapid and sensitive method.** *Romanian Biotechnological Letters*, 19(2): 9171-9178.
Key words: Genetic, Morphology

Ishiguro, N., Inoshima, Y., Sasaki, M., Matsui, A., Hongo, H., Takahashi, R., Prasetyaningtyas, W.E., Djuwita, I., Agungpriyono, S., Labiro, E. and Budipitojo, T. 2012. **mtDNA variation and human-mediated introgression of indigenous Sus populations on several Indonesian islands.** *Mammal Study*, 37(1): 1-10.
Key words: Domestication, Genetics (Indonesia)

Ishiguro, N., Inoshima, Y., Suzuki, K., Miyoshi, T. and Tanaka, T. 2008. **Construction of three-year genetic profile of Japanese wild boars in Wakayama prefecture, to estimate gene flow from crossbred Inobuta into wild boar populations.** *Mammal Study*, 33(2): 43-49.
Key words: Genetics, Population Biology (Japan)

Ishiguro, N., Sasaki, M., Iwasa, M., Shigehara, N., Hongo, H., Anezaki, T., Long, V.T., Lan, D.T.B. and Long, P.T. 2008. **mtDNA variation in Vietnamese pigs, with**

particular emphasis on the genetic relationship between wild boars from Vietnam and the Ryukyu Islands. *Mammal Study*, 33(2): 51-58.
Key words: Genetics, Taxonomy (Vietnam)

Ishiguro, N., Sasaki, M., Iwasa, M., Shigehara, N., Hongo, H., Anezaki, T., Long, V.T., Hao, P.X., Trach, H.X., Nam, N.H. and Thanh, V.N. 2008. **Morphological and genetic analysis of Vietnamese *Sus scrofa* bones for evidence of pig domestication.** *Animal Science Journal*, 79(6): 655-664.
Key words: Domestication (Vietman)

Iso-Touru, T., Kantanen, J., Li, M.H., Gizejewski, Z. and Vilkki, J. 2009. **Divergent evolution in the cytoplasmic domains of PRLR and GHR genes in Artiodactyla.** *BMC Evolutionary Biology*, 9(172): 1-11.
Key words: Taxonomy

J

Jankowiak, D., Pilarczyk, R., Drozd, R., Pilarczyk, B., Tomza-Marciniak, A., Wysocka, G., Rzad, I., Drozd, A. and Kuba, J. 2015. **Activity of antioxidant enzymes in the liver of wild boars (*Sus scrofa*) from a selenium-deficient area depending on sex, age, and season of the year.** *Turkish Journal of Biology*, 39(1): 129-138.
Key words: Physiology (Poland)

Jarolímek, J., Vaněk, J., Ježek, M., Masner, J. and Stočes, M. 2014. **The telemetric tracking of wild boar as a tool for field crops damage limitation.** *Plant, Soil and Environment*, 60(9): 418-425.
Key words: Control/Management

Jay-Russell, M.T., Bates, A., Harden, L., Miller, W.G. and Mandrell, R.E. 2012. **Isolation of Campylobacter from feral swine (*Sus scrofa*) on the ranch associated with the 2006 *Escherichia coli* O157: H7 spinach outbreak investigation in California.** *Zoonoses and Public Health*, 59(5): 314-319.
Key words: Diseases/Parasites (California-USA)

Jeong, W., Yoon, H., Kim, Y.K., Moon, O.K., Kim, D.S. and An, D.J. 2014. **Prevalence of antibodies to *Toxoplasma gondii* in South Korean wild boar (*Sus scrofa coreanus*).** *Journal of Wildlife Diseases*, 50(4): 902-905.

Key words: Diseases/Parasites (Korea)

Jeoung, H.Y., Lim, S.I., Kim, J.J., Cho, Y.Y., Kim, Y.K., Song, J.Y., Hyun, B.H. and An, D.J. 2015. **Serological prevalence of viral agents that induce reproductive failure in South Korean wild boar.** *BMC Veterinary Research*, 11(78): 1-4.

Key words: Diseases/Parasites, Reproduction (Korea)

Jerina, K., Pokorny, B. and Stergar, M., 2014. **First evidence of long-distance dispersal of adult female wild boar (*Sus scrofa*) with piglets.** *European Journal of Wildlife Research*, 60(2), pp.367-370.

Key words: Behavior (Solvenia)

Ježek, M., Štípek, K., Kušta, T., Červený, J. and Vícha, J. 2011. **Reproductive and morphometric characteristics of wild boar (*Sus scrofa*) in the Czech Republic.** *Journal of Forensic Sciences*, 57(7): 285-292.

Key words: Morphology, Reproduction (Czech Republic)

Ji, Y.Q., Wu, D.D., Wu, G.S., Wang, G.D. and Zhang, Y.P. 2011. **Multi-locus analysis reveals a different pattern of genetic diversity for mitochondrial and nuclear DNA between wild and domestic pigs in East Asia.** *PLOS ONE*, 6(10): 1-12.

Key words: Genetics, Taxonomy

Jiang, Y.N., Wu, C.Y., Huang, C.Y., Chu, H.P., Ke, M.W., Kung, M.S., Li, K.Y., Wang, C.H., Li, S.H., Wang, Y. and Ju, Y.T. 2008. **Interpopulation and intrapopulation maternal lineage genetics of the Lanyu pig by analysis of mitochondrial and control region sequences.** *Journal of Animal Science*, 86(10): 2461-2470.

Key words: Genetics, Taxonomy (Taiwan)

Jokelainen, P., Näreaho, A., Hälli, O., Heinonen, M. and Sukura, A. 2012. **Farmed wild boars exposed to *Toxoplasma gondii* and Trichinella spp.** *Veterinary Parasitology*, 187(1): 323-327.

Key words: Diseases/Parasites (Finland)

Jolley, D.B., Ditchkoff, S.S., Sparklin, B.D., Hanson, L.B., Mitchell, M.S. and Grand, J.B. 2010. **Estimate of herpetofauna depredation by a population of wild pigs.** *Journal of Mammalogy*, 91(2): 519-524.

Key words: Food Habits (Georgia-USA)

Jordt, A.M., Lange, M., Kramer-Schadt, S., Nielsen, L.H., Nielsen, S.S., Thulke, H.H., Vejre, H. and Alban, L. 2016. **Spatio-temporal modeling of the invasive potential of wild boar—a conflict-prone species—using multi-source citizen science data.** *Preventive Veterinary Medicine*, 124: 34-44.

Key words: Ecology, Population Biology (Denmark)

Jori, F. and Bastos, A.D. 2009. **Role of wild suids in the epidemiology of African swine fever.** *EcoHealth*, 6(2): 296-310.

Key words: Diseases/Parasites

Jung, K.C., Yu, S.L., Kim, T.H., Jeon, J.T., Rogel-Gaillard, C., Park, C.S., Jin, D.I., Moran, C. and Lee, J.H. 2007. **Insertional variations of two porcine endogenous retroviruses (PERVs) in Korean native pigs and Asian wild boars**. *Asian Australian Journal of Animal Sciences*, 20(4): 461-465.

Key words: Diseases/Parasites

Juricová, Z. and Hubálek, Z. 2009. **Serologic survey of the wild boar (*Sus scrofa*) for *Borrelia burgdorferi* sensu lato.** *Vector-Borne and Zoonotic Diseases*, 9(5): 479-482.

Key words: Diseases/Parasites (Czech Republic)

K

Kaba, M., Davoust, B., Marié, J.L. and Colson, P. 2010**. Detection of hepatitis E virus in wild boar (*Sus scrofa*) livers.** *The Veterinary Journal*, 186(2): 259-261.

Key words: Diseases/Parasites (France)

Kaden, V., Lange, E. and Faust, A. 2008. **Oral vaccination against classical swine fever with a chimeric Pestivirus: comparative investigations of liquid and lyophilized virus.** *European Journal of Wildlife Research*, 54(2): 237-244.

Key words: Diseases/Parasites (Germany)

Kaden, V., Lange, E., Hänel, A., Hlinak, A., Mewes, L., Hergarten, G., Irsch, B., Dedek, J. and Bruer, W. 2009. **Retrospective serological survey on selected viral pathogens in wild boar populations in Germany.** *European Journal of Wildlife Research*, 55(2): 153-159.

Key words: Diseases/Parasites (Germany)

Kaizer, M.C., Novaes, C.M. and Faria, M.B. 2014. **Wild boar *Sus scrofa* (Cetartiodactyla, Suidae) in fragments of the Atlantic Forest, southeastern Brazil: new records and potential environmental impacts.** *Mastozoologia Neotropical*, 21: 343-347.

Key words: Damage, Ecology (Brazil)

Kang, S.W., Doan, H.T.T., Noh, J.H., Choe, S.E., Yoo, M.S., Kim, Y.H., Reddy, K.E., Nguyen, T.T.D., Van Quyen, D., Nguyen, L.T.K. and Kweon, C.H. 2013. **Seroprevalence of *Toxoplasma gondii* and *Trichinella spiralis* infections in wild boars (*Sus scrofa*) in Korea.** *Parasitology International*, 62(6): 583-585.

Key words: Diseases/Parasites (Korea)

Kaulitz, D., Mihica, D., Adlhoch, C., Semaan, M. and Denner, J. 2013. **Improved pig donor screening including newly identified variants of porcine endogenous retrovirus-C (PERV-C).** *Archives of Virology*, 158(2): 341-348.

Key words: Diseases/Parasites (Germany)

Keiter, D.A., Cunningham, F.L., Rhodes Jr, O.E., Irwin, B.J. and Beasley, J.C. 2016. **Optimization of scat detection methods for a social ungulate, the wild pig, and experimental evaluation of factors affecting detection of scat.** *PLOS ONE*, 11(5): 1-14.

Key words: Morphology (Georgia/South Carolina- USA)

Keiter, D.A., Mayer, J.J. and Beasley, J.C., 2016. **What is in a "common" name? A call for consistent terminology for nonnative *Sus scrofa*.** *Wildlife Society Bulletin*, 40(2): 384-387.

Key words: Taxonomy

Keros, T., Brnić, D., Prpić, J., Dežđek, D., Jemeršić, L., Roić, B. and Bedeković, T. 2014. **Characterisation of pseudorabies virus in domestic pigs and wild boars in Croatia.** *Acta Veterinaria Hungarica*, 62(4): 512-519.
Key words: Diseases/Parasites (Croatia)

Keuling, O., Baubet, E., Duscher, A., Ebert, C., Fischer, C., Monaco, A., Podgórski, T., Prevot, C., Ronnenberg, K., Sodeikat, G. and Stier, N. 2013. **Mortality rates of wild boar *Sus scrofa* L. in central Europe.** *European Journal of Wildlife Research*, 59(6): 805-814.
Key words: Population Biology

Keuling, O., Lauterbach, K., Stier, N. and Roth, M. 2010. **Hunter feedback of individually marked wild boar *Sus scrofa* L.: dispersal and efficiency of hunting in northeastern Germany.** *European Journal of Wildlife Research*, 56(2): 159-167.
Key words: Hunting (Germany)

Keuling, O., Stier, N. and Roth, M. 2008. **Annual and seasonal space use of different age classes of female wild boar *Sus scrofa* L.** *European Journal of Wildlife Research*, 54(3): 403-412.
Key words: Ecology (Germany)

Keuling, O., Stier, N. and Roth, M. 2008. **How does hunting influence activity and spatial usage in wild boar *Sus scrofa* L.?.** *European Journal of Wildlife Research*, 54(4): 729-737.
Key words: Behavior, Ecology, Hunting (Germany)

Keuling, O., Stier, N. and Roth, M. 2009. **Commuting, shifting or remaining?: Different spatial utilisation patterns of wild boar *Sus scrofa* L. in forest and field crops during summer.** *Mammalian Biology-Zeitschrift für Säugetierkunde*, 74(2): 145-152.
Key words: Behavior, Ecology (Germany)

Keuling, O., Strauß, E. and Siebert, U. 2016. **Regulating wild boar populations is “somebody else's problem”!-Human dimension in wild boar management.** *Science of the Total Environment*, 554: 311-319.

Key words: Control/Management (Germany)

Kia, E.B., Meamar, A.R., Zahabiun, F. and Mirhendi, H. 2009. **The first occurrence of *Trichinella murrelli* in wild boar in Iran and a review of Iranian trichinellosis.** *Journal of Helminthology*, 83(04): 399-402.

Key words: Diseases/Parasites (Iran)

Kia, E.B., Mirhendi, H., Rezaeian, M., Zahabiun, F. and Sharbatkhori, M. 2011. **First molecular identification of *Sarcocystis miescheriana* (Protozoa, Apicomplexa) from wild boar (*Sus scrofa*) in Iran.** *Experimental Parasitology*, 127(3): 724-726.

Key words: Diseases/Parasites (Iran)

Kierepka, E.M., Unger, S.D., Keiter, D.A., Beasley, J.C., Rhodes, O.E., Cunningham, F.L. and Piaggio, A.J. 2016. **Identification of robust microsatellite markers for wild pig fecal DNA.** *The Journal of Wildlife Management,* 80(6): 1120-1128.

Key words: Genetics (Georgia/South Carolina-USA)

Killer, J., Havlik, J., Bunešová, V., Vlkova, E. and Benada, O. 2014. ***Pseudoscardovia radai* sp. nov., a representative of the family Bifidobacteriaceae isolated from the digestive tract of a wild pig (*Sus scrofa scrofa*).** *International Journal of Systematic and Evolutionary Microbiology*, 64(9): 2932-2938.

Key words: Diseases/Parasites (Czech Republic)

Kim, G., Choi, M.H., Kim, J.H., Kang, Y.M., Jeon, H.J., Jung, Y., Lee, M.J. and Oh, M.D. 2011. **An outbreak of trichinellosis with detection of Trichinella larvae in leftover wild boar meat.** *Journal of Korean Medical Science,* 26(12): 1630-1633.

Key words: Diseases/Parasites (Korea)

Kim, J.M., Ku, B.K., Lee, H.N., Hwang, I.Y., Jang, Y.B., Kim, J., Hyun, B.H. and Jung, S.C. 2013. ***Mycobacterium avium paratuberculosis* in wild boars in Korea.** *Journal of Wildlife Diseases,* 49(2): 413-417.

Key words: Diseases/Parasites (Korea)

Kirjušina, M., Deksne, G., Marucci, G., Bakasejevs, E., Jahundoviča, I., Daukšte, A., Zdankovska, A., Bērziņa, Z., Esīte, Z., Bella, A. and Galati, F. 2015. **A 38-year**

study on Trichinella spp. in wild boar (*Sus scrofa*) of Latvia shows a stable incidence with an increased parasite biomass in the last decade. *Parasites & Vectors,* 8(137): 1-8.

Key words: Diseases/Parasites (Latvia)

Kiss, T., Cadar, D., Krupaci, F.A., Bordeanu, A.D. and Spînu, M. 2014. **Prevalence of *Anaplasma phagocytophilum* infection in European wild boar (*Sus scrofa*) populations from Transylvania, Romania.** *Epidemiology and Infection*, 142(02): 246-250.

Key words: Diseases/Parasites (Romania)

Klimienė, A. and Klimas, R. 2010. **The influence of the wild boar on the biological and performance traits of domestic pigs.** *Polish Journal of Natural Science*, 25(2): 123-131.

Key words: Genetics (Lituania)

Kodera, Y., Nagatsuma, T., Sawada, S., Fujihara, S. and Kanamori, H. 2010. **How does spreading maize on fields influence the behavior of wild boar (*Sus scrofa*).** *Mamm Study*, 50: 137-144.

Key words: Behavior

Kolodziej, K., Nikolov, I., Schulz, H.K., Theissinger, K. and Schulz, R. 2013. **Evaluation of fecal storage and DNA extraction methods in wild boar (*Sus scrofa*).** *Biochemical Genetics*, 51(5-6): 406-412.

Key words: Genetics, Population Biology

Kolodziej, K., Schulz, H.K., Theissinger, K., Ebert, C., Hohmann, U. and Schulz, R. 2013. **Comparison of established methods for quantifying genotyping error rates in wildlife forensics.** *Conservation Genetics Resources*, 5(1): 287-292.

Key words: Genetics

Kolodziej, K., Theissinger, K., Brün, J., Schulz, H.K. and Schulz, R. 2012. **Determination of the minimum number of microsatellite markers for individual genotyping in wild boar (*Sus scrofa*) using a test with close relatives.** *European Journal of Wildlife Research*, 58(3): 621-628.

Key words: Genetics (Germany)

Konjević, D., Njemirovskij, V., Radovčić, J., Severin, K., Manojlović, L., Marotti, M. and Slavica, A. 2008. **The potential of virtual imaging in the understanding of normal and abnormal tusk structure in wild boar (*Sus scrofa* L.).** *Natura Croatica*, 17(4): 265-272.

Key words: Morphology (Croatia)

Konjević, D., Severin, K., Janicki, Z., Slavica, A., Grubešić, M., Tomljanović, K., Hadžiosmanović, M. and Kozačinski, L. 2008. **Contribution to knowledge of body growth of wild boars in their plain habitats in the Republic of Croatia.** *MESO: prvi hrvatski časopis o mesu*, 10(5.): 360-364.

Key words: Morphology (Croatia)

Köppel, C., Knopf, L., Ryser, M.P., Miserez, R., Thür, B. and Stärk, K.D.C. 2007. **Serosurveillance for selected infectious disease agents in wild boars (*Sus scrofa*) and outdoor pigs in Switzerland.** *European Journal of Wildlife Research*, 53(3): 212-220.

Key words: Diseases/Parasites (Switzerland)

Kotulski, Y. and König, A., 2008. **Conflicts, crises and challenges: wild boar in the Berlin City–a social empirical and statistical survey.** *Natura Croatica*, 17(4), pp.233-246.

Key words: Damage (Germany)

Koutsogiannouli, E.A., Moutou, K.A., Sarafidou, T., Stamatis, C. and Mamuris, Z. 2010. **Detection of hybrids between wild boars (*Sus scrofa scrofa*) and domestic pigs (*Sus scrofa f. domestica*) in Greece, using the PCR-RFLP method on melanocortin-1 receptor (MC1R) mutations.** *Mammalian Biology-Zeitschrift für Säugetierkunde*, 75(1): 69-73.

Key words: Genetics, Taxonomy (Greece)

Krajewska, M., Lipiec, M., Zabost, A., Augustynowicz-Kopeć, E. and Szulowski, K. 2014. **Bovine tuberculosis in a wild boar (*Sus scrofa*) in Poland.** *Journal of Wildlife Diseases*, 50(4): 1001-1002.

Key words: Diseases/Parasites (Poland)

Kramer-Schadt, S., Fernández, N. and Thulke, H.H. 2007. **Potential ecological and epidemiological factors affecting the persistence of classical swine fever in wild boar *Sus scrofa* populations.** *Mammal Review*, 37(1): 1-20.

Key words: Diseases/Parasites

Kramer-Schadt, S., Fernández, N., Eisinger, D., Grimm, V. and Thulke, H.H. 2009. **Individual variations in infectiousness explain long-term disease persistence in wildlife populations.** *Oikos*, 118(2): 199-208.

Key words: Diseases/Parasites

Krause-Kyora, B., Makarewicz, C., Evin, A., Flink, L.G., Dobney, K., Larson, G., Hartz, S., Schreiber, S., von Carnap-Bornheim, C., von Wurmb-Schwark, N. and Nebel, A. 2013. **Use of domesticated pigs by Mesolithic hunter-gatherers in northwestern Europe.** *Nature Communications*, 4(2348): 1-7.

Key words: Archaeological/Paleontology, Domestication (Germany)

Krithiga, K., Kowsigan, A., Jeyathilakan, N. and Balachandran, C. 2010. **A report on the incidence of *Macrocanthorhynchus hirudinanceus* in a wild boar.** *Tamilnadu Journal of Veterarian and Animal Science*, 6(6): 289-90.

Key words: Diseases/Parasites (India)

Kriz, B., Daniel, M., Benes, C. and Maly, M. 2014. **The role of game (wild boar and roe deer) in the spread of tick-borne encephalitis in the Czech Republic.** *Vector-Borne and Zoonotic Diseases*, 14(11): 801-807.

Key words: Diseases/Parasites (Czech Republic)

Krull, C.R. and Egeter, B. 2016. **Feral pig (*Sus scrofa*) predation of a green and golden bell frog (*Litoria aurea*).** *New Zealand Journal of Ecology*, 40(1): 191-195.

Key words: Food Habits (New Zealand)

Krull, C.R., Stanley, M.C., Burns, B.R., Choquenot, D. and Etherington, T.R. 2016. **Reducing wildlife damage with cost-effective management programmes.** *PLOS ONE*, 11(1): 1-15.

Key words: Control/Management, Economics (New Zealand)

Kuijper, D.P., Cromsigt, J.P.G.M., Churski, M., Adam, B., Jędrzejewska, B. and Jędrzejewski, W. 2009. **Do ungulates preferentially feed in forest gaps in European temperate forest?.** *Forest Ecology and Management*, 258(7): 1528-1535.

Key words: Behavior, Food Habits (Poland)

Kuijper, D.P., Verwijmeren, M., Churski, M., Zbyryt, A., Schmidt, K., Jędrzejewska, B. and Smit, C. 2014. **What cues do ungulates use to assess predation risk in dense temperate forests?.** *PLOS ONE*, 9(1): 1-12.

Key words: Behavior (Poland)

Kukushkin, S., Baborenko, E., Baybikov, T., Mikhalishin, V. and Domskiy, I. 2009. **Seroprevalence of antibodies to main porcine infectious pathogens in wild boar in some regions of Russia.** *Acta Silvatica et Lignaria Hungarica*, 5: 147-152.

Key words: Diseases/Parasites (Russia)

Kukushkin, S., Kanshina, A., Timina, A., Baybikov, T. and Mikhalishin, V. 2008. **Investigation of wild boar (*Sus scrofa*) for porcine reproductive and respiratory syndrome in some territories of Russia.** *European Journal of Wildlife Research*, 54(3): 515-518.

Key words: Diseases/Parasites (Russia)

Kusolsuk, T., Kamonrattanakun, S., Wesanonthawech, A., Dekumyoy, P., Thaenkham, U., Yoonuan, T., Nuamtanong, S., Sa-nguankiat, S., Pubampen, S., Maipanich, W. and Panitchakit, J. 2010. **The second outbreak of trichinellosis caused by *Trichinella papuae* in Thailand.** *Transactions of the Royal Society of Tropical Medicine and Hygiene*, 104(6): 433-437.

Key words: Diseases/Parasites (Thailand)

Kusza, S., Podgórski, T., Scandura, M., Borowik, T., Jávor, A., Sidorovich, V.E., Bunevich, A.N., Kolesnikov, M. and Jędrzejewska, B. 2014. **Contemporary genetic structure, phylogeography and past demographic processes of wild boar *Sus scrofa* population in Central and Eastern Europe.** *PLOS ONE*, 9(3): 1-11.

Key words: Taxonomy (Europe)

L

Lacour, S.A., Heckmann, A., Mace, P., Grasset-Chevillot, A., Zanella, G., Vallee, I., Kapel, C.M. and Boireau, P. 2013. **Freeze-tolerance of Trichinella muscle larvae in experimentally infected wild boars.** *Veterinary Parasitology*, 194(2): 175-178.

Key words: Diseases/Parasites

Lagos, L., Picos, J. and Valero, E. 2012. **Temporal pattern of wild ungulate-related traffic accidents in northwest Spain.** *European Journal of Wildlife Research*, 58(4): 661-668.

Key words: Damage (Spain)

Lange, M., Kramer-Schadt, S. and Thulke, H.H. 2012. **Efficiency of spatio-temporal vaccination regimes in wildlife populations under different viral constraints.** *Veterinary Research*, 43(37): 1-12.

Key words: Diseases/Parasites

Lange, M., Kramer-Schadt, S., Blome, S., Beer, M. and Thulke, H.H. 2012. **Disease severity declines over time after a wild boar population has been affected by classical swine fever—legend or actual epidemiological process?.** *Preventive Veterinary Medicine*, 106(2): 185-195.

Key words: Diseases/Parasites

Lara, G.H.B., Ribeiro, M.G., Leite, C.Q.F., Paes, A.C., Guazzelli, A., Da Silva, A.V., Santos, A.C.B. and Listoni, F.J.P. 2011. **Occurrence of Mycobacterium spp. and other pathogens in lymph nodes of slaughtered swine and wild boars (*Sus scrofa*).** *Research in Veterinary Science*, 90(2): 185-188.

Key words: Diseases/Parasites (Brazil)

Larson, G., Albarella, U., Dobney, K. and Rowley-Conwy, P. 2007. **Current views on Sus phylogeography and pig domestication as seen through modern mtDNA studies.** *Pigs and Humans*, 10: 30-41.

Key words: Domestication

Larson, G., Albarella, U., Dobney, K., Rowley-Conwy, P., Schibler, J., Tresset, A., Vigne, J.D., Edwards, C.J., Schlumbaum, A., Dinu, A. and Bălăçsescu, A. 2007. **Ancient DNA, pig domestication, and the spread of the Neolithic into Europe.** *Proceedings of the National Academy of Sciences*, 104(39): 15276-15281.

Key words: Archaeological/Paleontology, Domestication

Larson, G., Cucchi, T., Fujita, M., Matisoo-Smith, E., Robins, J., Anderson, A., Rolett, B., Spriggs, M., Dolman, G., Kim, T.H. and Thuy, N.T.D. 2007. **Phylogeny and ancient DNA of Sus provides insights into neolithic expansion in Island Southeast Asia and Oceania.** *Proceedings of the National Academy of Sciences*, 104(12): 4834-4839.

Key words: Archaeological/Paleontology

Larson, G., Liu, R., Zhao, X., Yuan, J., Fuller, D., Barton, L., Dobney, K., Fan, Q., Gu, Z., Liu, X.H. and Luo, Y. 2010. **Patterns of East Asian pig domestication, migration, and turnover revealed by modern and ancient DNA.** *Proceedings of the National Academy of Sciences*, 107(17): 7686-7691.

Key words: Archaeological/Paleontology, Domestication

Lattuada, L., Quaglia, F., Iannelli, F., Gissi, C., Mantecca, P., Bacchetta, R. and Polli, M. 2009. **Mitochondrial DNA sequence variations in some Italian wild boar populations.** *Journal of Animal Breeding and Genetics*, 126(2): 154-163.

Key words: Genetics (Italy)

Lavandera, P.A., Vicente, J., Alzaga, V. and Gortázar, C. 2009. **Wild boar abundance and hunting effectiveness in Atlantic Spain: environmental constraints.** *Galemys: Boletín informativo de la Sociedad Española para la conservación y estudio de los mamíferos*, 21(2): 13-29.

Key words: Control/Management, Population Biology (Spain)

Lavelle, M.J., Vercauteren, K.C., Hefley, T.J., Phillips, G.E., Hygnstrom, S.E., Long, D.B., Fischer, J.W., Swafford, S.R. and Campbell, T.A. 2011. **Evaluation of fences for containing feral swine under simulated depopulation conditions.** *The Journal of Wildlife Management*, 75(5): 1200-1208.

Key words: Control/Management (Texas-USA)

Laznik, Z. and Trdan, S. 2014. **Evaluation of different soil parameters and wild boar (*Sus scrofa* [L.]) grassland damage.** *Italian Journal of Animal Science*, 13(3434): 759-765.

Key words: Damage, Food Habits (Slovenia)

Lebocký, T. and Petráš, R. 2015. **The influence of wild boars on the growth of forest trees and stands: a case study of a wild boar game preserve.** *Acta Silvatica et Lignaria Hungarica*, 11(1): 65-75.

Key words: Food Habits (Slovakia)

Lega, C., Raia, P., Rook, L. and Fulgione, D. 2015. **Size matters: a comparative analysis of pig domestication.** *The Holocene*, 1-6.

Key words: Archaeological/Paleontology, Domestication (Italy)

Legge, A. 2013. **Practice with science': molar tooth eruption ages in domestic, feral and wild pigs (*Sus scrofa*).** *International Journal of Osteoarchaeology*: 1099-1212.

Key words: Archaeological/Paleontology, Morphology

Leifer, I., Hoffmann, B., Höper, D., Rasmussen, T.B., Blome, S., Strebelow, G., Höreth-Böntgen, D., Staubach, C. and Beer, M. 2010. **Molecular epidemiology of current classical swine fever virus isolates of wild boar in Germany.** *Journal of General Virology*, 91(11): 2687-2697.

Key words: Diseases/Parasites (Germany)

Leiser, O.P., Corn, J.L., Schmit, B.S., Keim, P.S. and Foster, J.T. 2013. **Feral swine brucellosis in the United States and prospective genomic techniques for disease epidemiology.** *Veterinary Microbiology*, 166(1): 1-10.

Key words: Diseases/Parasites (USA)

Lemoine, X., Zeder, M.A., Bishop, K.J. and Rufolo, S.J. 2014. **A new system for computing dentition-based age profiles in *Sus scrofa*.** *Journal of Archaeological Science*, 47: 179-193.

Key words: Archaeological/Paleontology, Morphology

Leslie, E., Cowled, B., Graeme Garner, M., Toribio, J. and Ward, M.P. 2014. **Effective surveillance strategies following a potential classical swine fever incursion in**

a remote wild pig population in north-western Australia. *Transboundary and Emerging Diseases*, 61(5): 432-442.

Key words: Diseases/Parasites (Australia)

Levy, B., Collins, C., Lenhart, S., Madden, M., Corn, J., Salinas, R.A. and Stiver, W. 2015. **A metapopulation model for feral hogs in Great Smoky Mountains National Park.** *Natural Resource Modeling*, 29(1): 71-97.

Key words: Population Biology (North Carolina/Tennessee-USA)

Li, C., Wang, X., Cai, H., Fu, Y., Luan, Y., Wang, W., Xiang, H. and Li, C. 2016. **Molecular microevolution and epigenetic patterns of the long non-coding gene H19 show its potential function in pig domestication and breed divergence.** *BMC Evolutionary Biology*, 16(87): 1-14.

Key words: Domestication, Genetics (China)

Li, J., Yang, H., Li, J.R., Li, H.P., Ning, T., Pan, X.R., Shi, P. and Zhang, Y.P. 2010. **Artificial selection of the melanocortin receptor 1 gene in Chinese domestic pigs during domestication.** *Heredity*, 105(3): 274-281.

Key words: Domestication, Genetics (China)

Li, K.T., Li, K.Y., Ju, Y.T. and Tsang, C.H. 2015. **Wild boars and domestic pigs in prehistoric southern Taiwan: some point of views on domestic pigs as a verification mark to the migration and dispersal of Austronesian speaking people.** *Bulletin of the Institue of History and Philogy Academia Sinica*, 86: 607-678.

Key words:, Archaeological/Paleontology, Domestication (Taiwan)

Li, L., Liu, H., Wan, D.M., Ma, Q., Zhang, S.Q. and Liu, Z. 2010. **Foraging habitat selection of wild boar in Laotudingzi Natural Reserve of Liaoning Province in winter.** *Chinese Journal of Ecology*, 12.

Key words: Food Habits (China)

Li, L., Shi, J., Wang, J., Gao, Y., Wang, L., Wang, J. and Ying, X. 2013. **Factors influencing wild boar damage in Taohongling National Nature Reserve in China: a model approach.** *European Journal of Wildlife Research*, 59(2): 179-184.

Key words: Damage (China)

Li, L.L., Wang, J. and Shi, J.B. 2010. **Human–wild boar (*Sus scrofa*) conflict: current status. Influence factors and management recommendations.** *Sichuan Journal of Zoology*, 29: 642-648.

Key words: Control/Management

Linkie, M., Dinata, Y., Nofrianto, A. and Leader-Williams, N. 2007. **Patterns and perceptions of wildlife crop raiding in and around Kerinci Seblat National Park, Sumatra.** *Animal Conservation*, 10(1): 127-135.

Key words: Damage (Indonesia)

Lipej, Z., Segales, J., Jemeršić, L., Olvera, A., Roić, B., Novosel, D., Mihaljević, Ž. and Manojlović, L. 2007. **First description of postweaning multisystemic wasting syndrome (PMWS) in wild boar (*Sus scrofa*) in Croatia and phylogenetic analysis of partial PCV2 sequences.** *Acta Veterinaria Hungarica*, 55(3): 389-404.

Key words: Diseases/Parasites (Croatia)

Liu, H., Li, L., Ma, Q., Wan, D.M., Zhang, S.Q. and Zhu, Y.P. 2011. **Review on wild boar research.** *Sichuan Journal of Zoology*, 2.

Key words: Ecology, Genetics

Lombardini, M., Vidus Rosin, A., Murru, M., Cinerari, C.E. and Meriggi, A. 2014. **Reproductive and demographic parameters in Sardinian wild boar, *Sus scrofa meridionalis*.** *Folia Zoologica*, 63(4): 301-307.

Key words: Population Biology, Reproduction (Italy)

López, V., Villar, M., Queirós, J., Vicente, J., Mateos-Hernández, L., Díez-Delgado, I., Contreras, M., Alves, P.C., Alberdi, P., Gortázar, C. and de la Fuente, J. 2016. **Comparative proteomics identifies host immune system proteins affected by infection with *Mycobacterium bovis*.** *PLOS Neglected Tropical Diseases*, 10(3): 1-22.

Key words: Diseases/Parasites (Spain)

Lord, T.C., Thorp, J.A. and Wilson, P. 2015. **A wild boar dominated ungulate assemblage from an early Holocene natural pit fall trap: cave shaft sediments**

in northwest England associated with the 9.3 ka BP cold event. *The Holocene*, 26(1): 147-153.

Key words: Archaeological/Paleontology (England)

Luetkemeier, E.S., Sodhi, M., Schook, L.B. and Malhi, R.S. 2010. **Multiple Asian pig origins revealed through genomic analyses.** *Molecular Phylogenetics and Evolution*, 54(3): 680-686.

Key words: Genetics, Taxonomy

Lui, J.F., Macuco, V.S.O., Cavalcante Neto, A., Tosta, P.A. and Malheiros, E.B. 2007. **Lipid, protein and cholesterol levels in the meat of wild boars (*Sus scrofa scrofa*) of different genetic groups.** *Archivos de Zootecnia*, 951-954.

Key words: Genetics, Physiology

Luo, J., Dong, G., Li, K., Lv, Z., Huo, X. and He, H. 2013. **Exposure to swine H1 and H3 and avian H5 and H9 influenza a viruses among feral swine in southern China, 2009.** *Journal of Wildlife Diseases*, 49(2): 375-380.

Key words: Diseases/Parasites (China)

Luskin, M.S., Christina, E.D., Kelley, L.C. and Potts, M.D. 2014. **Modern hunting practices and wild meat trade in the oil palm plantation-dominated landscapes of Sumatra, Indonesia.** *Human Ecology*, 42(1): 35-45.

Key words: Hunting (Indonesia)

Lyang, D.Y. and Lee, K.S. 2010. **Responses of an herbaceous community to wild boar (*Sus scrofa coreanus* Heude) disturbance in a *Quercus mongolica* forest at Mt. Jeombong, Korea.** *Journal of Ecology and Environment*, 33(3): 205-216.

Key words: Food Habits (Korea)

M

Macchi, E., Cucuzza, A.S., Badino, P., Odore, R., Re, F., Bevilacqua, L. and Malfatti, A. 2010. **Seasonality of reproduction in wild boar (*Sus scrofa*) assessed by fecal and plasmatic steroids.** *Theriogenology*, 73(9): 1230-1237.

Key words: Reproduction (Italy)

Macci, C., Doni, S., Bondi, G., Davini, D., Masciandaro, G. and Pistoia, A. 2012. **Effects of wild boar (*Sus scrofa*) grazing on soil properties in Mediterranean environment.** *Catena*, 98: 79-86.
Key words: Food Habits (Italy)

Magnell, O. and Carter, R. 2007. **The chronology of tooth development in wild boar–A guide to age determination of linear enamel hypoplasia in prehistoric and medieval pigs.** *Veterinarija ir Zootechnika*, 40(62): 43-48.
Key words: Archaeological/Paleontology, Morhphology (Poland, Sweden)

Mahmoud, H.Y., Suzuki, K., Tsuji, T., Yokoyama, M., Shimojima, M. and Maeda, K. 2011. **Pseudorabies virus infection in wild boars in Japan.** *Journal of Veterinary Medical Science*, 73(11): 1535-1537.
Key words: Diseases/Parasites (Japan)

Mainland, I., Schutkowski, H. and Thomson, A.F. 2007. **Macro-and micromorphological features of lifestyle differences in pigs and wild boar.** *Anthropozoologica*, 42(2): 89-106.
Key words: Domestication, Morphology (Luxembourg)

Malo, A.F. and Coulson, T. 2009. **Heterozygosity–fitness correlations and associative overdominance: new detection method and proof of principle in the Iberian wild boar.** *Molecular Ecology*, 18(13): 2741-2742.
Key words: Diseases/Parasites, Genetics

Manunza, A., Zidi, A., Yeghoyan, S., Balteanu, V.A., Carsai, T.C., Scherbakov, O., Ramírez, O., Eghbalsaied, S., Castello, A., Mercade, A. and Amills, M. 2013. **A high throughput genotyping approach reveals distinctive autosomal genetic signatures for European and Near Eastern wild boar.** *PLOS ONE*, 8(2): 1-8.
Key words: Genetics, Taxonomy

Marincs, F., Molnár, J., Tóth, G., Stéger, V. and Barta, E. 2013. **Introgression and isolation contributed to the development of Hungarian Mangalica pigs from a particular European ancient bloodline.** *Genetics Selection Evolution*, 45(22): 1-6.
Key words: Taxonomy (Hungary)

Marini, F., Franzetti, B., Calabrese, A., Cappellini, S. and Focardi, S. 2009. **Response to human presence during nocturnal line transect surveys in fallow deer (*Dama dama*) and wild boar (*Sus scrofa*).** *European Journal of Wildlife Research*, 55(2): 107-115.

Key words: Control/Management (Italy)

Maršálek, P., Zelníčková, L., Mikuláštíková, J., Svobodová, Z. and Hutařová, Z. 2013. **Organochlorine compound residues in muscle of wild boar (*Sus Scrofa* L.) and red deer (*Cervus elaphus* L.): effects of age and sex.** *Bulletin of Environmental Contamination and Toxicology*, 91(6): 673-677.

Key words: Contamination (Czech Republic)

Martinelli, N., Pavoni, E., Filogari, D., Ferrari, N., Chiari, M., Canelli, E. and Lombardi, G. 2015. **Hepatitis E virus in wild boar in the central northern part of Italy.** *Transboundary and Emerging Diseases*, 62(2): 217-222.

Key words: Diseases/Parasites (Italy)

Martín-Hernando, M.P., González, L.M., Ruiz-Fons, F., Garate, T. and Gortazar, C. 2008. **Massive presence of *Echinococcus granulosus* (Cestoda, Taeniidae) cysts in a wild boar (*Sus scrofa*) from Spain.** *Parasitology Research*, 103(3): 705-707.

Key words: Diseases/Parasites (Spain)

Martín-Hernando, M.P., Höfle, U., Vicente, J., Ruiz-Fons, F., Vidal, D., Barral, M., Garrido, J.M., de la Fuente, J. and Gortazar, C. 2007. **Lesions associated with *Mycobacterium tuberculosis* complex infection in the European wild boar.** *Tuberculosis*, 87(4): 360-367.

Key words: Diseases/Parasites (Spain)

Maselli, V., Polese, G., Larson, G., Raia, P., Forte, N., Rippa, D., Ligrone, R., Vicidomini, R. and Fulgione, D. 2014. **A dysfunctional sense of smell: the irreversibility of olfactory evolution in free-living pigs.** *Evolutionary Biology*, 41(2): 229-239.

Key words: Domestication, Physiology (Italy)

Maselli, V., Rippa, D., Russo, G., Ligrone, R., Soppelsa, O., D'Aniello, B., Raia, P. and Fulgione, D. 2014. **Wild boars' social structure in the Mediterranean habitat.** *Italian Journal of Zoology*, 81(4): 610-617.
Key words: Behavior (Italy)

Massei, G., Coats, J., Quy, R., Storer, K. and Cowan, D.P. 2010. **The Boar-Operated-System: a novel method to deliver baits to wild pigs.** *The Journal of Wildlife Management*, 74(2): 333-336.
Key words: Control/Management (United Kingdom)

Massei, G., Cowan, D.P., Coats, J., Bellamy, F., Quy, R., Pietravalle, S., Brash, M. and Miller, L.A. 2012. **Long-term effects of immunocontraception on wild boar fertility, physiology and behaviour.** *Wildlife Research*, 39(5): 378-385.
Key words: Control/Management (United Kingdom)

Massei, G., Cowan, D.P., Coats, J., Gladwell, F., Lane, J.E. and Miller, L.A. 2008. **Effect of the GnRH vaccine GonaCon on the fertility, physiology and behaviour of wild boar.** *Wildlife Research*, 35(6): 540-547.
Key words: Control/Management (United Kingdom)

Massei, G., Jones, A., Platt, T. and Cowan, D.P. 2009. **Iophenoxic acid as a long-term marker for wild boar.** *The Journal of Wildlife Management*, 73(3): 458-461.
Key words: Control/Management (United Kingdom)

Massei, G., Kindberg, J., Licoppe, A., Gačić, D., Šprem, N., Kamler, J., Baubet, E., Hohmann, U., Monaco, A., Ozoliņš, J. and Cellina, S. 2015. **Wild boar populations up, numbers of hunters down? A review of trends and implications for Europe.** *Pest Management Science*, 71(4): 492-500.
Key words: Hunting, Population Biology (United Kingdom)

Massei, G., Roy, S. and Bunting, R. 2011. **Too many hogs? A review of methods to mitigate impact by wild boar and feral hogs.** *Human-Wildlife Interactions*, 5(1): 79-99.
Key words: Control/Management (United Kingdom)

Masseti, M. 2007. **The economic role of Sus in early human fishing communities.** *Pigs and Humans*, 10: 156-170.

Key words: Archeological/Paleontology, Economics (Greece)

Massolo, A., della Stella, R.M. and Meriggi, A. 2007. **Zoning and wild boar management: a multi-criteria approach to planning.** *Hystrix, The Italian Journal of Mammalogy*, 18(1): 57-68.

Key words: Control/Management (Italy)

Matsumoto, J., Kako, Y., Morita, Y., Kabeya, H., Sakano, C., Nagai, A., Maruyama, S. and Nogami, S. 2011. **Seroprevalence of *Toxoplasma gondii* in wild boars (*Sus scrofa leucomystax*) and wild sika deer (*Cervus nippon*) in Gunma Prefecture, Japan.** *Parasitology International*, 60(3): 331-332.

Key words: Diseases/Parasites (Japan)

Mayer, W. and Hochegger, R. 2011. **Discrimination of two alleles of the melanocortin receptor 1 gene to discern European wild boar (*Sus scrofa scrofa*) and domestic pig (*Sus scrofa domestica*) in meat products by real-time PCR.** *European Food Research and Technology*, 232(4): 687-692.

Key words: Genetic, Taxonomy (Austria, Italy)

McCann, B.E. and Garcelon, D.K. 2008. **Eradication of feral pigs from Pinnacles National Monument.** *The Journal of Wildlife Management*, 72(6): 1287-1295.

Key words: Control/Management (California-USA)

Mccann, B.E., Malek, M.J., Newman, R.A., Schmit, B.S., Swafford, S.R., Sweitzer, R.A. and Simmons, R.B. 2014. **Mitochondrial diversity supports multiple origins for invasive pigs.** *The Journal of Wildlife Management*, 78(2): 202-213.

Key words: Genetics (United States of America)

McClure, M.L., Burdett, C.L., Farnsworth, M.L., Lutman, M.W., Theobald, D.M., Riggs, P.D., Grear, D.A. and Miller, R.S. 2015. **Modeling and mapping the probability of occurrence of invasive wild pigs across the contiguous United States.** *PLOS ONE*, 10(8): 1-17.

Key words: Population Biology (United States of America)

McDevitt, A.D., Carden, R.F., Coscia, I. and Frantz, A.C. 2013. **Are wild boars roaming Ireland once more?.** *European Journal of Wildlife Research*, 59(5): 761-764.

Key words: Genetics, Taxonomy (Ireland)

Meemken, D., Blaha, T., Hotzel, H., Strommenger, B., Klein, G., Ehricht, R., Monecke, S. and Kehrenberg, C. 2013. **Genotypic and phenotypic characterization of *Staphylococcus aureus* isolates from wild boars.** *Applied and Environmental Microbiology*, 79(5): 1739-1742.

Key words: Diseases/Parasites

Meixiang, G., Qingxi, G. and Yuanfeng, C. 2011. **Simulation of effects of habitat area and quality on population dynamics of wild boar.** *Journal of Northeast Forestry University*, 1.

Key words: Ecology, Population Biology (China)

Mellish, J.M., Sumrall, A., Campbell, T.A., Collier, B.A., Neill, W.H., Higginbotham, B. and Lopez, R.R. 2014. **Simulating potential population growth of qild pig, *Sus scrofa*, in Texas.** *Southeastern Naturalist*, 13(2): 367-376.

Key words: Ecology, Population Biology (Texas-USA)

Melzer, F., Lohse, R., Nieper, H., Liebert, M. and Sachse, K. 2007. **A serological study on brucellosis in wild boars in Germany.** *European Journal of Wildlife Research*, 53(2): 153-157.

Key words: Diseases/Parasites (Germany)

Meng, X.J., Lindsay, D.S. and Sriranganathan, N. 2009. **Wild boars as sources for infectious diseases in livestock and humans.** *Philosophical Transactions of the Royal Society of London B: Biological Sciences*, 364(1530): 2697-2707.

Key words: Diseases/Parasites

Mentaberre, G., Romero, B., De Juan, L., Navarro-González, N., Velarde, R., Mateos, A., Marco, I., Olivé-Boix, X., Domínguez, L., Lavín, S. and Serrano, E. 2014. **Long-term assessment of wild boar harvesting and cattle removal for bovine tuberculosis control in free ranging populations.** *PLOS ONE*, 9(2): 1-12.

Key words: Control/Management, Diseases/Parasites (Spain)

Merialdi, G., Bardasi, L., Fontana, M.C., Spaggiari, B., Maioli, G., Conedera, G., Vio, D., Londero, M., Marucci, G., Ludovisi, A. and Pozio, E. 2011. **First reports of**

***Trichinella pseudospiralis* in wild boars (*Sus scrofa*) of Italy.** *Veterinary Parasitology*, 178(3): 370-373.

Key words: Diseases/Parasites (Italy)

Merta, D., Bobek, B., Albrycht, M. and Furtek, J. 2015. **The age structure and sex ratio in wild boar (*Sus scrofa*) populations as determined by observations of free-roaming populations and by harvests of collective hunts in southern Poland.** *European Journal of Wildlife Research*, 61(1): 167-170.

Key words: Reproduction (Poland)

Merta, D., Mocała, P., Pomykacz, M. and Frąckowiak, W. 2014. **Autumn-winter diet and fat reserves of wild boars (*Sus scrofa*) inhabiting forest and forest-farmland environment in south-western Poland.** *Folia Zoologica*, 63(2): 95-102.

Key words: Food Habits, Physiology (Poland)

Metcalf, E.M., Parker, I.D., Lopez, R.R., Higginbotham, B., Davis, D.S. and Gersbach, J.R. 2014. **Impact of gate width of corral traps in potential wild pig trapping success.** *Wildlife Society Bulletin*, 38(4): 892-895.

Key words: Control/Management (Texas-USA)

Methner, U., Heller, M. and Bocklisch, H. 2010. ***Salmonella enterica* subspecies *enterica serovar Choleraesuis* in a wild boar population in Germany.** *European Journal of Wildlife Research*, 56(4): 493-502.

Key words: Diseases/Parasites (Germany)

Mezo, M., González-Warleta, M., Castro-Hermida, J.A., Manga-González, M.Y., Peixoto, R., Mas-Coma, S. and Valero, M.A. 2013. **The wild boar (*Sus scrofa* Linnaeus, 1758) as secondary reservoir of *Fasciola hepatica* in Galicia (NW Spain).** *Veterinary Parasitology*, 198(3): 274-283.

Key words: Diseases/Parasites (Spain)

Michalek, K., Czerniawska-Piatkowska, E., Grabowska, M. and Laszczynska, M. 2015. **Immunohistochemical identification of aquaporin 2 in the kidneys of wild boars (*Sus scrofa*).** *Turkish Journal of Biology*, 39(5): 692-697.

Key words: Physiology (Poland)

Michalik, J., Stańczak, J., Cieniuch, S., Racewicz, M., Sikora, B. and Dabert, M. 2012. **Wild boars as hosts of human-pathogenic *Anaplasma phagocytophilum*.** *Emerging Infectious Diseases*, 18: 998-1001.

Key words: Diseases/Parasites (Poland)

Mikawa, S., Morozumi, T., Shimanuki, S.I., Hayashi, T., Uenishi, H., Domukai, M., Okumura, N. and Awata, T. 2007. **Fine mapping of a swine quantitative trait locus for number of vertebrae and analysis of an orphan nuclear receptor, germ cell nuclear factor (NR6A1).** *Genome Research*, 17(5): 586-593.

Key words: Genetics

Mikawa, S., Sato, S., Nii, M., Morozumi, T., Yoshioka, G., Imaeda, N., Yamaguchi, T., Hayashi, T. and Awata, T. 2011. **Identification of a second gene associated with variation in vertebral number in domestic pigs.** *BMC Genetics*, 12(5): 1-13.

Key words: Genetics

Milner, J.M., Van Beest, F.M., Schmidt, K.T., Brook, R.K. and Storaas, T. 2014. **To feed or not to feed? Evidence of the intended and unintended effects of feeding wild ungulates.** *The Journal of Wildlife Management*, 78(8): 1322-1334.

Key words: Control/Management

Mitchell, J., Dorney, W., Mayer, R. and McIlroy, J. 2008. **Spatial and temporal patterns of feral pig diggings in rainforests of north Queensland.** *Wildlife Research*, 34(8): 597-602.

Key words: Food Habits (Australia)

Mitchell, J., Dorney, W., Mayer, R. and McIlroy, J. 2009. **Migration of feral pigs (*Sus scrofa*) in rainforests of north Queensland: fact or fiction?.** *Wildlife Research*, 36(2): 110-116.

Key words: Behavior, Population Biology (Australia)

Miyake, Y., Sakurai, M., Tanaka, S., Tunjung, W.A.S., Yokoo, M., Matsumoto, H., Aso, H., Yamaguchi, T. and Sato, E. 2009. **Expression of hyaluronan synthase 1 and distribution of hyaluronan during follicular atresia in pig ovaries.** *Biology of Reproduction*, 80(2): 249-257.

Key words: Reproduction (Japan)

Mizukawa, H., Nomiyama, K., Kunisue, T., Watanabe, M.X., Subramanian, A., Iwata, H., Ishizuka, M. and Tanabe, S. 2015. **Organohalogens and their hydroxylated metabolites in the blood of pigs from an open waste dumping site in south India: association with hepatic cytochrome P450.** *Environmental Research*, 138: 255-263.

Key words: Contamination (India)

Mokracka, J., Koczura, R. and Kaznowski, A. 2012. **Transferable integrons of Gram-negative bacteria isolated from the gut of a wild boar in the buffer zone of a national park.** *Annals of Microbiology*, 62(2): 877-880.

Key words: Diseases/Parasites (France)

Montagnaro, S., Sasso, S., De Martino, L., Longo, M., Iovane, V., Ghiurmino, G., Pisanelli, G., Nava, D., Baldi, L. and Pagnini, U. 2010. **Prevalence of antibodies to selected viral and bacterial pathogens in wild boar (*Sus scrofa*) in Campania Region, Italy.** *Journal of Wildlife Diseases*, 46(1): 316-319.

Key words: Diseases/Parasites (Italy)

Morelle, K. and Lejeune, P. 2015. **Seasonal variations of wild boar *Sus scrofa* distribution in agricultural landscapes: a species distribution modelling approach.** *European Journal of Wildlife Research*, 61(1): 45-56.

Key words: Ecology, Population Biology (Belgium)

Morelle, K., Lehaire, F. and Lejeune, P. 2014. **Is wild boar heading towards movement ecology? A review of trends and gaps.** *Wildlife Biology*, 20: 196-205.

Key words: Population Biology

Morelle, K., Podgórski, T., Prévot, C., Keuling, O., Lehaire, F. and Lejeune, P. 2015. **Towards understanding wild boar *Sus scrofa* movement: a synthetic movement ecology approach.** *Mammal Review*, 45(1): 15-29.

Key words: Ecology, Physiology

Morita, T., Haruta, K.I., Shibata-Haruta, A., Kanda, E., Imai, S. and Ike, K. 2007. **Lung worms of wild boars in the western region of Tokyo, Japan.** *Journal of Veterinary Medical Science*, 69(4): 417-420.

Key words: Diseases/Parasites (Japan)

Morelle, K., Lehaire, F. and Lejeune, P. 2013. **Spatio-temporal patterns of wildlife-vehicle collisions in a region with a high-density road network.** *Nature Conservation*, 5: 53-73.

Key words: Damage (Belgium)

Motoi, Y., Asano, M., Inokuma, H., Ando, S., Kawabata, H., Takano, A. and Suzuki, M. 2013. **Detection of *Rickettsia tamurae* DNA in ticks and wild boar (*Sus scrofa leucomystax*) skins in Shimane Prefecture, Japan.** *Journal of Veterinary Medical Science*, 75(3): 263-267.

Key words: Diseases/Parasites (Japan)

Moutou, K.A., Koutsogiannouli, E.A., Stamatis, C., Billinis, C., Kalbe, C., Scandura, M. and Mamuris, Z. 2013. **Domestication does not narrow MHC diversity in Sus scrofa.** *Immunogenetics*, 65(3): 195-209.

Key words: Domestication, Genetics (Europe)

Müller, T., Klupp, B.G., Freuling, C., Hoffmann, B., Mojcicz, M., Capua, I., Palfi, V., Toma, B., Lutz, W., Ruiz-Fon, F. and Gortárzar, C. 2010. **Characterization of pseudorabies virus of wild boar origin from Europe.** *Epidemiology and Infection*, 138(11): 1590-1600.

Key words: Diseaeses/Parasites (Europe)

Muñoz-Mendoza, M., Marreros, N., Boadella, M., Gortázar, C., Menéndez, S., de Juan, L., Bezos, J., Romero, B., Copano, M.F., Amado, J. and Sáez, J.L. 2013. **Wild boar tuberculosis in Iberian Atlantic Spain: a different picture from Mediterranean habitats.** *BMC Veterinary Research*, 9(176): 1-11.

Key words: Diseaeses/Parasites (Spain)

Mur, L., Boadella, M., Martínez-López, B., Gallardo, C., Gortazar, C. and Sánchez-Vizcaíno, J.M. 2012. **Monitoring of African swine fever in the wild boar population of the most recent endemic area of Spain.** *Transboundary and Emerging Diseases*, 59(6): 526-531.

Key words: Diseaeses/Parasites (Spain)

Murakami, K., Yoshikawa, S., Konishi, S., Ueno, Y., Watanabe, S. and Mizoguchi, Y. 2014. **Evaluation of genetic introgression from domesticated pigs into the**

Ryukyu wild boar population on Iriomote Island in Japan. *Animal Genetics*, 45(4): 517-523.

Key words: Genetics, Domestication (Japan)

Murase, K., Horie, R., Saito, M., Koganezawa, M., Sato, T. and Kaji, K. 2015. **Integrating analyses of population genetics and space-time information for wildlife management: an empirical study on Japanese wild boar populations.** *Mammal Study*, 40(2): 61-78.

Key words: Genetics, Population Biology (Japan)

Murphy, M.J., Inman-Narahari, F., Ostertag, R. and Litton, C.M. 2014. **Invasive feral pigs impact native tree ferns and woody seedlings in Hawaiian forest.** *Biological Invasions*, 16(1): 63-71.

Key words: Food Habits (Hawaii-USA)

Murta, D.V., Costa, D.S., Santos, M.D. and Faria, F.J. 2010. **Somatic and germ cell proliferation during post-natal development of the testis in the wild boar (*Sus scrofa scrofa*).** *Animal Reproduction Science*, 119(1): 154-159.

Key words: Morphology (Brazil)

Murta, D.V.F., Costa, D.S., Santos, M.D., Faria, F.J.C. and Paula, T.A.R.D. 2013. **Corporal and testicular biometry in wild boar from birth to 12 months of age.** *Revista Ceres*, 60(1): 1-6.

Key words: Morphology, Reproduction (Brazil)

Musser, J.M., Schwartz, A.L., Srinath, I. and Waldrup, K.A. 2013. **Use of serology and bacterial culture to determine prevalence of Brucella spp. in feral swine (*Sus scrofa*) in proximity to a beef cattle herd positive for *Brucella suis* and *Brucella abortus*.** *Journal of Wildlife Diseases*, 49(2): 215-220.

Key words: Diseases/Parasites (Texas-USA)

Mysterud, A., Tryjanowski, P., Panek, M., Pettorelli, N. and Stenseth, N.C. 2007. **Inter-specific synchrony of two contrasting ungulates: wild boar (*Sus scrofa*) and roe deer (*Capreolus capreolus*).** *Oecologia*, 151(2): 232-239.

Key words: Ecology (Poland)

N

Nagy, G., Csivincsik, Á. and Sugár, L. 2014. **Wild boar density drives Metastrongylus infection in earthworm.** *Acta Parasitologica*, 60(1): 35-39.

Key words: Diseases/Parasites (Hungary)

Nahayo, A., Bardiau, M., Volpe, R., Pirson, J., Paternostre, J., Fett, T. and Linden, A. 2014. **Molecular evidence of *Anaplasma* phagocytophilum in wild boar (*Sus scrofa*) in Belgium.** *BMC Veterinary Research*, 10(80): 1-5.

Key words: Diseases/Parasites (Belgium)

Nakano, T., Takahashi, K., Arai, M., Okano, H., Kato, H., Ayada, M., Okamoto, H. and Mishiro, S. 2013. **Identification of European-type hepatitis E virus subtype 3e isolates in Japanese wild boars: molecular tracing of HEV from swine to wild boars.** *Infection, Genetics and Evolution*, 18: 287-298.

Key words: Diseases/Parasites (Japan)

Nanev, V., Mutafova, T., Todev, I., Hrusanov, D. and Radev, V. 2007. **Morphological characteristics of Nematodes of the Globocephalus genus prevalent among wild boars from various regions of Bulgaria.** *Bulgarian Journal of Veterinary Medicine*, 10(10): 103-111.

Key words: Diseases/Parasites (Bulgaria)

Naranjo, V., Acevedo-Whitehouse, K., Vicente, J., Gortazar, C. and De La Fuente, J. 2008. **Influence of methylmalonyl-CoA mutase alleles on resistance to bovine tuberculosis in the European wild boar (*Sus scrofa*).** *Animal Genetics*, 39(3): 316-320.

Key words: Diseases/Parasites, Genetics

Nardini, R., Verin, R., Mazzei, M., Forzan, M. and Poli, A. 2014. **Hepatitis E virus-related liver alterations and viral antigen localization in European wild boar (*Sus scrofa*).** *European Journal of Wildlife Research*, 60(5): 835-838.

Key words: Diseases/Parasites

Nascimento, F.F., Gongora, J., Charleston, M., Tristem, M., Lowden, S. and Moran, C. 2011. **Evolution of endogenous retroviruses in the Suidae: evidence for**

different viral subpopulations in African and Eurasian host species. *BMC Evolutionary Biology*, 11(139): 1-13.

Key words: Diseases/Parasites

Nasiadka, P. and Janiszewski, P. 2015. **Food preferences of wild boars (*Sus scrofa* L.) in the summer and early autumn expressed by the damage caused in agricultural crops.** *SYLWAN*, 159(4): 307-317.

Key words: Damage, Food Habits (Poland)

Navarro-Gonzalez, N., Fernández-Llario, P., Pérez-Martín, J.E., Mentaberre, G., López-Martín, J.M., Lavín, S. and Serrano, E. 2013. **Supplemental feeding drives endoparasite infection in wild boar in western Spain.** *Veterinary Parasitology*, 196(1): 114-123.

Key words: Diseases/Parasites (Spain)

Navarro-Gonzalez, N., Mentaberre, G., Porrero, C.M., Serrano, E., Mateos, A., López-Martín, J.M., Lavín, S. and Domínguez, L. 2012. **Effect of cattle on Salmonella carriage, diversity and antimicrobial resistance in free-ranging wild boar (*Sus scrofa*) in northeastern Spain.** *PLOS ONE*, 7(12): 1-9.

Key words: Diseases/Parasites (Spain)

Navarro-Gonzalez, N., Porrero, M.C., Mentaberre, G., Serrano, E., Mateos, A., Cabal, A., Domínguez, L. and Lavín, S. 2015. ***Escherichia coli* O157: H7 in wild boars (*Sus scrofa*) and Iberian ibex (*Capra pyrenaica*) sharing pastures with free-ranging livestock in a natural environment in Spain.** *Veterinary Quarterly*, 35(2): 102-106.

Key words: Diseases/Parasites (Spain)

Němejc, K., Sak, B., Květoňová, D., Hanzal, V., Janiszewski, P., Forejtek, P., Rajský, D., Kotková, M., Ravaszová, P., McEvoy, J. and Kváč, M. 2014. **Prevalence and diversity of Encephalitozoon spp. and *Enterocytozoon bieneusi* in wild boars (*Sus scrofa*) in central Europe.** *Parasitology Research*, 113(2): 761-767.

Key words: Diseases/Parasites (Europe)

Němejc, K., Sak, B., Květoňová, D., Hanzal, V., Janiszewski, P., Forejtek, P., Rajský, D., Ravaszová, P., McEvoy, J. and Kváč, M. 2013. ***Cryptosporidium suis* and**

***Cryptosporidium scrofarum* in Eurasian wild boars (*Sus scrofa*) in Central Europe.** *Veterinary Parasitology*, 197(3): 504-508.

Key words: Diseases/Parasites (Europe)

Němejc, K., Sak, B., Květoňová, D., Hanzal, V., Jeníková, M. and Kváč, M. 2012. **The first report on *Cryptosporidium suis* and Cryptosporidium pig genotype II in Eurasian wild boars (*Sus scrofa*)(Czech Republic).** *Veterinary Parasitology,* 184(2): 122-125.

Key words: Diseases/Parasites (Czech Republic)

Nevado, J.J.B., Martín-Doimeadios, R.C.R., Mateo, R., Fariñas, N.R., Rodríguez-Estival, J. and Ropero, M.J.P. 2012. **Mercury exposure and mechanism of response in large game using the Almadén mercury mining area (Spain) as a case study.** *Environmental Research*, 112: 58-66.

Key words: Contamination (Spain)

Nicorescu, I.M.D., Ionita, M., Ciupescu, L., Buzatu, C.V., Tanasuica, R. and Mitrea, I.L. 2015. **New insights into the molecular epidemiology of Trichinella infection in domestic pigs, wild boars, and bears in Romania.** *Veterinary Parasitology*, 212(3): 257-261.

Key words: Diseases/Parasites (Romania)

Nidaira, M., Taira, K., Itokazu, K., Kudaka, J., Nakamura, M., Ohno, A. and Takasaki, T. 2007. **Survey of the antibody against Japanese encephalitis virus in Ryukyu wild boars (*Sus scrofa riukiuanus*) in Okinawa, Japan.** *Japanese Journal of Infectious Diseases*, 60(5): 309-311.

Key words: Diseases/Parasites (Japan)

Nidaira, M., Taira, K., Itokazu, K., Okano, S., Kudaka, J., Nakamura, M., Ohno, A. and Takasaki, T. 2008. **Detection of Japanese encephalitis virus genome in Ryukyu wild boars (*Sus scrofa riukiuanus*) in Okinawa, Japan.** *Japanese Journal of Infectious Diseases*, 61(2): 164-165.

Key words: Diseases/Parasites (Japan)

Nikitin, S.V., Yudin, N.S., Knyazev, S.P., Aytnazarov, R.B., Kobzev, V.F., Bekenev, V.A., Savina, M.A. and Yermolaev, V.I. 2008. **Frequency of chromosomes**

carrying endogenous retroviruses in the populations of domestic pig and wild boar. *Russian Journal of Genetics*, 44(6): 686-693.

Key words: Genetics (Russia)

Nikolov, I.S., Gum, B., Markov, G. and Kuehn, R. 2009. **Population genetic structure of wild boar *Sus scrofa* in Bulgaria as revealed by microsatellite analysis.** *Acta Theriologica*, 54(3): 193-205.

Key words: Genetics, Population Biology (Bulgaria)

Nomoto, K., Takahashi, T., Koganezawa, M. and Fukumura, K. 2010. **Relationships between crop damage by wild boar and surrounding environmental characteristics in paddy fields and non-paddy fields in Motegi, Japan.** *Mammal Science* 50: 129-135.

Key words: Damage, Ecology (Japan)

Nores, C., Llaneza, L. and Álvarez, Á. 2008. **Wild boar *Sus scrofa* mortality by hunting and wolf *Canis lupus* predation: an example in northern Spain.** *Wildlife Biology*, 14(1): 44-51.

Key words: Hunting, Predation (Spain)

Nosal, P., Kowal, J. and Nowosad, B. 2010. **Structure of Metastrongylidae in wild boars from southern Poland.** *Helminthologia*, 47(4): 212-218.

Key words: Diseases/Parasites (Poland)

Nugent, G., Yockney, I.J. and Whitford, E.J. 2011. **Intraspecific transmission of *Mycobacterium bovis* among penned feral pigs in New Zealand.** *Journal of Wildlife Diseases*, 47(2): 364-372.

Key words: Diseases/Parasites (New Zealand)

Nugent, G., Yockney, I.J. and Whitford, E.J. 2011. **Intraspecific transmission of *Mycobacterium bovis* among penned feral pigs in New Zealand.** *Journal of Wildlife Diseases*, 47(2): 364-372.

Key words: Diseases/Parasites (New Zealand)

Nugent, G., Yockney, I.J., Whitford, E.J. and Cross, M.L. 2014. **Assessing the effectiveness of tuberculosis management in brushtail possums (*Trichosurus**

***vulpecula*), through indirect surveillance of *Mycobacterium bovis* infection using released sentinel pigs.** *Veterinary Medicine International*, 1-13.
Key words: Diseases/Parasites (New Zealand)

<u>O</u>

Ohashi, H., Saito, M., Horie, R., Tsunoda, H., Noba, H., Ishii, H., Kuwabara, T., Hiroshige, Y., Koike, S., Hoshino, Y. and Toda, H. 2013. **Differences in the activity pattern of the wild boar *Sus scrofa* related to human disturbance.** *European Journal of Wildlife Research*, 59(2): 167-177.
Key words: Behavior (Japan)

Oja, R., Kaasik, A. and Valdmann, H. 2014. **Winter severity or supplementary feeding—which matters more for wild boar?.** *Acta Theriologica*, 59(4): 553-559.
Key words: Control/Management, Population Biology (Estonia)

Oja, R., Zilmer, K. and Valdmann, H. 2015. **Spatiotemporal effects of supplementary feeding of wild boar (*Sus scrofa*) on artificial ground nest depredation.** *PLOS ONE*, 10(8): 1-11.
Key words: Control/Management, Food Habits (Estonia)

Ojeda, A., Huang, L.S., Ren, J., Angiolillo, A., Cho, I.C., Soto, H., Lemus-Flores, C., Makuza, S.M., Folch, J.M. and Perez-Enciso, M. 2008. **Selection in the making: a worldwide survey of haplotypic diversity around a causative mutation in porcine IGF2.** *Genetics*, 178(3): 1639-1652.
Key words: Domesticaiton, Genetics

Okadera, K., Abe, M., Ito, N., Morikawa, S., Yamasaki, A., Masatani, T., Nakagawa, K., Yamaoka, S. and Sugiyama, M. 2013. **Evidence of natural transmission of group A rotavirus between domestic pigs and wild boars (*Sus scrofa*) in Japan.** *Infection, Genetics and Evolution*, 20: 54-60.
Key words: Diseases/Parasites (Japan)

Okano, H., Nakano, T., Sugimoto, K., Takahashi, K., Nagashima, S., Takahashi, M., Arai, M. and Okamoto, H. 2014. **High genomic similarity between European**

type hepatitis E virus subgenotype 3e strains isolated from an acute hepatitis patient and a wild boar in Mie, Japan. *Hepatology Research*, 44(6): 694-699.
Key words: Diseases/Parasites (Japan)

Oldfield, C.A. and Evans, J.P. 2016. **Twelve years of repeated wild hog activity promotes population maintenance of an invasive clonal plant in a coastal dune ecosystem.** *Ecology and Evolution*, 6(8): 2569-2578.
Key words: Food Habits (Georgia-USA)

Onac, D., Győrke, A., Oltean, M., Gavrea, R. and Cozma, V. 2013. **First detection of *Echinococcus granulosus* G1 and G7 in wild boars (*Sus scrofa*) and red deer (*Cervus elaphus*) in Romania using PCR and PCR-RFLP techniques.** *Veterinary Parasitology*, 193(1): 289-291.
Key words: Diseases/Parasites (Romania)

Ondrejková, A., Kiš, O., Ciberej, J., Oberhauserová, K., Ondrejka, R., Smitka, P. and Csank, T. 2015. **Does the infection with endoparasites influence the effect of oral vaccination against classical swine fever in wild boar?.** *Acta Veterinaria Brno*, 84(3): 225-230.
Key words: Diseases/Parasites (Slovakia)

Opsteegh, M., Swart, A., Fonville, M., Dekkers, L. and Van Der Giessen, J. 2011. **Age-related *Toxoplasma gondii* seroprevalence in Dutch wild boar inconsistent with lifelong persistence of antibodies.** *PLOS ONE*, 6(1): 1-6.
Key words: Diseases/Parasites (Netherlands)

Orłowska, L., Rembacz, W. and Florek, C. 2013. **Carcass weight, condition and reproduction of wild boar harvested in north-western Poland.** *Pest Management Science,* 69(3): 367-370.
Key words: Morphology, Reproduction (Poland)

Ortuno, A., Quesada, M., Lopez-Claessens, S., Castella, J., Sanfeliu, I., Anton, E. and Segura-Porta, F. 2007. **The role of wild boar (*Sus scrofa*) in the eco-epidemiology of *R. slovaca* in northeastern Spain.** *Vector-Borne and Zoonotic Diseases*, 7(1): 59-64.
Key words: Diseases/Parasites (Spain)

Osada, Y., Kuriyama, T., Asada, M., Yokomizo, H. and Miyashita, T. 2015. **Exploring the drivers of wildlife population dynamics from insufficient data by Bayesian model averaging.** *Population Ecology*, 57(3): 485-493.
Key words: Population Biology (Japan)

Otto, P., Chaignat, V., Klimpel, D., Diller, R., Melzer, F., Müller, W. and Tomaso, H. 2014. **Serological investigation of wild boars (*Sus scrofa*) and red foxes (*Vulpes vulpes*) as indicator animals for circulation of *Francisella tularensis* in Germany.** *Vector-Borne and Zoonotic Diseases*, 14(1): 46-51.
Key words: Diseases/Parasites (Germany)

Owen, J., Dobney, K., Evin, A., Cucchi, T., Larson, G. and Vidarsdottir, U.S. 2014. **The zooarchaeological application of quantifying cranial shape differences in wild boar and domestic pigs (*Sus scrofa*) using 3D geometric morphometrics.** *Journal of Archaeological Science*, 43: 159-167.
Key words: Archaeological/Paleontology, Morphology

P

Palacio, S., Bueno, C.G., Azorín, J., Maestro, M. and Gómez-García, D. 2013. **Wild-boar disturbance increases nutrient and C stores of geophytes in subalpine grasslands.** *American Journal of Botany*, 100(9): 1790-1799.
Key words: Ecology, Food Habits (Spain)

Palmieri, C., Brunetti, M. and Della Salda, L. 2007. **Immunohistochemical characterization of Kisselev nodules (ectopic lymphoid follicles) in wild boar (*Sus scrofa* L.).** *Research in Veterinary Science*, 83(1): 109-115.
Key words: Diseases/Parasites, Morphology

Pandey, P., Shaner, P.J.L. and Sharma, H.P. 2016. **The wild boar as a driver of human-wildlife conflict in the protected park lands of Nepal.** *European Journal of Wildlife Research*, 62(1): 103-108.
Key words: Damage (Nepal)

Pankova, N.L. 2013. **Wild boar's (*Sus scrofa*) role in the vegetation dynamics of water bodies of Oksky State Reserve.** *Russian Journal of Biological Iinvasions*, 4(4): 255-268.

Key words: Ecology, Food Habtis (Russia)

Parkes, J.P., Easdale, T.A., Williamson, W.M. and Forsyth, D.M. 2015. **Causes and consequences of ground disturbance by feral pigs (*Sus scrofa*) in a lowland New Zealand conifer-angiosperm forest.** *New Zealand Journal of Ecology*, 39(1): 34-42.

Key words: Ecolgy, Food Habits (New Zealand)

Parkes, J.P., Ramsey, D.S., Macdonald, N., Walker, K., McKnight, S., Cohen, B.S. and Morrison, S.A. 2010. **Rapid eradication of feral pigs (*Sus scrofa*) from Santa Cruz Island, California**. *Biological Conservation*, 143(3): 634-641.

Key words: Control/Management (California)

Paştiu, A.I., Györke, A., Blaga, R., Mircean, V., Rosenthal, B.M. and Cozma, V. 2013. **In Romania, exposure to *Toxoplasma gondii* occurs twice as often in swine raised for familial consumption as in hunted wild boar, but occurs rarely, if ever, among fattening pigs raised in confinement.** *Parasitology Research*, 112(6): 2403-2407.

Key words: Diseases/Parasites (Romania)

Paudel, Y., Madsen, O., Megens, H.J., Frantz, L.A., Bosse, M., Bastiaansen, J.W., Crooijmans, R.P. and Groenen, M.A. 2013. **Evolutionary dynamics of copy number variation in pig genomes in the context of adaptation and domestication.** *BMC Genomics*, 14(449): 1-13.

Key words: Domestication, Genetics

Paulsen, P., Ehebruster, J., Irschik, I., Lücker, E., Riehn, K., Winkelmayer, R. and Smulders, F.J. 2012. **Findings of *Alaria alata mesocercariae* in wild boars (*Sus scrofa*) in eastern Austria.** *European Journal of Wildlife Research*, 58(6): 991-995.

Key words: Diseases/Parasites (Austria)

Paulsen, P., Forejtek, P., Hutarova, Z. and Vodnansky, M. 2013. ***Alaria alata mesocercariae*** **in wild boar (*Sus scrofa*, Linnaeus, 1758) in south regions of the Czech Republic.** *Veterinary Parasitology*, 197(1): 384-387.
Key words: Diseases/Parasits (Czech Republic)

Payne, A., Chappa, S., Hars, J., Dufour, B. and Gilot-Fromont, E. 2016. **Wildlife visits to farm facilities assessed by camera traps in a bovine tuberculosis-infected area in France.** *European Journal of Wildlife Research*, 62(1): 33-42.
Key words: Diseases/Parasites (France)

Pedersen, K., Pabilonia, K.L., Anderson, T.D., Bevins, S.N., Hicks, C.R., Kloft, J.M. and Deliberto, T.J. 2015. **Widespread detection of antibodies to Leptospira in feral swine in the United States.** *Epidemiology and Infection*, 143(10): 2131-2136.
Key words: Diseases/Parasites (United States of America)

Pedrosa, F., Salerno, R., Padilha, F.V.B. and Galetti, M. 2015. **Current distribution of invasive feral pigs in Brazil: economic impacts and ecological uncertainty.** *Natureza & Conservação*, 13(1): 84-87.
Key words: Economics, Population Biology (Brazil)

Pejsak, Z. 2015. **Importance of wild boar in the spread of African swine fever, particularly in relation to Europe.** *Medycyna Weterynaryjna*, 71(2): 71-74.
Key words: Diseases/Parasites

Perea, R. and Gil, L. 2014. **Tree regeneration under high levels of wild ungulates: the use of chemically vs. physically-defended shrubs.** *Forest Ecology and Management*, 312: 47-54.
Key words: Control/Management (Spain)

Pérez-González, J., Costa, V., Santos, P., Slate, J., Carranza, J., Fernández-Llario, P., Zsolnai, A., Monteiro, N.M., Anton, I., Buzgó, J. and Varga, G., 2014. **Males and females contribute unequally to offspring genetic diversity in the polygynandrous mating system of wild boar.** *PLOS ONE*, 9(12): 1-22.
Key words: Genetics, Reproduction (Hungary, Portugal, Spain)

Pescador, M., Sanguinetti, J., Pastore, H. and Peris, S.J. 2009. **Expansion of the introduced wild boar (*Sus scrofa*) in the Andean Region, Argentinean**

Patagonia. *Galemys: Boletín informativo de la Sociedad Española para la conservación y estudio de los mamíferos*, 21(1): 121-132.

Key words: Ecology, Population Biology (Argentina)

Petrescu-Mag, I.V., Oroian, I.G., Botha, M. and Gavriloaie, C. 2014. **Wild boars and feral pigs as threats to humans.** *Porcine Research*, 4(2): 43-47.

Key words: Damage

Petrini, S., Barocci, S., Gavaudan, S., Villa, R., Briscolini, S., Sabbatini, M., Mattozzi, C., Barchiesi, F., Salamida, S., Ferrari, M. and Paniccià, M. 2009. **Detection of porcine circovirus type 2 (PCV2) from wild boars in central Italy.** *European Journal of Wildlife Research*, 55(5): 465-469.

Key words: Diseases/Parasites (Italy)

Petrovan, V., Buburuzan, L. and Zaulet, M. 2015. **False positive results using PCR detection method for African swine fever virus in wild boars from northern Romanian hunting zones.** *Turkish Journal of Veterinary and Animal Sciences*, 39(3): 287-294.

Key words: Diseases/Parasites (Romania)

Piattoni, F., Amicucci, A., Iotti, M., Ori, F., Stocchi, V. and Zambonelli, A. 2014. **Viability and morphology of *Tuber aestivum* spores after passage through the gut of Sus scrofa.** *Fungal Ecology*, 9: 52-60.

Key words: Diseases/Parasites

Picard, M. and Baltzinger, C. 2012. **Hitch-hiking in the wild: should seeds rely on ungulates?.** *Plant Ecology and Evolution*, 145(1): 24-30.

Key words: Ecology (France)

Pietschmann, J., Mur, L., Blome, S., Beer, M., Pérez-Sánchez, R., Oleaga, A. and Sánchez-Vizcaíno, J.M. 2016. **African swine fever virus transmission cycles in central Europe: evaluation of wild boar-soft tick contacts through detection of antibodies against *Ornithodoros erraticus* saliva antigen.** *BMC Veterinary Research*, 12(1): 1-5.

Key words: Diseases/Parasites (Europe)

Pike-Tay, A. and Ma, X. 2013. **A pilot study in odontochronology for the pig domestication question in north-central China.** *International Journal of Osteoarchaeology*, 23(5): 590-599.

Key words: Archaeological/Paleontology, Morphology (China)

Pike-Tay, A., Ma, X., Hou, Y., Liang, F., Lin, M. and Peterson, V. 2014. **Combining odontochronology, tooth wear assessment, and linear enamel hypoplasia (LEH) recording to assess pig domestication in Neolithic Henan, China.** *International Journal of Osteoarchaeology*, 1-8.

Key words: Archaeological/Paleontology, Morphology (China)

Pilarczyk, B., Hendzel, D., Pilarczyk, R., Tomza-Marciniak, A., Błaszczyk, B., Dąbrowska-Wieczorek, M., Bąkowska, M., Adamowicz, E. and Bujak, T. 2010. **Liver and kidney concentrations of selenium in wild boars (*Sus scrofa*) from northwestern Poland.** *European Journal of Wildlife Research*, 56(5): 797-802.

Key words: Physiology (Poland)

Pilo, C., Addis, G., Deidda, M., Tedde, M.T. and Liciardi, M. 2015. **A serosurvey for Brucellosis in wild boar (*Sus scrofa*) in Sardinia, Italy.** *Journal of Wildlife Diseases*, 51(4): 885-888.

Key words: Diseases/Parasites (Italy)

Ping, X., Li, C., Jiang, Z., Liu, W. and Zhu, H. 2011. **Interference competition and group size effect in sika deer (*Cervus nippon*) at salt licks.** *Acta Ethologica*, 14(1): 43-49.

Key words: Ecology (China)

Piper, P.J., Hung, H.C., Campos, F.Z., Bellwood, P. and Santiago, R. 2009. **A 4000 year-old introduction of domestic pigs into the Philippine Archipelago: implications for understanding routes of human migration through Island Southeast Asia and Wallacea.** *Antiquity*, 83(321): 687-695.

Key words: Archaeological/Paleontology, Domestication (Philippines)

Plhal, R., Kamler, J. and Homolka, M. 2014. **Faecal pellet group counting as a promising method of wild boar population density estimation.** *Acta Theriologica*, 59(4): 561-569.

Key words: Population Biology (Czech Republic)

Plhal, R., Kamler, J., Homolka, M. and Adamec, Z. 2011. **An assessment of the applicability of photo trapping to estimate wild boar population density in a forest environment.** *Folia Zoologica*, 60(3): 237-246.

Key words: Population Biology (Czech Republic)

Plhal, R., Kamler, J., Homolka, M. and Drimaj, J. 2014. **An assessment of the applicability of dung count to estimate the wild boar population density in a forest environment.** *Journal of Forensic Sciences*, 60(4): 174-180.

Key words: Population Biology (Czech Republic)

Podgórski, T., Baś, G., Jędrzejewska, B., Sönnichsen, L., Śnieżko, S., Jędrzejewski, W. and Okarma, H. 2013. **Spatiotemporal behavioral plasticity of wild boar (*Sus scrofa*) under contrasting conditions of human pressure: primeval forest and metropolitan area.** *Journal of Mammalogy*, 94(1): 109-119.

Key words: Behavior (Poland)

Podgórski, T., Lusseau, D., Scandura, M., Sönnichsen, L. and Jędrzejewska, B. 2014. **Long-lasting, kin-directed female interactions in a spatially structured wild boar social network.** *PLOS ONE*, 9(6): 1-11.

Key words: Behavior (Poland)

Podgórski, T., Scandura, M. and Jędrzejewska, B. 2014. **Next of kin next door– philopatry and socio-genetic population structure in wild boar.** *Journal of Zoology*, 294(3): 190-197.

Key words: Behavior (Poland)

Poeta, P., Costa, D., Igrejas, G., Rodrigues, J. and Torres, C. 2007. **Phenotypic and genotypic characterization of antimicrobial resistance in faecal enterococci from wild boars (*Sus scrofa*).** *Veterinary Microbiology*, 125(3): 368-374.

Key words: Diseases/Parasites (Portugal)

Poeta, P., Costa, D., Igrejas, G., Rojo-Bezares, B., Sáenz, Y., Zarazaga, M., Ruiz-Larrea, F., Rodrigues, J. and Torres, C. 2007. **Characterization of van A-containing *Enterococcus faecium* isolates carrying Tn 5397-like and Tn 916/Tn 1545-like**

transposons in wild boars (*Sus Scrofa*). *Microbial Drug Resistance*, 13(3): 151-156.

Key words: Diseases/Parasites (Portugal)

Poglayen, G., Marchesi, B., Dall'Oglio, G., Barlozzari, G., Galuppi, R. and Morandi, B. 2016. **Lung parasites of the genus Metastrongylus Molin, 1861 (Nematoda: Metastrongilidae) in wild boar (*Sus scrofa* L., 1758) in Central-Italy: an eco-epidemiological study**. *Veterinary Parasitology*, 217: 45-52.

Key words: Diseases/Parasites (Italy)

Pokharel, K.P. and Storch, I. 2016. **Habitat niche relationships within an assemblage of ungulates in Bardia National Park, Nepal.** *Acta Oecologica*, 70: 29-36.

Key words: Ecology (Nepal)

Portier, J., Vallée, I., Lacour, S.A., Martin-Schaller, R., Ferté, H. and Durand, B. 2014. **Increasing circulation of *Alaria alata mesocercaria* in wild boar populations of the Rhine valley, France, 2007–2011.** *Veterinary Parasitology*, 199(3): 153-159.

Key words: Diseases/Parasites (France)

Poteaux, C., Baubet, E., Kaminski, G., Brandt, S., Dobson, F.S. and Baudoin, C. 2009. **Socio-genetic structure and mating system of a wild boar population.** *Journal of Zoology*, 278(2): 116-125.

Key words: Reproduction (France)

Potter, P. 2011. **When snouted wild-boars routing tender corn/Anger our huntsman.** *Emerging Infectious Diseases*, 17(12): 2402-2403.

Key words: Folklore/Fiction

Pozio, E., Cossu, P., Marucci, G., Amati, M., Ludovisi, A., Morales, M.A.G., La Rosa, G. and Firinu, T. 2009. **The birth of a *Trichinella britovi* focus on the Mediterranean island of Sardinia (Italy).** *Veterinary Parasitology*, 159(3): 361-363.

Key words: Diseases/Parasites (Italy)

Pradhan, V., Dar, M.A., Maqbool Rather, M., Panwar, M. and Pala, N.A. 2012. **Human-wildlife conflict in Kitam Bird Sanctuary: perceptions and possible solutions.** *Indian Forester*, 138(10): 915-920.

Key words: Food Habits (India)

Prevendar Crnić, A., Šuran, J., Cipriš Madunić, H. and Božić, F. 2015. **Cadmium concentrations in the tissues of young wild boar (*Sus scrofa* L.) from Moslavina and Slavonia in lowland Croatia.** *Veterinarski Arhiv*, 85(3): 323-334.

Key words: Contamination (Croatia)

Prévot, C. and Licoppe, A. 2013. **Comparing red deer (*Cervus elaphus* L.) and wild boar (*Sus scrofa* L.) dispersal patterns in southern Belgium.** *European Journal of Wildlife Research*, 59(6): 795-803.

Key words: Behavior, Ecology (Belgium)

Primi, R., Pelorosso, R., Nicolina Ripa, M. and Amici, A. 2009. **A statistical GIS-based analysis of wild boar (*Sus scrofa*) traffic collisions in a Mediterranean area.** *Italian Journal of Animal Science*, 8(Suppl.2): 649-651.

Key words: Damage (Italy)

Prodělalová, J. 2012. **The survey of porcine teschoviruses, sapeloviruses and enteroviruses B infecting domestic pigs and wild boars in the Czech Republic between 2005 and 2011.** *Infection, Genetics and Evolution*, 12(7): 1447-1451.

Key words: Diseases/Parasites (Czech Republic)

Puvanesuaran, V.R., Noordin, R. and Balakrishnan, V. 2013. **Genotyping of *Toxoplasma gondii* isolates from wild boars in Peninsular Malaysia.** *PLOS ONE*, 8(4): 1-4.

Key words: Diseases/Parasites (Malaysia)

Q

Quaresma, M.A.G., Alves, S.P., Trigo-Rodrigues, I., Pereira-Silva, R., Santos, N., Lemos, J.P.C., Barreto, A.S. and Bessa, R.J.B. 2011. **Nutritional evaluation of**

the lipid fraction of feral wild boar (*Sus scrofa scrofa*) meat. *Meat Science*, 89(4): 457-461.

Key words: Morphology (Portugal)

Quintela, F.M., Santos, M.B., de Oliveira, S.V., Costa, R.C. and Christoff, A.U. 2010. **Wild boars and feral pigs (Suidae, *Sus scrofa*) in the Restinga of Rio Grande, RS, Brazil: ecosystems of occurrence and preliminary data on environmental impacts.** *Neotropical Biology and Conservation*, 5(3): 172-178.

Key words: Ecology (Brazil)

Quy, R.J., Massei, G., Lambert, M.S., Coats, J., Miller, L.A. and Cowan, D.P. 2014. **Effects of a GnRH vaccine on the movement and activity of free-living wild boar (*Sus scrofa*).** *Wildlife Research*, 41(3): 185-193.

Key words: Behavior, Control/Management (England)

R

Rabanal, V.C., Bosch, J., Muñoz, M.J. and Peris, S.J. 2012. **Influence of new irrigated croplands on wild boar (Sus scrofa) road kills in NW Spain.** *Animal Biodiversity and Conservation*, 35(2): 247-252.

Key words: Damage, Ecology (Spain)

Racka, K., Bártová, E., Budíková, M. and Vodrazka, P. 2015. **Survey of *Toxoplasma gondii* antibodies in meat juice of wild boar (*Sus scrofa*) in several districts of the Czech Republic.** *Annals of Agricultural and Environmental Medicine*, 22(2): 231-235.

Key words: Diseases/Parasites (Czech Republic)

Rahimi, P., Sohrabi, A., Ashrafihelan, J., Edalat, R., Alamdari, M., Masoudi, M., Mostofi, S. and Azadmanesh, K. 2010. **Emergence of African swine fever virus, northwestern Iran.** *Emerging Infectious Diseases*, 16(12): 1946-1948.

Key words: Diseases/Parasites (Iran)

Rajkhowa, T.K., Hauhnar, L., Lalrohlua, I. and Mohanarao G, J. 2014. **Emergence of 2.1. subgenotype of classical swine fever virus in pig population of India in 2011**. *Veterinary Quarterly*, 34(4): 224-228.

Key words: Diseases/Parasites (Iran)

Ramayo, Y., Shemeret'eva, I.N. and Pérez-Enciso, M. 2011. **Mitochondrial DNA diversity in wild boar from the Primorsky Krai Region (east Russia).** *Animal Genetics*, 42(1): 96-99.

Key words: Genetics (Russia)

Ramírez, O., Burgos-Paz, W., Casas, E., Ballester, M., Bianco, E., Olalde, I., Santpere, G., Novella, V., Gut, M., Lalueza-Fox, C. and Sana, M. 2015. **Genome data from a sixteenth century pig illuminate modern breed relationships.** *Heredity*, 114(2): 175-184.

Key words: Archaeological/Paleontology, Genetics (Spain)

Ramirez, O., Ojeda, A., Tomas, A., Gallardo, D., Huang, L.S., Folch, J.M., Clop, A., Sánchez, A., Badaoui, B., Hanotte, O. and Galman-Omitogun, O. 2009. **Integrating Y-chromosome, mitochondrial, and autosomal data to analyze the origin of pig breeds.** *Molecular Biology and Evolution*, 26(9): 2061-2072.

Key words: Genetics, Taxonomy

Ramos-Onsins, S.E., Burgos-Paz, W., Manunza, A. and Amills, M. 2014. **Mining the pig genome to investigate the domestication process.** *Heredity*, 113(6): 471-484.

Key words: Domestication, Genetics

Randi, E. 2014. **Conservation genetics of the genus Sus**. *Journal of Mountain Ecology*, 3:6-12.

Key words: Genetics

Ranucci, D., Veronesi, F., Moretti, A., Branciari, R., Miraglia, D., Manfredi, M.T. and Fioretti, D.P. 2013. **Seroprevalence of *Toxoplasma gondii* in wild boars (*Sus scrofa*) from central Italy.** *Parasite*, 20: 48.

Key words: Diseases/Parasites (Italy)

Razmaite, V., J. Švirmickas, G. and Šiukščius, A. 2012. **Effect of weight, sex and hunting period on fatty acid composition of intramuscular and subcutaneous fat from wild boar.** *Italian Journal of Animal Science*, 11(2): 173-179.

Key words: Morphology, Physiology (Lithuania)

Regmi, B., Lalromawia, K. and Sankar, K. 2007. **Infanticide in wild pigs in Sariska Tiger Reserve, Rajasthan.** *Indian Forester*, 133(10): 1422-1422.

Key words: Reproduction (India)

Rehfeldt, C., Henning, M. and Fiedler, I. 2008. **Consequences of pig domestication for skeletal muscle growth and cellularity.** *Livestock Science,* 116(1): 30-41.

Key words: Domestication, Morphology (Germany)

Reidy, M.M., Campbell, T.A. and Hewitt, D.G. 2011. **A mark–recapture technique for monitoring feral swine populations**. *Rangeland Ecology & Management*, 64(3): 316-318.

Key words: Control/Management (Texas-USA)

Reiner, G., Fresen, C., Bronnert, S., Haack, I. and Willems, H. 2010. **Prevalence of *Actinobacillus pleuropneumoniae* infection in hunted wild boars (*Sus scrofa*) in Germany.** *Journal of Wildlife Diseases,* 46(2): 551-555.

Key words: Diseases/Parasites (Germany)

Reiner, G., Fresen, C., Bronnert, S., Haack, I. and Willems, H. 2010. **Prevalence of *Haemophilus parasuis* infection in hunted wild boars (*Sus scrofa*) in Germany.** *European Journal of Wildlife Research*, 56(5): 815-818.

Key words: Diseases/Parasites (Germany)

Reiner, G., Winkelmann, M. and Willems, H. 2011. **Prevalence of *Lawsonia intracellularis*, *Brachyspira hyodysenteriae*, and *Brachyspira pilosicoli* infection in hunted wild boars (*Sus scrofa*) in Germany.** *European Journal of Wildlife Research,* 57(3): 443-448.

Key words: Diseases/Parasites (Germany)

Reiterová, K., Špilovská, S., Blaňarová, L., Derdáková, M., Čobádiová, A. and Hisira, V. 2016. **Wild boar (*Sus scrofa*)–reservoir host of *Toxoplasma gondii, Neospora caninum* and *Anaplasma phagocytophilum* in Slovakia.** *Acta Parasitologica*, 61(2): 255-260.

Key words: Diseases/Parasites (Slovakia)

Renner, S.C., Suarez-Rubio, M., Wiesner, K.R., Drögemüller, C., Gockel, S., Kalko, E.K., Ayasse, M. and Frantz, A.C., 2015. **Using multiple landscape genetic**

approaches to test the validity of genetic clusters in a species characterized by an isolation-by-distance pattern. *Biological Journal of the Linnean Society*, 118: 292-303.

Key words: Ecology, Genetics (Germany)

Reuter, G., Nemes, C., Boros, Á., Kapusinszky, B., Delwart, E. and Pankovics, P. 2013. **Porcine kobuvirus in wild boars (*Sus scrofa*).** *Archives of Virology*, 158(1): 281-282.

Key words: Diseases/Parasites (Hungary)

Ribeiro, M.G., Takai, S., Guazzelli, A., Lara, G.H.B., da Silva, A.V., Fernandes, M.C., Condas, L.A.Z., Siqueira, A.K. and Salerno, T. 2011. **Virulence genes and plasmid profiles in *Rhodococcus equi* isolates from domestic pigs and wild boars (*Sus scrofa*) in Brazil.** *Research in Veterinary Science*, 91(3): 478-481.

Key words: Diseases/Parasites (Brazil)

Richomme, C., Afonso, E., Tolon, V., Ducrot, C., Halos, L., Alliot, A., Perret, C., Thomas, M., Boireau, P. and Gilot-Fromont, E. 2010. **Seroprevalence and factors associated with *Toxoplasma gondii* infection in wild boar (*Sus scrofa*) in a Mediterranean island.** *Epidemiology and Infection*, 138(09): 1257-1266.

Key words: Diseases/Parasites (France)

Richomme, C., Aubert, D., Gilot-Fromont, E., Ajzenberg, D., Mercier, A., Ducrot, C., Ferté, H., Delorme, D. and Villena, I. 2009. **Genetic characterization of *Toxoplasma gondii* from wild boar (*Sus scrofa*) in France.** *Veterinary Parasitology*, 164(2): 296-300.

Key words: Diseases/Parasites (France)

Richomme, C., Boadella, M., Courcoul, A., Durand, B., Drapeau, A., Corde, Y., Hars, J., Payne, A., Fediaevsky, A. and Boschiroli, M.L. 2013. **Exposure of wild boar to *Mycobacterium tuberculosis* complex in France since 2000 is consistent with the distribution of bovine tuberculosis outbreaks in cattle.** *PLOS ONE*, 8(10): 1-7.

Key words: Diseases/Parasites (France)

Richomme, C., Boschiroli, M.L., Hars, J., Casabianca, F. and Ducrot, C. 2010. **Bovine tuberculosis in livestock and wild boar on the Mediterranean Island, Corsica.** *Journal of Wildlife Diseases*, 46(2): 627-631.
Key words: Diseases/Parasites (Corsica-France)

Richomme, C., Lacour, S.A., Ducrot, C., Gilot-Fromont, E., Casabianca, F., Maestrini, O., Vallée, I., Grasset, A., Van Der Giessen, J. and Boireau, P. 2010. **Epidemiological survey of trichinellosis in wild boar (*Sus scrofa*) and fox (*Vulpes vulpes*) in a French insular region, Corsica.** *Veterinary Parasitology*, 172(1): 150-154.
Key words: Diseases/Parasites (Corsica-France)

Riehn, K., Hamedy, A., Große, K., Wüste, T. and Lücker, E. 2012. ***Alaria alata* in wild boars (*Sus scrofa*, Linnaeus, 1758) in the eastern parts of Germany.** *Parasitology Research*, 111(4): 1857-1861.
Key words: Diseases/Parasites (Germany)

Riehn, K., Lalkovski, N., Hamedy, A. and Lücker, E. 2014. **First detection of *Alaria alata mesocercariae* in wild boars (*Sus scrofa* Linnaeus, 1758) from Bulgaria.** *Journal of Helminthology*, 88(02): 247-249.
Key words: Diseases/Parasites (Germany)

Risch, A.C., Wirthner, S., Busse, M.D., Page-Dumroese, D.S. and Schütz, M. 2010. **Grubbing by wild boars (*Sus scrofa* L.) and its impact on hardwood forest soil carbon dioxide emissions in Switzerland.** *Oecologia*, 164(3): 773-784.
Key words: Ecology, Food Habits (Switzerland)

Risco, D., Cuesta, J.M., Fernández-Llario, P., Salguero, F.J., Gonçalves, P., García-Jiménez, W.L., Martínez, R., Velarde, R., de Mendoza, M.H., Gómez, L. and de Mendoza, J.H. 2015. **Pathological observations of porcine respiratory disease complex (PRDC) in the wild boar (*Sus scrofa*).** *European Journal of Wildlife Research*, 61(5): 669-679.
Key words: Diseases/Parasites (Spain)

Risco, D., Fernández-Llario, P., Cuesta, J.M., Benítez-Medina, J.M., García-Jiménez, W.L., Martínez, R., Gonçalves, P., de Mendoza, J.H., Gómez, L. and García, A.

2013. **Isolation of *Aeromonas hydrophila* in the respiratory tract of wild boar: pathologic implications.** *Journal of Zoo and Wildlife Medicine*, 44(4): 1090-1093.

Key words: Diseases/Parasites (Spain)

Risco, D., Fernández-Llario, P., Cuesta, J.M., García-Jiménez, W.L., Gonçalves, P., Martínez, R., García, A., Rosales, R., Gómez, L. and de Mendoza, J.H. 2015. **Fatal case of *Streptococcus suis* infection in a young wild boar (*Sus scrofa*) from southwestern Spain.** *Journal of Zoo and Wildlife Medicine*, 46(2): 370-373.

Key words: Diseases/Parasites (Spain)

Risco, D., Fernández-Llario, P., Cuesta, J.M., García-Jiménez, W.L., Gil, M., Gonçalves, P., Martínez, R., Gómez, L., García, A., Rey, J. and de Mendoza, M.H. 2013. **Fatal outbreak of systemic pasteurellosis in a wild boar (*Sus scrofa*) population from southwest Spain.** *Journal of Veterinary Diagnostic Investigation*, 25(6): 791-794.

Key words: Diseases/Parasites (Spain)

Risco, D., Fernández-Llario, P., García-Jiménez, W.L., Gonçalves, P., Cuesta, J.M., Martínez, R., Sanz, C., Sequeda, M., Gómez, L., Carranza, J. and Mendoza, J.H. 2013. **Influence of porcine circovirus type 2 infections on bovine tuberculosis in wild boar populations.** *Transboundary and Emerging Diseases*, 60(Suppl.1): 121-127.

Key words: Diseases/Parasites (Spain)

Risco, D., García, A., Fernández-Llario, P., García, W.L., Benítez, J.M., Gonçalves, P., Cuesta, J.M., Gómez, L., Rey, J. and de Mendoza, J.H. 2013. **Ocular lesions associated with *Chlamydia suis* in a wild boar piglet (*Sus scrofa*) from a semi-free range population in Spain.** *Journal of Zoo and Wildlife Medicine*, 44(1): 159-162.

Key words: Diseases/Parasites (Spain)

Risco, D., García, A., Serrano, E., Fernandez-Llario, P., Benítez, J.M., Martínez, R., García, W.L. and Mendoza, J.H. 2014. **High-density dependence but low**

impact on selected reproduction parameters of *Brucella suis* Biovar 2 in wild boar hunting estates from south-western Spain. *Transboundary and Emerging Diseases*, 61(6): 555-562.

Key words: Diseases/Parasites (Spain)

Risco, D., Serrano, E., Fernández-Llario, P., Cuesta, J.M., Gonçalves, P., García-Jiménez, W.L., Martínez, R., Cerrato, R., Velarde, R., Gómez, L. and Segalés, J. 2014. **Severity of bovine tuberculosis is associated with co-infection with common pathogens in wild boar.** *PLOS ONE*, 9(10): 1-10.

Key words: Diseases/Parasites (Spain)

Rivero, J., Hodgkinson, S.M. and López-Villalobos, N. 2013. **Definition of the breeding goal and determination of breeding objectives for European wild boar (*Sus scrofa* L.) in a semi-extensive production system.** *Livestock Science*, 157(1): 38-47.

Key words: Economics

Rodrigáñez, J., Barragán, C., Alves, E., Gortázar, C., Toro, M.A. and Silió, L. 2008. **Genetic diversity and allelic richness in Spanish wild and domestic pig population estimated from microsatellite markers.** *Spanish Journal of Agricultural Research*, 6(Suppl.1): 107-115.

Key words: Genetics, Population Biology

Rodríguez, E., Olmedo, J., Ubeira, F.M., Blanco, C. and Gárate, T. 2008. **Mixed infection, *Trichinella spiralis* and *Trichinella britovi*, in a wild boar hunted in the Province of Cáceres (Spain).** *Experimental Parasitology*, 119(3): 430-432.

Key words: Diseases/Parasites (Spain)

Rodríguez-Estival, J., Martinez-Haro, M., Monsalve-González, L. and Mateo, R. 2011. **Interactions between endogenous and dietary antioxidants against Pb-induced oxidative stress in wild ungulates from a Pb polluted mining area.** *Science of the Total Environment*, 409(14): 2725-2733.

Key words: Contamination (Spain)

Rodríguez-Estival, J., Taggart, M.A. and Mateo, R. 2011. **Alterations in vitamin A and E levels in liver and testis of wild ungulates from a lead mining area.** *Archives of Environmental Contamination and Toxicology*, 60(2): 361-371.

Key words: Contamination (Spain)

Rodríguez-Morales, B., Díaz-Varela, E.R. and Marey-Pérez, M.F. 2013. **Spatiotemporal analysis of vehicle collisions involving wild boar and roe deer in NW Spain.** *Accident Analysis & Prevention*, 60: 121-133.

Key words: Behavior, Damage (Spain)

Rodríguez-Prieto, V., Kukielka, D., Martínez-López, B., de las Heras, A.I., Barasona, J.Á., Gortázar, C., Sánchez-Vizcaíno, J.M. and Vicente, J. 2013. **Porcine reproductive and respiratory syndrome (PRRS) virus in wild boar and Iberian pigs in south-central Spain.** *European Journal of Wildlife Research*, 59(6): 859-867.

Key words: Diseases/Parasites (Spain)

Roic, B., Depner, K.R., Jemersic, L., Lipej, Z., Cajavec, S., Toncic, J., Lojkic, M. and Mihauevic, Z. 2007. **Serum antibodies directed against classical swine fever virus and other pestiviruses in wild boar (*Sus scrofa*) in the Republic of Croatia. DTW.** *Deutsche tierarztliche Wochenschrift*, 114(4): 145-148.

Key words: Diseases/Parasites (Croatia)

Romano, F., Motta, A., Melino, M., Negro, M., Gavotto, G., Decastelli, L., Careddu, E., Bianchi, C., Bianchi, D.M. and Pozio, E. 2011. **Investigation on a focus of human trichinellosis revealed by an atypical clinical case after wild-boar (*Sus scrofa*) pork consumption in northern Italy.** *Parasite: journal de la Société Française de Parasitologie*, 18(1): 85-87.

Key words: Diseases/Parasites (Italy)

Römer, A., Wieler, L.H. and Schierack, P. 2012. **Analyses of intestinal commensal *Escherichia coli* strains from wild boars suggest adaptation to conventional pig production conditions.** *Veterinary Microbiology*, 161(1): 122-129.

Key words: Diseases/Parasites (Germany)

Rónai, Z., Kreizinger, Z., Dán, Á., Drees, K., Foster, J.T., Bányai, K., Marton, S., Szeredi, L., Jánosi, S. and Gyuranecz, M. 2015. **First isolation and characterization of *Brucella microti* from wild boar.** *BMC Veterinary Research*, 11(1): 1-6.

Key words: Diseases/Parasites (Czech Republic)

Rose, N., Opriessnig, T., Grasland, B. and Jestin, A. 2012. **Epidemiology and transmission of porcine circovirus type 2 (PCV2).** *Virus Research*, 164(1): 78-89.

Key words: Diseases/Parasites

Rosell, C., Navàs, F. and Romero, S. 2012. **Reproduction of wild boar in a cropland and coastal wetland area: implications for management.** *Animal Biodiversity and Conservation*, 35(2): 209-217.

Key words: Control/Management, Reproduction (Spain)

Rosenthal, B.M., LaRosa, G., Zarlenga, D., Dunams, D., Chunyu, Y., Mingyuan, L. and Pozio, E. 2008. **Human dispersal of *Trichinella spiralis* in domesticated pigs.** *Infection, Genetics and Evolution*, 8(6): 799-805.

Key words: Diseases/Parasites (Italy)

Rossell Jr, C.R., Clarke, H.D., Schultz, M., Schwartzman, E. and Patch, S.C. 2016. **Description of rich montane seeps and effects of wild pigs on the plant and salamander assemblages.** *The American Midland Naturalist*, 175(2): 139-154.

Key words: Ecology, Food Habits (North Carolina/Tennessee-USA)

Rossi, S., Doucelin, A., Le Potier, M.F., Eraud, C. and Gilot-Fromont, E. 2013. **Innate immunity correlates with host fitness in wild boar (*Sus scrofa*) exposed to classical swine fever.** *PLOS ONE*, 8(11): 1-8.

Key words: Diseases/Parasites (France)

Rossi, S., Pol, F., Forot, B., Masse-Provin, N., Rigaux, S., Bronner, A. and Le Potier, M.F. 2010. **Preventive vaccination contributes to control classical swine fever in wild boar (*Sus scrofa* sp.).** *Veterinary Microbiology*, 142(1): 99-107.

Key words: Diseases/Parasites (France)

Rossi, S., Staubach, C., Blome, S., Guberti, V., Thulke, H.H., Vos, A., Koenen, F. and Le Potier, M.F. 2015. **Controlling of CSFV in European wild boar using oral vaccination: a review.** *Frontiers in Microbiology*, 6: 1141.

Key words: Diseases/Parasites

Rossi, S., Toigo, C., Hars, J., Pol, F., Hamann, J.L., Depner, K. and Le Potier, M.F. 2011. **New insights on the management of wildlife diseases using multi-state recapture models: the case of classical swine fever in wild boar.** *PLOS ONE,* 6(9): 1-9.

Key words: Diseases/Parasites (France)

Rosvold, J. and Andersen, R. 2008. **Wild boar in Norway–is climate a limiting factor.** *NTNU Vitesnskapsmuseet Rapp. Zool,* 1: 1-23.

Key words: Ecology, Population Biology (Norway)

Rosvold, J., Halley, D.J., Hufthammer, A.K., Minagawa, M. and Andersen, R. 2010. **The rise and fall of wild boar in a northern environment: evidence from stable isotopes and subfossil finds.** *The Holocene*, 20(7): 1113-1121.

Key words: Archaeological/Paleontology, Ecology (Norway)

Rowley-Conwy, P. and Dobney, K. 2007. **Wild boar and domestic pigs in Mesolithic and Neolithic southern Scandinavia.** *Pigs and Humans*, 10: 131-155.

Key words: Archaeological/Paleontology (Scandinavia)

Rowley-Conwy, P., Albarella, U. and Dobney, K. 2012. **Distinguishing wild boar from domestic pigs in prehistory: a review of approaches and recent results.** *Journal of World Prehistory,* 25(1): 1-44.

Key words: Archaeological/Paleontology, Taxonomy

Rozycka, D., Lim, J.M., Trout, R.C. and Brooks, S. 2015. **Have feral boar significantly impacted hazel dormouse populations in Sussex, England?.** *Folia Zoologica*, 64(4): 337-341.

Key words: Ecology, Food Habits (England)

Rubin, C.J., Megens, H.J., Barrio, A.M., Maqbool, K., Sayyab, S., Schwochow, D., Wang, C., Carlborg, Ö., Jern, P., Jørgensen, C.B. and Archibald, A.L. 2012.

Strong signatures of selection in the domestic pig genome. *Proceedings of the National Academy of Sciences*, 109(48): 19529-19536.

Key words: Genetics, Domestication

Rückert, C., Stratz, P., Preuss, S. and Bennewitz, J. 2012. **Mapping quantitative trait loci for metabolic and cytological fatness traits of connected F crosses in pigs.** *Journal of Animal Science*, 90(2): 399-409.

Key words: Genetics, Morphology (Germany)

Ruiz, V.L.A., Bersano, J.G., Brandão, P.E., Gregori, F., Soares, R.M., Villalobos, E.M.C. and Richtzenhain, L.J. 2009. **Identification of *Porcine parvovirus* from wild boars by partial sequencing of the VP-2 coding gene.** *Arquivo Brasileiro de Medicina Veterinária e Zootecnia*, 61(5): 1218-1221.

Key words: Diseases/Parasites

Ruiz-Fons, F., Vidal, D., Vicente, J., Acevedo, P., Fernández-de-Mera, I.G., Montoro, V. and Gortázar, C. 2008. **Epidemiological risk factors of Aujeszky's disease in wild boars (*Sus scrofa*) and domestic pigs in Spain.** *European Journal of Wildlife Research*, 54(4): 549-555.

Key words: Diseases/Parasites (Spain)

Rybnikova, I.A. and Kuznetsov, A.V. 2015. **Complexes of Formica s. str. nests in the Darwin Nature Reserve and causes of their degradation.** *Entomological Review*, 95(8): 947-952.

Key words: Ecology (Russia)

S

Sabrina, S., Jean-Michel, G., Carole, T., Serge, B. and Eric, B. 2009. **Pulsed resources and climate-induced variation in the reproductive traits of wild boar under high hunting pressure.** *Journal of Animal Ecology*, 78(6): 1278-1290.

Key words: Reproduction (France)

Saïd, S., Tolon, V., Brandt, S. and Baubet, E. 2012. **Sex effect on habitat selection in response to hunting disturbance: the study of wild boar.** *European Journal of Wildlife Research*, 58(1): 107-115.

Key words: Behavior (France)

Saito, M., Koike, F., Momose, H., Mihira, T., Uematsu, S., Ohtani, T. and Sekiyama, K. 2012. **Forecasting the range expansion of a recolonising wild boar *Sus scrofa* population.** *Wildlife Biology*, 18(4): 383-392.

Key words: Population Biology (Japan)

Saito, M., Momose, H. and Mihira, T. 2011. **Both environmental factors and countermeasures affect wild boar damage to rice paddies in Boso Peninsula, Japan.** *Crop Protection*, 30(8): 1048-1054.

Key words: Control/Management, Damage (Japan)

Saito, M., Momose, H., Mihira, T. and Uematsu, S. 2012. **Predicting the risk of wild boar damage to rice paddies using presence-only data in Chiba Prefecture, Japan.** *International Journal of Pest Management*, 58(1): 65-71.

Key words: Damage, Population Biology (Japan)

Sakai, K., Hagiwara, K., Omatsu, T., Hamasaki, C., Kuwata, R., Shimoda, H., Suzuki, K., Endoh, D., Nagata, N., Nagai, M. and Katayama, Y. 2015. **Isolation and characterization of a novel Rhabdovirus from a wild boar (*Sus scrofa*) in Japan.** *Veterinary Microbiology*, 179(3): 197-203.

Key words: Diseases/Parasites (Japan)

Sakai, M., Ohno, R., Higuchi, C., Sudo, M., Suzuki, K., Sato, H., Maeda, K., Sasaki, Y., Kakuda, T. and Takai, S. 2012. **Isolation of *Rhodococcus equi* from wild boars (*Sus scrofa*) in Japan.** *Journal of Wildlife Diseases*, 48(3): 815-817.

Key words: Diseases/Parasites (Japan)

Sakano, C., Morita, Y., Shiono, M., Yokota, Y., Mokudai, T., Sato-Motoi, Y., Noda, A., Nobusawa, T., Sakaniwa, H., Nagai, A. and Kabeya, H. 2009. **Prevalence of hepatitis E virus (HEV) infection in wild boars (*Sus scrofa leucomystax*) and pigs in Gunma Prefecture, Japan.** *Journal of Veterinary Medical Science*, 71(1): 21-25.

Key words: Diseases/Parasites (Japan)

Sakata, H., Samejima, H. and Yokoyama, M. 2008. **Present status of a wild boar (*Sus scrofa*) population estimated by sighting per unit effort (SPUE), and**

relationships to snowfall, vegetation, hunting effort, agricultural damages and the SPUE of Sika deer (*Cervus nippon*). *Honyurui Kagaku/Mammalian Science*, 48(2): 245-253.

Key words: Population Biology (Japan)

Salerni, E., Gardin, L., Baglioni, F. and Perini, C., 2013. **Effects of wild boar grazing on the yield of summer truffle (Tuscany, Italy).** *Acta Mycologica*, 48(1): 73-80.

Key words: Food Habits (Italy)

Salinas, R.A., Stiver, W.H., Corn, J.L., Lenhart, S., Collins, C., Madden, M., Vercauteren, K.C., Schmit, B.B., Kasari, E., Odoi, A. and Hickling, G. 2015. **An individual-based model for feral hogs in Great Smoky Mountains National Park.** *Natural Resource Modeling*, 28(1): 18-36.

Key words: Ecology, Population Biology (North Carolina/Tennessee-USA)

Sánchez, E., Cáceres, O., Náquira, C., Miranda, E., Samudio, F. and Fernandes, O. 2012. ***Echinococcus granulosus* genotypes circulating in alpacas (*Lama pacos*) and pigs (*Sus scrofa*) from an endemic region in Peru.** *Memórias do Instituto Oswaldo Cruz*, 107(2): 275-278.

Key words: Diseases/Parasites (Peru)

Sánchez, S., Martínez, R., García, A., Vidal, D., Blanco, J., Blanco, M., Blanco, J.E., Mora, A., Herrera-León, S., Echeita, A. and Alonso, J.M. 2010. **Detection and characterisation of O157: H7 and non-O157 Shiga toxin-producing *Escherichia coli* in wild boars.** *Veterinary Microbiology*, 143(2): 420-423.

Key words: Diseases/Parasites (Spain)

Sanders, D.L., Xie, F., Mauldin, R.E., Hurley, J.C., Miller, L.A., Garcia, M.R., DeYoung, R.W., Long, D.B. and Campbell, T.A. 2011. **Efficacy of ERL-4221 as an ovotoxin for feral pigs (*Sus scrofa*).** *Wildlife Research*, 38(2): 168-172.

Key words: Reproduction (Texas-USA)

Sandfoss, M., DePerno, C., Patton, S., Flowers, J. and Kennedy-Stoskopf, S. 2011. **Prevalence of antibody to *Toxoplasma gondii* and Trichinella spp. in feral pigs (*Sus scrofa*) of eastern North Carolina.** *Journal of Wildlife Diseases*, 47(2): 338-343.

Key words: Diseases/Parasites (North Carolina-USA)

Sandom, C.J., Hughes, J. and Macdonald, D.W. 2013. **Rewilding the Scottish Highlands: do wild boar, *sus scrofa*, use a suitable foraging strategy to be effective ecosystem engineers?.** *Restoration Ecology*, 21(3): 336-343.

Key words: Food Habits (Scottland)

Sandom, C.J., Hughes, J. and Macdonald, D.W. 2013. **Rooting for rewilding: quantifying wild boar's *Sus scrofa* rooting rate in the Scottish Highlands.** *Restoration Ecology*, 21(3): 329-335.

Key words: Damage, Food Habits (Scottland)

Sanguinetti, J. and Kitzberger, T. 2010. **Factors controlling seed predation by rodents and non-native *Sus scrofa* in *Araucaria araucana* forests: potential effects on seedling establishment.** *Biological Invasions*, 12(3): 689-706.

Key words: Food Habits (Argentina)

Santilli, F. and Varuzza, P. 2013. **Factors affecting wild boar (*Sus scrofa*) abundance in southern Tuscany.** *Hystrix, the Italian Journal of Mammalogy*, 24(2): 169-173.

Key words: Ecology, Population Biology (Italy)

Santos, N., Correia-Neves, M., Ghebremichael, S., Källenius, G., Svenson, S.B. and Almeida, V. 2009. **Epidemiology of *Mycobacterium bovis* infection in wild boar (*Sus scrofa*) from Portugal.** *Journal of Wildlife Diseases*, 45(4): 1048-1061.

Key words: Diseases/Parasites (Portugal)

Santos, N., Geraldes, M., Afonso, A., Almeida, V. and Correia-Neves, M. 2010. **Diagnosis of tuberculosis in the wild boar (*Sus scrofa*): a comparison of methods applicable to hunter-harvested animals.** *PLOS ONE*, 5(9): 1-8.

Key words: Diseases/Parasites (Portugal)

Santrac, V., Nedic, D.N., Maric, J., Nikolic, S., Stevanovic, O., Vasilev, S., Cvetkovic, J. and Sofronic-Milosavljevic, L. 2015. **The first report of *Trichinella pseudospiralis* presence in domestic swine and *T. britovi* in wild boar in Bosnia and Herzegovina.** *Acta Parasitologica*, 60(3): 471-475.

Key words: Diseases/Parasites (Bosnia and Herzegovina)

Sarasa, M. and Sarasa, J.A. 2013. **Intensive monitoring suggests population oscillations and migration in wild boar *Sus scrofa* in the Pyrenees.** *Animal Biodiversity and Conservation*, 36(1): 79-88.

Key words: Population Biology (Spain)

Satheeshkumar, P., Manjusha, U., Pillai, N. and Kumar, D.S. 2012. **Wild boars: is elimination the way forward?.** *Current Science*, 102(1): 14-15.

Key words: Damage (Kerala-India)

Sato, H., Suzuki, K. and Yokoyama, M. 2008. **Visceral helminths of wild boars (*Sus scrofa leucomystax*) in Japan, with special reference to a new species of the genus Morgascaridia Inglis, 1958 (Nematoda: Schneidernematidae).** *Journal of Helminthology*, 82(02): 159-168.

Key words: Diseases/Parasites (Japan)

Sato, Y., Sato, H., Naka, K., Furuya, S., Tsukiji, H., Kitagawa, K., Sonoda, Y., Usui, T., Sakamoto, H., Yoshino, S. and Shimizu, Y. 2011. **A nationwide survey of hepatitis E virus (HEV) infection in wild boars in Japan: identification of boar HEV strains of genotypes 3 and 4 and unrecognized genotypes.** *Archives of Virology*, 156(8): 1345-1358.

Key words: Diseases/Parasites (Japan)

Scandura, M., Iacolina, L. and Apollonio, M. 2011. **Genetic diversity in the European wild boar *Sus scrofa*: phylogeography, population structure and wild x domestic hybridization.** *Mammal Review*, 41(2): 125-137.

Key words: Genetics, Taxonomy

Scandura, M., Iacolina, L., Cossu, A. and Apollonio, M. 2011. **Effects of human perturbation on the genetic make-up of an island population: the case of the Sardinian wild boar.** *Heredity*, 106(6): 1012-1020.

Key words: Domestication, Genetics (Italy)

Scandura, M., Iacolina, L., Crestanello, B., Pecchioli, E., Di Benedetto, M.F., Russo, V., Davoli, R., Apollonio, M. and Bertorelle, G. 2008. **Ancient vs. recent processes as factors shaping the genetic variation of the European wild boar: are the**

effects of the last glaciation still detectable?. *Molecular Ecology*, 17(7): 1745-1762.

Key words: Genetics, Taxonomy (Europe)

Schiaffini, M.I. and Vila, A.R. 2012. **Habitat use of the wild boar, *Sus scrofa* Linnaeus 1758, in Los Alerces National Park, Argentina.** *Studies on Neotropical Fauna and Environment*, 47(1): 11-17.

Key words: Ecology (Argentina)

Schierack, P., Rödiger, S., Kuhl, C., Hiemann, R., Roggenbuck, D., Li, G., Weinreich, J., Berger, E., Nolan, L.K., Nicholson, B. and Römer, A. 2013. **Porcine *E. coli*: virulence-associated genes, resistance genes and adhesion and probiotic activity tested by a new screening method.** *PLOS ONE*, 8(4): 1-13.

Key words: Diseases/Parasites (Germany)

Schlageter, A. and Haag-Wackernagel, D. 2011. **Effectiveness of solar blinkers as a means of crop protection from wild boar damage.** *Crop Protection*, 30(9): 1216-1222.

Key words: Control/Management (Switzerland)

Schlageter, A. and Haag-Wackernagel, D. 2012. **Evaluation of an odor repellent for protecting crops from wild boar damage.** *Journal of Pest Science*, 85(2): 209-215.

Key words: Control/Management (Switzerland)

Schley, L., Dufrêne, M., Krier, A. and Frantz, A.C. 2008. **Patterns of crop damage by wild boar (*Sus scrofa*) in Luxembourg over a 10-year period.** *European Journal of Wildlife Research*, 54(4): 589-599.

Key words: Damage (Luxembourg)

Schlichting, P.E., Richardson, C.L., Chandler, B., Gipson, P.S., Mayer, J.J. and Dabbert, C.B. 2015. **Wild pig (*Sus scrofa*) reproduction and diet in the Rolling Plains of Texas.** *The Southwestern Naturalist*, *60*(4): 321-326.

Key words: Food Habits, Reproduction (Texas)

Schroyen, M., Stinckens, A., Verhelst, R., Niewold, T. and Buys, N. 2012. **The search for the gene mutations underlying enterotoxigenic *Escherichia coli* F4ab/ac susceptibility in pigs: a review.** *Veterinary Research*, 43(70): 1-8.

Key words: Diseases/Parasites, Genetics

Schulze, C., Hlinak, A., Wohlsein, P., Kutzer, P. and Mueller, T. 2009. **Spontaneous Aujeszky's disease (pseudorabies) in European wild boars (*Sus scrofa*) in the federal state of Brandenburg, Germany.** *Berliner und Munchener Tierarztliche Wochenschrift*, 123(9-10): 359-364.

Key words: Diseases/Parasites (Germany)

Scillitani, L., Monaco, A. and Toso, S. 2010. **Do intensive drive hunts affect wild boar (*Sus scrofa*) spatial behaviour in Italy? Some evidences and management implications.** *European Journal of Wildlife Research*, 56(3): 307-318.

Key words: Behavior, Control/Management (Italy)

Sedlak, K., Bartova, E. and Machova, J. 2008. **Antibodies to selected viral disease agents in wild boars from the Czech Republic.** *Journal of Wildlife Diseases*, 44(3): 777-780.

Key words: Diseases/Parasites (Czech Republic)

Segura, A., Acevedo, P., Rodríguez, O., Naves, J. and Obeso, J.R. 2014. **Biotic and abiotic factors modulating wild boar relative abundance in Atlantic Spain.** *European Journal of Wildlife Research*, 60(3): 469-476.

Key words: Ecology, Population Biology (Spain)

Selmi, M., Martello, E., Bertolotti, L., Bisanzio, D. and Tomassone, L. 2009. ***Rickettsia slovaca* and *Rickettsia raoultii* in *Dermacentor marginatus* ticks collected on wild boars in Tuscany, Italy.** *Journal of Medical Entomology*, 46(6): 1490-1493.

Key words: Diseases/Parasites (Italy)

Selva, N., Berezowska-Cnota, T. and Elguero-Claramunt, I. 2014. **Unforeseen effects of supplementary feeding: ungulate baiting sites as hotspots for ground-nest predation.** *PLOS ONE*, 9(3): 1-8.

Key words: Behavior, Food Habits (Poland)

Semizhon, T., Putyrskaya, V., Zibold, G. and Klemt, E. 2009. **Time-dependency of the 137 Cs contamination of wild boar from a region in southern Germany in the years 1998 to 2008.** *Journal of Environmental Radioactivity*, 100(11): 988-992.

Key words: Contamination (Germany)

Senlik, B., Cirak, V.Y., Girisgin, O. and Akyol, C.V. 2011. **Helminth infections of wild boars (*Sus scrofa*) in the Bursa province of Turkey.** *Journal of Helminthology*, 85(04): 404-408.

Key words: Diseases/Parasites (Turkey)

Serracca, L., Battistini, R., Rossini, I., Mignone, W., Peletto, S., Boin, C., Pistone, G., Ercolini, R. and Ercolini, C. 2015. **Molecular investigation on the presence of hepatitis E virus (HEV) in wild game in north-western Italy.** *Food and Environmental Virology*, 7(3): 206-212.

Key words: Diseases/Parasites (Italy)

Servanty, S., Choquet, R., Baubet, É., Brandt, S., Gaillard, J.M., Schaub, M., Toïgo, C., Lebreton, J.D., Buoro, M. and Gimenez, O. 2010. **Assessing whether mortality is additive using marked animals: a Bayesian state–space modeling approach.** *Ecology*, 91(7): 1916-1923.

Key words: Population Biology (France)

Servanty, S., Gaillard, J.M., Allainé, D., Brandt, S. and Baubet, E. 2007. **Litter size and fetal sex ratio adjustment in a highly polytocous species: the wild boar.** *Behavioral Ecology*, 18(2): 427-432.

Key words: Reproduction (France)

Servanty, S., Gaillard, J.M., Ronchi, F., Focardi, S., Baubet, E. and Gimenez, O. 2011. **Influence of harvesting pressure on demographic tactics: implications for wildlife management.** *Journal of Applied Ecology*, 48(4): 835-843.

Key words: Control/Management (France)

Shcherbakov, A.V., Kukushkin, S.A., Timina, A.M., Baĭbikov, T.Z., Kovalishin, V.F., Kan'shina, A.V., Prokhvatilova, L.B., Ruchnova, O.I., Bakunov, I.N. and Babkin, M.V. 2006. **Monitoring of infectious diseases among wild boars.** *Voprosy Virusologii*, 52(3): 29-33.

Key words: Diseases/Parasites (Ukraine)

Shinkai, H., Okumura, N., Suzuki, R., Muneta, Y. and Uenishi, H. 2012. **Toll-Like receptor 4 polymorphism impairing lipopolysaccharide signaling in *Sus scrofa*, and its restricted distribution among Japanese wild boar populations.** *DNA and Cell Biology*, 31(4): 575-581.

Key words: Genetics (Japan)

Shiomi, H.H., Pinho, R.O., Lima, D.M.A., Siqueira, J.B., Santos, M.C.R., Costa, E.V., Lopes, P.S., Guimarães, S.E.F. and Guimarães, J.D. 2015. **Cryopreservation of Piau-breed wild boar sperm: assessment of cooling curves and centrifugation regimes.** *Reproduction in Domestic Animals*, 50(4): 545-553.

Key words: Reproduction (Brazil)

Shreejata, G. and Sinha, A. 2014. **A wild boar hunting: predation on a bonnet macaque by a wild boar in the Bandipur National Park, southern India.** *Current Science*, 106(9): 1186-1187.

Key words: Food Habits (India)

Silaghi, C., Pfister, K. and Overzier, E. 2014. **Molecular investigation for bacterial and protozoan tick-borne pathogens in wild boars (*Sus scrofa*) from southern Germany.** *Vector-Borne and Zoonotic Diseases*, 14(5): 371-373.

Key words: Diseases/Parasites (Germany)

Silva, P.V.C.D., Lui, J.F., Band, G.D.O., Regitano, L.C.D.A., Grossi, S.D.F., Sollero, B.P. and Nunes, C.D.S. 2011. **Genetic variability among the wild boars (*Sus scrofa scrofa*), crossbred animals and pigs using microsatellite markers (STRs).** *Brazilian Archives of Biology and Technology*, 54(2): 301-306.

Key words: Genetics (Brazil)

Sims, N.K., John, E.A. and Stewart, A.J. 2014. **Short-term response and recovery of bluebells (*Hyacinthoides non-scripta*) after rooting by wild boar (*Sus scrofa*).** *Plant Ecology*, 215(12): 1409-1416.

Key words: Ecology (Britian)

Singh, K.J., Robindro, R., James, M. and Nongmeikapam, M., 2011. **Wild boar, a new threat to the Manipur Brow-antlered deer-the Sangai.** *ZOO's PRINT,* 26(10): 3-4.

Key words: Food Habits (India)

Siroka, Z., Bily, R., Polacek, V., Dvorak, J. and Svoboda, M. 2014. **Massive death of wild boars caused by ethylene glycol: a case report.** *Veterinarni Medicina*, 59(8): 388-395.

Key words: Contamination (Czech Republic)

Skewes, O. and Jaksic, F.M. 2015. **History of the introduction and present distribution of the European wild boar (*Sus scrofa*) in Chile.** *Mastozoología Neotropical*, 22(1): 113-124.

Key words: History, Population Biology (Chile)

Skewes, O., Cádiz, P., Merino, V., Islas, A. and Morales, R. 2014. **Muscle fibre characteristics, enzyme activity and meat colour of wild boar (*Sus scrofa* s. L.) muscle with 2n= 36 compared to those of phenotypically similar crossbreeds (2n= 37 and 2n= 38).** *Meat Science*, 98(2): 272-278.

Key words: Morphology (Chile)

Skewes, O., Moraga, C.A., Arriagada, P. and Rau, J.R. 2012. **The European wild boar (*Sus scrofa*): a biological invader as a recent prey of the American puma (*Puma concolor*) in southern Chile.** *Revista Chilena de Historia Natural*, 85(2): 227-232.

Key words: Predation (Chile)

Skewes, O., Rodríguez, R., and Jaksic, F.M. 2007. **Trophic ecology of the wild boar (*Sus scrofa*) in Chile.** *Revista Chilena De Historia Natural*, 80(3): 295-307.

Key words: Ecology, Food Habits (Chile)

Slavica, A., Cvetnić, Ž., Konjević, D., Janicki, Z., Severin, K., Dežđek, D., Starešina, V., Sindičić, M. and Antić, J. 2010. **Detection of Leptospira spp. serovars in wild boars (*Sus scrofa*) from continental Croatia.** *Veterinarski Arhiv*, 80(2): 247-257.

Key words: Diseases/Parasites (Croatia)

Sliz, I., Vlasakova, M., Jackova, A. and Vilcek, S. 2015. **Characterization of *Porcine parvovirus* type 3 and *Porcine circovirus* type 2 in wild boars (*Sus scrofa*) in Slovakia.** *Journal of Wildlife Diseases*, 51(3): 703-711.

Key words: Diseases/Parasites (Slovakia)

Smith, T.N., Smith, M.D., Johnson, D.K. and Ditchkoff, S.S. 2014. **Evaluation of continuous-catch doors for trapping wild pigs.** *Wildlife Society Bulletin*, 38(1): 175-181.

Key words: Control/Management (Alabama-USA)

Snow, N.P., Halseth, J.M., Lavelle, M.J., Hanson, T.E., Blass, C.R., Foster, J.A., Humphrys, S.T., Staples, L.D., Hewitt, D.G. and VerCauteren, K.C. 2016. **Bait preference of free-ranging feral swine for delivery of a novel toxicant.** *PLOS ONE*, 11(1): 1-15.

Key words: Control/Management (Texas-USA)

Soares, H.S., Ramos, V.D.N., Osava, C.F., Oliveira, S., Szabó, M.P.J., Piovezan, U., Castro, B.B. and Gennari, S.M. 2016. **Occurrence of antibodies against *Neospora caninum* in wild pigs (*Sus scrofa*) in the Pantanal, Mato Grosso do Sul, Brazil**. *Brazilian Journal of Veterinary Research and Animal Science*, 53(1): 112-116.

Key words: Diseases/Parasites (Brazil)

Sodeikat, G. and Pohlmeyer, K. 2007. **Impact of drive hunts on daytime resting site areas of wild boar family groups (*Sus scrofa* L.).** *Wildlife Biology in Practice*, 3(1): 28-38.

Key words: Behavior (Germany)

Sofia, M., Billinis, C., Psychas, V., Birtsas, P., Sofianidis, G., Leontides, L., Knowles, N. and Spyrou, V. 2008. **Detection and genetic characterization of porcine circovirus 2 isolates from the first cases of postweaning multisystemic and wasting syndrome in wild boars in Greece.** *Journal of Wildlife Diseases*, 44(4): 864-870.

Key words: Diseases/Parasites (Greece)

Sommer, V., Lowe, A. and Dietrich, T. 2016. **Not eating like a pig: European wild boar wash their food.** *Animal Cognition*, 19(1): 245-249.

Key words: Behavior, Food Habits (Switzerland)

Souron, A., Merceron, G., Blondel, C., Brunetière, N., Colyn, M., Hofman-Kamińska, E. and Boisserie, J.R. 2015. **Three-dimensional dental microwear texture analysis and diet in extant Suidae (Mammalia: Cetartiodactyla).** *Mammalia*, 79(3): 279-291.

Key words: Food Habits, Morphology

Sparkes, J., Ballard, G. and Fleming, P.J. 2016. **Cooperative hunting between humans and domestic dogs in eastern and northern Australia.** *Wildlife Research*, 43(1): 20-26.

Key words: Control/Management, Hunting (Australia)

Sparklin, B.D., Mitchell, M.S., Hanson, L.B., Jolley, D. and Ditchkoff, S.S. 2009. **Territoriality of feral pigs in a highly persecuted population on Fort Benning, Georgia.** *The Journal of Wildlife Management*, 73(4): 497-502.

Key words: Behavior, Population Biology (Georgia-USA)

Spear, D. and Chown, S.L. 2009. **Non-indigenous ungulates as a threat to biodiversity.** *Journal of Zoology*, 279(1): 1-17.

Key words: Damage, Ecology

Šprem, N., Piria, M., Florijančić, T., Antunović, B., Dumić, T., Gutzmirtl, H., Treer, T. and Curik, I. 2011. **Morphometrical analysis of reproduction traits for the wild boar (*Sus scrofa* L.) in Croatia.** *Agriculturae Conspectus Scientificus (ACS)*, 76(3): 263-265.

Key words: Morphology, Reproduction (Croatia)

Šprem, N., Piria, M., Prđun, S., Novosel, H. and Treer, T. 2015. **Variation of wild boar reproductive performance in different habitat types: implications for management.** *Russian Journal of Ecology*, 46(6): 579-585.

Key words: Control/Management, Ecology, Reproduction

Šprem, N., Safner, T., Treer, T., Florijančić, T., Jurić, J., Cubric-Curik, V., Frantz, A.C. and Curik, I. 2016. **Are the dinaric mountains a boundary between continental**

and mediterranean wild boar populations in Croatia?. *European Journal of Wildlife Research*, 1-11.

Key words: Ecology, Population Biology (Croatia)

Šprem, N., Salajpal, K., Safner, T., Đikić, D., Jurić, J., Curik, I., Đikić, M. and Cubric-Curik, V. 2014. **Genetic analysis of hybridization between domesticated endangered pig breeds and wild boar.** *Livestock Science*, 162, 1-4.

Key words: Genetics, Taxonomy (Croatia)

Srivastava, T. and Khan, A. 2009. **Population status and habitat use of wild pigs *Sus scrofa* in Keolandeo National Park, Bharatpur, India.** *Journal of the Bombay Natural History Society*, 106(3): 298-304.

Key words: Ecology, Population Biology (India)

Stahl, T., Falk, S., Failing, K., Berger, J., Georgii, S. and Brunn, H. 2012. **Perfluorooctanoic acid and perfluorooctane sulfonate in liver and muscle tissue from wild boar in Hesse, Germany**. *Archives of Environmental Contamination and Toxicology*, 62(4): 696-703.

Key words: Contamination (Germany)

Stahnke, N., Liebscher, V., Staubach, C. and Ziller, M. 2013. **An approach to model monitoring and surveillance data of wildlife diseases—exemplified by classical swine fever in wild boar.** *Preventive Veterinary Medicine*, 112(3): 355-369.

Key words: Diseases/Parasites (Germany)

Stanc, S. and Bejenaru, L. 2009. **Archaeozoological analysis of a sample of roman period in the Isaccea site.** *Analele Ştiinţifice ale Universităţii „Al. I. Cuza" Iaşi*, 229-234.

Key words: Archaeological/Paleontology (Romania)

Steinhauser, G. and Saey, P.R. 2015. **137Cs in the meat of wild boars: a comparison of the impacts of Chernobyl and Fukushima.** *Journal of Radioanalytical and Nuclear Chemistry*, 1-6.

Key words: Radioecology (Japan, Ukraine)

Stolle, K., van Beest, F.M., Vander Wal, E. and Brook, R.K. 2015. **Diurnal and nocturnal activity patterns of invasive wild boar (*Sus scrofa*) in Saskatchewan, Canada.** *The Canadian Field-Naturalist*, 129(1): 76-79.
Key words: Behavior (Canada)

Sugiyama, H., Shibata, K., Kawakami, Y., Arakawa, K., Morishima, Y., Yamasaki, H., Gokuden, M., Iwakiri, T. and Fukumori, J. 2015. **Paragonimiasis due to the consumption of wild boar meat in Japan: contamination levels of lung fluke larvae in muscle samples of wild boars caught in Kagoshima Prefecture.** *Japanese Journal of Infectious Diseases*, 68(6): 536-537.
Key words: Diseases/Parasites (Japan)

Šuran, J., Prišć, M., Rašić, D., Srebočan, E. and Crnić, A.P. 2013. **Malondialdehyde and heavy metal concentrations in tissues of wild boar (*Sus scrofa* L.) from central Croatia.** *Journal of Environmental Science and Health, Part B*, 48(2): 147-152.
Key words: Contamination (Croatia)

Suselbeek, L., Adamczyk, V.M., Bongers, F., Nolet, B.A., Prins, H.H., van Wieren, S.E. and Jansen, P.A. 2014. **Scatter hoarding and cache pilferage by superior competitors: an experiment with wild boar, *Sus scrofa*.** *Animal Behaviour*, 96: 107-115.
Key words: Behavior, Food Habits (Netherlands)

Sweitzer, R.A. and Van Vuren, D.H., 2008. **Effects of wild pigs on seedling survival in California oak woodlands. In proceedings of the 6th symposium on oak woodlands: today's challenges, tomorrow's opportunities.** *General Technical Report PSW-GRT-217. Albany California: Pacific Southwest Research Station, Forest Service, US Department of Agriculture*, 267-277.
Key words: Ecology, Food Habits (California)

Széll, Z., Marucci, G., Ludovisi, A., Gómez-Morales, M.A., Sréter, T. and Pozio, E. 2012. **Spatial distribution of *Trichinella britovi*, *T. spiralis* and *T. pseudospiralis* of domestic pigs and wild boars (*Sus scrofa*) in Hungary.** *Veterinary Parasitology*, 183(3): 393-396.

Key words: Diseases/Parasites (Hungary)

T

Tăbăran, A., Mihaiu, M., Dan, S.D., Mihaiu, R., Cordiş, I.V. and Cordea, D. 2013. **Incidence of Sarcocystis spp. infestation in pork and wild boar samples in Transylvania.** *Porcine Research*, 3(2): 36-39.

Key words: Diseases/Parasites (Transylvania)

Takada, K., Hayashi, K., Sato, Y. and Hirasawa, M. 2010. ***Streptococcus dentapri*** **sp. nov., isolated from the wild boar oral cavity.** *International Journal of Systematic and Evolutionary Microbiology*, 60(4): 820-823.

Key words: Diseases/Parasites

Takahashi, M., Nishizawa, T., Sato, H., Sato, Y., Nagashima, S. and Okamoto, H. 2011. **Analysis of the full-length genome of a hepatitis E virus isolate obtained from a wild boar in Japan that is classifiable into a novel genotype.** *Journal of General Virology*, 92(4): 902-908.

Key words: Diseases/Parasites (Japan)

Tanaka, K., Iwaki, Y., Takizawa, T., Dorji, T., Tshering, G., Kurosawa, Y., Maeda, Y., Mannen, H., Nomura, K., Dang, V.B. and Chhum-phith, L. 2008. **Mitochondrial diversity of native pigs in the mainland south and south-east Asian countries and its relationships between local wild boars.** *Animal Science Journal*, 79(4): 417-434.

Key words: Domestication, Genetics (Asia)

Tanaka, K., Iwaki, Y., Takizawa, T., Murakami, M., Mannen, H., Maeda, Y., Kurosawa, Y., Dang, V.B., Chhum-phith, L., Bouahom, B. and Yamamoto, Y. 2007. **The novel polymorphism of the beta 3-adrenergic receptor gene and its distribution in domestic pigs and wild boars in Asia.** *Animal Science Journal*, 78(3): 243-250.

Key words: Domestication, Genetics (Asia)

Tanaka, K., Takizawa, T., Oki, O., Fukawa, K., Ito, T., Miyabe, M., Mannen, H., Kurosawa, Y. and Hirose, K. 2015. **Allele frequency for c. 335 A> C**

polymorphisms in porcine ghrelin/obestatin prepropeptide gene and association analysis with performance traits in various pig breeds. *Czech Journal of Animal Science*, 60(9): 411-416.
Key words: Genetics

Taniguchi, M., Hayashi, T., Nii, M., Yamaguchi, T., Fujishima-Kanaya, N., Awata, T. and Mikawa, S. 2010. **Fine mapping of quantitative trait loci for meat color on chromosome 6: Analysis of the swine gene.** *Journal of Animal Science*, 88(1): 23-31.
Key words: Genetics

Tanomtong, A., Supanuam, P., Siripiyasing, P. and Bunjonrat, R. 2007. **A comparative chromosome analysis of Thai wild boar (*Sus scrofa jubatus*) and relationship to domestic pig (*S. s. domestica*) by conventional staining, G-banding and high-resolution technique.** *Songklanakarin Journal of Science and Technology (Thailand)*, 29(1): 1-13.
Key words: Genetics, Taxonomy (Thailand)

Taylor, D.L., Leung, L.P. and Gordon, I.J. 2011. **The impact of feral pigs (*Sus scrofa*) on an Australian lowland tropical rainforest.** *Wildlife Research*, 38(5): 437-445.
Key words: Damage, Ecology (Australia)

Teng, L., Liu, Z. and Song, Y. 2007. **Habitat selection of wild boar (*Sus scrofa*) in Hainan Datian Reserve.** *Chinese Journal of Zoology-Peking-*, 42(1): 1.
Key words: Ecology (China)

Terman, A., Mikolajczyk, K., Polasik, D., Pilarczyk, B., Bąkowska, M., Tyra, M. and Żαk, G. 2013. **Association between GPX5 gene polymorphism and selenium concentration in liver and kidney of wild boars from west Pomerania Province, Poland.** *Italian Journal of Animal Science*, 12(4): 535-537.
Key words: Genetics, Morphology (Poland)

Thi, N.V., Nguyen, V.D., Praet, N., Claes, L., Gabriël, S., Huyen, N.T. and Dorny, P. 2014. **Trichinella infection in wild boars and synanthropic rats in northwest Vietnam.** *Veterinary Parasitology*, 200(1): 207-211.

Key words: Diseases/Parasites (Vietnam)

Thurfjell, H., Ball, J.P., Åhlén, P.A., Kornacher, P., Dettki, H. and Sjöberg, K. 2009. **Habitat use and spatial patterns of wild boar *Sus scrofa* (L.): agricultural fields and edges.** *European Journal of Wildlife Research*, 55(5): 517-523.

Key words: Behavior, Ecology (Sweden)

Thurfjell, H., Spong, G. and Ericsson, G. 2013. **Effects of hunting on wild boar *Sus scrofa* behaviour.** *Wildlife Biology*, 19(1): 87-93.

Key words: Behavior, Hunting (Sweden)

Thurfjell, H., Spong, G. and Ericsson, G. 2014. **Effects of weather, season, and daylight on female wild boar movement.** *Acta Theriologica*, 59(3): 467-472.

Key words: Behavior, Ecology (Sweden)

Thurfjell, H., Spong, G., Olsson, M. and Ericsson, G. 2015. **Avoidance of high traffic levels results in lower risk of wild boar-vehicle accidents.** *Landscape and Urban Planning*, 133: 98-104.

Key words: Damage (Sweden)

Toïgo, C., Servanty, S., Gaillard, J.M., Brandt, S. and Baubet, E. 2008. **Disentangling natural from hunting mortality in an intensively hunted wild boar population.** *The Journal of Wildlife Management*, 72(7): 1532-1539.

Key words: Population Biology (France)

Tolnai, Z., Széll, Z., Marucci, G., Pozio, E. and Sréter, T. 2014. **Environmental determinants of the spatial distribution of *Trichinella britovi* and *Trichinella spiralis* in Hungary.** *Veterinary Parasitology*, 204(3): 426-429.

Key words: Diseases/Parasites (Hungary)

Tolon, V., Dray, S., Loison, A., Zeileis, A., Fischer, C. and Baubet, E. 2009. **Responding to spatial and temporal variations in predation risk: space use of a game species in a changing landscape of fear.** *Canadian Journal of Zoology*, 87(12): 1129-1137.

Key words: Behavior (France, Sweden)

Tolon, V., Martin, J., Dray, S., Loison, A., Fischer, C. and Baubet, E. 2012. **Predator–prey spatial game as a tool to understand the effects of protected areas on harvester–wildlife interactions.** *Ecological Applications*, 22(2): 648-657.

Key words: Behavior (France, Sweden)

Tomza-Marciniak, A. 2013. **Organochlorine compounds in wild boars from an area containing an old landfill of obsolete pesticides.** *Fresenius Environmental Bulletin*, 22(8 A): 2415-2422.

Key words: Contamination (Poland)

Tomza-Marciniak, A., Marciniak, A., Pilarczyk, B., Drozd, R., Ligocki, M. and Prokulewicz, A. 2014. **Wild boar (*Sus scrofa*) as a bioindicator of organochlorine compound contamination in terrestrial ecosystems of west Pomerania Province, NW Poland.** *Environmental Monitoring and Assessment*, 186(1): 229-238.

Key words: Contamination (Poland)

Torre, A., Bosch, J., Iglesias, I., Muñoz, M.J., Mur, L., Martínez-López, B., Martínez, M. and Sánchez-Vizcaíno, J.M. 2015. **Assessing the risk of African swine fever introduction into the European Union by wild boar.** *Transboundary and Emerging Diseases*, 62(3): 272-279.

Key words: Diseases/Parasites (Europe)

Torres-Porras, J., Fernandez-Llario, P., Carranza, J. and Mateos, C., 2015. **Conifer plantations negatively affect density of wild boars in a Mediterranean ecosystem.** *Folia Zoologica*, 64(1): 25-31.

Key words: Ecology, Population Biology (Spain)

Trabucco, B., Charrier, F., Jori, F., Maestrini, O., Cornelis, D., Etter, E., Molia, S., Relun, A. and Casabianca, F. 2013. **Stakeholder's practices and representations of contacts between domestic and wild pigs: a new approach for disease risk assessment?.** *Acta agriculturae Slovenica*, 4: 119-122.

Key words: Diseases/Parasites (Corsica-France)

Treyer, D., Linderoth, P., Liebl, T., Pegel, M., Weiler, U. and Claus, R. 2012. **Influence of sex, age and season on body weight, energy intake and endocrine**

parameter in wild living wild boars in southern Germany. *European Journal of Wildlife Research*, 58(1): 373-378.

Key words: Physiology (Germany)

Tsachalidis, E.P. and Hadjisterkotis, E. 2008. **Wild boar hunting and socioeconomic trends in northern Greece, 1993–2002.** *European Journal of Wildlife Research*, 54(4): 643-649.

Key words: Economics, Hunting (Greece)

Tsuji, T., Yokoyama, M., Asano, M. and Suzuki, M. 2013. **Estimation of the fertility rates of Japanese wild boars (*Sus scrofa leucomystax*) using fetuses and corpora albicans.** *Acta theriologica*, 58(3): 315-323.

Key words: Reproduction (Japan)

Turcitu, M.A., Wellenberg, G.J., Barboi, G., Codreanu, M.D., Vuta, V.B., Nicolae, S., Barbuceanu, F., Coste, H. and Cioranu, R. 2011. **Genetic diversity of porcine circovirus type 2 (PCV2) in the Romanian wild boar population.** *Research in Veterinary Science*, 91(3): 103-106.

Key words: Diseases/Parasites (Europe)

Turner, S.P., Farnworth, M.J., Mendl, M., Erhard, H.W. and Lawrence, A.B. 2011. **Evidence for residence-induced enhancement of aggressiveness in the non-territorial pig.** *Applied Animal Behaviour Science*, 130(1): 10-19.

Key words: Behavior

U

Ucarli, Y. 2013. **Effects of wild boar (*Sus scrofa*) on farming activities: A case study of Turkey**. *African Journal of Biotechnology*, 10(44): 8823-8828.

Key words: Damage (Turkey)

Uglyanets, A.V. and Kudryashov, V.P. 2008. **Peculiar features of 137Cs accumulation in tissues and organs of wild boar in the National Park Pripyatski.** *Vestsi Natsyyanal'naj Akadehmii Navuk Belarusi*, 45(34): 93-97.

Key words: Radioecology (Belarus)

Újváry, D., Schally, G., Buczkó, M., Szabó, L. and Szemethy, L. 2014. **A simple method for the assessment of wild boars'(*Sus scrofa*) habitat use.** *Journal of Veterinary Behavior: Clinical Applications and Research*, 9(3): 127-131.

Key words: Behavrior, Population Biology (Hungary)

Ukkonen, P., Mannermaa, K. and Nummi, P. 2014. **New evidence of the presence of wild boar (*Sus scrofa*) in Finland during early Holocene: dispersal restricted by snow and hunting?.** *The Holocene*, 25(2):391-397.

Key words: Archaeological/Paleontology (Finland)

Umhang, G., Richomme, C., Hormaz, V., Boucher, J.M. and Boué, F. 2014. **Pigs and wild boar in Corsica harbor *Echinococcus canadensis* G6/7 at levels of concern for public health and local economy.** *Acta Tropica*, 133: 64-68.

Key words: Diseases/Parasites, Economics (Corsica-France)

Uni, S., Fukuda, M., Agatsuma, T., Bain, O., Otsuka, Y., Nakatani, J., Matsubayashi, M., Harada, M., Omar, H., Ramli, R. and Hashim, R. 2015. ***Onchocerca takaokai* n. sp.(Nematoda: Filarioidea) in Japanese wild boars (*Sus scrofa leucomystax*): description and molecular identification of intradermal females.** *Parasitology International*, 64(6): 493-502.

Key words: Diseases/Parasites (Japan)

Vai, S., Vilaça, S.T., Romandini, M., Benazzo, A., Visentini, P., Modolo, M., Bertolini, M., MacQueen, P., Austin, J., Cooper, A. and Caramelli, D. 2015. **The Biarzo case in northern Italy: is the temporal dynamic of swine mitochondrial DNA lineages in Europe related to domestication?.** *Scientific Reports*, 5: 16514.

Key words: Domestication, Taxonomy (Italy)

Van Asch, B., Pereira, F., Santos, L.S., Carneiro, J., Santos, N. and Amorim, A. 2012. **Mitochondrial lineages reveal intense gene flow between Iberian wild boars and south Iberian pig breeds.** *Animal Genetics*, 43(1): 35-41.

Key words: Genetics, Taxonomy (Iberia)

Van Asch, B., Silva Santos, L., Carneiro, J., Pereira, F. and Amorim, A. 2011. **Identification of mtDNA lineages of *Sus scrofa* by multiplex single base**

extension for the authentication of processed food products. *Journal of Agricultural and Food Chemistry*, 59(13): 6920-6926.
Key words: Genetics

van Doormaal, N., Ohashi, H., Koike, S. and Kaji, K. 2015. **Influence of human activities on the activity patterns of Japanese sika deer (*Cervus nippon*) and wild boar (*Sus scrofa*) in Central Japan.** *European Journal of Wildlife Research*, 61(4): 517-527.
Key words: Behavior (Japan)

Van Ginkel, H.A.L., Kuijper, D.P.J., Churski, M., Zub, K., Szafrańska, P. and Smit, C. 2013. **Safe for saplings not safe for seeds: *Quercus robur* recruitment in relation to coarse woody debris in Białowieża Primeval Forest, Poland.** *Forest Ecology and Management*, 304: 73-79.
Key words: Ecology, Food Habits (Poland)

Vanschoenwinkel, B., Waterkeyn, A., Vandecaetsbeek, T., Pineau, O., Grillas, P. and Brendonck, L. 2008. **Dispersal of freshwater invertebrates by large terrestrial mammals: a case study with wild boar (*Sus scrofa*) in Mediterranean wetlands.** *Freshwater Biology*, 53(11): 2264-2273.
Key words: Behavior (France)

Veeroja, R. and Männil, P. 2013. **Population development and reproduction of wild boar (*Sus scrofa*) in Estonia.** *Wildlife Biology in Practice*, 10(3): 17-21.
Key words: Population Biology, Reproduction (Estonia)

Veličković, N., Djan, M., Ferreira, E., Stergar, M., Obreht, D., Maletić, V. and Fonseca, C. 2015. **From north to south and back: the role of the Balkans and other southern peninsulas in the recolonization of Europe by wild boar.** *Journal of Biogeography*, 42(4): 716-728.
Key words: Genetics, Taxonomy

Velickovic, N., Djan, M., Obreht, D. and Vapa, L. 2012. **Population genetic structure of wild boars in the west Balkan region.** *Russian Journal of Genetics*, 48(8): 859-863.
Key words: Genetics, Population Biology

Velickovic, N., Djan, M., Zorić, M., Obreht, D., Gagrčin, M. and Vapa, L. 2010. **An assessment of the genetic diversity in the wild boar population from the Podunavlje-Podravlje hunting area.** *Archives of Biological Sciences*, 62(3): 807-810.

Key words: Genetics, Population Biology (Croatia)

Vengušt, G., Hostnik, P., Cerovšek, M., Cilenšek, P. and Malovrh, T. 2011. **Presence of antibodies against rabies in wild boars.** *Acta Veterinaria Hungarica*, 59(1): 149-154.

Key words: Diseases/Parasites (Slovenia)

Vengust, G., Lindtner-Knific, R., Zele, D. and Bidovec, A. 2008. **Leptospira antibodies in wild boars (*Sus scrofa*) in Slovenia.** *European Journal of Wildlife Research*, 54(4): 749-752.

Key words: Diseases/Parasites (Slovenia)

Vergne, T., Guinat, C., Petkova, P., Gogin, A., Kolbasov, D., Blome, S., Molia, S., Pinto Ferreira, J., Wieland, B., Nathues, H. and Pfeiffer, D.U. 2014. **Attitudes and beliefs of pig farmers and wild boar hunters towards reporting of African swine fever in Bulgaria, Germany and the western part of the Russian Federation.** *Transboundary and Emerging Diseases*, 1-11.

Key words: Control/Management (Bulgaria, Germany, Russia)

Verin, R., Varuzza, P., Mazzei, M. and Poli, A. 2014. **Serologic, molecular, and pathologic survey of pseudorabies virus infection in hunted wild boars (*Sus scrofa*) in Italy.** *Journal of Wildlife Diseases*, 50(3): 559-565.

Key words: Diseases/Parasites (Italy)

Verpoest, S., Cay, A.B., Favoreel, H. and De Regge, N. 2016. **Pseudorabies virus isolates from domestic pigs and wild boars show no apparent in vitro differences in replication kinetics and sensitivity to interferon-induced antiviral status.** *Journal of General Virology*, 97(2): 473-479.

Key words: Diseases/Parasites

Verpoest, S., Cay, A.B., Van Campe, W., Mostin, L., Welby, S., Favoreel, H. and De Regge, N. 2016. **Age-and strain-dependent differences in the outcome of**

experimental infections of domestic pigs with wild boar pseudorabies virus isolates. *Journal of General Virology*, 97(2): 487-495.

Key words: Diseases/Parasites

Vetter, S.G., Brandstätter, C., Macheiner, M., Suchentrunk, F., Gerritsmann, H. and Bieber, C. 2016. **Shy is sometimes better: personality and juvenile body mass affect adult reproductive success in wild boars, *Sus scrofa*.** *Animal Behaviour*, 115: 193-205.

Key words: Behavior, Reproduction (Austria)

Vetter, S.G., Ruf, T., Bieber, C. and Arnold, W. 2015. **What is a mild winter? Regional differences in within-species responses to climate change.** *PLOS ONE*, 10(7): 1-17.

Key words: Ecology, Population Biology (Europe)

Vicente-Rubiano, M., Martínez-López, B., Sánchez-Vizcaíno, F. and Sánchez-Vizcaíno, J.M. 2014. **A new approach for rapidly assessing the risk of Aujeszky's disease reintroduction into a disease-free Spanish territory by analysing the movement of live pigs and potential contacts with wild boar.** *Transboundary and Emerging Diseases*, 61(4): 350-361.

Key words: Control/Management, *Diseases/Parasites* (Spain)

Vieira, Y.R., Silva, M.F., Santos, D.R., Vieira, A.A., Zanella, J.R.C., Barquero, G., Lago, B.V.D., Gomes, S.A., Pinto, M.A. and Paula, V.S.D. 2015. **Serological and molecular evidence of Hepadnavirus infection in swine.** *Annals of Agricultureal and Environmental Medicine*, 22(1): 11-16.

Key words: Diseases/Parasites (Spain)

Vieira-Pinto, M., Alberto, J., Aranha, J., Serejo, J., Canto, A., Cunha, M.V. and Botelho, A. 2011. **Combined evaluation of bovine tuberculosis in wild boar (*Sus scrofa*) and red deer (*Cervus elaphus*) from central-east Portugal.** *European Journal of Wildlife Research*, 57(6): 1189-1201.

Key words: Diseases/Parasites (Portugal)

Vigne, J.D., Zazzo, A., Saliège, J.F., Poplin, F., Guilaine, J. and Simmons, A. 2009. **Pre-Neolithic wild boar management and introduction to Cyprus more than**

11,400 years ago. *Proceedings of the National Academy of Sciences*, 106(38): 16135-16138.
Key words: Archaeological/Paleontology, Control/Management (Cyprus)

Vilaça, S.T., Biosa, D., Zachos, F., Iacolina, L., Kirschning, J., Alves, P.C., Paule, L., Gortazar, C., Mamuris, Z., Jędrzejewska, B. and Borowik, T. 2014. **Mitochondrial phylogeography of the European wild boar: the effect of climate on genetic diversity and spatial lineage sorting across Europe.** *Journal of Biogeography*, 41(5): 987-998.
Key words: Genetics, Population Biology, Taxonomy

Vilardell, A., Capalleras, X., Budó, J., Molist, F. and Pons, P. 2008. **Test of the efficacy of two chemical repellents in the control of Hermann's tortoise nest predation.** *European Journal of Wildlife Research*, 54(4): 745-748.
Key words: Control/Management (Spain)

Vilcek, S., Molnar, L., Vlasakova, M. and Jackova, A. 2014. **The first detection of PRRSV in wild boars in Slovakia.** *Berliner und Munchener tierarztliche Wochenschrift*, 128(1-2): 31-33.
Key words: Diseases/Parasites (Slovakia)

Vittecoq, M., Grandhomme, V., Simon, G., Herve, S., Blanchon, T., Renaud, F., Thomas, F., Gauthier-Clerc, M. and van der Werf, S. 2012. **Study of influenza A virus in wild boars living in a major duck wintering site.** *Infection, Genetics and Evolution*, 12(2): 483-486.
Key words: Diseases/Parasites (France)

Volkmann, M., Skiebe, E., Kerrinnes, T., Faber, F., Lepka, D., Pfeifer, Y., Holland, G., Bannert, N. and Wilharm, G. 2010. ***Orbus hercynius* gen. nov., sp. nov., isolated from faeces of wild boar, is most closely related to members of the orders 'Enterobacteriales' and Pasteurellales.** *International Journal of Systematic and Evolutionary Microbiology*, 60(11): 2601-2605.
Key words: Diseases/Parasites

von Altrock, A., Seinige, D. and Kehrenberg, C. 2015. ***Yersinia enterocolitica* isolates from wild boars hunted in lower Saxony, Germany.** *Applied and Environmental Microbiology*, 81(14): 4835-4840.
Key words: Diseases/Parasites (Germany)

W

Wang, J., Guo, J., Hao, X., Hu, H., Lin, H., Zhang, Y., Wang, C. and Wu, Y. 2010. **Phylogenetic relationships of pig breeds from Shandong province of China and their influence by modern commercial breeds by analysis of mitochondrial DNA sequences.** *Italian Journal of Animal Science*, 9(2): 248-254.
Key words: Genetics, Taxonomy (China)

Wang, W., Zhang, J., Ma, J. and Liu, H. 2007. **Analysis on wild boars home ranges in south Lesser Khingan Mountains**. *Acta Theriologica Sinica*, 27(3): 257-262.
Key words: Behaviour (China)

Wannajuk, M., Sangthong, P., Natapintu, S., Wonnapinij, P., Vuttipongchaikij, S., Kubera, A., Won-In, K., Mingmuang, M. and Surat, W. 2013. **Ancient DNA of pigs in Thailand: evidence of multiple origins of Thai pigs in the late Neolithic period.** *ScienceAsia*, 39(5): 456-465.
Key words: Archaeological/Paleontology, Genetics (Thailand)

Ward, M.P., Garner, M.G. and Cowled, B.D. 2015. **Modelling foot-and-mouth disease transmission in a wild pig–domestic cattle ecosystem.** *Australian Veterinary Journal*, 93(1-2): 4-12.
Key words: Diseases/Parasites (Australia)

Wegorek, P., Zamojska, J., Bandyk, A. and Olejarski, P. 2014. **Results of the monitoring of the effectiveness of repellents against wild boar in the fields.** *Progress in Plant Protection*, 54(2): 159-162.
Key words: Control/Management (Poland)

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

Key words: Control/Management (United States of America)

Wiedemann, S., Lutz, B., Albrecht, C., Kuehn, R., Killermann, B., Einspanier, R. and Meyer, H.H. 2009. **Fate of genetically modified maize and conventional rapeseed, and endozoochory in wild boar (*Sus scrofa*).** *Mammalian Biology-Zeitschrift für Säugetierkunde*, 74(3): 191-197.

Key words: Food Habits (Switzerland)

Wilcox, J.T. and Van Vuren, D.H. 2009. **Wild pigs as predators in oak woodlands of California.** *Journal of Mammalogy*, 90(1): 114-118.

Key words: Food Habits (California-USA)

Wilcox, J.T. 2015. **Implications of predation by wild pigs on native vertebrates: a case study.** *California Fish and Game*, 101(1): 72-77.

Key words: Food Habits (California-USA)

Williams, B.L., Holtfreter, R.W., Ditchkoff, S.S. and Grand, J.B. 2011. **Trap style influences wild pig behavior and trapping success.** *The Journal of Wildlife Management*, 75(2): 432-436.

Key words: Control/Management (Georgia-USA)

Williams, B.L., Holtfreter, R.W., Ditchkoff, S.S. and Grand, J.B. 2011. **Efficiency of time-lapse intervals and simple baits for camera surveys of wild pigs.** *The Journal of Wildlife Management*, 75(3): 655-659.

Key words: Control/Management (Georgia-USA)

Wilson, C.J. 2013. **The establishment and distribution of feral wild boar (*Sus scrofa*) in England.** *Wildlife Biology in Practice*, 10(3): 1-6.

Key words: Ecology, Population Biology (England)

Wiratsudakul, A., Sariya, L., Prompiram, P., Tantawet, S., Suraruangchai, D., Sedwisai, P., Sangkachai, N., Suksai, P. and Ratanakorn, P. 2012. **Detection and phylogenetic characterization of hepatitis E virus genotype 3 in a captive wild boar in Thailand.** *Journal of Zoo and Wildlife Medicine*, 43(3): 640-644.

Key words: Diseases/Parasites (Thailand)

Wirthner, S., Frey, B., Busse, M.D., Schütz, M. and Risch, A.C. 2011. **Effects of wild boar (*Sus scrofa* L.) rooting on the bacterial community structure in mixed-**

hardwood forest soils in Switzerland. *European Journal of Soil Biology*, 47(5): 296-302.

Key words: Ecology, Food Habtis (Switzerland)

Wirthner, S., Schütz, M., Page-Dumroese, D.S., Busse, M.D., Kirchner, J.W. and Risch, A.C. 2012. **Do changes in soil properties after rooting by wild boars (*Sus scrofa*) affect understory vegetation in Swiss hardwood forests?.** *Canadian Journal of Forest Research*, 42(3): 585-592.

Key words: Ecology, Food Habtis (Switzerland)

Wu, G.S., Yao, Y.G., Qu, K.X., Ding, Z.L., Li, H., Palanichamy, M.G., Duan, Z.Y., Li, N., Chen, Y.S. and Zhang, Y.P. 2007. **Population phylogenomic analysis of mitochondrial DNA in wild boars and domestic pigs revealed multiple domestication events in East Asia.** *Genome Biology*, 8(11): 1-12.

Key words: Domestication, Genetics (Asia)

Wu, N., Abril, C., Hinicacute, V., Brodard, I., Thür, B., Fattebert, J., Hüssy, D. and Ryser-Degiorgis, M.P. 2011. **Free-ranging wild boar: a disease threat to domestic pigs in Switzerland?.** *Journal of Wildlife Diseases*, 47(4): 868-879.

Key words: Diseases/Parasites (Switzerland)

Wu, N., Abril, C., Thomann, A., Grosclaude, E., Doherr, M.G., Boujon, P. and Ryser-Degiorgis, M.P. 2012. **Risk factors for contacts between wild boar and outdoor pigs in Switzerland and investigations on potential Brucella suis spill-over.** *BMC Veterinary Research*, 8(116): 1-12.

Key words: Diseases/Parasites (Switzerland)

X

Xu, F., Cai, T.J., Ju, C.Y. and Zhao, Y.L. 2011. **Autumn habitat selection of wild boar in the Fenghuangshan Nature Reserve, Heilongjiang Province.** *Journal of Beijing Forestry University*, 33(3): 86-91.

Key words: Ecology (China)

Y

Yagoob, G., Saeed, M. and Ali, O. 2014. **Helminth parasites of a hunted-wild boar (*Sus scrofa*) in the Talesh City, north of Iran.** *Bulletin of Environment, Pharmacology and Life Sciences*, 3(3): 247-250.

Key words: Diseases/Parasites (Iran)

Yamazaki, Y., Adachi, F. and Sawamura, A. 2016. **Multiple Origins and admixture of recently expanding Japanese wild boar (*Sus scrofa leucomystax*) populations in Toyama Prefecture of Japan.** *Zoological Science*, 33(1): 38-43.

Key words: Population Biology, Taxonomy (Japan)

Yang, S., Zhang, H., Mao, H., Yan, D., Lu, S., Lian, L., Zhao, G., Yan, Y., Deng, W., Shi, X. and Han, S. 2011. **The local origin of the Tibetan pig and additional insights into the origin of Asian pigs.** *PLOS ONE*, 6(12): 1-7.

Key words: Genetics, Taxonomy (Tibet)

Yang, X.Q., Lian, L.S., NIE, Q., Wang, J.J., Wang, S.X. and Li, Z.Y. 2009. **Research on the satellite polymorphism of the Xishuangbanna wild boar.** *Journal of Yunnan Agricultural University*, 4: 1.

Key words: Genetics (China)

Yarsan, E., Yipel, M., Dikmen, B., Altıntaş, L., Ekici, H. and Köksal, A. 2014. **Concentrations of essential and non-essential toxic trace elements in wild boar (*Sus Scrofa* L., 1758) tissues from southern Turkey.** *Bulletin of Environmental Contamination and Toxicology*, 92(1): 10-14.

Key words: Contamination (Turkey)

Yeh, J.Y. 2014. **Seroprevalence of porcine proliferative enteropathy among wild boars in the Republic of Korea.** *BMC Veterinary Research*, 10(5): 1-4.

Key words: Diseases/Parasites (Korea)

Yong, D.L., Lee, B.P.Y.H., Ang, A. and Tan, K.H. 2010. **The status on Singapore island of the Eurasian wild pig *Sus scrofa* (Mammalia: Suidae).** *Nature in Singapore,* 3: 227-237.

Key words: Population Biology (Singapore)

Z

Zacharko-Siembida, A. and Arciszewski, M.B. 2014. **Immunoreactivity to cocaine-and amphetamine-regulated transcript in the enteric nervous system of the pig and wild boar stomach.** *Anatomia, Histologia, Embryologia*, 43(1): 48-55.
Key words: Physiology

Zamora, M.J., Alvarez, M., Olmedo, J., Blanco, M.C. and Pozio, E. 2015. ***Trichinella pseudospiralis* in the Iberian peninsula.** *Veterinary Parasitology*, 210(3): 255-259.
Key words: Diseases/Parasites (Spain)

Zanetti, S., Bua, A., Molicotti, P., Delogu, G., Mura, A., Ortu, S. and Sechi, L. 2008. **Identification of mycobacterial infections in wild boars in northern Sardinia, Italy.** *Acta Veterinaria Hungarica*, 56(2): 145-152.
Key words: Diseases/Parasites (Italy)

Zawadzki, A., Szuba-Trznadel, A. and Fuchs, B. 2011. **The base of nourishment, characteristic of population and breeding season of wild boars (*Sus scrofa*) in the Kaczawskie Mountains.** *Zeszyty Naukowe Uniwersytetu Przyrodniczego we Wrocławiu-Biologia i Hodowla Zwierzat*, 63(583): 363-376.
Key words: Food Habits, Population Biology, Reproduction (Poland)

Zawadzki, A., Szuba-Trznadel, A. and Fuchs, B. 2011. **Zearalenone contamination of maize in diets for wild boars (*Sus scrofa*) in the Kaczawskie Mountains.** *Zeszyty Naukowe Uniwersytetu Przyrodniczego we Wrocławiu-Biologia i Hodowla Zwierzat*, 63(583): 377-384.
Key words: Contamination (Poland)

Zeder, M.A., Lemoine, X. and Payne, S. 2015. **A new system for computing long-bone fusion age profiles in *Sus scrofa*.** *Journal of Archaeological Science*, 55: 135-150.
Key words: Archaeological/Paleontology, Morphology

Zhang, B.W., Zhang, C.L., Chen, J.P., Ding, D., Li, C.Q., Zhou, K.Y. and Chang, Q. 2008. **Genetic structure and subspecies divergence of wild boars *Sus scrofa* in mainland China based on the microsatellite variation analysis.** *Acta Zoologica Sinica*, 54(5): 753-761.

Key words: Genetic, Taxonomy (China)

Zhang, C. and Plastow, G. 2011. **Genomic diversity in pig (*Sus scrofa*) and its comparison with human and other livestock.** *Current Genomics*, 12(2): 138-146.

Key words: Domestication, Genetics

Zhang, J., Wang, W. and Zhang, W. 2007. **Activity patterns of wild boar in south Xiaoxing'an Mountains.** *Chinese Journal of Zoology*, 42(5): 90-93.

Key words: Behavior (China)

Zhang, M.T., Liu, B.W., Liu, D. and Siberian, T.P. 2015. **The research on the damage control of wild boar (*Sus scrofa*) around Hunchun Area, Jilin Province.** *Chinese Journal of Zoology*, 6: 1.

Key words: Control/Management (China)

Zhao, X., Liu, Z.Y. and Liu, Q.X. 2015. **Gene coexpression networks reveal key drivers of phenotypic divergence in porcine muscle.** *BMC Genomics*, 16(50): 1-15.

Key words: Genetics, Morphology

Zhou, C., Li, M., Yuan, K., Hu, N. and Peng, W. 2011. **Phylogeography of *Ascaris lumbricoides* and *A. suum* from China.** *Parasitology Research*, 109(2): 329-338.

Key words: Diseases/Parasites (China)

Zhou, C.X., Elsheikha, H.M., Zhou, D.H., Liu, Q., Zhu, X.Q. and Suo, X. 2016. **Dual identification and analysis of differentially expressed transcripts of porcine PK-15 cells and *Toxoplasma gondii* during in vitro infection.** *Frontiers in Microbiology*, 7: 721.

Key words: Diseases/Parasites (China)

Zhu, H.Q., Ge, Z.Y., Chang, S.H., Liu, G., Wu, J.C., Shi, X.J., Xu, J.F. and Mao, Z.X. 2011. **Winter habitat selection of wild boar (*Sus scrofa ussuricus*) in Huangnihe Nature Reserve.** *Chinese Journal of Ecology*, 4: 18.

Key words: Behavior, Ecology (China)

Zielonka, Ł., Gajęcka, M., Rozicka, A., Dąbrowski, M., Żmudzki, J. and Gajęcki, M. 2014. **The effect of environmental mycotoxins on selected ovarian tissue fragments of multiparous female wild boars at the beginning of astronomical winter.** *Toxicon*, 89: 26-31.

Key words: Contamination, Reproduction (Poland)

Zielonka, Ł., Gajęcka, M., Żmudzki, J. and Gajęcki, M. 2015. **The effect of selected environmental Fusarium mycotoxins on the ovaries in the female wild boar (*Sus scrofa*).** *Polish Journal of Veterinary Sciences*, 18(2): 391-399.

Key words: Contamination, Reproduction (Poland)

Zinoviev, A.V. 2010. **A supernumerary permanent mandibular premolar of wild boar (*Sus scrofa* L.) from the early medieval Novgorod, Russia.** *International Journal of Osteoarchaeology*, 20(5): 586-590.

Key words: Archaeological/Paleontology (Russia)

CHAPTER 3

Economic Estimates of Wild Hog (*Sus scrofa*) Damage and Control Among Young Forest Plantations in Alabama

3.1. Introduction

3.1.1. Current Status of Wild Hogs in the United States and Their Potential Impact on Alabama's Forests

Non-native wild hogs (*Sus scrofa*) rank as one of the top three most prolific invasive animals in the United States (US) (Pimentel 2007). Now present in over 44 states, the rapid expansion of wild hogs has been facilitated by illegal translocation and a naturally high fecundity rate (Mayer 2009a). Once introduced to an area, the reproductive potential and adaptable biology of these animals enables them to quickly become established (Seward et al. 2004, West et al. 2009). This species is particularly problematic to landowners because of their tendency to travel in groups and ability to cause extensive damage to timberlands, pastures, and agriculture crops (Graves 1984, Seward et al. 2004, West et al. 2009). Problems stemming from the presence of wild hogs are not new to the US; however, in recent years more attention is being given to the growing range of this species and the accumulating evidence of their deleterious impacts on agricultural and forested areas (Campbell and Long 2009, Slootmaker et al. 2017).

Agriculture, forestry, and other related sectors are major contributors to Alabama’s economy, with a combined value of well over $100 billion (Fields et al. 2013). Wild hog damage has the potential to affect over 90 industrial sectors related to agriculture and forestry within the State. As the State’s second largest manufacturing industry, forestry produced an estimated $14.8 billion of products in 2013 (AFC 2016).

Ninety-four percent of Alabama’s timberland acreage is privately owned with around 50 percent of the total timberland being pine plantations (AFC 2016). With Alabama’s land area comprised of 27 percent farm operations and 69 percent timberlands, the deleterious effects from wild hog presence in the State is a major cause for concern (AFC 2016, USDA 2016). With isolated populations of wild hogs in at least 64 counties (Conley et al. 2014), this species has emerged as one of the leading wildlife problems. One wildlife biologist working for the Alabama Department of Conservation and Natural Resources describes wild hogs as “the most destructive nuisance animal ever brought to Alabama” (Jaworowski 2011).

With non-industrial private landowners in control of the majority of Alabama’s agriculture and forest lands, the successful management of these operations is critical to the State’s natural resource industry. In 2015, the Natural Resources Conservation Service (NRCS) allocated $100,000 in financial assistance to Alabama landowners from select counties to address the growing threat from wild hogs. These funds were made available through the Environmental Quality Incentive Program (EQIP) to help cover the costs associated with wild hog control. Whether or not the monetary aid being offered is substantial enough to mitigate the damage being done to the State’s agriculture and forest lands has yet to be determined. It does, however, suggest the wild hog problem has grown serious enough in Alabama to warrant an assistance program for control efforts. The State currently has a no closed season/no bag limit hunting policy for wild hogs but efforts like these rarely make any substantial progress towards population reduction (Jerrolds et al. 2014, Massei et al. 2011).

Funding to manage wild hogs and protect valuable resources is finite and must be applied carefully in order to optimize its use. When economic restraints govern the management actions that can be taken towards controlling wild hogs, the metric for success of the management actions are measured by the amount and value of resources protected (Engeman et al. 2003). Therefore, providing an estimation of the monetary value to the damage wild hogs inflict on a resource would permit economic analyses to help guide and evaluate management actions (Engeman et al. 2003). Wild hog damage estimates often extend to agricultural crops (Anderson et al. 2016, Herrero et al. 2006, Schley and Roper 2003, Seward et al. 2004), while damage estimates among forest plantations are lacking.

3.1.2. Wild Hog Damage to Forestry and Timber Resources

The most comprehensive review of scientific literature describing wild hog damage to forests was done by Campbell and Long (2009). Many studies described forest ecosystem damage but few studies were mentioned which described damage to forest plantations while none provided economic estimates for the cost of damage. Most reports and scientific literature on wild hog predation of seedlings concerns natural regenerated pine (*Pinus* spp.), oak (*Quercus* spp.), and beech (*Fagus* spp.)species (Bruinderink and

Hazebroek 1996, Hanson and Karstad 1959, Ickes et al. 2005, Lipscomb 1989, Siemann et al. 2009, Sweitzer and Van Vuren 2002). Few reports or research exists which specifically address wild hog predation on planted seedlings. The only reports of wild hog predation of planted southern pines came after an intensive planting effort by the U.S. Forest Service across the Southeast in the mid-1900's (Conley 1977, Lucas 1977, Wakeley 1954). Entire plantations of longleaf pine (*Pinus palustris* Mill.) and slash pine (*Pinus elliottii*) were reported to have been destroyed by wild hogs in Alabama, Florida, Louisiana, and Mississippi (Lucus 1977, Wakeley 1954).

Mayer et al. (2000) is the only study of which we are aware that documents wild hog predation among planted hardwood seedlings. The group found that of nine hardwood species planted in a wetland restoration area in South Carolina, cherrybark oak (*Quercus pagodaefolia*), swamp chestnut oak (*Q. michauxii*), water hickory (*Carya aquatica*), and swamp tupelo (*Nyssa sylvatica* var. *biflora*) were the only species impacted by wild hog foraging activities. Non-effected seedling species included water oak (*Q. nigra*), green ash (*Fraxinus pennsylvanica*), persimmon (*Diospyros virginiana*), bald cypress (*Taxodium distichum*), and water tupelo (*Nyssa aquatica*). Though the study was informative about wild hog's preference among planted hardwood species, it lacked an economic component quantifying the cost of damage in the wetland restoration area.

Trees are most vulnerable to wild hogs during the initial years after planting or germination (Mayer 2009b, Sweeney et al. 2003). A single hog is reportedly capable of rooting up to six longleaf seedlings a minute, destroying an estimated 400-1000 seedlings a day (Hopkins 1947, Wakeley 1954). These animals have the potential to cause complete crop failure in young timber plantations while seedlings are in their initial growth stages. In South Carolina, Lipscomb (1989) observed after two growing seasons, only eight of 845 longleaf seedlings survived hog predation in an unfenced area, versus 64 percent of seedlings surviving in fenced-in sites.

Wild hogs will occasionally cause damage to slash pine and loblolly pine (*Pinus taeda*), but the most extensive damage is reported to occur with longleaf (Wakeley 1954). Longleaf is unique among other planted tree species in that they have evolved with landscapes exposed to frequent fire. While other tree species focus energy into rapid vertical growth during initial stages of development, longleaf may remain in a fire-resistant grass stage for several years before initiating vertical growth (Croker and Boyer 1975). This development trait, along with a few other adaptations (long needles, thick bark, thickly scaled bud), allows longleaf to survive on landscapes with frequent fire intervals. During the grass stage, longleaf grows a thick tap root which may prove more appealing to wild hogs compared to root stems of other planted species (Hopkins 1947). Wood and Roark (1980) concluded the hogs are not actually consuming the pine saplings, but instead are chewing on the roots to access the sap and starches, then discarding the woody tissue.

The majority of longleaf forests in the US occur on non-industrial private lands (AFC 2016). Longleaf is desirable to landowners because it is generally more resistant to fire, hurricane damage, and pine bark beetle attacks than other southern pine species (Landers et al. 1995). Longleaf is also economically attractive because it produces a higher quality timber (North Carolina Forest Service 2011) and pine straw (Dyer 2012) than loblolly and slash pine. On many sites longleaf can grow competitively or even exceed the growth of other southern pine species (Kush et al. 2007).

The structure of longleaf forests is ideal for multiple-use management because of the unique canopy structure which allows ample amount of sunlight to reach the forest floor (Franklin 2008). Alternative forestry (e.g., silvopasture, agroforestry, forest farming) has the potential to be more profitable than traditional forestry. Stainback and Alavalapati (2004) developed a stand level economic model of a silvopasture system utilizing longleaf to explore its potential profitability. The profitability of a silvopasture system was then compared with traditional pasture and traditional forestry scenarios. In addition, they also incorporated carbon payments and the effect of lengthening rotations to produce red-cockaded woodpecker (RCW) (*Picoides borealis*) habitat. Silvopasture was found to be more profitable than both traditional forestry and tradition pasture with and without carbon payments. The opportunity cost for increasing the rotation age to create RCW habitat was significantly less for silvopasture than for traditional forestry. The opportunity costs for both scenarios also decreased as carbon payments increased. The group found silvopasture to be an attractive land use opportunity for landowners wanting to plant longleaf on pastureland and take advantage of incentives for providing RCW habitat.

Longleaf forests have a high non-commodity value in terms of aesthetics and wildlife. Longleaf forests are among of the most diversified ecosystems in North American in terms of floral and faunal species (Means 2007, Peet 2007). These forests are good habitat for game-species (Franklin 2008) and can bring a landowner additional income from hunting leases. There are also a number of non-game species endemic to longleaf pine ecosystems, two of which are endangered keystone species, the gopher tortoise (*Gopherus polyphemus*) and RCW (Means 2007). A number of studies have been done to explore if RCW habitat management can be profitable while producing timber (Lancia et al. 1989, Roise et al. 1990, Roise et al. 1991). Roise et al. (1991) developed a stand level economic model of a longleaf stand utilizing a shelterwood system with the addition of pine straw production. They concluded desirable RCW habitat can be profitably maintained for a longleaf operation given their management scenario. They also found harvesting pine straw contributed more income to the operations profitability than the timber revenue.

3.1.3. Research Needs and Project Description

Stand level economic models, like those described earlier in the studies by Stainback and Alavalapati (2004) and Roise et al. (1991), can be useful tools for evaluating the financial feasibility of growing timber. We are not aware of any studies which examine the economic impact of wild hog damage and control to young forest plantations, a concerning fact considering privately owned forests constitute nearly all of Alabama's timberland acreage and much of the forestland across the Southeast. Wild hogs can frustrate the efforts of landowners to establish forest plantations by incurring additional replanting costs after initial site preparation and planting expenses have been invested. In 2016, a landowner establishing a forest plantation would spend anywhere from $29-141 per acre on site preparation, $59-84 per acre on labor for planting, plus the additional cost of seedlings (which vary widely depending on supplier, species, and number of trees planted per acre) (Maggard and Barlow 2017). With depredation of planted pine seedlings by wild hogs being an area of considerable economic costs when it comes to forest plantations (Mayer 2009b), any additional research pertaining to this topic could prove valuable to landowners and resource professionals.

The goal of this project was to fill in the knowledge gap concerning the economic impact of wild hogs to young forest plantations. A mail survey was conducted among non-industrial private landowners in Alabama to gain an understanding about wild hog damage and control in forest plantations. The survey was designed to simultaneously capture information related to wild hog presence on private lands, damage to forested areas, forest types, control methods, and hunting. When estimating the cost of wild hogs it is important to not only include the costs from the physical damage to the stand, but also the incurred costs from control measures aimed at preventing future damage. For this reason we included control costs as a part of our economic analyses. We then created a stand level economic model to explore potential outcomes of private forest landowner's responses to wild hog damage. Lastly, we utilized sensitivity analyses to examine how varying discount rates and amounts of damage might affect the cost of wild hog damage and control. Such information is beneficial in guiding forest management decisions as the threat from wild hogs becomes more widespread.

3.2. Methods

A number of tasks were created in order to guide this project through the research process. These tasks were designed to help accomplish the goal of providing information about the economic impact of wild hogs to forest stands. Five main tasks were associated with this portion of the study:

Task 1. Develop a questionnaire capable of soliciting information from private landowners regarding their forest stands and the presence of wild hogs on their property.

Task 2. Conduct a survey of non-industrial private landowners in Alabama to determine a reasonable estimate for the economic impact of wild hogs on young forest plantations.

Task 3. Perform descriptive statistics on survey response data and organize the results by physiographic region.

Task 4. Develop a stand level economic model and explore possible outcomes of landowner responses to wild hog damage.

Task 5. Using the stand level economic model, perform sensitivity analysis to determine how varying discount rates and levels of damage would affect the overall cost of damage from wild hogs.

3.2.1. Overview of Questionnaire Development

The questionnaire created to accomplish Task 1 was based on a prior survey conducted during the summer of 2015 (Anderson et al. 2016). In their survey, farmers from 11 states in the southern US were surveyed to assess the economic impact of wild hogs on crops, livestock, farmland, and the corresponding costs associated with wild hog control. Portions from the survey used for estimating damages were restructured to include questions relating to forestry. The survey was designed to simultaneously capture information related to wild hog presence on private lands and in forest stands, damage to forested areas, forest types, control methods, and hunting.

The questionnaire was designed to take 10 to 15 minutes to complete. Question types included multiple choice and fill-in-the-blank. Ample margin space was provided to give respondents the opportunity to write comments or include additional information. Questions were designed to minimize confusion, require minimal response effort, and maximize the amount of desirable information.

3.2.2. Timber Stand Section of Survey

Information on damage to young forest plantations was inferred by the questions listed in Appendix A. Landowners could choose to include their top two timber crops planted each year from 2013 to 2015. Even if the landowners did not experience wild hog damage, the survey questions were structured in such a way that useful information about their forest plantation could still be captured. Questions in this section also included asking landowners to provide the number of acres damaged by wild hogs for each tree species planted and the percentage of seedlings destroyed on those acres.

Additional questions solicited landowners to report the frequency with which they had observed wild hogs from a number of general land cover types within their property. Participants were then asked to describe their property by assigning the percent of their land which best corresponded to a selection of predefined land cover categories (Appendix A)

3.2.3. Wild Hog Control Section of Survey

In this section of the questionnaire, landowners were asked to give information on the efforts used to control wild hogs on their property (Appendix A). Specifically, participants were questioned about the control methods used, the dollar amount invested in each method, and their perception on how effective the method was at controlling wild hogs. Questions about fencing, both non-electric and electric, had to be formatted differently from the control methods because they were categorized as fixed-cost. Lastly, landowners were asked to report how many wild hogs were killed on their land in 2015 and if they sought help from any county, state, or federal agencies in response to wild pig damage on their property.

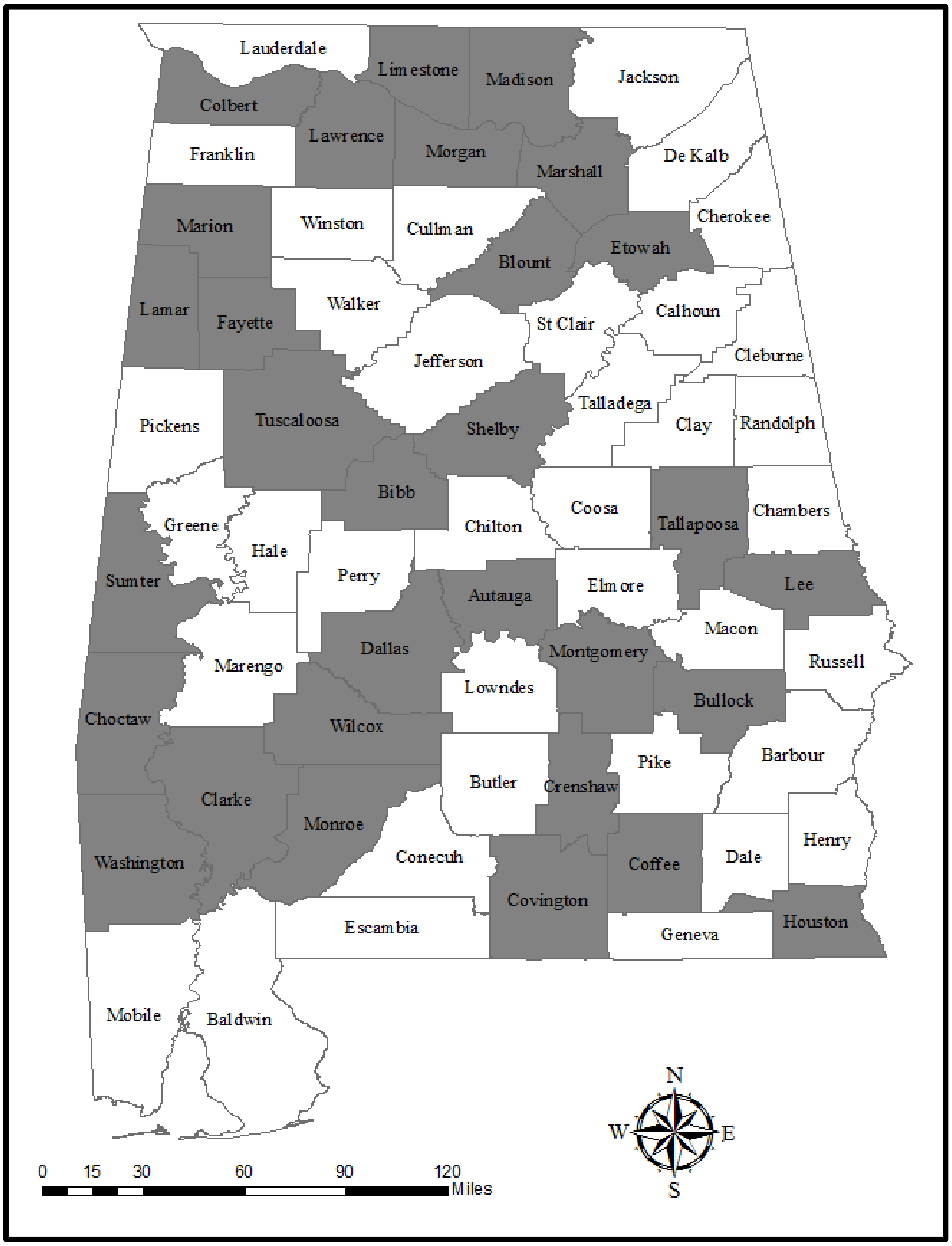
3.2.4. Willingness-to-pay (WTP)/Willingess-to-accept (WTA) Section of Survey

In order to gauge landowner preferences for wild hog density and willingness to pay for eradication, participants were asked to select a category which best reflected their situation and opinion of wild hogs on their property or area (Appendix A). In responding to this question, landowners would indicate the current status of wild hogs on their property and whether they would prefer more, fewer, or no change in wild hog density. The questionnaire was designed to group participants into those who preferred wild hogs and those who did not. Survey takers would then indicate a dollar amount from $0 to $1000 which they would be willing to pay or be paid annually on a per acre basis for eradication. Landowners who had wild hogs on their land but preferred fewer were grouped with those not wanting pigs because both associate negative values with wild hog presence. Other landowners, who desired to be supplemented for eradication because of the positive values they associated with wild hogs, were grouped together. This questionnaire assumes participants understood the hypothetical eradication would be permanent and that eradication costs would be shared regionally.

3.2.5. Survey Implementation

In Task 2, survey questionnaires were administered and coordinated by the Auburn University School of Forestry and Wildlife Sciences during the summer of 2016. Thirty of the 67 counties in Alabama were randomly selected to receive survey questionnaires (Figure 3.1). A stratified random sample of approximately 1,200 private landowners was taken from county tax roll records, equivalent to 40 samples from each of the selected counties. The mailing of the questionnaire and the timing of implementation was in accordance with the recommendations made by Dillman et al (2014). This included a pre-notice letter, survey questionnaire, follow-up letter, and second-round survey questionnaire. The pre-notice letter preceded the survey questionnaire by five days. The follow-up letter was sent a week after the mailing of the survey questionnaire. Finally, the second-round survey questionnaire was sent two weeks after the mailing of the follow-up letter. All elements involved in this survey were approved by Auburn University's Institutional Review Board (Document Approval number: 16-184 EX 1605).

Figure 3.1. Counties in Alabama selected to receive the 2016 survey of wild hog damage on non-industrial private lands.



3.2.6. Survey Response Data Analysis and Organization

Task 3 involved performing descriptive statistics on the survey data using R Statistical Analysis Software (R Core Team 2013). Alabama consists of physiographic regions with a variety of properties promoting or limiting the optimal growth of certain tree species. For this reason the response data was organized by major physiographic regions of Alabama which include the Limestone Valley (LV), Appalachian Plateau (AP), Upper Coastal Plains (UCP), Black Belt Prairies (BBP), Piedmont Plateau (PP), and Lower Coastal Plains (LCP). In most instances data were summarized by physiographic region in order to collect averages for questionnaire responses by region. Specific information regarding timber stands planted from 2013-2015 were not summarized by physiographic region in order to obtain State-wide averages for replanting costs due to wild hog damage. Additionally, maps and figures were created to examine the distribution of responses by county using ArcGIS® (ESRI 2013).

3.2.7. Overview of Developing a Stand Level Economic Model

For Task 4, the results from the statistical analysis of the survey data were used to develop a stand level economic model utilizing longleaf as the species of interest for the model. Longleaf was selected over loblolly because of its historic association with wild hog damage. The long-term production goal for the stand level economic model was to produce high quality sawtimber and poles on a 60-year rotation (Boyer and Farrar 1981) while utilizing a shelterwood system (Croker and Boyer 1975). Managing the stand as a shelterwood system would allow natural regeneration to be captured near the end of the rotation and either eliminate or reduce future costs associated with seedling purchases.

An additional short-term production goal for the model was to take advantage of pine straw collection during the peak years of litter fall.

Management decisions for utilizing a shelterwood system were in accordance with the recommendations of Croker and Boyer (1975). According to the authors, prescribed burns should be implemented on a 2-3 year cycle over the duration of the rotation (with the exception of years where regeneration has not become established and is particularly vulnerable to fire). During the 60 year rotation, a preparatory cut would be made at year 40 to reduce the stand's basal area (BA) to 60-70 square feet per acre. This cut would be followed by a seed cut in the 50th year of the rotation to further reduce the stand's BA to 35 square feet per acre. Under this management regime an even-aged longleaf pine forest should successfully produce regeneration for the following rotation as well as produce high quality sawtimber and poles.

3.2.8. Stand Level Economic Model: Cost Assumptions

Site preparation and planting procedures were based on the recommendations from Longleaf Alliance (2007) which outline the steps for successfully establishing planted longleaf. The publication recommended mechanical site preparation prior to planting, followed by a herbaceous release treatment and prescribed burn the following year after planting. The costs associated with site preparation, planting, and stand management (herbaceous release treatment and prescribed burn) were taken from Maggard and Barlow's (2017) averages for Southern forestry practices in 2016. Maggard and Barlow (2017) reported hand planting to be more common than machine planting, so the average labor costs associated with this planting method were incorporated into the model. Survey participants indicated a preference for planting containerized longleaf seedlings over bareroot; therefore, cost assumptions for containerized longleaf seedlings were used ($0.20 per seedling to hand plant). The pricing for containerized longleaf seedlings were $0.20 per seedling based on Rayonier's 2016 seedling prices (Mark Davis, Elberta Nursery Director, Rayonier, personal communication, August 8, 2017). Rayonier was selected as a reputable seedling provider in Alabama from The Longleaf Alliance Grower's Directory (Available at: http://www.longleaf alliance.org/what-we-do/restoration-management/resources/nurseries/grower-listings/Alabama). Finally, the number of seedlings planted per acre was assumed to be the average planting density reported by survey respondents.

3.2.9. Stand Level Economic Model: Growth and Yield Model Development

Predicting longleaf growth and product yield on a stand level is difficult because a truly satisfactory model has yet to be created (John Kush, personal communication, August 15, 2017). When choosing a growth and yield model it is important to consider the performance of the model, the biological realism, the application environment, and design of the modeling process (Buchman and Shifley 1983). While longleaf growth projection models have been used in scientific literature, no suitable models existed or were available for this project. Consequently, longleaf pine growth and yield values were estimated using a combination of available modeling software, weight tables, and real-world data.

NLongleaf (Matney 1996) software was used to project the growth of three longleaf stands grown for 48, 49, and 50 years. The stands had the same site index (SI) and trees per acre (TPA) upon initiation. Stands were grown with the assumed SI of 70 feet (base age 50) which would be considered normal for sites within the Coastal Plain. The program was useful to an extent but had age limitations on the thinning operations which could be performed. For this reason the different aged stands were grown to the point where the preparatory cut would take place such that the three stands were 38, 39, and 40 years old. The diameter distribution, TPA, tree heights, and BA were recorded from each stand’s projected inventory. The largest and smallest trees were removed from the stand inventory until the remaining BA was between 60-70 square feet per acre. After the preparatory cut was made, useful growth projection information from NLongleaf (Matney 1996) was limited for its application to the projects growth and yield model. NLongleaf does not allow for stand management options after the 37th year of a rotation so growth projections after the preparatory cut could not be generated utilizing this particular software.

Additional data were needed in order to project the growth of the stands an additional 10 and 20 years past the preparatory cut. The data were taken from the Escambia Experimental Forest in south Alabama which was established in 1947. Since that time the longleaf demonstration forest has been managed by periodic thinnings and prescribed fire on a three year cycle. Plots were selected with similar TPA and SI as was assumed for the NLongleaf model using stand table projection methods. Using stand table projection methods trees were then sorted into age groups in order to calculate the growth index ratio (GIR) (Avery and Burkhart 2015). The GIR was used to estimate how the diameter distribution of trees changed over time. The GIR for trees growing from ages 40-50 (n = 43) and 50-60 (n = 11) was the difference in the diameter at breast height

(DBH) for a given tree in each age class after 10 years of growth. The DBH is a tree measurement often used in conjunction with calculating the BA. DBH is defined as the diameter of a tree at 4.5 feet above the ground.

Linear regressions were run using SPSS (IBM Corp. 2015) to create regression equations capable of predicting the 10-year growth rate for trees within the respective age ranges. The resulting regression equations were:

$$Y'_{40\text{-}50} = 0.623 + 0.1X_1 \tag{1}$$

$$Y'_{50\text{-}60} = 0.085 + 0.092X_2 \tag{2}$$

$Y'_{40\text{-}50}$ is the 10-year growth rate of longleaf pine trees growing from age 40 to 50 and X_1 is the DBH of a tree at age 40. $Y'_{50\text{-}60}$ is the 10-year growth rate of longleaf pine trees growing from age 50 to 60 and X_2 is the DBH of a tree at age 50. Equation 1 was used to predict the new diameter distribution of trees grown for 10 years after the preparatory cut (after subtracting out 10 percent of assumed tree mortality). The diameter class distribution at age 50 was then used to calculate the BA of the stand.

A shelterwood cut was then made in the 50th year of the rotation to reduce the BA of the stand to 35 square feet per acre. For this cut the largest trees were removed until the desired BA was achieved. Equation 2 was then used to predict the new diameter distribution of trees grown for 10 years after the seed cut (after subtracting out 10 percent of assumed tree mortality). The final harvest of the remaining trees was to take place in year 60 of the rotation.

Calculating the tons of timber removed after the preparatory cut, seed cut, and final harvest was done using a weight table for predicting single tree weight given the diameter class and tree height (Clark and Saucier 1990). Projected tree heights for diameter classes were extracted from the NLongleaf (Matney 2016) outputs run earlier. With the tree heights and diameter classes previously calculated, we then used the weight table to estimate the individual tree weight for each diameter class (Table 2 in Clark and Saucier 1990). The pounds per tree could then be multiplied by the number of trees harvested to attain the tonnage harvested for each diameter class.

Timber products and pricing were based on the 2016 State-wide averages for Alabama (Harrison et al. 2017). Trees with a 6-7 inch DBH were considered pulpwood products and had an average price of $9.40 per ton. Trees with an 8-11 inch DBH were considered Chip-n-Saw products and had an average price of $16.81 per ton. Sawtimber and poles would be the expected timber products from trees with a DBH greater than 12 inches and had average prices of $24.28 and $49.86 per ton, respectively. It was assumed with proper management, a longleaf stand would be capable of growing a 60/40 pole to sawtimber ratio after 40 years of age (North Carolina Forest Service 2011). This ratio was applied to trees harvested with DBH's greater than 12 inches.

The majority of Alabama landowners with pine forests indicated an interest in taking advantage of non-timber forest products like pine straw (Dyer 2012); therefore, pine straw harvesting was incorporated into the economic model. The model's harvesting schedule was developed in accordance with the recommendations of Franklin (2008) to allow for pine straw to be collected during peak periods of litter fall. Pine straw would be collected every other year for 12 years starting in year 10 of the rotation. For the purposes of the model, harvesting would not take place on stands younger than 10 years old. In order to calculate pine straw yields a pine straw production function from Dyer (2012) was utilized:

$$Y' = 1.266X1 + -0.661X2 + 1.228X3 + 21.043 \tag{3}$$

where Y' is the number of green bales of pine straw produced per acre per year, X1 is the BA in square feet per acre, X2 is the stand age, and X3 is the SI. The pine straw production equation should be a fairly accurate predictor of pine straw yields for the modeled stands because the growth parameters resembled those to which the equation was intended. Input data used to calculate pine straw yields was based on the projected stand inventory data from Nlongleaf (Matney 1996). The price received per bale of pine straw was assumed to be the average price a landowner would expect to receive according to Franklin (2008) ($0.35-$3.00). The price used of $1.68 per bale was intended to be a fairly modest estimate.

3.2.10. Stand Level Economic Model: Scenarios for Exploring Possible Landowner Responses to Wild Hog Damage

Revenues from timber and pine straw growth and yield models were calculated for stands grown for 58 years (stand-58), 59 years (stand-59), and 60 years (stand-60). Four scenarios were created to examine how profitability of the modeled stand might be affected by wild hog damage given a landowner's response. The net present value (NPV) was calculated for each scenario at a discount rate of 5 percent. In the first scenario

(scenario-1), no damage occurs, thus replanting is not necessary. The NPV for a full rotation or stand-60 is used to calculate the economic value of the forest stand for scenario-1. Survey results indicated average seedling mortality of 23 percent for acres impacted by wild hogs; therefore, this percent of damage was used for scenarios 2-4. In the second scenario (scenario-2), the modeled stand was damaged by wild hogs and the landowner has decided to replant the damaged portion the following year. The seedlings replanted a year later have one less year of growth than the seedlings planted at the beginning of the rotation. In order to calculate how this 1-year loss of growth would affect timber and pine straw revenues, the following equation was used:

$$Revenues_{scenario2} = ((1\text{- }\%damage)Revenue_{stand\text{-}60}) + (\%damage \text{ x } Revenue_{stand\text{-}59}) \quad (4)$$

where $Revenues_{scenario2}$ is the discounted timber and pine straw revenue for scenario-2, %damage is the seedling mortality from wild hog predation, $Revenue_{stand\text{-}60}$ is the discounted timber and pine straw revenues for stand-60, and $Revenue_{stand\text{-}59}$ is the discounted timber and pine straw revenues for stand-59. Replanting costs based on the percent of the stand damaged were also incorporated when replanting took place. The difference between the NPV’s from scenario-1 and -2 represent the cost of wild hog damage to the stand that could not be recovered even after replanting the next year. It could alternatively be viewed as the amount a landowner could invest in wild hog control given an expected amount of damage they thought might occur.

In scenario-3, we examined how the forest stand would be affected if wild hog damage occurred but replanting was delayed for two years. In order to calculate how a two year loss of growth would affect timber and pine straw revenues, equation 4 was used but the revenues from stand-58 were substituted for stand-59. The difference between the NPV's from scenario-1 and -3 represent the cost of wild hog damage which could not be recovered with replanting delayed an extra year. It could also alternatively be viewed as the amount a landowner could invest in wild hog control given an expected amount of damage they thought might occur.

In the final scenario (scenario-4), we examined the cost of damage to a forest stand where wild hog damage occurred but replanting did not take place. This was calculated by subtracting out the amount of seedling mortality from the timber and pine straw revenues from stand-60. Because replanting did not occur, the costs associated with scenario-1 would be the same as those for scenario-4. The difference between the NPV's for scenario-1 and -4 represent the loss in value of the forest stand caused by wild hog damage.

3.2.11. Conducting Sensitivity Analyses on Scenarios 2-4

In Task 5, sensitivity analyses were performed on scenarios 2-4 to examine how the cost of wild hog damage fluctuated when exposed to a range of discount rates and amounts of damage. The cost of damage can also be interpreted as the amount which could be alternately invested in control methods. In order to give landowners an idea of what it would cost to reduce wild hog damage in their young forest plantation during periods when seedlings are in a vulnerable stage of growth, three levels of control were created based on different combinations of the most commonly used control methods reported from survey respondents. For the lowest level of control only shooting on site and hunting (without dogs) were combined. A medium level of control combined shooting on site, hunting (without dogs), and trapping. A high level of control utilized shooting on site, hunting (without dogs), trapping, and hunting with dogs. The annual spending on each of the control methods was based on the average spending reported by survey respondents. The required years of implementing control methods varied depending on if the landowner replanted. The cost of control was calculated for 3, 4, and 5 years of implementation at each level of intensity. Based on the historic reports, wild hog predation seems to primarily occur among very young pine seedlings in or just leaving the grass stage. It was assumed after three growing seasons the planted longleaf seedlings would have left the grass stage and developed enough so they were less appealing to wild hogs. Based on when replanting occurred, vulnerable seedlings could remain in the plantation up to fifth year of the rotation.

3.3. Results

3.3.1. Survey Results

Out of the 1,200 surveys mailed, 406 landowners responded which resulted in 352 usable surveys. The response rate for this survey was 35 percent after deducting 40 surveys from the total mailed out due to bad addresses, deceased recipients, or those declining to participate. A summary of responses by county based on physiographic region is listed in Table 3.1 and illustrated in Figure 3.2. It should be noted that a number of responses came from 15 additional counties not in the original sample group but were included in the analysis because the data still proved pertinent. These respondents owned properties outside of the county with their listed mailing address. The counties with the highest response rates (n = 17) were Bullock (Black Belt Prairie), Coffee (Lower Coastal Plain), Sumter (Black Belt Prairie), and Tallapoosa (Piedmont Plateau) Counties. The Lower Coastal Plains had the most counties represented by survey responses (n = 111) compared to other regions.

Table 3.1. Counties and the number of corresponding responses (in parentheses) to the 2016 survey of wild hog damage to non-industrial private lands in Alabama. Counties are organized by major physiographic region.

Limestone Valley	**Appalachian Plateau**	**Upper Coastal Plain**	
Cherokee (1)	Blount (8)	Autauga (12)	Tuscaloosa (9)
Colbert (10)	Etowah (10)	Bibb (9)	
Lawrence (6)	Jackson (2)	Chilton (1)	
Limestone (11)	Jefferson (1)	Fayette (6)	
Madison (13)	Marshall (9)	Lamar (9)	
	Morgan (7)	Marion (12)	
	Shelby (8)	Pickens (1)	
Black Belt Prairie	**Piedmont Plateau**	**Lower Coastal Plain**	
Bullock (17)	Cleburne (1)	Butler (2)	Geneva (2)
Dallas (15)	Clay (1)	Choctaw (14)	Henry (3)
Lowndes (3)	Coosa (2)	Clarke (10)	Houston (14)
Macon (1)	Lee (14)	Coffee (17)	Monroe (2)
Marengo (1)	Tallapoosa (17)	Conecuh (1)	Washington (9)
Montgomery (10)		Covington (9)	Wilcox (16)
Sumter (17)		Crenshaw (9)	

Figure 3.2. Distribution and number of responses to the 2016 survey of wild hog damage to non-industrial private lands in Alabama. Counties are organized by major physiographic region.

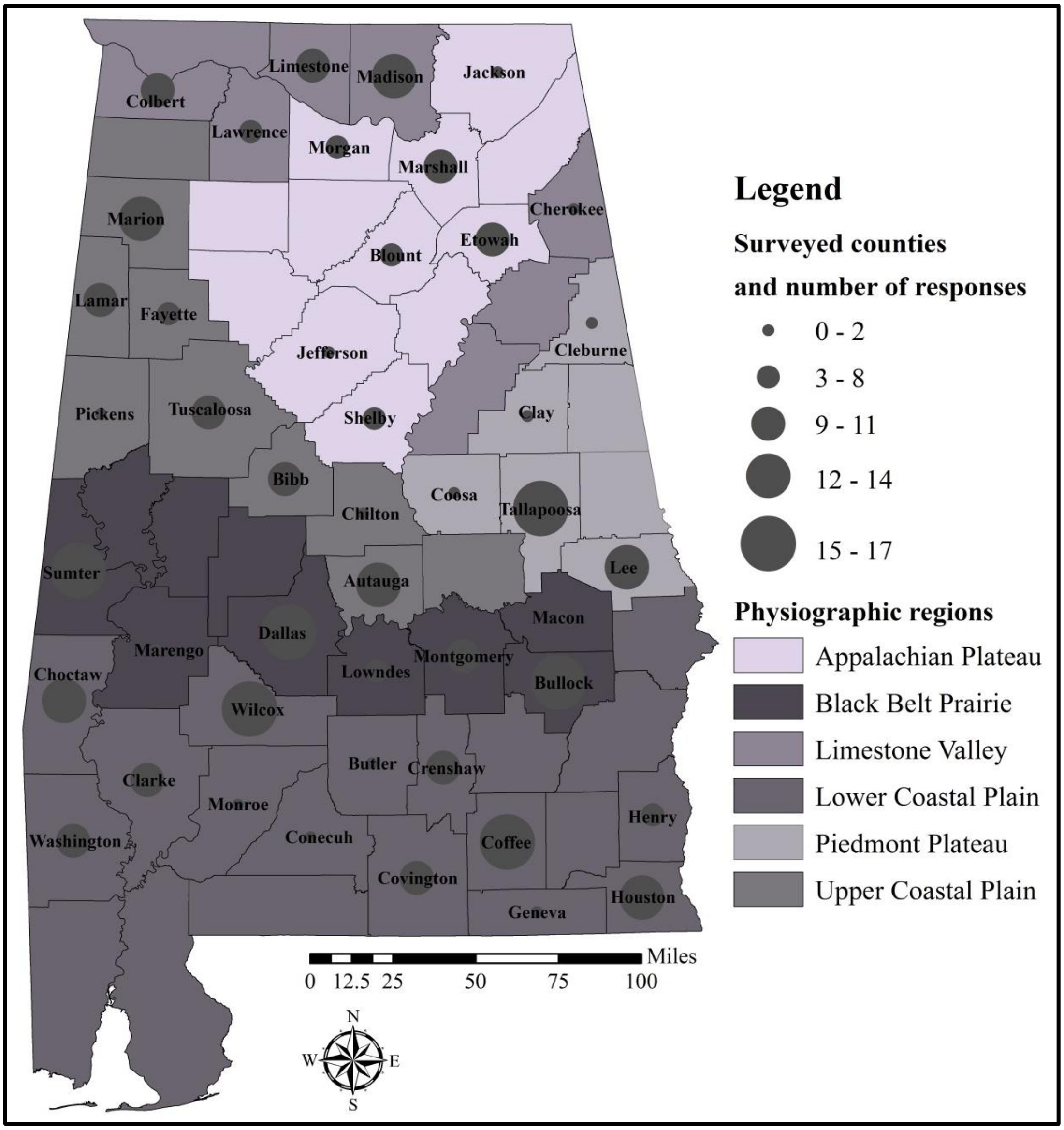


Table 3.2 summarizes the number of responses by region and other relative information about forest plantations, damage, and control efforts. Responses were evenly distributed among regions except for the LCP which had nearly double the response rate compared to other regions. The BBP and LCP held the highest reported values for all categories listed in the table. The largest sample of young forest plantations initiated in 2013-2015 were reported from the LCP (n = 25). The number of respondents who planted seedlings during 2013-2015 made up 17 percent of the total respondents who returned usable surveys. The percentage of respondents reporting wild hog damage to their stand was similar between the BBP (33.3%) and the LCP (36.0%). Of the young forest plantations planted from 2013-2015, 25 percent were reported to have sustained damage from wild hogs. Survey results indicate the BBP and the LCP had the largest sample of landowners reporting wild hogs on their land and use of control methods. The regions with the smallest sample of landowners reporting wild hogs on their land and use of control methods were the LV and AP. The highest numbers of hogs killed in 2015 were reported from the BBP, LCP, and LV; in fact, there were a number of cases where respondents indicated killing over 200 wild hogs on their property. A number of respondents indicated they had killed wild hogs on their property but did not report the quantity; therefore, averages in the last column of the table only consider respondents who reported a positive number of wild hogs killed.

Table 3.2. Results from the 2016 survey of non-industrial private landowners. Total responses and percent for each region of Alabama reporting a forest plantation, damage from wild hogs, and control.

Physiographic region	Responses (#)	Landowners who planted seedlings between 2013-15 (%)	Forest stand damage by wild hogs (%)	Wild hogs on land (%)	Attempt to control wild hogs (%)	Hunt on property (%)	Wild hogs killed in 2015 (of positive) (#)
Limestone Valley	41	4	25.0%	7.7% (39)	6.1% (33)	69.7% (33)	125 (1)
Appalachian Plateau	45	2	0.0%	7.5% (40)	3.1% (32)	47.1% (34)	3.3 (2)
Upper Coastal Plain	59	9	0.0%	26.3% (57)	10.0% (50)	79.6% (49)	5.8 (4)
Black Belt Prairie	64	15	33.3%	70.5% (61)	49.1% (57)	81.8% (55)	72 (24)
Piedmont Plateau	35	5	0.0%	17.1% (35)	18.2% (33)	83.9% (31)	1.3 (3)
Lower Coastal Plain	108	25	36.0%	53.8% (106)	36.5% (96)	81.4% (97)	22.8 (39)

Numbers of responses in parentheses where necessary

The results of seedling mortality due to wild hog activity and the associated costs with replanting are presented in Table 3.3. The top three tree species planted by landowners across the State from 2013-2015 were loblolly (n = 46), longleaf (n = 35), and unspecified oak (n = 9). For pine stands planted in 2013-2015, the average number of acres planted was 130 and 47 for longleaf and loblolly, respectively. The greatest amount of forest damage from wild hogs was reported to have occurred in longleaf plantations. Where damage occurred, wild hogs destroyed more loblolly seedlings (179 seedlings/acre) than longleaf (125 seedlings/acre) but affected larger portions of longleaf plantations (34 percent) than loblolly (13 percent). Respondent's answers did not specify how wild hogs had destroyed the seedlings so it could not be determined if seedling mortality was due to direct predation. It was reported the average longleaf plantation had 44 acres damaged by wild hogs. On damaged acres, wild hogs destroyed an average of 23 percent of longleaf seedlings. Loblolly plantations had an average of 6 acres damaged; for every acre damaged in loblolly plantations, wild hogs destroyed an average of 27 percent of seedlings. Assuming replanting occurred, we calculated the cost to replant areas affected by wild hogs in longleaf and loblolly stands. On a per acre basis, replanting costs for damaged longleaf acres were nearly double that for loblolly due to the higher seedling and planting costs associated with containerized longleaf seedlings. The total costs to recover damaged portions of the average sized stands were calculated to be $2,185.92 and $150.14 for longleaf and loblolly, respectively. No wild hog damage was reported in any of the hardwood plantations.

Table 3.3. Results from the timber stand section of the 2016 survey of non-industrial private landowners in Alabama. Reported below are the averages for the forest stand information, wild hog damage, and calculated replanting cost assuming respondents replanted after damage occurred.

Species	Number reporting	Size of stand (Acres)	Trees per acre planted	Acres damage by wild hogs (Acres)	Percent of seedlings destroyed per damaged acre (%)	Replanting cost per acre ($/acre damaged)	Replanting cost for the average stand ($)
Longleaf pine	32	130	540	44	23	*49.68	*2,185.92
Loblolly pine	41	47	662	6	27	*25.02	*150.14
Oak	8	15	344	0	-	-	-

*Planting cost are based on Maggard and Barlow (2017), seedling cost are based on Rayonier's 2016 prices in Alabama: $0.40 and $0.14 per seedling for longleaf and loblolly, respectively.

The top three land cover types with the most frequent sightings of wild hogs were agricultural fields, grassland/pastureland, and bottomland hardwoods (Appendix A). Survey results indicate that of the land cover options, hardwood plantations had the least number of wild hog sightings.

The total cost of each control method by region is presented in Table 3.4. Regardless of the region, the top four most common control methods reported were hunting (without dogs), shooting on sight, trapping, and hunting with dogs. Only two respondents in the BBP region indicated the use of repellents for wild hog control. Based on the reports of responding landowners, the use of fencing (electric or non-electric) for controlling wild hog damage was relatively uncommon. Those who used electric or non-electric fencing made up less than 3 percent of landowners. The largest sample of landowners who reported the use of electric (n=5) and non-electric fencing (n=4) for wild hog control were in the LCP and BBP, respectively. Of the regions considered, landowners in the BBP spent the highest total amount on shooting on sight ($6,450), hunting without dogs ($6,370), and trapping ($20,500). The highest regional total spent on hunting with dogs was $2,550 by landowners in the LCP. No monetary values were reported for wild hog control from the AP.

Table 3.4. Total cost of wild hog control methods by physiographic region in Alabama from the 2016 survey of non-industrial landowners.

Physiographic region	Shoot on sight	Hunt w/dogs	Hunt w/out dogs	Aerial	Trap	Repellents	Electric fence	Non-electric fence
Limestone Valley	$60 (2)	$0 (0)	$0 (2)	$0 (0)	$2,300 (2)	$0 (0)	$0 (1)	$0 (0)
Appalachian Plateau	$0 (1)	$0 (0)	$0 (0)	$0 (0)	$0 (0)	$0 (0)	$0 (0)	$0 (0)
Upper Coastal Plain	$500 (4)	$0 (0)	$0 (1)	$0 (0)	$1,200 (3)	$0 (0)	$0 (0)	$0 (1)
Black Belt Prairie	$6,450 (25)	$0 (9)	$6,370 (16)	$0 (0)	$20,500 (23)	$5,500 (2)	$233 (1)	$1,233 (4)
Piedmont Plateau	$30 (5)	$0 (2)	$0 (4)	$0 (0)	$0 (1)	$0 (0)	$0 (0)	$0 (0)
Lower Coastal Plain	$3,070 (36)	$2,550 (12)	$250 (21)	$0 (0)	$9,915 (18)	$0 (0)	$1,387 (5)	$0 (0)

Numbers of responses in parentheses

Fencing costs are annualized based on initial cost and suspected length of use

The average amount spent annually on control methods in each region is listed in Table 3.5. With the highest cost of those reported for regions offering larger sample sizes, a landowner in the BBP spent, on average, $258 shooting on sight, $398 hunting without dogs, and $891 trapping. The LCP had the largest sample size and highest average expense paid by landowners to hunt with dogs at $212. The percentage of landowners in each region who indicated using control methods is reported in Table 3.6. The only regions which utilized hunting with dogs were the BBP, LCP, and PP. The BBP was the only region with reports of all control methods being utilized by landowners with the exception of aerial hunting. For this region the most commonly implemented methods were shooting on sight (43.9%) and trapping (40.4%).

Table 3.5. Average spending of wild hog control methods by physiographic region in Alabama from the 2016 survey of non-industrial landowners.

Physiographic region	Shoot on sight	Hunt w/dogs	Hunt w/out dogs	Aerial	Trap	Repellents	Electric fence	Non-electric fence
Limestone Valley	$30 (2)	-	$0 (2)	-	$1,150 (2)	-	$0 (1)	-
Appalachian Plateau	$0 (1)	-	-	-	-	-	-	-
Upper Coastal Plain	$125 (4)	-	$0 (1)	-	$400 (3)	-	-	$0 (1)
Black Belt Prairie	$258 (25)	$0 (9)	$398 (16)	-	$891 (23)	$2,750 (2)	$233 (1)	$308 (4)
Piedmont Plateau	$6 (5)	$0 (2)	$0 (4)	-	$0 (1)	-	-	-
Lower Coastal Plain	$85 (36)	$212 (12)	$12 (21)	-	$551 (18)	-	$277 (5)	-

Numbers of responses in parentheses

Fencing costs are annualized based on initial cost and suspected length of use

Table 3.6. Percentage of responses reporting use of wild hog control methods by physiographic region in Alabama from the 2016 survey of non-industrial landowners.

Physiographic region	Shoot on sight	Hunt w/dogs	Hunt w/out dogs	Aerial	Trap	Repellents	Electric fence	Non-electric fence
Limestone Valley	6.1%	0.0%	6.1%	0.0%	6.1%	0.0%	16.7%	0.0%
Appalachian Plateau	3.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Upper Coastal Plain	8.0%	0.0%	2.0%	0.0%	6.0%	0.0%	0.0%	16.7%
Black Belt Prairie	43.9%	15.8%	28.1%	0.0%	40.4%	3.5%	16.7%	66.7%
Piedmont Plateau	15.2%	6.1%	12.1%	0.0%	3.0%	0.0%	0.0%	0.0%
Lower Coastal Plain	37.5%	12.5%	21.9%	0.0%	18.8%	0.0%	83.3%	0.0%

The majority of respondents answering the WTP/WTA question indicated a preference for wild hog eradication (Table 3.7). Landowners preferring wild hogs on their property indicated a dollar amount they would have to be paid to accept eradication (WTA), while those in favor of permanently getting rid of wild hogs indicated an amount they are willing to pay for eradication (WTP). From this sample, landowners who wanted fewer/no wild hogs had an willingness to pay for eradication that exceeded the amount required by those who prefer wild hogs but were willing to be financially supplemented to allow their eradication, such that WTP > WTA.

Only one respondent indicated wanting to be supplemented for accepting eradication. Of those who preferred wild hogs on their property, 56 percent hunted hogs but none reported generating income from hog hunting leases. Only two individuals in favor of eradication reported any profitability from hog hunting. The income generated from their hog hunting leases made up 2.2 percent of the total amount made from all hunting leases.

Of the landowners who indicated a dollar amount they would be willing to pay for eradication, 43 percent said they would be willing to pay while others wanted fewer/no wild hogs but were not willing to pay for wild hog eradication. The survey data suggests a trend that landowners without wild hogs on their property were willing to pay more than those with wild hogs. On a regional basis, landowners in the BBP who did not have wild hogs on their land were willing to pay the most ($206 per acre per year) for eradication (Table 3.8).

Table 3.7. Alabama landowners' mean reported willingness to pay (WTP) for or willingness to accept (WTA) wild hog eradication ($ per acre/year) from the 2016 survey of non-industrial private landowners.

	Pigs on land	n	Mean ($)
WTP for eradication	N	151	$22.40
(prefer fewer/none)	Y	114	$8.37
WTA eradication	N	5	-
(prefer them)	Y	9	$71.43

Table 3.8. Mean reported willingness to pay (WTP) for wild hog eradication ($ per acre/year) by physiographic region in Alabama from the 2016 survey of non-industrial private landowners.

Physiographic region	Pigs on land	n	Mean ($)
	N	2	$1.09
Limestone Valley	Y	23	$5.00
	N	24	$14.38
Appalachian Plateau	Y	2	$5.00
	N	22	$3.86
Upper Coastal Plain	Y	16	$9.69
	N	10	$206.00
Black Belt Prairie	Y	29	$11.03
	N	15	$3.33
Piedmont Plateau	Y	2	$2.50
	N	26	$5.58
Lower Coastal Plain	Y	47	$6.81

3.3.2. Stand Level Economic Model: Growth and Yield Results for Projected Timber and Pine Straw Revenues

The timber harvest results from the modeled stands after each cut are presented in Table 3.9. Stand-58 (forest stand with 58 year rotation) had the highest weight of timber removed throughout the rotation yet had the lowest net present value (NPV) for timber revenue. This can be explained by stand-58 consisting of a higher proportion of smaller trees compared to the other stands. Stand-59 (forest stand with 59 year rotation) had the second highest weight of timber removed and a NPV for timber revenue $1.10 more than the NPV for stand-60's (forest stand with 60 year rotation) timber harvest. Stand-60 held a higher proportion of larger trees compared to other stands which resulted in the greatest quantity of sawtimber and pole products being produced. A two years loss in rotation length resulted in an 11 percent decrease in sawtimber and pole products for stand-58 compared to stand-60. The greatest difference in NPV's for timber revenues was seen between stand-60 and stand-58, which was approximately $12 per acre.

The pine straw harvest results for the modeled stands are presented in Table 3.10. Stand-60 produced 135 and 157 more bales of pine straw per acre per year than stand-59 and stand-58, respectively. The year loss in rotation length between stand-60 and stand-59 resulted in a difference in NPV for pine straw sales of $132 an acre. A two year loss in rotation length between stand-60 and stand-58 resulted in a $149 an acre loss of potential pine straw revenue for stand-58.

Table 3.9. Stand level economic model: projected timber harvest for 3 stands of varying age utilizing a shelterwood system growing longleaf pine on a 60-year rotation given a site index of 70 and planted at 540 trees per acre.

	Pulp (tons/acre)	C-N-S (tons/acre)	Sawtimber (tons/acre)	Poles (tons/acre)	Total (tons/acre)	NPV ($)
			Preparatory cut, year 40			
Stand-60	14.16	0	4.32	6.48	24.96	$ 79.69
Stand-59	14.69	0	3.82	5.73	24.24	$ 73.38
Stand-58	15.48	0	2.73	4.10	22.31	$ 59.10
			Seed cut, year 50			
Stand-60	0	0	15.80	23.71	39.51	$ 136.53
Stand-59	0	2.86	16.60	24.89	44.35	$ 147.56
Stand-58	0	5.51	16.55	24.83	46.89	$ 151.06
			Final harvest, year 60			
Stand-60	0	24.76	6.34	9.51	40.61	$ 55.93
Stand-59	0	26.59	5.35	8.03	39.97	$ 52.30
Stand-58	0	28.62	4.56	6.84	40.02	$ 49.93

Product	DBH range	$/ton
Pulpwood (Pulp)	6-7 inch	$ 9.40
Chip-n-saw (C-N-S)	8-11 inch	$ 16.81
Sawtimber	12+ inch	$ 24.28
Poles	12+ inch	$ 49.86

Table 3.10. Stand level economic model: projected pine straw harvest for 3 stands of varying age with harvest occurring every other year for 12 years starting at year 10 of the rotation given a site index of 70 and planted at 540 trees per acre.

	Total green bales harvested	$/bale	NPV
Stand-60	937	$ 1.68	$ 717.30
Stand-59	802	$ 1.68	$ 585.12
Stand-58	780	$ 1.68	$ 568.49

3.3.3. Stand Level Economic Model: Economic Results of Four Scenarios for an Even Aged Longleaf Pine Operation Utilizing a Shelterwood System

Table 3.11 presents the results of the four scenarios created to explore the potential economic impact of wild hogs to a longleaf pine operation. A sub-table is also included with the cost assumptions used to calculate the NPV for each scenario. Survey results indicated that acres damaged by wild hogs had 23 percent seedling mortality; therefore, this percent was applied to scenarios where wild hog damage occurred. Additionally, a five percent discount rate was also assumed for each of scenario's NPV calculations.

The NPV for scenario-1 was $430 per acre with $560 per acre in establishment and maintenance costs and $989 per acre in discounted timber and pine straw revenues. In scenario-2, pine straw and timber revenues decreased by $30 per acre while replanting added $47 per acre more to the operation's costs resulting in a NPV of $352 per acre. The cost of the damage that could not be recovered by replanting the following year was $77 per acre. Alternatively, if a landowner was considering establishing a longleaf plantation in an area where they expected wild hogs to damage at least 23 percent of seedlings per acre then they could allocate $77 per acre to be spent on control methods.

In scenario-3, pine straw and timber revenues decreased an additional $7 an acre with a resulting NPV of $348 per acre. The cost of the damage from delaying replanting an additional year was $82 per acre. In the final scenario, establishment and maintenance costs did not change from scenario-1 because replanting did not occur; however, the timber and pine straw revenues decreased $227 per acre as a result of the wild hog damage bringing the NPV to $202 an acre. The resulting cost of damage was the greatest for scenario-4 at $228 per acre. Based on these results, if a landowner replanted the year after damage occurred they could recover nearly 66 percent of the value that would be lost if they did not replant. Alternatively, if a landowner decided to delay replanting by an additional year they could still recover 64 percent of the value that would be lost if they did not replant at all.

Table 3.11. Stand level economic model: the costs, revenues, and net present values for four scenarios involving wild hog's potential impact on an even-aged planted longleaf pine operation on a 60 year rotation utilizing a shelterwood system.

	Revenues ($/ac)	Costs ($/ac)	Damage (%/ac)	NPV ($/ac)	Cost of damage ($/ac)
Scenario 1: no damage	$ 989	$ 560	0%	$ 430	$ -
Scenario 2: damage, replant	$ 959	$ 607	23%	$ 352	$ 77
Scenario 3: damage, delay replant	$ 952	$ 605	23%	$ 348	$ 82
Scenario 4: damage, no replant	$ 762	$ 560	23%	$ 202	$ 228

Assumptions:	
Costs	
Site preparation	
Mechanical	$141/ac
Herbicide	$48/ac
Prescribed burn	$155/ac
Planting	
Seedlings	$108/ac
Hand planting	$108/ac
Discount rate	5%

3.3.4. Sensitivity Analyses Results

Sensitivity analyses were performed on scenarios 2-4 to examine how the cost of wild hog damage fluctuated when exposed to a range of discount rates and amounts of damage. The discount rates ranged from 2-6 percent to cover all realistic discount rates a landowner might expect for a forestry investment. Amounts of wild hog damage ranged from 3-48 percent increasing by increments of five percent. The results of the analyses are presented in Tables 3.12-3.14. The sensitivity analyses revealed slight adjustments in discount rates and amounts of damage sustained impacted the potential profitability of the forest stand.

The resulting cost of damage caused by wild hogs from scenarios 2-4 represent the value a landowner could alternately spend on reducing future damage. Without a frame of reference on what the control costs might be these values mean little. In order to estimate how much control could be afforded given the cost of damage, sub-tables were included below the sensitivity analyses tables. The levels of control in the sub-tables were calculated over a range of discount rates corresponding with the sensitivity analyses for the cost of damage. For example, if a landowner predicts a 23 percent loss of seedlings per acre due to wild hogs, but plans to replant the next year, they could expect the damage to cost them $77 an acre (at a 5 percent discount rate) (Table 3.12). The $77 per acre could have been spent controlling wild hogs to prevent or reduce future damage. If replanting occurred after the first year of the rotation, seedlings vulnerable to hog predation would remain in the plantation until after the fourth year. Given this scenario, a landowner could only afford the lowest level of control spending (shooting on site and hunting without dogs). If the landowner did not replant after damage occurred but wanted to protect the remaining seedlings, they could invest the expected value for the cost of damage in the highest level of control.

The results of the sensitivity analyses suggest a landowner considering establishing a longleaf plantation would benefit from investing the equivalent to a high amount of wild hog control to prevent or reduce damage during the first three growing seasons. If damage does occur, replanting the following year is the viable option to recover the majority of value lost to wild hog damage. By delaying replanting an additional year a landowner only incurs an additional $5 to the cost of damage from wild hogs.

Table 3.12. Scenario 2: Sensitivity analysis- estimated cost of wild hog damage ($/ac) to a young longleaf pine plantation given that replanting takes place the year after damage occurs.

	Discount rate				
%damage,	**2%**	**3%**	**4%**	**5%**	**6%**
3%	$ 12	$ 11	$ 11	$ 10	$ 10
8%	$ 31	$ 30	$ 28	$ 27	$ 26
13%	$ 50	$ 48	$ 46	$ 44	$ 42
18%	$ 70	$ 66	$ 63	$ 61	$ 58
23%	$ 89	$ 85	$ 81	$ 77	$ 74
28%	$ 108	$ 103	$ 99	$ 94	$ 90
33%	$ 128	$ 122	$ 116	$ 111	$ 106
38%	$ 147	$ 140	$ 134	$ 128	$ 123
43%	$ 166	$ 159	$ 151	$ 145	$ 139
48%	$ 186	$ 177	$ 169	$ 162	$ 155

Sub-Table 3.12. Cost ($/ac) for 4 years of varying levels of wild hog control exposed to a range of discount rates.

	Discount rate				
Control level,	**2%**	**3%**	**4%**	**5%**	**6%**
High	$ 118	$ 115	$ 113	$ 110	$ 107
Medium	$ 99	$ 97	$ 95	$ 93	$ 90
Low	$ 56	$ 55	$ 54	$ 52	$ 51

Table 3.13. Scenario 3: Sensitivity analysis- estimated cost of wild hog damage ($/ac) to a young longleaf pine plantation given that replanting is delayed until 2 years after damage occurs.

	Discount rate				
%damage,	**2%**	**3%**	**4%**	**5%**	**6%**
3%	$ 14	$ 12	$ 12	$ 11	$ 10
8%	$ 36	$ 33	$ 31	$ 29	$ 27
13%	$ 59	$ 54	$ 50	$ 46	$ 43
18%	$ 82	$ 75	$ 69	$ 64	$ 60
23%	$ 105	$ 96	$ 88	$ 82	$ 77
28%	$ 127	$ 116	$ 107	$ 100	$ 94
33%	$ 150	$ 137	$ 127	$ 118	$ 110
38%	$ 173	$ 158	$ 146	$ 136	$ 127
43%	$ 195	$ 179	$ 165	$ 153	$ 144
48%	$ 218	$ 199	$ 184	$ 171	$ 160

Sub-Table 3.13. Cost ($/ac) for 5 years of varying levels of wild hog control exposed to a range of discount rates.

	Discount rate				
Control level,	**2%**	**3%**	**4%**	**5%**	**6%**
High	$ 146	$ 142	$ 138	$ 134	$ 131
Medium	$ 123	$ 120	$ 116	$ 113	$ 110
Low	$ 70	$ 68	$ 66	$ 64	$ 62

Table 3.14. Scenario 4: Sensitivity analysis- estimated cost of wild hog damage ($/ac) to a young longleaf pine plantation given that no replanting occurs after damage.

	Discount rate				
%damage,	**2%**	**3%**	**4%**	**5%**	**6%**
3%	$ 69	$ 50	$ 38	$ 30	$ 24
8%	$ 183	$ 134	$ 102	$ 79	$ 63
13%	$ 298	$ 218	$ 165	$ 129	$ 103
18%	$ 413	$ 302	$ 229	$ 178	$ 142
23%	$ 527	$ 386	$ 292	$ 228	$ 182
28%	$ 642	$ 470	$ 356	$ 277	$ 221
33%	$ 757	$ 554	$ 419	$ 327	$ 261
38%	$ 871	$ 638	$ 483	$ 376	$ 300
43%	$ 986	$ 722	$ 546	$ 425	$ 340
48%	$ 1,101	$ 806	$ 610	$ 475	$ 379

Sub-Table 3.14. Cost ($/ac) for 3 years of varying levels of wild hog control exposed to a range of discount rates.

	Discount rate				
Control level,	**2%**	**3%**	**4%**	**5%**	**6%**
High	$ 89	$ 88	$ 86	$ 84	$ 83
Medium	$ 75	$ 74	$ 72	$ 71	$ 70
Low	$ 43	$ 42	$ 41	$ 40	$ 39

3.4. Discussion

The primary goal of this project was to estimate the cost of wild hog damage to non-industrial private landowner's forest stands in Alabama. In order to accomplish this goal we used a questionnaire to solicit pertinent information needed to create a damage estimate. Survey results indicated wild hog's damaged more acres in longleaf plantations than any other tree species planted from 2013-2015. The resulting cost to replant damaged acres of the average longleaf plantation was 15 times more than replanting cost for the average loblolly plantation (based on Rayonier's 2016 seedling prices and planting costs from Maggard and Barlow 2016). The higher replanting costs associated with longleaf are primarily due to the increased cost of seedlings. Containerized longleaf seedlings cost 65% more than bareroot loblolly seedlings. Due to the higher seedling cost and wild hog damage associated with longleaf, we recommend landowners invest in wild hog control to protect their plantation during the first three growing seasons. The estimated cost of wild hog damage extends beyond the cost of replanting and includes the amount that must be invested in preventing future damage (i.e. wild hog control), for this reason additional economic and sensitivity analysis was necessary.

In addition to estimating the cost of wild hog damage to forestry operations on non-industrial private lands, this project also included the economic analysis of potential management decisions in response to damage. If a landowner establishes a longleaf plantation in an area where wild hogs are known to reside, then they should be aware of the potential risk of damage occurring. While being proactive with wild hog control does not guarantee damage will not occur, it may prove a viable option for mitigating the risk of damage compared to a more reactive approach. Investing in wild hog control upfront could prevent the time, effort, and additional costs associated with having to replant. Even so, scenario-2 showed that more immediate replanting is the best way to reduce the cost of the damage to the landowner. Scenario-3 may be the good option in some cases where a landowner would want to invest additional funds and time into wild hog control while still recovering a portion of the value lost to damage.

Due to the long-term nature of forestry investments, landowners are likely to want to replant even after relatively low level damage occurs. Crop failure in a young forest plantation can offset a rotation by years and carries considerably more economic loss into the future compared to agricultural crops. The cost of damage to a forest stand grows quickly when replanting is not an option as was seen in the sensitivity analysis for scenario-4 (Table 3.14.). For example, with a 5 percent discount rate the cost of 8 percent damage to a longleaf pine plantation would be $84 per acre (Table 3.14.) when replanting does not take place compared to $27 per acre (Table 3.12.) with replanting. The decision to replant, invest in control methods, or do nothing will ultimately depend on the landowner and their objectives, but hopefully the tables created for this project will aid in the decision making process.

Survey respondents reported nearly double the amount of acres planted with longleaf than loblolly between 2013 and 2015 in Alabama. Cost-share programs which incentivize landowners to plant longleaf could explain why so many more acres were planted with longleaf than loblolly. Maggard and Barlow’s (2017) survey of forestry practices in the South, which is conducted every two years, also reported an increase in a number of containerized longleaf being planted. If this trend continues it is likely wild hog damage to longleaf plantations will be become more common in the South.

Our sample group of respondents consisted of 352 private landowners, of which 17 percent reported establishing a forest stand in 2013-2015. For landowners who planted trees during this time, 25 percent had wild hog damage to their young forest stand. All reports of wild hog damage to forests stands came from counties in the BBP, LCP, or LV. Forestry insurance policies do not cover damages from wild hogs. Landowners who received damage were likely to have had to cover the cost to replant; consequently, forest plantation owners should budget for replanting when wild hogs are present. The NRCS cost-share program provides financial assistance to help cover the costs of site preparation, seedlings costs, and planting of longleaf. The program will help cover the cost of replanting only if the cause of damage was from an “act of nature”. There was at least one case in Alabama in 2016 where the NRCS provided financial assistance to replant after wild hog damage occurred (Tim Albritton, State Forester, NRCS, personal communication, August 25, 2017). In this case, wild hogs were considered an act of nature and the landowner had demonstrated using wild hog control efforts to try to prevent damage. If wild hog populations continue to grow and expand unimpeded, perhaps future conditions will warrant forestry insurance or cost-share program policies to cover wild hog damage.

It is interesting to note landowners reported spending the most on trapping as a method for controlling wild hogs yet assigned it the lowest efficiency rating. It is possible landowners did not feel they were they were getting a high enough return on their investment in terms of the hogs killed per dollar spent on trapping. The results also suggested landowners felt hunting with dogs was the most efficient control method. Campbell and Long (2009) conducted an extensive literature review of wild hog damage and damage management in forested ecosystem and surmised that wild hog management is most successful when a variety of techniques are used in an integrated fashion. Wild hogs are very adaptable and can learn to evade capture or removal when only one technique is utilized (Choquenot et al. 1999); therefore, despite how landowners felt about the efficiency of certain control techniques, using a combination of methods should yield the best results.

Creating policies governing invasive species management and use is often a reflection of the costs and benefits individuals associate with their presence. These policies in turn, drive differences in legal classifications, dictate permissible control methods, conservation outcomes, and wildlife densities across the state. The results of this current study can be used to inform policy makers; for example, in deciding which counties would be eligible to receive NRCS assistance, distribution data would be critical to know where the largest populations of wild hogs resided. Data from studies like Conely et al. (2014), who conducted a survey to map the distribution of wild hogs in Alabama, would serve as very beneficial information in deciding where to allocate funding. The group found wild hogs were present in 64 counties and abundant in 31 counties. Our survey also indicated that wild hog populations were distributed through all major physiographic regions in Alabama but appeared to have the greatest densities in the BBP, LCP, and UPC. Interestingly, all 16 counties eligible to receive NRCS assistance funding for wild hog control efforts are within the BBP, LCP, and UPC.

The results from the willingness to pay question suggest Alabama landowners are primarily in favor of wild hog eradication. The results were heavily weighted towards those who preferred fewer/no wild pigs if present on their property, or if not present, preferred to keep it that way. Interestingly, of those who were willing to pay for wild hog eradication, a few landowners without wild hogs on their property were willing to pay the highest reported amounts. In the BBP where wild hog populations appear to be causing the most damage, landowners without wild hogs on their land were willing to pay nearly $195 more per acre for eradication than those actually dealing with the animals on their property. This trend was also observed in survey responses from the AP and PP, though the differences in values reported were not as drastic as those for the BBP. In most cases it appears landowners without wild hogs on their land assumed they would cause more damage than they apparently do. The costs of wild hog introduction into an area may be felt over many years as their presence would create uncertainty and risk to a timber investment, perhaps explaining why these owners were willing to put such a premium on prevention.

Out of the nine respondents who felt they benefitted from wild hogs on their property, only one individual felt they needed to be compensated to allow wild hog eradication. This individual did not report making any income from wild hog hunting. Of the 51 respondents who reported making money from wildlife hunting leases on their property, only two individuals reported any profitability from hog hunting. The income reported from hunting leases specifically for wild hogs only constituted a small portion of the income produced from all hunting leases. These findings suggest the positive values respondents associate with wild hogs on their property cannot be explained by the financial benefits alone. Around 56 percent of landowners who preferred the presence of wild hogs on their property indicated they hunted the animals; therefore, these landowners likely place a high value on having wild hogs available to hunt.

A few limitations should be acknowledged concerning the survey and its analysis. It is possible landowners did not have an accurate perception of damage done to their forest stand. The survey required respondents to recall a number of different figures and expenditures so any bias in answers could have been unintentional. Another area of improvement for this project concerns the growth and yield model used for the economic analysis. Although the model was created using the best resources available, it could potentially be improved to better reflect more accurate timber and pine straw harvest yields. The lack of a growth and yield model that accounts for a longer rotation given the management criteria specified for the stand level economic model proved to be a major obstacle that had to be overcome. Considering the goals of this project, we feel the model was sufficient in allowing us to look at how wild hog damage and resulting management decisions affected stand profitability.

During the course of the project it became evident that additional research was needed in a number of areas. The first is the need for a longleaf growth and yield model which can handle a variety of management options. This tool would prove valuable to anyone involved in planting or managing longleaf. The second is the need for more research on the potential for forestry insurance to cover wild hog damage. One survey respondent reported 95 percent seedling mortality on 410 acres of longleaf due to wild hog damage. In this case, replanting costs alone would be over $84,000. Although this was the largest case of damage reported, it illustrated the potential destructive ability of wild hogs in a forest plantation. Having an insurance policy to cover wild hog damage in longleaf plantations would prevent landowners from being forced to abandon their investment after unsustainable damage occurs. Third, additional research will be needed to investigate the efficiency of other control techniques as they become more common or available in the future. Wildlife Services is currently evaluating an aerial gunning program in Alabama which was initiated in 2016. Also, a wild hog toxicant is currently being researched for its potential use by Wildlife Services personnel. Adding to the variety of control techniques will be beneficial for wild hog management in the State, but time will tell if they are the solution.

In this study we sought to fill in the information gap concerning wild hog's impact on forest plantations. The results from this project offer State-wide damage estimates to forest stands where previously published estimates of this type did not exist. Additionally, the group's findings have identified regions in Alabama where reports of wild hog populations and damage appear to be more prevalent. Brook and van Beest (2014) acknowledge the importance of survey data in characterizing social-biological problems as well as providing a cost-effective and accurate means of acquiring data on a species' distribution. Likewise, as noted in Anderson et al. (2016), the self-reporting of wildlife damage to crops is common and provides reliable results. Having both a precise and broad understanding of how stand damage from wild hogs varies across tree species and region is valuable information for anyone involved in the forestry sector. Considerable effort is expended to manage wild hog populations by individuals, state, and federal agencies; the survey information from this study could help these entities allocate resources to regions where wild hog problems are most severe. Additionally, the economic model and sensitivity analysis tables could prove beneficial to landowners and resources professionals who must make management decisions concerning forest stands amidst the growing threat from wild hogs. The information learned from this project will be a valuable resource for getting people thinking about the true cost of wild hog damage to forest stands as more longleaf is being planted across the Southeast.

CHAPTER 4

Wild Hog (*Sus scrofa*) Preference Among Planted Pine and Hardwood Seedlings and the Ecological Factors Influencing Young Forest Plantation Damage

4.1. Introduction

4.1.1. Current Status of Wild Hogs in the United States

Wild hogs (*Sus scrofa*) are among the most destructive introduced or exotic vertebrates to have become established in the Americas. As with their introduction to the continental United States (US), their recent expanse in range stems from anthropogenic causes. In 2000, wild hogs were known to occur in 21 states, but less than a decade later were found in at least 44 states (Mayer et al. 2000, Mayer 2009a). The rapid spread of this species across the US is likely due to a combination of illegal translocation or escaped animals from private or commercial fenced enclosures (Mayer 2009a). As a species, wild hogs quickly become established once introduced to an area due to a highly adaptable biology and prolific reproductive potential (Seward et al. 2004, West et al. 2009). Though problems stemming from the presence of wild hogs are not new to the US, in recent years more attention is being given to their rapid range expansion and the accumulating evidence of their deleterious impacts on the environment (Campbell and Long 2009, Slootmaker et al. 2017).

4.1.2. Wild Hog Damage in Relation to Forestry

Wild hogs are particularly problematic to landowners because of their tendency to travel in groups and cause extensive damage to timberlands, pastures, and agriculture crops (Graves 1984, Seward et al. 2004, West et al. 2009). Damage to pine stands is likely more common in the Southeast where populations of wild hogs are dense and forested acres are abundant. In Alabama alone, timberland makes up nearly 70 percent of the State's total land area (AFC 2016). Wild hogs impact timber crops in a variety of ways including girdling trees through rubbing, damaging the lateral roots by rooting and chewing, and removing the bark of trees by tusking (Mayer 2009b). However, the most widespread and economically costly damage to the timber industry from wild hogs is the depredation of planted pine seedlings (Mayer 2009b).

Trees are most vulnerable to wild hogs during the initial years after planting or germination (Mayer 2009b, Sweeney et al. 2003). A single hog is reportedly capable of rooting up to six longleaf pine (*Pinus palustris* Mill.) seedlings a minute, destroying an estimated 400-1000 seedlings a day (Hopkins 1947, Wakeley 1954). These animals have the potential to cause complete crop failure in young timber plantations while seedlings are in their initial growth stages. In South Carolina, Lipscomb (1989) observed after two growing seasons, only eight of 845 longleaf seedlings survived hog predation in an unfenced area, versus 64 percent of seedlings surviving in fenced-in sites.

4.1.3. Southeastern Tree Species Commonly Associated with Wild Hog Damage

Wild hogs will occasionally cause damage to loblolly pine (*Pinus taeda*) and slash pine (*Pinus elliottii*), but the most extensive damage occurs with longleaf (Frost 1993, Wakeley 1954). Historical reports after a period of intensive planting by the US Forest Service in the mid-1900's documented entire longleaf plantations in Alabama, Florida, Louisiana, and Mississippi resulting in crop failure due to wild hogs (Lucas 1977, Wakeley 1954). Events like this could potentially become more commonplace as increasing amounts of longleaf acreage is planted by groups interested in longleaf restoration. Alabama has been one of the main southern states where longleaf restoration work has taken place in recent years (progress reports and other information about the Longleaf Pine Initiative is available online at https://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/national/programs/initiatives/?cid=nrcsdev11_023913). Interestingly, a recent survey in Alabama of non-industrial private landowners reported more acres of longleaf were planted in 2013-2015 than loblolly (Chapter 3). It was also found that wild hogs damage more acres of planted longleaf than loblolly. Wild hog-induced crop failure would prove very problematic for states like Alabama where around 50 percent of timberlands are pine plantations (AFC 2016).

Longleaf pine is unique among southern pines in that they have evolved with landscapes exposed to frequent fire. While other tree species focus energy into rapid vertical growth during initial stages of development, longleaf may remain in a fire-resistant grass stage for several years before initiating vertical growth (Croker and Boyer 1975). This development trait, along with a few other adaptations (long needles, thick bark, thickly scaled bud), allows longleaf to survive on landscapes with frequent fire intervals. During the grass stage, longleaf grows a thick tap root which may prove more appealing to wild hogs compared to root stems of other planted species (Mayer et al. 2000, Wood and Lynn 1977). Wood and Roark (1980) concluded that hogs were not actually consuming pine saplings, but instead were chewing on the roots to access the sap and starches then discarding the woody tissue. As a result of not actually ingesting the woody tissue, the group warned that wild hog's use of woody plant parts may be underestimated by stomach analyses.

Depredation to planted seedlings by wild hogs is not exclusive to southern pine species. Mayer et al. (2000) is the only study we are aware of to examine wild hog's impact on planted hardwood species. The group found wild hogs caused extensive damage to a number of planted hardwood seedlings in a wetland restoration area located in South Carolina. It was reported that of nine hardwood species planted, cherrybark oak (*Quercus pagodaefolia*), swamp chestnut oak (*Q. michauxii*), water hickory (*Carya aquatica*), and swamp tupelo (*Nyssa sylvatica* var. *biflora*) were the only species impacted by wild hog foraging activities. Non-effected seedling species included water oak (*Q. nigra*), green ash (*Fraxinus pennsylvanica*), persimmon (*Diospyros virginiana*), bald cypress (*Taxodium distichum*), and water tupelo (*Nyssa aquatica*). They postulated depredated tree species were more aromatic than non-impacted species which made them more appealing to the hog's highly developed sense of smell. It was also suggested wild hogs might have targeted the seedlings because the root tissue of nursery stock is often more succulent when transplanted than the corresponding root mass of natural seedlings. In a nursery, optimal growing conditions of nutrition and water management are maintained to increase root volume prior to dormancy induction. As a result, seedlings with larger root volumes and increased starch and sugar levels are then transplanted to the field. They theorized the root tissue of nursery stock would be more succulent and appealing to wild hogs compared to natural seedlings. Additional findings from the study suggested one of the leading factors influencing seedling predation was the use of site preparation methods (e.g., prescribed burning) which enabled easy access to planted sites.

4.1.4. Ecological Factors Influencing Seedling Damage

A combination of ecological factors may determine the severity of wild hog depredation of planted seedlings (Mayer et al. 2000). Seedlings are found and removed through the rooting process, therefore factors affecting rooting will ultimately influence mortality from wild hogs. Rooting is the most widespread and observable type of damage done by wild hogs because all hogs root as a primary method of searching out food (e.g., roots, tubers, fungi and fossorial species) (Mayer 2009b). Wild hogs root throughout the year, but depending on location the intensity and frequency of rooting can be seasonal (Mayer 2009c). Ballari and Barrios-Garcia (2014) reviewed scientific literature pertaining to factors affecting food selection by wild hogs and found the use of food resource to be related to food availability, energy requirements, seasonal, and geographical variations. They also found some studies showing dietary differences between ages and sexes of wild hogs. In Schley and Roper's (2003) review of research concerning wild hog's diet, the group summarized that plant matter, both above and below ground parts, are a staple for the animal regardless of age, sex, or location. From the studies reviewed by Ballari and Barrios-Garcia (2014) and Schley and Roper (2003) it can be inferred seedling predation is most likely to occur in the winter and spring than in the summer and fall based on the seasonal availability of food resources. In South Carolina, Wood and Roark (1980) suggested a similar timeframe for when longleaf seedlings are impacted by wild hogs; however, they concluded it is difficult to prove through stomach analysis because woody tissue is not actually ingested. In the Netherlands, naturally regenerated oak and beech seedlings were found to be selectively foraged by wild hogs in the late winter and spring (Bruinderink and Hazebroek 1996).

Site conditions in young forest plantations are widely varied, so determining specific conditions which attract wild hogs is difficult. Wild hogs are very selective in their choice of foraging areas which can be influenced by vegetative cover and/or soil moisture (Dexter 1998, Schley et al. 2008, Siemann et al. 2009, Wood and Roark 1980). Wild hogs may avoid pastures during abnormally dry years in favor for more hydric or mesic sites (Everitt and Alaniz 1980). Hunting pressure can also affect habitat usage by wild hogs. For example, in Alabama it was found wild hogs utilized wetland areas when hunting pressure was low but moved towards upland pine forests as hunting pressure intensified (Gaston et al. 2008). The degree of seedling predation in young forest plantations is site dependent and likely influenced by a combination of food availability, seedling accessibility, hog density, land cover, hunting pressure, and soil moisture.

4.1.5. Research Needs and Project Description

There is an apparent lack of research pertaining to wild hog behavior in young forest plantations. Most reports and scientific literature on wild hog predation of seedlings concern naturally regenerated pine, oak, and beech species (Bruinderink and

Hazebroek 1996, Hanson and Karstad 1959, Ickes et al. 2005, Lipscomb 1989, Siemann et al. 2009, Sweitzer and Van Vuren 2002). Few reports or research exist which specifically address wild hog depredation of planted seedlings. Mayer et al. (2000) is the only study we are aware of which tests for wild hog preference among planted hardwood seedlings and reported factors which influenced observed damage. With forestry trends in the Southeast indicating an increase in longleaf pine planting, any additional research pertaining to plantation damage by wild hogs could prove valuable to landowners and resources professionals.

The goal of this project was to build on the previous works of Mayer et al. (2000) and examine wild hog preferences between planted pine and hardwood seedlings. It was also of interest to observe the ecological factors which might influence differing amounts of wild hog damage in young forest plantations. We conducted a field study at two research locations with uniquely different site conditions in order to test for wild hog preference among planted seedlings and make inferences about the damage. Such information is beneficial in guiding forest management decisions as the threat from wild hogs becomes more widespread.

4.2. Methods

A number of tasks were created in order to guide this project through the research process. These tasks were designed to help accomplish the goal of determining if wild hogs had a preference among selected seedling species and identifying ecological factors that may influence forest plantation damage. Three main tasks were associated with this portion of the study:

Task 1. Identify two study sites within reasonable proximity to a creek drainage system with evidence of wild hogs in the area. Collect data on soil type, precipitation, and landcover to describe site conditions.

Task 2. Conduct an observational study to identify if wild hogs have a preference among planted seedling species.

Task 3. Establish camera traps to detect wild hog presence in the research area throughout the study period.

4.2.1. Site Selection and Description

In order to accomplish Task 1, two suitable sites were identified on private properties in Bullock County, Alabama. The first site (S1) (N 32° 10’ 1.999”, W 85° 37’ 52.32”) was located on the Auburn University Turnipseed-Ikenberry Place approximately 10 miles from the second site (S2). The location of the second site has been omitted at the request of the landowner.

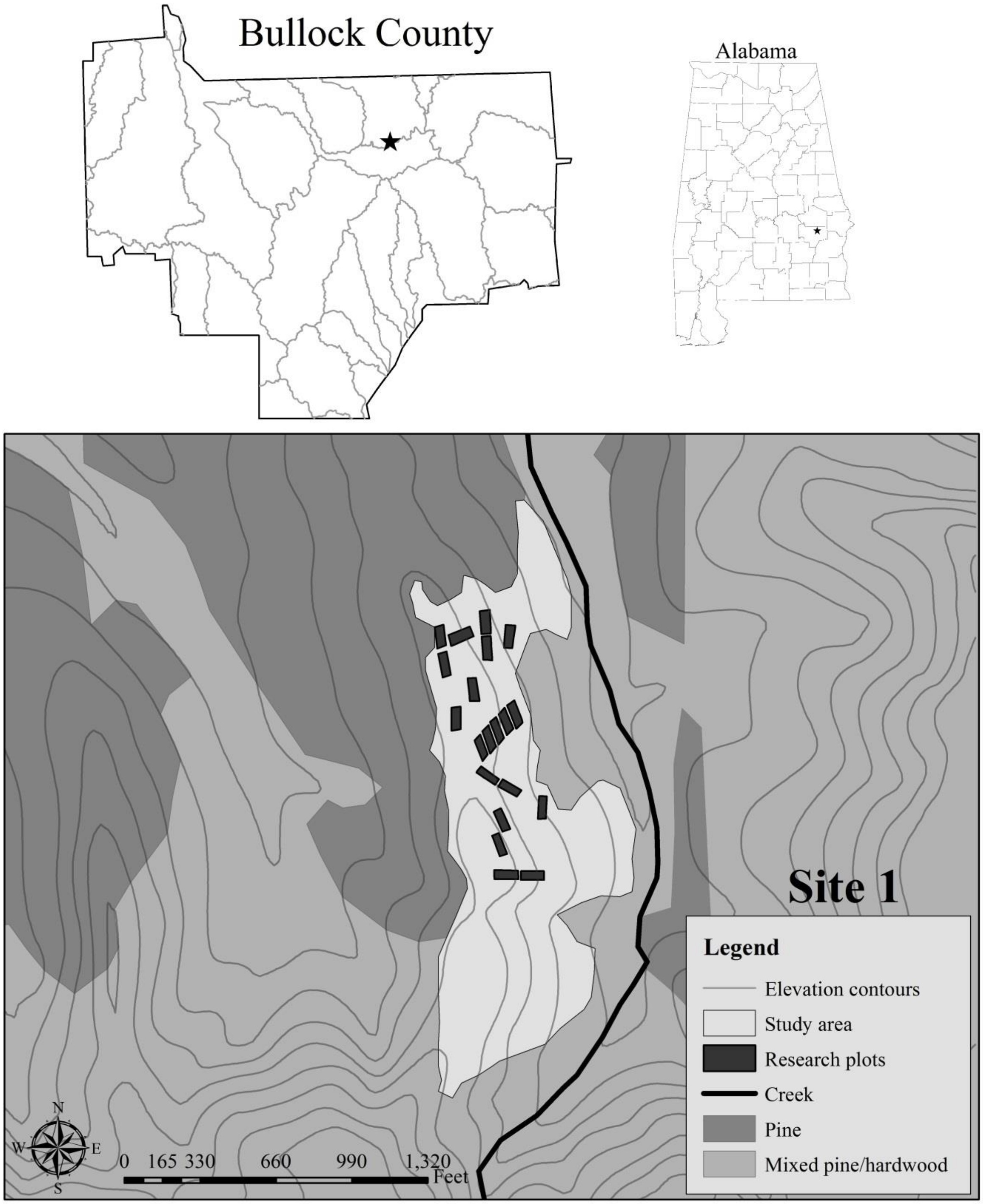
Areas chosen for the study sites were less than 100 yards from a creek drainage system. Drainage systems are often utilized by wild hogs for cover and ease of movement; therefore, placing research sites close to drainage systems would reduce the amount of time it would take the animals to find the planted seedlings. Reducing the search time for wild hogs to find seedlings was desirable for this project given the year-long study period.

Wild hog populations were confirmed at S1 by setting up a bait station consisting of soured corn and a trail camera (Moutlrie M-1100i Mini Game Camera) to capture visitation. Signs of wild hog presence in the field and along the drainage system was identified by rooting, tree rubs, and tracks. There was very little, if any, hunting pressure at S1. The groundskeeper for the property did not know of any previous attempts to control wild hogs aside from the occasional shooting on sight by turkey and deer hunters. A handicap shooting house was present on the southern end of the field, but it is unlikely wild hogs were harassed at the other end of the field given the contour of the land.

The 28.5 acre field where S1 (Figure 4.1) was located had previously been a pecan (*Carya illinoinensis*) orchard and still retained a number of pecan trees dispersed throughout the field. The landcover in the field was primarily dominated by bahaigrass (*Paspalum nontatum*). Bahaigrass is a desirable cover species in pecan orchards because it can be easily mowed and is relatively shade tolerant. This species is a deep-rooted perennial which grows low to the ground and spreads with stolons and stout, scaly rhizomes to form dense mats (Houck 2009). Bahaigrass is resistant to drought and well suited for southern pastures. In September 2017, the field was mowed around the plots to allow easier access for observational visits. Other vegetation observed growing among bahaigrass was blackberry (*Rubus* spp.), bushy bluestem (*Andropogon glomeratus*), Sericea lespedeza (*Lespedeza cuneata*), late boneset (*Eupatorium serotinum*), and purple tridens (*Tridens flavus*).

The surrounding forest type varied from pine to mixed hardwood species. The pine stands were located at the top of the hill in the northern section of the study area while the mixed pine and hardwood forest constituted the southern, bottomland portion. Pine species included loblolly and shortleaf pine (*Pinus echinata*). The overstory in the bottomland portion was dominated by loblolly and water oak while the mid-story consisted of American sycamore (*Plantanus occidentalis*), eastern red cedar (*Juniperus virginiana*), red mulberry (*Morus rubra*), and sweetgum (*Liquidambar styraciflua*). The understory was comprised of Chinese privet (*Ligustrum sinense*), greenbrier (*Smilax* spp.), Japanese honeysuckle (*Lonicera japonica*), Mary's grass (*Microstegium vimineum*), and spike uniola (*Chasmanthium laxum*).

Figure 4.1. Location of research area at site 1 (S1) for the planted seedling preference by wild hogs study in Bullock County, Alabama (March 2016-March 2017).



The majority of the field at S1 was located on a hill side with an estimated slope of 5 to 20 percent. Taxonomic information regarding the soil series at S1 was collected using the United States Department of Agriculture's (USDA) Web Soil Survey (Available online at https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm). The soil in the field at S1 had properties consistent with Conecuh series soils (Soil Survey Staff 2014a). They are formed in clayey and shaley marine sediments. The family classification for the Conecuh series is fine, smectitic, thermic, Vertic Hapludults. Conecuh series soils are found on uplands and hill slopes in the Southern Coastal Plains. They are a moderately well drained soil with very slow permeability due to the higher clay content in subsurface horizons. These soils have a surface horizon consisting of sandy loam (0-5 inches thick) and Argillic subsurface horizons (5-39 inches thick). Argillic horizons are primarily composed of alluvial clays and indicative of increasing clay content with increasing depth. Soils at the summit of the hill were more eroded than those found below.

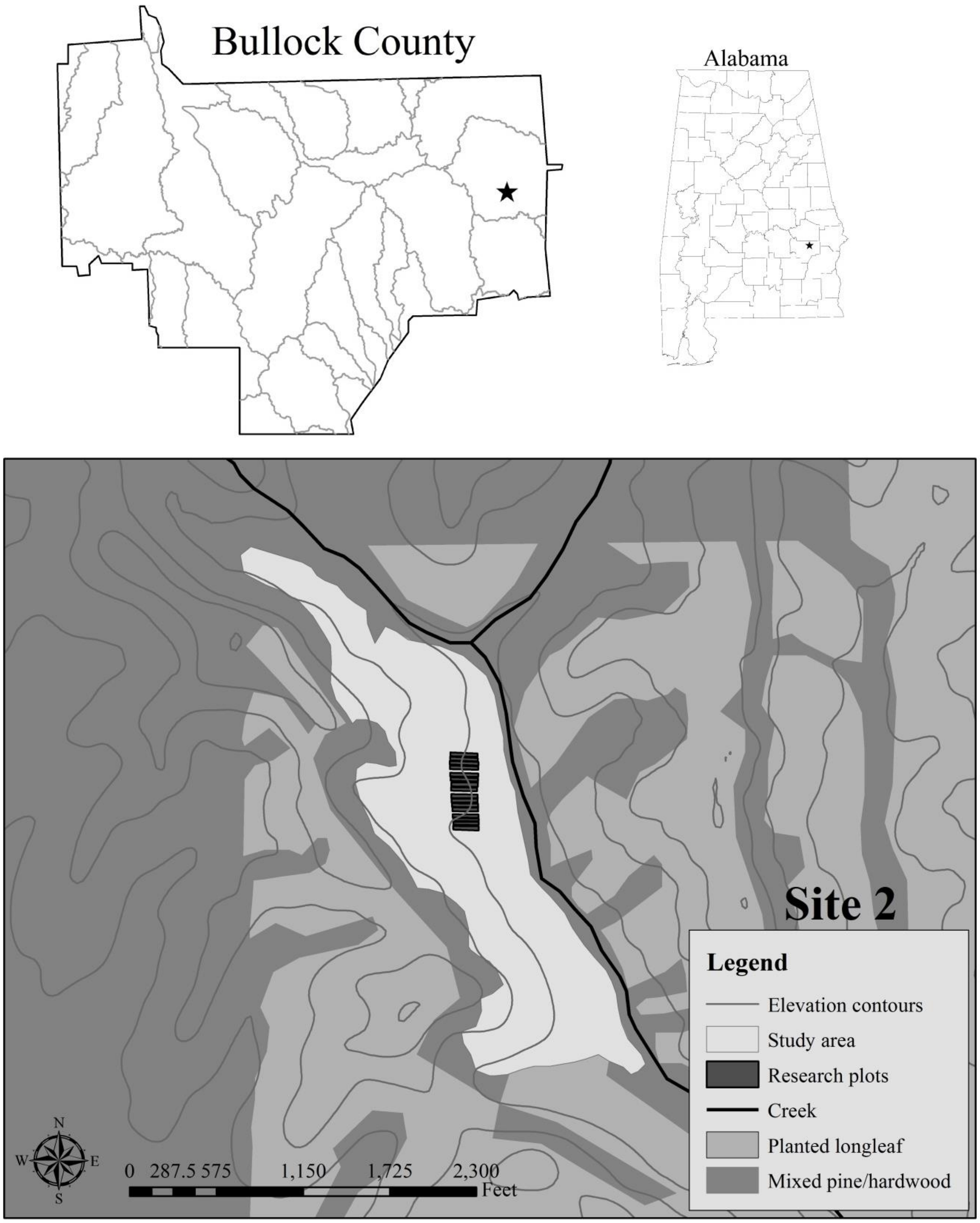
Soils at the bottom of the hill and extending to the drainage system were dominated by Mantachie series soils (Soil Survey Staff 2013c). The family classification for the Mantachie series is fine-loamy, siliceous, active, acid, thermic Fluventic Endoaquepts. Mantachie series soils are formed in loamy alluvium and are somewhat poorly drained with moderate permeability. These soils are commonly associated with flood plains in the Southern Coastal Plains. The surface horizon is made up of fine sandy loam all the way through the A-horizon (0-11 inches thick). Signs of gleying are found below the A-horizon which is indicative of aquic soil conditions (19+ inches below).

S2 (Figure 4.2) was located on 90 acres of cutover land previously planted with longleaf pine in January 2015. The longleaf plantation sustained such high levels of wild hog damage over the pursuing weeks that the landowner was forced to replant the following year. The landowner at S2 described frequent sightings of wild hogs in the field of interest. Evidence of the landowner's reports was supported by signs of wild hog presence, so bait stations were not necessary as at S1. The landowner utilized hunting and trapping in an effort to decrease the wild hog population on the property in and around the area where the study site was located. The field containing the study site was part of a large acreage primarily managed for game species and longleaf production.

The field at S2 was a cutover site with frequent stumps and woody debris left over from a loblolly stand clearcut in 2010. After the clearcut, the remaining tree cover available to wildlife immediately surrounding the research area was mixed pine and hardwood forests along the stream management zone (SMZ). Tree species found in the SMZ primarily consisted of loblolly, laurel oak (*Q. laurifolia*), and water oak. The most commonly found vegetation in the understory of the SMZ was river cane (*Arundinaria gigantea*) and spike uniola interspersed with beautyberry (*Callicarpa americana*) and muscadine (*Vitis rotundifolia*). Over the peak of the hill, the adjacent forest to the east of the research site consisted of mixed pine and hardwood forest including laurel oak, loblolly, post oak (*Q. stellata*), shortleaf pine, southern red oak (*Q. falcata*), sweetgum, and water oak.

A prescribed burn was performed by the landowner before the initial planting of longleaf in September 2015. Bare-ground was visible during the initial months of the field study but became less common as panicgrass (*Panicum* spp.) became more abundant. Other species frequently observed were common ragweed (*Ambrosia artemisiifolia*), dogfennel (*Eupatorium capillifolium*), purple false foxglove (*Agalinis purpurea*), late boneset, and sericia lespedeza.

Figure 4.2. Location of research area at site 2 (S2) for the planted seedling preference by wild hogs study in Bullock County, Alabama (March 2016-March 2017).

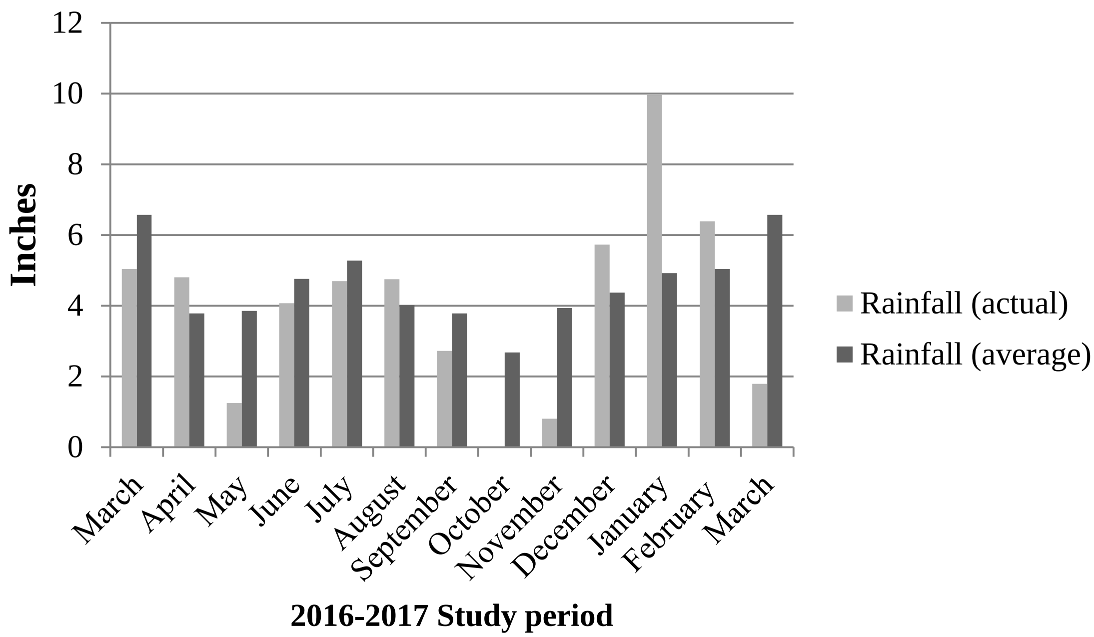


S2 was located on hill side with an estimated slope ranging from 5 to 15 percent. Taxonomic information regarding the soil series at S2 was also collected using the USDA's Web Soil Survey. The soil in the field had properties consistent with Luverne series soils (Soil Survey Staff 2014b). They are formed in stratified marine sediments. The family classification is Fine, mixed, semiactive, thermic Typic Hapludults. Simliar to Conecuh series, Luverne series soils are found on uplands in the Southern Coastal Plains but in areas where erosion has caused the landscape to become dissected. One of the more prominent differences between the Luverne and the Conecuh series soils is in their drainage and permeability properties. Luverne series soils are well drained with moderately slow permeability due to the E-horizon underlying the epipedon. These soils have a surface horizon consisting of fine sandy loam (0-7 inches thick) and Argillic subsurface horizons (7-30 inches thick). In contrast to S1, S2 was associated with higher erodibility and slightly increased amounts of sand and silt.

Soils at the bottom of the hill and extending to the drainage system were dominated by Blanton (Soil Survey Staff 2013a) and Bonifay (Soil Survey Staff 2013b) series soils. The family classification for the Blanton series is Loamy, siliceous, semiactive, thermic Grossarenic Paleudults. The family classification for the Bonifay series is Loamy, siliceous, subactive, thermic Grossarenic Plinthic Paleudults. Blanton and Bonifay series soils are formed in sandy and loamy marine deposits. They are excessively to moderately well drained with moderate to slow permeability. Blanton series soils are commonly associated with upland and stream terraces in the Southern Coastal Plains while Bonifay series soils are found on ridges and side slopes. Blanton series soils have thick layers of fine sand above the underlying Argillic horizons (0-52 inches thick). Similarly, the Bonifay series has a thick layer of sand above the Argillic horizon (0-57 inches thick). This area was commonly flooded except during periods of drought.

Monthly precipitation data during the course of the field study is presented in Figure 4.3. These data were collected from the US climate data website (Available online at https://usclimatedata.com/). Also included in the figure is the normal monthly precipitation data based on historic averages for comparison purposes. In 2016, severe drought conditions were observed throughout Alabama during October and November. Research sites did not receive any rainfall for a 62 day period from September 28 to November 29, 2016. The overall amount of precipitation for the study period was 12 percent lower than normal. The overall rainfall for the duration of the study period was 52.03 inches.

Figure 4.3. Observed and expected monthly precipitation data for Bullock County, Alabama from March 2016 to March 2017.



4.2.2. Description of Experimental Design for Testing Planted Seedling Preference by Wild Hogs

For Task 2, seedlings were purchased from nurseries in Alabama, Georgia, and Tennessee. Seedling species used in this study included longleaf pine, loblolly pine, cherrybark oak, chinkapin oak (*Q. muehlenbergii*), and persimmon. The only seedlings not bareroot were longleaf, which were containerized. Species chosen for this study had two or more of the following qualifications: 1) association with wild hog damage, 2) commonly planted in the Coastal Plains region, and 3) availability from nurseries. Longleaf, loblolly, and cherrybark oak are some of the seedling species most often associated with wild hog damage. In chapter 3, longleaf and loblolly pine plantations sustained the highest levels of wild hog damage according to a survey of non-industrial private landowners in Alabama. Cherrybark oak was found to be the most highly damaged planted hardwood species in a wetland restoration area in South Carolina (Mayer et al. 2000). Chinkapin oak and persimmon can be commonly found growing in the Coastal Plains and were readily available from nurseries.

Planting procedures took place in March 2016. Each site was divided into 4 blocks. The blocks at S1 were further divided into five, one-tenth-acre plots while the blocks at S2 were divided into four, one-tenth acre plots. Plots at S1 were oriented so they were not shaded by pecan trees located occasionally throughout the field. There were no trees in the field at S2 so plots were oriented sequentially. Each plot within a block was assigned a tree species to be planted through random assignment without replacement. Plots were planted with the equivalent of 545 trees per acre with 8 x 10 foot spacing between trees. Each tree was assigned a numbered flag placed next to the seedling. Ten seedlings in each plot were randomly selected to serve as the control and received protective netted-tubes. The tree tubes were anchored by bamboo or wooden stakes and secured with zip-ties. Planting procedures were uniform between the two sites with the exception of the longleaf seedlings at S2. In February 2016, the landowner planted 400 acres of longleaf which included the cutover land the research site was located on. Due to this previous planting, it was not necessary to plant additional longleaf. Within each one-tenth-acre plot at S2, hardwood and loblolly seedlings were planted between longleaf seedlings. Since every other seedling at S2 was longleaf, a plot from each block was chosen through random assignment without replacement to serve as the longleaf plot for control samples and measurements.

After planting, the ground-line diameter (GLD) was recorded for every fifth seedling in a plot as well the seedlings serving as the control. This measurement was repeated the following year at the conclusion of the study. The status of seedlings was monitored throughout the experiment with monthly visits, except for months corresponding with deer and turkey hunting seasons when the sites were not accessible. During monthly visits, each seedling's status would be marked as either 'alive', 'dead', or 'hogMortality'.

4.2.3. Camera Trap Deployment for Wild Hog Detection

In order to fulfill Task 3, three camera traps (Moutlrie M-1100i Mini Game Camera) were set up at each site on game trails between the drainage system and the planted seedlings. Passive observation techniques were chosen to avoid potential affects from using bait sites. Using bait sites to estimate wild hog density might have altered foraging behavior or attracted unwanted attention from hunters. Cameras were set to take one photo every five minutes and had trigger sensitivity on the high setting. The cameras were kept operational throughout the majority of the study period except for a short period of time when camera maintenance was performed (between July and August 2016). The quantity of pictures featuring wild hogs collected each month were weighted based on the number of cameras at each site and the number of days cameras were operational. This was done to compensate for when cameras were not in use for maintenance or technical malfunctions.

4.2.4. Statistical Analyses for Field Study Data

Statistical analyses were performed using SPSS (IBM Corp. 2015) to test the following hypothesis: 1) seedling mortality due to wild hogs is different among planted species. Two additional hypotheses were created because of a severe drought during the field study. These hypotheses were 2) mortality rates among species were different, and 3) the seedlings in the mortality group would have larger GLD measurements than the seedlings that survived.

A Pearson's Chi-square test was used to test hypothesis 1 to determine if the number of seedlings associated with wild hog damage was significantly different among seedlings species. A Pearson's Chi-square test was also used to test hypothesis 2 in order to determine if the non-hog related mortality was different among species. Lastly, a one-way ANOVA was performed to see if the initial GLD for seedlings in the mortality group was significantly larger than those that survived.

4.3. Results

4.3.1. Results for the Wild Hog Seedling Preference Experiment and Statistical Analyses

Table 4.1 summarizes the results of the descriptive statistics performed on the seedling data. At the conclusion of the study seedlings either survived (Alive), suffered mortality not caused by wild hogs (Dead), or were destroyed by wild hogs (HogMortality). Mortality from wild hogs was easily distinguished by observing rooting where the seedling had been originally planted. In some cases the seedling was found nearby with the root stock having been masticated. When seedling mortality occurred from wild hogs, the time of year and location of the damage with respect to hill slope was recorded. At S1, 89 percent of wild hog damage to seedlings occurred in the spring and 11 percent occurred in the summer. All seedling mortality from wild hogs at S1 were from plots located at the bottom of the hill. At S2, 74 percent of wild hog damage to seedlings occurred in the spring and 26 percent occurred in the summer. Seedling damage at S2 was evenly distributed between the top, middle, bottom of the hill.

The percent of seedling mortality due to wild hogs was low at S1. Cherrybark had the most seedlings damaged (n=5), followed by longleaf (n=2) and loblolly (n=2). There was no hog-related mortality in chinkapin or persimmon. Chi-square analyses were used to determine if observed frequencies of mortality differed from that which would be expected. The expected mortality is the number of seedlings that would have had to have suffered mortality due to wild hogs if the damage was equally distributed. The Chi-square analysis used to test if hog-related seedling mortality was different among planted species (Hypothesis 1) at S1 was not significant for hog-related mortality (n=9) compared to other mortality (n=243) (χ^2 = 2.01, *d.f.* = 2, $p > 0.05$), while the Chi-square analysis used to test hypothesis 1 for S2 did detect a significant difference in hog-related mortality (n=96) compared to other mortality (n=626) (χ^2 = 75.34, *d.f.* = 4, $p < 0.001$). At S2, longleaf was the most heavily damaged by wild hogs (n=77) and had more than double the expected frequency of mortatlity (n=39.8). Cherrybark was the second most damaged species by wild hogs and had similar observed mortality (n=10) as expected mortality (n=11). Persimmon seedlings had around half the observed wild hog mortality (n=5) than the expected mortality (n=10.6). Loblolly had considerably less observed mortality (n=3) than the expected mortality (n=12.4). Lastly, chinkapin had the lowest number of seedlings damaged (n=1) compared to the mortality expected (n=22.2).

Alabama experienced a dry year in 2016 with a two month drought which started in October and lasted through November which resulted in lower survival of seedlings than would normally be expected. Non-hog related mortality is summarized for each species in Table 4.1. The Chi-square analysis used to test if mortality rates among species was different (Hypothesis 2) indicated a significant difference existed between the expected and observed survival and mortality of seedlings species (S1: χ^2 = 94.12, *d.f.* = 4, $p < 0.001$; S2: χ^2 = 173.58, *d.f.* = 4, $p < 0.001$). Based on the frequency of observations the Chi-square analyses indicated the expected mortality at S1 and S2 for seedlings species was 70.2 and 84.4, respectively, with the exception of longleaf at S2 which had an expected mortality of 307.5 due to the larger sample size. At S1, loblolly (n=114) and cherrybark (n=96) experienced higher mortality than the expected frequency. Longleaf (n=42) and persimmon (n=38) performed the best despite severe drought conditions and had mortality less than half the expected frequency. At S2, longleaf (n=222) again had the lowest amount of mortality compared to the expected frequency. Loblolly (n=93) mortality was slightly higher than the expected frequency while cherrybark (n=83) and persimmon (n=80) had observed amounts of mortality just below the expected frequency. At 77 percent mortality, chinkapin (n=167) suffered the largest losses.

Descriptive results of the average GLD measurement taken at the beginning of the study are presented in Table 4.1. The GLD averages for each species are organized by status. For the status titled HogMort, GLD averages or standard deviations were not available for all species because the sample group for measured seedlings damaged by wild hogs only contained a single sample or none. Due to the low number of measured seedlings being damaged by wild hogs, it was not possible to statistically test for a relationship between seedling size and hog damage. However, a general trend was observed in that smaller seedlings (indicated by a smaller GLD) survived better compared to larger seedlings. In order to test this relationship, a one-way ANOVA was conducted for each species at each site to see if the average initial GLD of surviving seedlings was statistically different from those in the mortality group (Hypothesis 3). The results of the analyses were only significant at S2 for chinkapin oak, $F\,(1,74) = 6.50$, $p < 0.05$, $\eta^2 = 0.08$, and persimmon, $F\,(1,73) = 9.48$, $p < 0.05$, $\eta^2 = 0.12$. Based on the results of the analyses, we fail to reject the null hypothesis for chinkapin and persimmon sample groups at S2. These results suggest the initial GLD for chinkapin and persimmon were significantly larger in seedlings that died than in seedlings that survived. The one-way ANOVA results for chinkapin oak are consistent with field observations made when planting S2. Chinkapin seedlings were larger and more cumbersome to plant compared to other species.

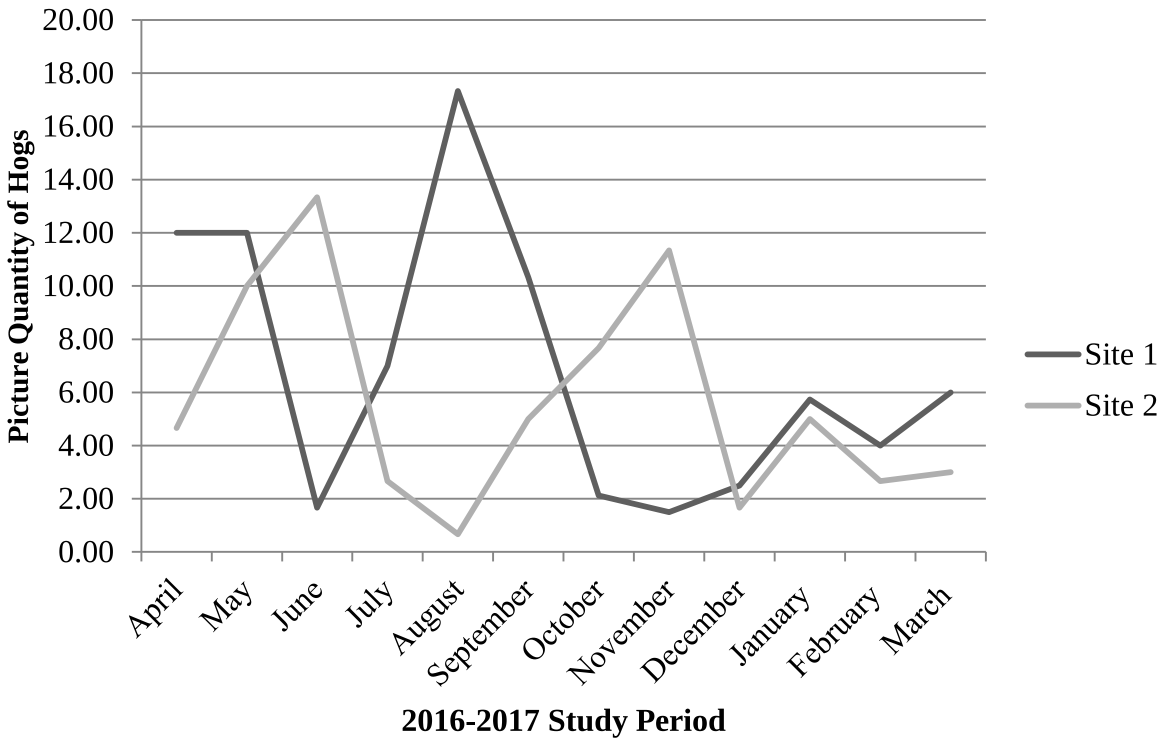
Table 4.1. Wild hog seedling preference results including percent survival, mortality, and wild hog mortality with respective averages for ground line diameters (GLD) and standard deviation (SD) for sites in Bullock County, Alabama.

Site	Species	% Alive	Mean GLD	SD	% Dead	Mean GLD	SD	% HogMort	Mean GLD	SD
	Loblolly	48%	3.63	0.92	51%	3.87	0.89	2%	4.74	2.18
	Persimmon	83%	5.86	1.63	17%	6.23	1.78	0%	-	-
S 1	Chinkapin	72%	6.08	1.94	28%	7.62	3.79	0%	-	-
	Cherrybark	56%	7.63	2.17	41%	8.23	3.56	5%	6.19	-
	Longleaf	81%	11.31	2.44	18%	12.85	3.79	5%	-	-
	Loblolly	57%	4.01	0.68	42%	4.16	1.15	3%	4.60	-
	Persimmon	63%	6.56	1.55	35%	8.00	2.34	6%	5.32	-
S 2	Chinkapin	23%	10.84	4.21	77%	13.64	4.82	1%	-	-
	Cherrybark	62%	7.79	2.37	34%	8.24	2.88	12%	9.37	2.51
	Longleaf	65%	10.67	2.28	26%	9.42	3.21	26%	12.98	1.53

4.3.2. Results of Wild Hog Detection in Research Areas

The results of wild hog detection in the research area for each site are presented in Figure 4.4. Wild hogs frequented the research areas more during the spring and summer months compared to winter months. The cyclical nature of the results for S2 was most likely due to intense periods of hunting and trapping efforts by the landowner. The largest drop in wild hog detection around S2 in August can be explained by the landowner hunting over the study site more frequently compared to other months. There was another large drop in detection at the first site during the month of June, what caused the hogs to disappear from the research area during this time is unknown.

Figure 4.4. Wild hog detection data collected at site 1 (S1) and site 2 (S2) study areas in Bullock County, Alabama. Y-axis values are weighted based on the number of days cameras were operational.



In a similar study conducted in South Carolina, Lipscomb (1989) used the following density indices to describe the population of wild hogs in an area: low (less than one hog per 20 acres), medium (more than one hog per 20 acres but less than 1 per 10 acres), and high (more than 1 hog per 10 acres). Our detection results suggest the wild hog population at S1 and S2 would qualify in the high density range.

There were differences between sites for the time of year when piglets were observed in picture data. The number of months piglets appeared in picture data was higher for S2 than S1. At S1, young piglets were seen in April and May 2016 and February 2017. At S2, piglets were observed in May, June, July, September, and

November 2016 and January 2017. These results suggest offspring were born in the late winter and spring at S1 while offspring were born in each season at S2.

4.4. Discussion

4.4.1. Seedling Preference Results in Relation to Other Research

The main goal of this project was to determine if wild hogs had a preference among planted pine and hardwood seedlings or if damage was due more to chance encounter. Although Mayer et al. (2000) showed wild hog's had a preference among planted hardwood species, there are no previous studies which examine both planted pine and hardwood species.

The results at S2 were consistent with historic and scientific reports of wild hogs preference towards planted longleaf pine and cherrybark oak. If the resulting wild hog damage to longleaf and cherrybark seedlings from S2 were extrapolated to a per-acre bases, the result would be 48 and 25 seedlings per acre, respectively. The per acre seedling loss may be more substantial in situations where cherrybark is planted because planting densities are normally not as high as in longleaf plantations. Longleaf appeared to be the most highly preferred seedling species among those tested. It should be noted that at S2 the sample group for longleaf was nearly four times larger than the other species tested; therefore, there was a higher chance of longleaf being damaged. Only a small portion of the total area of the property planted with longleaf was monitored for the purposes of this study, so similar damage could be assumed to be occurring elsewhere in unmonitored areas.

4.4.2. Site 2: A Case Study

The events which occurred at S2 in 2015 serve as an important case study of the potential devastating impacts wild hogs can have on young longleaf pine plantations. According to the landowner, 400 acres of longleaf were planted in winter of 2015, and one month later wild hogs had destroyed around 95 percent of seedlings. After investing considerable time and money managing the wild hog population on the property, the landowner was able to substantially reduce hog-related mortality but did not eliminate it all together. During the year-long duration of the study, the landowner reportedly killed around 300 wild hogs on the property while spending an estimated $5,000 on hunting costs and trapping material. This case study illustrates how, if left unmanaged, wild hogs can cause substantial financial loss for forest plantation owners. Through a relatively small investment in management efforts the damage can be mitigated. Schely et al. (2008) postulated that wild hog density was the most important predictor of damage and reducing the population would be a useful management tool. Population reduction through trapping and hunting appears to have been an efficient way for the landowner to reduce damage in the forest plantation compared to the previous year when no control was implemented.

Another observation worth noting in relation to mitigating damage to seedlings, is that the screened tree tubes were 99.5 percent effective at protecting seedlings in the control group from wild hog damage. Only two seedlings in the control group protected by plastic tubes were destroyed by hogs. Perhaps the tubes with wooden or bamboo stakes were a physical deterrent which discourage wild hogs away towards more easily accessed foods. More research would be needed to test tree tube effectiveness in preventing wild hog damage. Tree tubes or some related type of individual tree protection could be an inexpensive way to add extra protection to planted seedlings.

4.4.3. Potential Explanations for Trends in Wild Hog Detectability

It was interesting to note how wild hog detectability results varied between sites with respect to the differing amounts of hunting pressure. S1 received low hunting pressure while S2 had high hunting pressure. In May 2016, the observational visit to S2 attracted the attention of the landowner who took notice at the amount of rooting which had occurred the previous months. It was noted how the landowner made plans to start hunting over the field site which could explain why wild hog detection dropped between the middle of July to the middle of August. After a period of time not seeing wild hogs in the field, the landowner likely concentrated hunting and trapping efforts elsewhere on the property. The frequent removal of hogs by the landowner could have been the cause of the increased amount of recruitment observed throughout the year at S2 in contrast to S1 where piglets appeared in picture data primarily in the spring.

When natural sources of food are abundant, wild hogs may not be attracted to bait and trapping can be inefficient (West et al. 2009). The landowner at S2 indicated trapping efforts became more intense in the winter after hard mast became less available. Trapping during this time reportedly yielded better results because hogs were more likely to enter traps in search of food. The second drop in December could be explained by the landowner having more success with trapping after the sources of mast were exhausted and wild hogs were easier to trap. These conclusions are supported by Barrett and

Birmingham (1994) who documented that trapping success was low during periods of heavy acorn production.

Gaston et al. (2008) found varying levels of hunting pressure caused modifications in wild hog behavior. It is possible that the difference in hunting pressure differences between sites caused a variation in wild hog behavior as well as seedling damage. Optimal foraging theory suggests time spent foraging in the open is a trade-off between accessing optimal food sources and the risk associated with leaving cover. Under the premise of the optimal foraging theory, wild hogs at S2 would likely have lingered in the open for less time and been forced to forage more quickly than those at S1. In contrast to S2, wild hogs at S1 would be able to forage in the open for longer periods of time and be more selective. These wild hogs might not have found seedlings to be the most desirable food source in the pasture and therefore avoided them.

4.4.4. Seedling Depredation: A Learned Behavior

Through studying the damage in the experimental plots, insights were gained on factors potentially influencing wild hog damage in young forest plantations. These insights are beneficial to landowners and managers and could help prevent wild hogs from causing heavy financial losses among forest plantations. Perhaps the most important postulation derived from the evident difference in levels of seedling damage between the two sites is that seedling predation of planted species is apparently a learned behavior among wild hogs.

As habitat generalist, wild hogs are an efficient invasive species because they are able to meet their dietary needs even in non-native ranges (Ballari and Barrios-Garcia 2014). This is accomplished by using heightened olfactory senses to explore and discover desirable foods (Moulton 1967). If all wild hogs found longleaf as a highly favored food source then the hog-related mortality at S1 would have been much higher. The amount of rooting next to one of the plots confirmed wild hogs had found the longleaf seedlings, yet only 1 percent of all available longleaf seedlings were consumed. Additionally, extensive rooting was done in 80 percent of one cherrybark plot at S1, yet no seedlings were damaged or consumed.

In contrast to the wild hog population at S1, the wild hogs at S2 would have been less naïve about planted seedlings as a food source because the landowner had multiple-aged stands located on the property which meant planted seedlings had been available in previous years. It is possible a few of the remaining hogs still remained on the property were familiar with planted longleaf seedlings as a food source. Predation on seedlings could have been observed by other hogs which would explain why seedling damage was more common at S2. This theory has important management implications for forest plantation owners because if wild hogs begin to learn that planted seedlings are a desirable food source then that population would need to be removed so the behavior would not be passed along to other hogs. On the other hand, if the population of hogs is naïve to eating the planted seedlings it may prove beneficial to leave them alone; otherwise, new wild hogs that recognize the seedlings as a desirable food source may move into the area. This concept concerning wild hogs and planted seedlings has not been encountered in scientific literature and warrants more research.

4.4.5. The Impacts of Land Cover and Soil Type on Wild Hog Damage

Another observation with important management implications for forestland owners is that cutover sites appear to create very attractive foraging areas for wild hogs. The woody debris left after the clearcut at S2 appeared to be an attractant to wild hogs interested in searching for invertebrates among the decomposing logs and stumps. Similarly, a study in South Carolina by Zengel and Conner (2008) found a positive association between rooting frequency and amounts of coarse woody debris. Invertebrates make up a small percentage of wild hog's diet but play an important role as a source of protein required year round (Ballaria and Barrios-Garcia 2014, Schley and Roper 2003, Wood and Roark 1980). Consequently, wild hogs were frequently attracted to foraging in the research site and were more likely to encounter seedlings in their search for food.

Interestingly, seedling damage at S2 was minimal later in the year as seedlings were hidden under thick amounts of vegetation which would have made them difficult to access. The idea that depredation of planted seedlings is related to accessibility was suggested by Mayer et al. (2000) who found that areas pretreated (clearing and burning) were the most severely impacted by hogs. The conditions at S2 would support this observation but not at S1. In September 2016, the bahaigrass and briars had made observational visits difficult, so the field was bushhogged around the seedling plots. After the grass had been mowed the seedlings would have been very accessible to hogs for the rest of the study period, yet seedling damage did not occur. This suggests that factors other than accessibility may be more important in influencing predation of planted seedlings by hogs.

Wild hog damage at S1 was notably less than the amount that occurred at S2. Given the differences in the two sites it is likely land cover played a role in the observed damage. Initially it was assumed the damage at S1 would have occurred at a higher level than observed because wild hog damage in pastures is quiet common. Schley et al. (2008) found wild hog damage to grasslands in Germany to be severe and occur frequently. Additionally, the 2016 survey of non-industrial private landowner in Alabama (Chapter 3) indicated that grassland/pasturelands was one of the top three most commonly reported land cover types for wild hogs sightings. Damage was mostly limited to a small section in the northeastern quadrant at the bottom of the hill where water drainage would have kept the soil more moist compared to the rest of the pasture. Everitt and Alaniz (1980) observed wild hogs avoided pastures in abnormally dry years which may explain why damage at S1 was minimal.

The Conecuh series soil appeared to be an important factor in limiting hog damage to periods when rain events allowed hogs to penetrate the soil surface in search of food. The high content of clay, which causes this particular soil to have very slow water permeability, created a cement-like barrier when soil was devoid of sufficient amounts of moisture. The Luverne and Blanton series soils at S2 also had Argillic subsurface horizons but had thicker A and E horizons separating the soil surface from the layer where increases in clay are found. With 2016 being a drier year than normal in Alabama, it is possible the field was not conducive for wild hogs to root and forage for food compared to other areas. It was evident the majority of wild hog activity was concentrated in areas near the drainage system where the soils transitioned from the Conecuh series to the Mantachie series. The higher sand and silt content of the Mantachie series soil would have made rooting relatively easier.

As with S1, soil type was also a factor affecting hog damage at S2. The Blanton, Bonifay, and Luverne series soils appeared to be more beneficial to rooting activities because wild hogs will root and dig to depths of 24 inches below the soil surface in search of food (Schley and Roper 2003). Despite how dry it was throughout the year, the sand and loam components of the soil at S2 made it easier to penetrate the soil surface than at S1. The friability of the soil structure was also evident because of the amount of erosion occurring in the area.

4.4.6. Changes in Seedling Damage in Respect to Food Availability

The vegetative diversity was greater at S2 and included a large abundance of panicgrass which is one of the most frequently consumed herbages by wild hogs in this part of the world (Wood and Roark 1980). Panicgrass and other flora would mainly have been consumed during the spring when new shoots and herbs were most luxuriant (Ballari and Barrios-Garcia 2014, Wood and Roark 1980). As was initially expected, the majority of seedling damage occurred in the spring of 2016 at both sites as hogs foraged for succulent shoots and roots. The amount of seedling damage decreased by a third during summer months compared to the spring which was not surprising considering wild hog’s summer diet consists primarily of fruit (Ballari and Barrios-Garcia 2014). Seedling damage was minimal through the fall and winter months as hard mast became available.

Seedling damage was expected to be higher in the winter as above-ground plant parts became scarce and sources of hard mast were depleted; however, this was not the case at either site for reasons that could not be determined.

4.4.7. Impact of Drought Conditions and Areas of Project Improvement

The outcome of this study was impacted by the unusually dry year for Alabama as well as the drought in October and November. We believe this caused the high mortality rates observed in seedlings and potentially reduced the amount of damage from wild hogs both to the sites and the seedlings. Casperson and Kobe (2001) showed soil moisture and tree species' ecological response to environmental stress have a dramatic effect on seedling survivorship. They suggested seedling size might have played a role in the differences in mortality rates among species tested. Conifer sapling mortality did not vary with respect to soil moisture due to the needle leaves having low surface area and thus, a low evaporative demand. This was not the case for broadleaf species whose larger leaf area requires greater evaporative demand which incurs a tradeoff between maximizing carbon gain and minimizing water loss when exposed to drought conditions. Contrary to their findings, loblolly seedlings in our study suffered nearly 50 percent mortality at both sites. We are uncertain why observed loblolly mortality was so high in this study.

A general trend was observed that smaller seedlings had better survivorship than larger seedlings. This trend was consistent for all species at both sites except for the longleaf at S1. The difference in seedling sizes between the mortality and surviving group was statistically significant only for chinkapin and persimmon seedlings at S2. Unfortunately the only seedlings available from nurseries at the time of planting varied in sizes within species. Many of the chinkapin oak seedlings were large and cumbersome to plant at S2 which could explain why the mortality rate was so high based on the findings of Casperson and Kobe (2001). This project could have potentially been improved by sorting through the seedlings and creating a more uniform size class. Additionally, this project could have been more informative if the study duration included two or three growing seasons in order to gain a more accurate idea of how wild hog predation of planted seedlings changes over time.

4.4.8. Implications of Results and Management Suggestions

In summary, we suggest the level of damage among planted seedlings is likely driven by a wild hog's preference and familiarity with the species as a food source. Reducing the amount of time wild hogs spend in the plantation should lower the likelihood of the animals becoming educated about seedlings as a preferred food source. Not all seedlings species are preferred and wild hog presence in the area does not guarantee seedlings will be targeted. A combination of ecological factors discussed earlier, rather than just a single factor, is likely to influence the severity of wild hog damage in forest plantations.

The results of this project are an additional step towards better understanding variations of wild hog behavior in young forest plantations. Research projects like these are important for finding how changes in management could improve seedling survival during the stage of vulnerability to wild hogs. The following recommendations are based on the knowledge gained through observations made during this study and will require further testing as to their effectiveness. The recommendations are as follows: 1) request logging crews to pile woody debris away from the site where seedlings will be planted rather than scattering the debris, 2) wild hog population reduction through hunting and trapping should be implemented during the first three growing seasons in young forest plantations once seedlings are observed to be damaged, 3) add seedling tubes adequately anchored in the soil to make it more difficult for hogs to access seedlings, and 4) delay herbaceous release treatments by a year to allow vegetation to grow up around the seedlings making them more difficult for wild hogs to find or access.

CHAPTER 5

Conclusion

It would appear efforts to raise awareness about the importance the longleaf pine (*Pinus palustris* Mill.), from both a historic and ecological standpoint, are starting to come to fruition. Data from the Forest Inventory and Analysis (FIA) program indicated longleaf had been declining in the southern United States (US) from 1970-2010 (Oswalt et al. 2012), but in recent years it seems this trend has been reversed (Guldin et al. 2016). The 2015 south-wide estimate for longleaf acreage was 4.7 million (LPC 2017), this represents a 30 percent increase from 2010 (Guldin et al. 2016). The recent increase in longleaf acreage can primarily be attributed to the efforts of America's Longleaf Restoration Initiative (ARLI). Founded in 2009, the ARLI involved federal resources to recover longleaf across its former range. The overall goal of ALRI is to restore longleaf to 8 million acres by 2025 (LPC 2017). More than half of the restoration work accomplished in 2016 occurred in Florida and Alabama. According to progress reports from the Longleaf Pine Initiative (LLPI) (an initiative created by the Natural Resources Conservation Service to support the ALRI), Alabama holds the annual record for the most acres put into longleaf restoration (progress reports and other information about the LLPI is available online at https://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/national/

programs/initiatives/?cid=nrcsdev11_023913). Alabama contains a large number of counties given high restoration priority because of their value in connecting existing longleaf landscapes. Due to the high number of priority counties in Alabama, the state is critical to longleaf restoration efforts.

The majority of longleaf establishment since 2000 has taken place in the eastern portion of the Coastal Plains region (Oswalt et al. 2012). Among the recent planting efforts in 2016, 79 and 21 percent were on private and public lands, respectively (LPC 2017). It is apparent private landowners have an important role in the successful reestablishment of longleaf across its native range. In Alabama, non-industrial private landowners hold 88 percent of the forest land (AFC 2016); therefore, insuring the successful establishment of longleaf on non-industrial private lands should be a priority.

The wild hog (*Sus scrofa*) has shown itself capable of hindering longleaf restoration efforts; this animal's propensity for damaging longleaf seedlings has been a topic frequently discussed in previous chapters. Wild hogs can have a substantial economic impact on young longleaf plantations of non-industrial private landowners, most of whom must personally absorb the financial costs of wild hog damage and control. In most cases, financial assistance is not available to help compensate for wild hog damage or to offset control costs. In contrast to non-industrial private lands, the impact of damage to longleaf established on public or private industrial lands is likely minimal due to the funds and resources available to recover any losses from wild hogs.

As more acres of longleaf are planted across the South in years to come, it is likely the corresponding damage from wild hogs will increase as well. Historical reports showed this to be the case nearly 70 years ago when entire longleaf plantations in Alabama, Florida, Louisiana, and Mississippi resulted in crop failure due to wild hogs after intensive planting efforts by the US Forest Service (Lucas 1977). The future damage to longleaf plantations may be even more extensive than in the 1950's as recent wild hog populations have grown more abundant. Repeated years of hog-damage to a non-industrial private landowner's plantation may prove enough to discourage them away from producing longleaf. With non-industrial private landowners being a critical component of longleaf restoration efforts, losing the support of this group would prove detrimental in reaching the goal of 8 million acres by 2025.

Management suggestions are made in the third and fourth chapters in an effort to help forest plantation owners plan for wild hog damage and reduce seedling mortality. The impact of wild hogs can be remediated by financially preparing for the possibility of damage. The economic analyses from chapter 3 showed how replanting the year after wild hog damage occurs can reduce most of the cost of damage. Even postponing replanting an extra year allows the majority of stand profitability to be recovered compared to not replanting. When simulations were run in a scenario where replanting does not occur, the cost of damage quickly exceeded profitability. The sensitivity analyses tables created for this project are applicable for landowners or resource professionals utilizing a shelterwood system to grow longleaf on a 60 year rotation. Applying the sensitivity analyses tables to scenarios outside of the parameters they were intended could have misleading results; however, they are useful in getting people thinking about planning for wild hog damage and control before trees have even been planted. This project serves as a starting point in creating awareness of the economic ramifications and scale of wild hog damage to forest plantations.

In chapter 4 we showed tree species and ecological factors can influence the amount of damage to forest plantations from wild hogs. Planting highly preferred tree species in an area where there are wild hogs does not guarantee direct mortality will occur. Results from the field study suggest seedling depredation in forest plantations is largely a learned behavior among wild hogs. In populations where wild hogs were naïve to eating planted seedlings, plantation damage was minimal. Even so, it is important for individuals interested in establishing forest plantations to be mindful of the ecological conditions in and around the plantation. If planting a highly preferred tree species in an area commonly used by wild hogs, it is important to be proactive in discouraging wild hogs from discovering seedlings. This can be accomplished in a number of ways but a combination of methods might produce the best outcome for protecting seedlings during the first three growing seasons. We recommend the active management of wild hogs for at least the first three growing seasons until seedlings reach a size where they are no longer desirable as a food source. This does not guarantee wild hog damage will not occur after this point but the scale of damage will likely not be as large as in the first three growing seasons.

Based on field observations it appears there is merit to using tree tubes to discourage wild hogs away from seedlings and towards more easily obtained food sources. Tree-tube stakes should be adequately anchored in the ground to reduce the likelihood of damage to seedlings by rooting. In conjunction with tree tubes, reducing desirable food sources in the plantation will also help in limiting the possibility of wild hogs discovering seedlings. In situations where cutover sites have been planted it could prove beneficial to remove woody debris; doing so would give wild hogs one less reason to enter the plantation area in search of abundant sources of invertebrates. There is a positive association between rooting frequency by wild hogs and the presence of coarse woody debris (Zengel and Conner 2008). Additionally, hunting over the plantation in the spring, when seedling damage is most likely to occur, could deter wild hogs from the area until vegetation has grown thick enough to help protect seedlings. Delaying the herbaceous release treatment will also allow for thicker layers of vegetation making it more difficult to find and access planted seedlings.

Hog density is also an important factor influencing the severity of damage in forest plantations; having more wild hogs in an area increases the chance of plantation damage occurring. Survey results indicated plantation owners in the Coastal Plains region of Alabama experienced higher levels of damage than those in northern regions where wild hog densities are lower. Population reduction on the property can be an important management tool for protecting forestry investments like young pine stands. In general, survey respondents did not feel the current control methods available for wild hog removal were very efficient. However, survey respondents did associate the highest efficiency ratings with hunting with dogs, yet this method was not as commonly utilized compared to other control methods. Some speculate hunting with dogs can cause home range shifts and harass wild hogs away from particular areas of concern (Engeman et al. 2007, Gaston 2008); therefore, this could be a very useful management technique for plantation owners needing to protect their seedlings.

Wild hog research pertaining to forestry has become substantially less common as other more popular topics capture public attention. Over the past decade wild hog research has been dominated by topics related to diseases, parasites, and genetics. The two subject categories, diseases/parasites and genetics, account for 40 percent of key words used to describe entries in the bibliography created for this project (Chapter 2). This study is one step toward understanding the economic impact wild hogs have on the forest industry and the ecological factors influencing forest plantation damage. Future research is needed to examine the possibility of insurance policies to protect young forest stands against wild hog damage. The need for such policies will become apparent as more longleaf plantations are impacted by growing and expanding hog populations. The management suggestions mentioned previously warrant more research to test their efficiency in minimizing seedling damage in forest plantations. Similar experiments as the study performed in chapter 4 can be repeated over extended growing periods to gain a better understanding of why seedling depredation varies based on location.

In conclusion, the long-term nature of forestry investments warrants the threat from wild hogs be taken seriously. Crop failure in a young forest plantation can offset a rotation by years and carries considerably more economic loss into the future compared to traditional/annual agricultural crops. The costs of wild hog introduction into an area may be felt over many years as their presence would create uncertainty and risk to timber investments. The short-term protection and minimization of seedling depredation in young forest plantations is the most realistic solution to reducing the impact of wild hogs on forestry and timber resources.

References

Alabama Forestry Commission (AFC). 2016. Forest resource report 2016. Available online at http: //www.forestry.alabama.gov/PDFs/AlabamaForestResource Report.pdfAlabama; last accessed September 2017.

Alavalapati, J.R.R., Stainback, G.A. and Matta, J.R. 2007. Longleaf pine restoration: Economics and policy. In The Longleaf Pine Ecosystem. Jose, S., Jokela, E.J. and Miller, D.L., editors. Springer, New York, 403-413.

Anderson, A., Slootmaker, C., Harper, E., Holderieath, J. and Shwiff, S.A. 2016. Economic estimates of feral swine damage and control in 11 US states. Crop Protection, 89: 89-94.

Arrington, D.A., Toth, L.A. and Koebel, J.W. 1999. Effects of rooting by feral hogs *Sus scrofa* L. on the structure of a floodplain vegetation assemblage. Wetlands, 19(3): 535-544.

Avery, T.E. and Burkhart, H.E. 2015. Forest measurements (5th ed.). Long Grove, Illinois: Waveland Press, Inc., 345-354.

Ballari, S.A. and Barrios-García, M.N. 2014. A review of wild boar *Sus scrofa* diet and factors affecting food selection in native and introduced ranges. Mammal Review, 44(2): 124-134.

Barrett, R.H. and Birmingham, G.H. 1994. Wild pigs. In Prevention and control of wildlife damage. Hygstrom, S., Timm, R. and Larsen, G., editors. Cooperative Extension Service, University of Nebraska, Nebraska, 65-70.

Barrios-Garcia, M.N. and Ballari, S.A. 2012. Impact of wild boar (*Sus scrofa*) in its introduced and native range: a review. Biological Invasions, 14(11): 2283-2300.

Boyer, W.D. and Farrar, R.M. 1981. Thirty years of management on a small longleaf pine forest. Southern Journal of Applied Forestry, 5(2): 73-77.

Bratton, S.P. 1975. The effect of the European wild boar, *Sus scrofa*, on gray beech forest in the Great Smoky Mountains. Ecology, 1356-1366.

Brockway, D.G., Outcalt, K.W. and Boyer, W.D. 2007. Longleaf pine regeneration ecology and methods. In The Longleaf Pine Ecosystem. Jose, S., Jokela, E.J. and Miller, D.L., editors. Springer, New York, 95-133.

Brook, R.K. and van Beest, F.M. 2014. Feral wild boar distribution and perceptions of risk on the central Canadian prairies. Wildlife Society Bulletin, 38(3): 486-494.

Bruinderink, G.G. and Hazebroek, E. 1996. Wild boar (*Sus scrofa scrofa* L.) rooting and forest regeneration on podzolic soils in the Netherlands. Forest Ecology and Management, 88(1-2): 71-80.

Buchman, R.G. and Shifley, S.R. 1983. Guide to evaluating forest growth projection systems. Journal of Forestry, 81(4): 232-254.

Cairns, R.D. 2017. Faustmann's formulas for forests. Natural Resource Modeling, 30(1): 52-73.

Campbell, T.A. and Long, D.B. 2009. Feral swine damage and damage management in forested ecosystems. Forest Ecology and Management, 257(12): 2319-2326.

Caspersen, J.P. and Kobe, R.K. 2001. Interspecific variation in sapling mortality in relation to growth and soil moisture. Oikos, 92(1): 160-168.

Chapman, H.H. 1932. Is the longleaf type a climax?. Ecology, 13(4): 328-334.

Chavarria, P.M., Lopez, R.R., Bowser, G. and Silvy, N.J. 2007. A landscape-level survey of feral hog impacts to natural resources of the Big Thicket National Preserve. Human-Wildlife Conflicts, 1(2): 199-204.

Choquenot, D., Hone, J. and Saunders, G. 1999. Using aspects of predator-prey theory to evaluate helicopter shooting for feral pig control. Wildlife Research, 26(3): 251-261.

Clark III, A. and Saucier, J.R. 1990. Tables for estimating total-tree weights, stem weights, and volumes of planted and natural southern pines in the Southeast. Georgia Forest Research Paper 79. Georgia Forestry Commission, Macon, Georgia.

Comer, C.E. and Mayer, J. 2009. Biology of wild pigs: Wild pig reproductive biology. In Wild Pigs: Biology, Damage, Control Techniques and Management (No. SRNL-RP-2009-00869). Mayer, J. and Brisbin, L., editors. Savannah River Site, Aiken, South Carolina, 51-75.

Conely, R.E., Smith, M.D. and Armstrong, J.B. 2014. Mapping the distribution of wild pigs in Alabama [abstract]. In the 2014 International Wild Pig Conference, Montgomery, Alabama.

Conley, R.H. 1977. Management and research of the European wild hog in Tennessee. In Research and Management of Wild Hog Populations. Wood, G.W., editor. Clemson University, Georgetown, South Carolina, 67-70.

Costa, R. and DeLotelle, R.S. 2007. Reintroduction of fauna to longleaf pine ecosystems. In The Longleaf Pine Ecosystem. Jose, S., Jokela, E.J. and Miller, D.L., editors. Springer, New York, 335-376.

Croker Jr, T.C. and Boyer, W.D. 1975. Regenerating longleaf pine naturally. USDA Forest Service, Southern Forest Experiment Station, Research Paper SO-105, New Orleans, Louisiana.

Crooks, J.A. 2002. Characterizing ecosystem-level consequences of biological invasions: the role of ecosystem engineers. Oikos, 97(2): 153-166.

Dexter, N. 1998. The influence of pasture distribution and temperature on habitat selection by feral pigs in a semi-arid environment. Wildlife Research, 25(5): 547-559.

Dillman, D.A., Smyth, J.D. and Christian, L.M. 2014. Internet, phone, mail, and mixed-mode surveys: the tailored design method. Fourth edition. New Jersey: John Wiley & Sons, 351-396.

Dyer, J.A.F. 2012. Three essays on pine straw in Alabama: Needlefall yields, market demands, and landowner interest in harvesting. (Doctoral dissertation). Retrieved from Auburn University's Electronic Dissertation Database; available online at https: //etd.auburn.edu/bitstream/handle/10415/3110/DYER_DISSERTATION _2012.pdf?sequence=2; last accessed August 2017.

Engeman, R.M., Smith, H.T., Shwiff, S.A., Constantin, B., Woolard, J., Nelson, M. and Griffin, D. 2003. Prevalence and economic value of feral swine damage to native habitat in three Florida state parks. Environmental Conservation, 30(4): 319-324.

Engeman, R.M., Stevens, A., Allen, J., Dunlap, J., Daniel, M., Teague, D. and Constantin, B. 2007. Feral swine management for conservation of an imperiled wetland habitat: Florida's vanishing seepage slopes. Biological Conservation, 134(3), 440-446.

ESRI. 2013. ArcGIS Desktop: Release 10.2. Redlands, California: Environmental Systems Research Institute.

Everitt, J.H. and Alaniz, M.A. 1980. Fall and winter diets of feral pigs in south Texas. Journal of Range Management, 126-129.

Fagiani, S., Fipaldini, D., Santarelli, L., Burrascano, S., Del Vico, E., Giarrizzo, E., Mei, M., Taglianti, A.V., Boitani, L. and Mortelliti, A. 2014. Monitoring protocols for the evaluation of the impact of wild boar (*Sus scrofa*) rooting on plants and animals in forest ecosystems. Hystrix, the Italian Journal of Mammalogy, 25(1): 31-38.

Fields, D., Guo, Z., Hodges, A. W. and Rahmani, M. 2013. Economic impacts of Alabama’s agricultural, forestry and related industries (ANR-1456). Auburn University Extension Publication; available at http://www.aces.edu/pubs/docs /A/ANR-1456/ANR-1456.pdf; last accessed September 2017.

Frost, C.C. 1993. Four centuries of changing landscape patterns in the longleaf pine ecosystem. In Proceedings of the Tall Timbers Fire Ecology Conference, No 18. Hermann, S.M., editor. Tall Timbers Research Station, Tallahassee, Florida, 17-43.

Franklin, R.M. 2008. Stewards of longleaf pine forests: A guide for landowners. Longleaf Alliance Report No. 2. Andalusia, Alabama: The Longleaf Alliance, Auburn University; available online at http://www.aces.edu/pubs/docs/A/ANR-1456/ANR-1456.pdf; last accessed May 2016.

Gaston, W.D., Armstrong, J.B., Arjo, W.M. and Stribling, H.L. 2008. Home range and habitat use of feral pigs (*Sus scrofa*) on Lowndes County, WMA, Alabama. In Proceeding of the 2008 National Conference of Feral Hogs, St. Louis, Missouri.

Graves, H.B. 1984. Behavior and ecology of wild and feral swine (*Sus scrofa*). Journal of Animal Science, 58: 482-492.

Greene, S.W. 1931. The forest that fire made. American Forests, 37: 583-584.

Guldin, J.M., Rosson, J.F. and Dana, N. 2016. Restoration of longleaf pine--the status of our Knowledge (SRS-212). In Proceedings of the 18th Biennial Southern Silvicultural Research Conference, Asheville, North Carolina, 323-331.

Hanson, R.P. and Karstad, L. 1959. Feral swine in the southeastern United States. Journal of Wildlife Management, 23: 64-73.

Harper, R.M. 1913. Economic botany of Alabama. Part 1. University, Alabama: Geological Survey of Alabama, Monograph 8.

Harrison, H., Harris, T., Siry, J., Baldwin, S., Smith, J. and Caulfied, J. 2017. U.S. southern annual review: 2016 (Timber prices and markets). TimberMart-South, Athens, Georgia.

Herrero, J., García-Serrano, A., Couto, S., Ortuño, V.M. and García-González, R. 2006. Diet of wild boar *Sus scrofa* L. and crop damage in an intensive agroecosystem. European Journal of Wildlife Research, 52(4): 245-250.

Hopkins, W. 1947. Hogs or logs. South Lumberman, 175: 151-153.

Houck, M. 2009. Plant fact sheet for bahiagrass (*Paspalum notatum* Flüggé). USDA-Natural Resources Conservation Service, Louisiana. Available online at https://plants.usda.gov/factsheet/pdf/fs_pano2.pdf, last accessed September 2017.

Howe, T.D. and Bratton, S.P. 1976. Winter rooting activity of the European wild boar in the Great Smoky Mountains National Park. Castanea, 256-264.

IBM Corp. 2015. IBM SPSS Statistics for Windows, Version 23.0. Armonk, NewYork: IBM Corp.

Ickes, K., Dewalt, S.J. and Appanah, S. 2001. Effects of native pigs (*Sus scrofa*) on woody understory vegetation in a Malaysian lowland rain forest. Journal of Tropical Ecology, 17(02), 191-206.

Ickes, K., Paciorek, C.J. and Thomas, S.C. 2005. Impacts of nest construction by native pigs (*Sus scrofa*) on lowland Malaysian rain forest saplings. Ecology, 86(6): 1540-1547.

Jaworowski, C. 2011. Hogs gone wild: controlling feral hogs. Alabama's TREASURED Forests. Alabama Forestry Commission, fall/winter edition, 13-15.

Jerrolds, W.R., Pelren, E.C., Darroch, B.A. and Anderson, R.G. 2014. A survey to estimate population distribution of and damage caused by feral swine in Tennessee. Journal of the Southeastern Association of Fish and Wildlife Agencies, 1: 167-174.

Kush, J.S., Goelz, J.C.G., Williams, R.A., Carter, D.R. and Linehan, P.E. 2007. Longleaf pine growth and yield. In The Longleaf Pine Ecosystem. Jose, S., Jokela, E.J. and Miller, D.L., editors. Springer, New York, 251-267.

Lacki, M.J. and Lancia, R.A. 1986. Effects of wild pigs on beech growth in Great Smoky Mountains National Park. The Journal of Wildlife Management, 655-659.

Lancia, R.A., Roise, J.P., Adams, D.A. and Lennartz, M.R. 1989. Opportunity costs of red-cockaded woodpecker foraging habitat. Southern Journal of Applied Forestry, 13(2): 81-85.

Landers, J.L., Van Lear, D.H. and Boyer, W.D. 1995. The longleaf pine forests of the Southeast: requiem or renaissance?. Journal of Forestry, 93(11): 39-44.

Lipscomb, D.J. 1989. Impacts of feral hogs on longleaf pine regeneration. Southern Journal of Applied Forestry, 13(4): 177-181.

Longleaf Alliance (LLA). 2007. Keys to successfully planting and establishing longleaf pine. The Longleaf Alliance, Note No. 12. Available online at http: //www. forestry.alabama.gov/PDFs/Keys_to_Longleaf.pdf; last accessed August 2017.

Longleaf Partnership Council (LPC). 2017. America’s longleaf restoration initiative 2016 range-wide accomplishment report. Available online at http://www.americaslong leaf.org/media/23979/fy16_llp_rangewideaccompreport_final_web.pdf; last accessed September 2017.

Lucas, E.G. 1977. Feral hogs- problems and control on national forest lands. In Research and Management of Wild Hog Populations. Wood, G.W., editor. Clemson Univsersity, Georgetown, South Carolina, 17-21.

Maggard, A. and Barlow, R. 2017. Costs and trends of southern forestry practices, 2016. Alabama Cooperative Extension System, 1: 2-7. In Press.

Massei, G., Roy, S. and Bunting, R. 2011. Too many hogs? A review of methods to mitigate impact by wild boar and feral hogs. Human–Wildlife Interactions, 5(1): 79-99.

Matney, T.G. 1996. NLongleaf: Growth and Yield Interface (Computer software). Forest and Wildlife Research Center, Starksville, Mississippi.

Mayer, J. 2009a. Biology of wild pigs: Taxonomy and history of wild pigs in the Unites States. In Wild Pigs: Biology, Damage, Control Techniques and Management (No. SRNL-RP-2009-00869). Mayer, J. and Brisbin, L., editors. Savannah River Site, Aiken, South Carolina, 5-23.

Mayer, J. 2009b. Wild pig damage: Overview of wild pig damage. In Wild Pigs: Biology, Damage, Control Techniques and Management (No. SRNL-RP-2009-00869). Mayer, J. and Brisbin, L., editors. Savannah River Site, Aiken, South Carolina, 221-225.

Mayer, J. 2009c. Wild pig field sign. In Wild Pigs: Biology, Damage, Control Techniques and Management (No. SRNL-RP-2009-00869). Mayer, J. and Brisbin, L., editors. Savannah River Site, Aiken, South Carolina, 205-218.

Mayer, J.J., Nelson, E.A. and Wike, L.D. 2000. Selective depredation of planted hardwood seedlings by wild pigs in a wetland restoration area. Ecological Engineering, 15: 79-85.

Mayer, J.J. and Shedrow, C.B. 2007. Annotated bibliography of the wild pig (*Sus scrofa*) (WSRC-TR-2002-000129). Washington Savannah River Company, Aiken, South Carolina.

Means, D.B. 2007. Vertebrate faunal diversity of longleaf pine ecosystems. In The Longleaf Pine Ecosystem. Jose, S., Jokela, E.J. and Miller, D.L., editors. Springer, New York, 157-213.

Moulton, D.G. 1967. Olfaction in mammals. American Zoologist, 7(3): 421-429.

Oswalt, C.M., Cooper, J.A., Brockway, D.G., Brooks, H.W., Walker, J.L., Connor, K.F., Oswalt, S.N. and Conner, R.C. 2012. History and current condition of longleaf pine in the Southern United States. USDA Forest Service General Technical Report SRS-166, 219-231.

North Carolina Forest Service. 2011. The economics of longleaf pine management. North Carolina Forest Service, Longleaf Leaflet-#7; available online at http: //ncforestservice.gov/publications/LongleafLeaflets/LL07.pdf; last accessed August 2017.

Peet, R.K. 2007. Ecological classification of longleaf pine woodlands. In The Longleaf Pine Ecosystem. Jose, S., Jokela, E.J. and Miller, D.L., editors. Springer, New York, 51-93.

Pimentel, D. 2007. Environmental and economic costs of vertebrate species invasions into the United States. Managing Vertebrate Invasive Species, 38: 1-8.

R Core Team. 2013. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL http://www.R-project.org/.

Roise, J., Chung, J., Lancia, R. and Lennartz, M. 1990. Red-cockaded woodpecker habitat and timber management: production possibilities. Southern Journal of Applied Forestry, 14(1): 6-12.

Roise, J.P., Chung, J. and Lancia, R. 1991. Red-cockaded woodpecker habitat management and longleaf pine straw production: an economic analysis. Southern Journal of Applied Forestry, 15(2): 88-92.

Schley, L., Dufrêne, M., Krier, A. and Frantz, A.C. 2008. Patterns of crop damage by wild boar (*Sus scrofa*) in Luxembourg over a 10-year period. European Journal of Wildlife Research, 54(4): 589-599.

Schley, L. and Roper, T.J. 2003. Diet of wild boar *Sus scrofa* in Western Europe, with particular reference to consumption of agricultural crops. Mammal Review, 33(1): 43-56.

Schwarz, G.F. 1907. The longleaf pine in virgin forest: a silvical study. New Jersery: J. Wiley & sons, 1-17.

Seward , N.W., VerCauteren, K.C., Witmer, G.W. and Engeman, R.M. 2004. Feral swine impacts on agriculture and the environment. Sheep and Goat Research Journal, 19: 34-40.

Siemann, E., Carrillo, J.A., Gabler, C.A., Zipp, R. and Rogers, W.E. 2009. Experimental test of the impacts of feral hogs on forest dynamics and processes in the southeastern US. Forest Ecology and Management, 258(5): 546-553.

Singer, F.J., Swank, W.T. and Clebsch, E.E. 1984. Effects of wild pig rooting in a deciduous forest. The Journal of Wildlife Management, 464-473.

Slootmaker, C., Anderson, A., Harper, E. and Shwiff, S. A. 2017. Limited resource producer preferences for wild pig presence in the Southeastern United States. In Press.

Soil Survey Staff. 2013a. Blanton series. Natural Resources Conservation Service, United States Department of Agriculture. Official Soil Series Descriptions. Available online at https://soilseries.sc.egov.usda.gov/OSD_Docs/B/BLANTON.html; last accessed June 2017.

Soil Survey Staff. 2013b. Bonifay series. Natural Resources Conservation Service, United States Department of Agriculture. Official Soil Series Descriptions. Available online at https://soilseries.sc.egov.usda.gov/OSD_Docs/B/BONIFAY .html; last accessed June 2017.

Soil Survey Staff. 2013c. Mantachie series. Natural Resources Conservation Service, United States Department of Agriculture. Official Soil Series Descriptions. Available online at https://soilseries.sc.egov.usda.gov/OSD_Docs/M/

MANTACHIE.html; last accessed June 2017.

Soil Survey Staff. 2014a. Conecuh series. Natural Resources Conservation Service, United States Department of Agriculture. Official Soil Series Descriptions. Available online at https://soilseries.sc.egov.usda.gov/OSD_Docs/C/CONECUH.html; last accessed June 2017.

Soil Survey Staff. 2014b. Luverne series. Natural Resources Conservation Service, United States Department of Agriculture. Official Soil Series Descriptions. Available online at https://soilseries.sc.egov.usda.gov/OSD_Docs/L/LUVERNE.html; last accessed June 2017.

Stainback, G.A. and Alavalapati, J.R. 2004. Restoring longleaf pine through silvopasture practices: an economic analysis. Forest Policy and Economics, 6(3): 371-378.

Sweeney, J.R., Sweeney, J.M. and Sweeney, S.W. 2003. Feral pigs. In Wild Mammals of North America. Feldhamer, G., Thompson, B., and Chapman, J., editors. John Hopkins University Press. Baltimore, Maryland, 1164–1179

Sweitzer, R.A. and Van Vuren, D.H. 2002. Rooting and foraging effects of wild pigs on tree regeneration and acorn survival in California's oak woodland ecosystems. USDA Forest Service General Technical Report PSW-GTR-184.

United States Department of Agriculture (USDA). 2016. 2016 State agriculture overview: Alabama. United Sates Department of Agriculture, National Agricultural Statistics Service; available online at https://www.nass.usda.gov/Quick_Stats/Ag_Overview/stateOverview.php?state=ALABAMA; last accessed September 2017.

Van Lear, D.H., Carroll, W.D., Kapeluck, P.R. and Johnson, R. 2005. History and restoration of the longleaf pine-grassland ecosystem: implications for species at risk. Forest Ecology and Management, 211(1): 150-165.

Wakeley, P.C. 1954. Planting the southern pines. Forest Service, U.S. Department of Agriculture, Agriculture Monograph No. 18. Washington, D.C.

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

Wirthner, S., Schütz, M., Page-Dumroese, D.S., Busse, M.D., Kirchner, J.W. and Risch, A.C. 2012. Do changes in soil properties after rooting by wild boars (*Sus scrofa*) affect understory vegetation in Swiss hardwood forests?. Canadian Journal of Forest Research, 42(3): 585-592.

Wolf, T. and Conover, M.R. 2003. Feral pigs and the environment: an annotated bibliography. Berryman Institute Publication 21. Utah State University, Logan, Utah, and Mississippi State University, Starkville, Mississippi.

Wood, G.W. and Lynn, T.E. 1977. Wild hogs in southern forests. Southern Journal of Applied Forestry, 1(2): 12-17.

Wood, G.W. and Roark, D.N. 1980. Food habits of feral hogs in coastal South Carolina. Journal of Wildlife Management, 44(2): 506-511.

Zengel, S.A. and Conner, W.H. 2008. Could wild pigs impact water quality and aquatic biota in floodplain wetland and stream habitats at Congaree National Park, South Carolina?. In Proceedings of the 2008 South Carolina Water Resources Conference, Charleston, South Carolina.

Appendix A

FERAL SWINE SURVEY – 2016

Auburn University School of Forestry and Wildlife Sciences

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Alabama Cooperative Extension System

Please make corrections to name, address and ZIP Code, if necessary.

The information you provide will be used for statistical purposes only. In accordance with the Confidential Information Protection provisions of Title V, Subtitle A, Public Law 107–347 and other applicable Federal laws, your responses will be kept confidential and will not be disclosed in identifiable form to anyone other than employees or agents. By law, every employee and agent has taken an oath and is subject to a jail term, a fine, or both if he or she willfully discloses ANY identifiable information about you or your operation. Response is **voluntary**.

The time required to complete this information collection is estimated to average 15 minutes per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information.

SECTION 1 – GENERAL

For the purposes of this study, wild pigs refer to all species of feral swine, feral hogs, and wild boar.

	Acres
1. On June 1, 2015, how many forest acres did you:	
a. Own?	100
b. Rent or Lease from others or use Rent Free? (**Exclude** land used on an animal unit month (AUM) basis, BLM and Forest Service land.).	101
c. Rent to others?	102

2. In what state and county is the majority of your forest land located?

State	County

OFFICE USE
103
104

3. During the last three years, have wild pigs been present in the county reported in item 2?

105 1☐ Yes 3☐ No 2☐ Don't Know

4. During the last three years, have wild pigs been present on your property?

106 1☐ Yes 3☐ No 2☐ Don't Know

SECTION 2 – TIMBER STANDS

(*Please answer the following in terms of the forest acres specified in question 1 of section 1*)

1. Were any tree seedlings planted on your forest land in 2013-2015?

   107 1☐ Yes – Continue 3☐ No – Go to Item 3

2. Please report acreage planted in 2013-2015.

	Unit	2013 Stand	2014 Stand	2015 Stand
a. What tree species were planted? (List top 2 dominant species planted)	Species	108	109	110
(i) Were the seedlings planted **containerized**?	Check Mark	111 1☐ Yes 3☐ No 1☐ Yes 3☐ No	112 1☐ Yes 3☐ No 1☐ Yes 3☐ No	113 1☐ Yes 3☐ No 1☐ Yes 3☐ No
(ii) What was the total payment spent prepping the site before planting?	Dollars	114 $	115 $	116 $
(iii) How many acres of each tree species were planted?	Acres	117	118	119
b. How many trees per acre were planted?	Trees Per Acre	120	121	122
c. Around how many trees per acre survived **1 year** after planting?	Trees Per Acre	123	124	125
(i) How many total acres of this stand were damaged by **wildlife in general**?	Acres	126 ________	127 ________	128 ________
d. Were wild pigs present in any part of the stand? (If **Yes**, continue. If **No** or **Don't Know**, go to Item 3.)	Check Mark	129 1☐ Yes 3☐ No 2☐ Don't Know	130 1☐ Yes 3☐ No 2☐ Don't Know	131 1☐ Yes 3☐ No 2☐ Don't Know
(i) Was this stand damaged by wild pigs? (If **Yes**, continue. If **No** or **Don't Know**, go to Item 3.)	Check Mark	132 1☐ Yes 3☐ No 2☐ Don't Know	133 1☐ Yes 3☐ No 2☐ Don't Know	134 1☐ Yes 3☐ No 2☐ Don't Know
(ii) How many acres of this stand were damaged by **wild pigs**?	Acres	135	136	137
(iii) On the acres that were damaged by wild pigs, what percentage of seedlings were **destroyed**?	Percentage	138	139	140

3. On your property, in which type of habitat did you observe **wild hog activity** between 2013-2015? *(Check one for each)*

		FREQUENCY OF SIGHTING		
		Never	Rarely	Frequently
a. Bottomland hardwood	141	1☐	2☐	3☐
b. Hardwood plantation	142	1☐	2☐	3☐
c. Upland hardwood	143	1☐	2☐	3☐
d. Agricultural field	144	1☐	2☐	3☐
e. Grassland/pastureland	145	1☐	2☐	3☐
f. Pine plantation	146	1☐	2☐	3☐
g. Clearcut	147	1☐	2☐	3☐
h. Developed area/roads	148	1☐	2☐	3☐
e. Swamp	149	1☐	2☐	3☐
f. Mixed pine & hardwood	150	1☐	2☐	3☐
g. Natural pine	151	1☐	2☐	3☐
h. Other (Specify:___________)	152	1☐	2☐	3☐

4. What percent of each forest type would best describe your forest land? (*Total should equal 100%)*

153 ___% Bottomland hardwood
154 ___% Hardwood plantation
155 ___% Upland hardwood
156 ___% Agricultural field
157 ___% Grassland/pastureland
158 ___% Pine plantation
159 ___% Clearcut
160 ___% Developed area/roads
161 ___% Swamp
162 ___% Mixed pine and hardwood
163 ___% Natural pine
164 ___% Other → *Please specify*____

SECTION 3 – CONTROL

(*Please answer the following in terms of the forest acres specified in question 1 of section 1*)

1. In 2015, were any control methods used on your operation in order to **reduce** or **prevent** damage from wild pigs?

165
1 ☐ Yes – Continue 3 ☐ No – Go to Item 3

2. In 2015, which of the following control methods were used on your operation in order to **reduce** or **prevent** damage from wild pigs? If the method was used in 2015, how much did that method cost (including labor) and how effective was it?

Control Method	**Used on operation in 2015?**	**Cost (Include labor)** (Dollars)	**How effective was the control method?** Check one per row			
			Not Effective	**Slightly Effective**	**Moderately Effective**	**Very Effective**
a. Shooting wild pigs on sight	166 1 ☐ Yes 3 ☐ No	167 $	168 1 ☐	2 ☐	3 ☐	4 ☐
b. Hunting wild pigs **with** dogs	169 1 ☐ Yes 3 ☐ No	170 $	171 1 ☐	2 ☐	3 ☐	4 ☐
c. Hunting wild pigs **without** dogs	172 1 ☐ Yes 3 ☐ No	173 $	174 1 ☐	2 ☐	3 ☐	4 ☐
d. Aerial hunting (helicopter)	175 1 ☐ Yes 3 ☐ No	176 $	177 1 ☐	2 ☐	3 ☐	4 ☐
e. Trapping and removing wild pigs	178 1 ☐ Yes 3 ☐ No	179 $	180 1 ☐	2 ☐	3 ☐	4 ☐
f. Repellents for wild pigs	181 1 ☐ Yes 3 ☐ No	182 $	183 1 ☐	2 ☐	3 ☐	4 ☐
g. Other (Specify: __________________)	184 1 ☐ Yes 3 ☐ No	185 $	186 1 ☐	2 ☐	3 ☐	4 ☐

3. In 2015, did you use **electric** fencing on your operation **specifically** to reduce damage by wild pigs?

187
1 ☐ Yes – Continue 3 ☐ No – Go to Item 4

a. How much did it cost to install this **electric** fencing?. . . . . **Dollars** 188

b. At the time of installation, how many years was the expected useful life of this **electric** fencing?. . **Years** 189

SECTION 3 – CONTROL

(*Please answer the following in terms of the forest acres specified in question 1 of section 1*)

4. In 2015, did you use **non-electric** fencing on your operation **specifically** to reduce damage by wild pigs?

190
1 ☐ Yes – Continue   3 ☐ No – Go to Item 5

a. How much did it cost to install this **non-electric** fencing? . . . . **Dollars** 191

b. At the time of installation, how many years was the expected useful life of this **non-electric** fencing? . . . . **Years** 192

5. In 2015, how many wild pigs were **killed** on your land? . . . . None ☐ **Head** 193

6. In 2015, did you seek help from a county, state, or federal agency because of the damage due to wild pigs on your land?

194
1 ☐ Yes
3 ☐ No
4 ☐ NA – No damage by wild pigs

7. Please choose **only one** of the statements below that best describes your opinion:

I **have** some wild pigs on my land, and I wouldn't change how many.	195	____	(go to **1A** below)
I **have** some wild pigs on my land, but would prefer to have more.	196	____	(go to **1A** below)
I **have** some wild pigs on my land, but would prefer to have fewer.	197	____	(go to **1B** below)
I **have** some wild pigs on my land, but would prefer to have none.	198	____	(go to **1B** below)
I **don't have** wild pigs on my land, and I would prefer to keep it that way.	199	____	(go to **1C** below)
I **don't have** wild pigs on my land, but would prefer to have them.	200	____	(go to **1D** below)

Please answer **only one** of the following questions based on your response above.

201 **1A.** What is the minimum you would have to be paid per acre to allow permanent eradication of wild pigs from ALL of your land? (Check **ONE** dollar amount below)

202 **1B.** If eradication costs were spread across all farmers in your region, what is the most you would pay to guarantee permanent eradication of wild pigs from your land? (Check **ONE** dollar amount below)

203 **1C.** What would be the most you would pay to guarantee that wild pigs never spread to your land? (Check **ONE** dollar amount below)

204 **1D.** What is the minimum you would have to be paid per acre to never have wild pigs on your land? (Check **ONE** dollar amount below)

1 ____$0	4 ____$5/acre per year	7 ____$10/acre per year	10 ____$15/acre per year
2 ____$20/acre per year	5 ____$25/acre per year	8 ____$50/acre per year	11 ____$75/acre per year
3 ____$100/acre per year	6 ____$200/acre per year	9 ____$500/acre per year	12 ____$1,000/acre per year

SECTION 4 – HUNTING

(*Please answer the following in terms of the forest acres specified in question 1 of section 1*)

1. In 2015, did you or anyone else hunt on your land?

205
1 ☐ Yes – Continue   3 ☐ No – Go to Section 5   2 ☐ Don't Know – Go to Section 5

2. Please answer the following items regarding hunting of wildlife on your operation in 2015. Check all that apply

Hunting	Wild Pigs	Deer	Upland Birds	Waterfowl	Turkeys	Other
a. Which animals did you or your immediate family hunt on your land in 2015?	206 ☐	207 ☐	208 ☐	209 ☐	210 ☐	211 ☐
b. Which animals did anyone other than your immediate family hunt on your land in 2015 without paying?	212 ☐	213 ☐	214 ☐	215 ☐	216 ☐	217 ☐
c. Which animals did anyone pay to be allowed to hunt on your land in 2015? (Exclude guide or outfitting services)	218 ☐	219 ☐	220 ☐	221 ☐	222 ☐	223 ☐
d. For which animals did you provide a guide or outfitting service to paying hunters on your land in 2015?	224 ☐	225 ☐	226 ☐	227 ☐	228 ☐	229 ☐
e. Which animals have experienced a decline in population on your land in the last few years due to wild pigs?		230 ☐	231 ☐	232 ☐	233 ☐	234 ☐

3. During 2015, what was your net income from:

	None	Dollars
a. **Wild pig hunting** on your land?.	☐	235
b. **All hunting activities** on your land?.	☐	236

SECTION 5 – DEMOGRAPHICS

	Years
1. What was your age on December 31, 2015?.	237

2. What is your gender?. . . . . 238 1☐ Male 3☐ Female

4. Do you make the majority of the decisions about your forest land? . . . . 239 1☐ Yes 3☐ No

5. Do you have a hired manager for your forest?. . . . . 240 1☐ Yes 3☐ No

6. Do you currently live on your forest?. . . . . 241 1☐ Yes 3☐ No

	Year (YYYY)
7. In what year did you begin to make day-to-day decisions for your forest land?.	242

8. In 2015, what was your total household income before taxes? Check one only

243

- 1 ☐ Less than $1,000
- 2 ☐ $1,000 to $2,499
- 3 ☐ $2,500 to $4,999
- 4 ☐ $5,000 to $9,999
- 5 ☐ $10,000 to $24,999
- 6 ☐ $25,000 to $49,999
- 7 ☐ $50,000 to $99,999
- 8 ☐ $100,000 to $249,999
- 9 ☐ $250,000 to $499,999
- 10 ☐ $500,000 to $999,999
- 11 ☐ $1,000,000 or more

9. In 2015, what percent of your total household income came from forest related activities? Check one only

244

- 1 ☐ None
- 2 ☐ 1% to 25%
- 3 ☐ 26% to 50%
- 4 ☐ 51% to 75%
- 5 ☐ 76% to 99%
- 6 ☐ 100%