

11th International
Symposium on
Wild Boar
& Other Suids



5th to 8th September 2016
in Luxembourg

Abstract booklet



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Programme

Monday 5th of September

8-8:45 Registrations

9-9:30 Welcome talks

Welcome by the Minister of Environment, C. DIESCHBOURG

Welcome by the Benelux Secretary general, A. DE MUYSER

9:30-10:30 Session 1

- 1.1 Ecology, conservation and management of wild pigs and peccaries
- 1.2 The reproductive response of wild boar on environmental and physiological factors as well as hunting in Germany

10:30-11:15 Coffee break

11:15-12:30 Session 2: Census methods

- 2.1 Yes we can! (estimate wild boar populations)
- 2.2 Catch me if you can! new capture and handling methods for wild boars
- 2.3 Estimating wild boar population size: camera traps or distance sampling?

12:30-14:00 Lunch

14:00-15:40 Session 3: Damage

- 3.1 Using an online survey to map the extent and nature of wild boar agricultural damage in Flanders, Belgium
- 3.2 Spatio-temporal characteristics of crop damages caused by wild boar in north-eastern Poland
- 3.3 Using stable isotopes to assess the feeding regime of wild boar from different areas of central Italy
- 3.4 Main characteristics of wild boar-vehicle collisions in Slovenia
- 3.5 Overview of mitigation measures to reduce wild boar-vehicle collisions

15:40-16:25 Coffee break

16:25-17:45 Session 4: Management/hunt

- 4.1 A new tool in the toolbox for controlling wild boar in Bavaria: hunting with night vision devices and artificial light sources
- 4.2 Wild boar status, necessity of controlling the growth of its population and inefficient contribution from the hunting activity. The case of the Province of Rieti (Italy).
- 4.3 Wolf poaching in areas of wild boar hunting. A case study in central Italy.
- 4.4 How does the hunting method affect the trophy value of wild boar?



Tuesday 6th of September

9:00-10:30 Session 5: Spatial behaviour

- 5.1 First study on the endangered Bawean warty pig *Sus blouchi*: population size, ecology, behaviour and conservation
- 5.2 Occupancy and factors affecting habitat use of sympatric populations of bush pigs *Potamochoerus larvatus* and warthogs *Phacochoerus africanus* in a Miombo woodland ecosystem in western Tanzania
- 5.3 Warthog, landscape of fear, and leopard predation risk
- 5.4 Characteristics of the use of potentially damaged agricultural areas by wild boar

10:30-11:15 Coffee Break

11:15-12:30 Session 6: Urban issues

- 6.1 Wild boar becomes a citizen in Barcelona
- 6.2 Understanding urban wild boar populations: do cities represent sources or sinks?
- 6.3 Secrets of success in synanthropic mammals: spatiotemporal adjustment of wild boar to urban environments

12:30-14:00 Lunch

14:00-15:30 Workshops

- 14:00-14:45 EUROBOAR, an innovative European network for sharing data and experience between wild boar research groups
- 14:45-15:30 Use, possibilities and limitations of camera traps in wild boar research

15:30-16:15 Coffee break

16:15-16:30 Feedback from the workshops

16:30-18:00 Poster session

On the causes of why the management of the wild boar is missing in areas with overabundance and subject to damage. A case study in a protected area in Central Italy
Structural and functional connectivity of wild boar (<i>Sus scrofa</i>) along agro-forested areas: relationship to crop damage
The activity of genital glands of piglets during the reproductive period of wild boar
Connectivity of urban and rural wild boar (<i>Sus scrofa</i>) populations: Does the city of Rostock generate isolated populations or act functionally as an attractive sink for rural dispersers?
Status and management of wild boar populations in Serbia
Habitat preference and damage caused by wild boar in an urban area
Using aerial photography and drones to map agricultural damage by wild boars
Analysing wild boar hunting bag in Flanders, northern Belgium
Emerging foodborne pathogens: non-O157 STEC in wild boar (<i>Sus scrofa</i>) in Portugal
Puzzling genetic structure in the wild boar population of Umbria, Italy
Genetic diversity and population structure of Lithuanian wild boars (<i>Sus scrofa</i>)
Magnetoreception
Wild boar and its dependence on food sources of human origin in the Czech Republic
Using camera traps to monitor wild boar management in a National Park
The applicability of unmanned aerial vehicle to estimate damages on winter wheat caused by wild boar

18:30-19:30 Reception

Welcome by a representative of the Municipal Council of Mersch

19:30 Conference dinner



Wednesday 7th of September

9:00 - 10:30 Session 7: Management/hunt

- 7.1 Comparative analysis of wild boar harvest in Serbia and Slovenia, with an emphasis on hunter safety
- 7.2 What drives wild boar populations?
- 7.3 Wild boar population characteristics: result of hunter's management?
- 7.4 Towards a qualitative management of a Belgian wild boar population

10:30-11:15 Coffee Break

11:15-12:30 Session 8: Diseases

- 8.1 African swine fever in wild boar population: Lithuanian experience
- 8.2 Impact of extreme weather conditions on wild boar mortality in lowland forest ecosystems in Croatia
- 8.3 Slow spread of the African swine fever in Poland - the role of wild boar behaviour and management

12:30-14:00 Lunch

14:00-15:40 Session 9: Genetics

- 9.1 Polymorphisms in mc1r and nr6a1 genes in wild boars from South-Eastern Europe
- 9.2 Genetic variability of wild boar populations in the northern Dinaric Balkans: how does it fit in European context?
- 9.3 Development of wild boar species-specific DNA markers
- 9.4 SNP data in the detection of hybridization levels between wild boar and domestic pig in Europe
- 9.5 Assessing rates and patterns of hybridization between wild boar and domestic pig in Europe

15:40-16:15 Coffee break

16:15-17:45 Session 10: Reproduction and diet

- 10.1 Investigating factors affecting multiple paternity rates in wild boar: an inter-population approach
- 10.2 Sex ratios revealed by non-invasive genetics as an important factor in wild boar management
- 10.3 Activity of wild boar sows during the reproductive period
- 10.4 Dietary items as possible sources of 137cs in wild boar from the forest ecosystem, western Croatia

17:45-18:00 Student awards and farewell



Thursday 8th of September

Excursion

- Departure 9:00 in Mersch, train station
- The [Grand-Duke's former hunting reserve](#) and wild boar feeding place (historic site)
- Lunch
- A stop at the airport/train station or a transport there can be arranged.
- The very recently inaugurated impressive visitor's center "[Biodiversum](#)" in the commune of [SCHENGEN](#), situated in a Natura2000 and RAMSAR wetland-area with a particularly rich avifauna, surrounded by vineyards and hosting, of course, wild boar, a complicated constellation!
- Departure: around 17h, stop at Luxembourg train station around 18, a stop at the airport can be scheduled



Introduction

32 years after the first conference in France, the 11th symposium on wild boar and other suids will be held in Luxembourg. The fact that the conference being successfully held with over 100 participants, in a 2-year rhythm, shows the importance of an exchange of advances by research teams working in Europe, but also around the world. Increasing knowledge about this economically important species, mainly with the aim to achieve effective, humane and environmentally sensitive management and conservation of suids is of high concern to conservation biologists, wildlife managers, veterinarians, policy makers and the general public.

The most recent results from basic research, on population monitoring, behaviour, ecology, spatial use or genetics will be presented in the first sessions, to address problems such as urbanisation, disease transmission or damage mitigation in the following sessions and workshop.

The worldwide interest in ecology, management and population control of these species is continuing to grow rapidly. Therefore, the time is ripe for the 11th Symposium to provide an up-to-date overview of the most recent advances.



Session 1

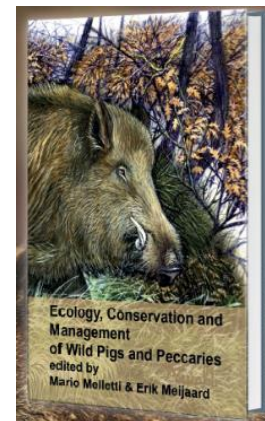
1.1 Ecology, Conservation and management of wild pigs and peccaries

MELLETTI M.¹, MEIJAARD E.²

This forthcoming volume summarizes most literature available on ecology, conservation and management of wild pigs and peccaries. The initial stages of this work were begun in 2015 when the editors set out to put together a basic idea of the topics to treat on Suidae and Tayassuidae families. In addition to the wild species, we decided to include some important aspects on feral pigs management from most Continents. These topics are very important and current in the present day because these invasive animals pose serious threats, for example, impacting negatively many ecosystems, threatening indigenous species in particular in small islands and destroying cultivated land with important economic losses. The layout of the book follows a detailed arrangement in three sections consisting of 37 chapters. The first section begins with "Evolution, Taxonomy and Domestication" (chapters 1-5) and presents a review of the phylogenetic relationships, evolution and domestication of extant and fossil Suidae. The second one starts with "Species Accounts" (chapters 6-25). The aim of this section is to give to the readers detailed and comprehensive accounts summarising most literature available for each species. In the last section "Conservation and Management" (chapters 26-37), we have arranged a variety of accounts about conservation status, ecological impact of wild boar, ex situ conservation programmes and some manuscripts related to wild boar and feral pigs management through different regions.

We hope that the final result will be an original and comprehensive volume made possible thanks to the contribution of almost 100 international experts from 23 countries including Wild Pig Specialist Group and Peccary Specialist Group of IUCN/SSC to contribute with their valuable expertise to this project. We also hope that this book will inform and inspire greater interest on these groups of species to help in our understanding of them and in their successful conservation.

Keywords: Ecology, Conservation, Management, Pigs, Peccaries



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1.2 The reproductive response of wild boar on environmental and physiological factors as well as hunting in Germany

FRAUENDORF M.¹, LUSTIG, J.¹, GETHÖFFER F.¹, KEULING O.¹

Wild boar populations increased in Europe in the last decades and cause problems like crop damage, disease transmission and vehicle accidents. Therefore, it is necessary to investigate the underlying causes to reduce populations effectively. Wild boar reproductive capacity is one of the highest among mammals. Thus, factors determining wild boar reproduction are still one of the main areas of research.

During twelve hunting seasons (2003 - 2014), we sampled 3011 reproductive tracts of wild boar females. Maternal age and body mass were determined and the number, sex and size of foetuses were measured/determined. Weather and mast conditions as well as hunting index (HI) were associated with each sampled individual. Generalized linear models and other statistics were performed to detect which factors influence reproductive parameters of wild boar.

Likelihood of puberty had a higher increase in a small body mass interval, than in an age time lapse. Puberty was possible even at a body mass of 10 kg dressed weight, whereas pregnancy did not considerably occur below 30 kg dressed weight. Higher age and body mass led to larger litter size and earlier parturition. Heavier sows produced more male offspring in years of oak mast failure as well as in rainy summers, whereas in excellent mast years they invested more in females. Excellent mast conditions of oak had a positive effect on litter size and earlier parturition. Rainy and warm autumns resulted in increased litter size. Warm autumns led to earlier parturition in piglets but did not change the parturition time in yearlings and adults. Low HI of the same year was positively correlated with high litter size and earlier parturition. With increasing HI of the previous year sows produced more female offspring.

Wild boar reproduction responds to maternal physiology, environment, hunting and/or density. Those information should be used for management purpose.

Keywords: reproduction, puberty, litter size, parturition date, sex ratio

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Session 2: Census methods

2.1 Yes we can! (Estimate wild boar populations)

FOCARDI S.¹, FRANZETTI B.², LA MORGIA V.², MONTANARO P.², RIGA F.², CALABRESE A.², RONCHI F.², ARAGNO P.², SCACCO M.², CALMANTI R.²

The lack of reliable estimates of wild boar populations is a huge obstacle to define scientifically sound management. In the lack of reliable estimation procedures, wildlife biologists and managers have to use proxies of density whose use is however vulnerable to criticisms and requires careful calibration to be useful in scientific wildlife management. Unfortunately, such calibration has been seldom, if ever, performed in wild boar management. A methodology based on line transect, thermal imagery and distance sampling (Nocturnal Line Transect, NLT) was proved to be able to assess with good precision a wild boar population in forested Mediterranean ecosystems. But other researches have failed to reproduce such results and have attributed their failure to unfavourable habitat conditions (for instance low visibility or low population density).

In order to better evaluate merits and limitations of NLT methodology in the assessment of wild boar populations we performed several NLT experiments in four different locations characterized by habitats with different visibility and structure, as well as variable wild boar densities. Experiments were performed on hills (Colli Euganei), plains (Castelporziano) and mountains (Monte Arcosu, Casentino), in broadleaves, coniferous, scrublands and open habitats, characterized by a standardized index of visibility spanning one order of magnitude i.e. from 9.7 m in scrublands at Monte Arcosu to 95 m in the open areas at Castelporziano. Estimated population density varied from 3.6 boar/km² in the mountain area of Casentino to 43.5 boar/km² in the woods of Castelporziano. We show that the average detectability of wild boar was quite variable and ranged between 0.13 and 0.60 but that, in every case, it was possible to estimate animal density. Reliability of our estimates was clearly depending on sample size. The relationship between precision of estimates and the log_e of sample size is inverse ($r=-0.64$) but in part depended on the study area. We discuss these results in a cost-benefit framework and we show that under common conditions of use, NLT can be quite effective for estimating wild boar populations. We describe the methodology adopted to estimate habitat visibility and the field protocol of the survey. In the distance sampling the “devil is in the details” and only a careful organization of the survey can lead wildlife managers to get reliable results. We discuss the relevance of performing adequate population assessment for a better management of wild boar populations.

Keywords: population assessment, distance sampling, monitoring, thermal imaging

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2.2 Catch me if you can! New capture and handling methods for wild boar

SUTER S.M.¹, STOLLER S.¹

Capture, handling and marking of wild boar may be necessary for management and scientific purpose. Some wild boar do not enter a cage or a compound trap and thus are very difficult to catch. With the net-lift and the radio-controlled anaesthesia we developed and optimized two new methods for the capture of particularly shy individuals. The handling of wild boar for marking and GPS-collar application can be dangerous. With anaesthesia it is possible to reduce the risk that involved people get hurt during animal manipulation. However, anaesthesia may also bear risks for people and animals. We developed a simple and efficient handling technique that can be applied to wild boar without the use of anaesthesia. The advantages and risks of the new methods are discussed.

Keywords: wild boar, capture, handling, net-lift, radio-controlled anaesthesia

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2.3 Estimating wild boar population size: camera traps or distance sampling?

MASSEI G.¹, CHAUVENET A.¹, WARD A.¹, GILL R.¹

Wild boar in Europe are increasing in numbers and range and they also occur in many suburban areas. The species has a significant impact on crops, livestock, plant and animal communities and it is involved in disease transmission to livestock or humans. Assessing wild boar local densities is important to monitor population trends and to quantify the impact of population control methods. However, counting wild boar is notoriously difficult, particularly in areas where animals are regularly hunted. This is particularly relevant to the UK, where wild boar went extinct and recently recolonized parts of the country as a result of escapes from farms and illegal introductions. We present preliminary results on the theoretical and empirical use of camera trapping and distance sampling to monitor wild boar numbers in England. We built a spatially-explicit individual based model to investigate the accuracy and precision of both monitoring techniques in estimating known densities and we trialed both methods in the Forest of Dean in England.

The model showed that both distance sampling and camera trapping produced reasonably accurate estimates of the true population. Camera trapping estimates had narrow confidence intervals and were not affected by population size, but the estimates obtained through this method were highly sensitive to mean group size. Distance sampling estimates were more accurate but less precise than those from camera trapping. In addition, distance sampling consistently underestimated wild boar numbers and was sensitive to population size. Field applications of both methods resulted in very similar estimates of densities, thus increasing the credibility of the conclusions drawn from the model. We will present these data together with considerations of the relative merits and disadvantages of using other methods to monitor population trends as well as range expansion of wild boar.

Keywords: census, density estimate, modelling, population trends.

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Session 3: Damage

3.1 Using an online survey to map the extent and nature of wild boar agricultural damage in Flanders, Belgium

RUTTEN A.¹, CASAER J.², ONKELINX T.², DE SMET, L.² LEIRS H.¹

Wild boar reappeared in Flanders (Belgium) in 2006, after almost half a century of absence. The current Flemish landscape is highly fragmented which causes wild boar to come frequently into contact with human activities. Conflicts with human interests are increasing due to an increasing wild boar population. At this moment however, there is no idea of the real extent of crop damage in Flanders. In order to solve this knowledge gap, an online questionnaire was sent to farmers in the province of Limburg (Eastern Flanders). To get some idea of the possible bias linked to the characteristics of respondents, we conducted a non-respondent analysis. The analysis showed that farmers who already had damage are more inclined to respond to the online survey and that the percentage of farmers that suffered damage within the non-respondents was smaller than indicated by the results of the online survey (23,5% vs 44,3%). The difference between the results of the online survey and the answers of the non-respondents when looking at the factors influencing wild boar damage was remarkable: while forest coverage is not linked to damage according to the non-respondent analysis, it is positively correlated to damage according to the online survey. Also the effect of hunting record is not one-sided between both survey results (no effect in non-respondent survey and positive effect according to online survey). Using the information of both respondents and non-respondents, a model was built that predicted the probability for crop damage to occur for each municipality in the province of Limburg. Clear regional differences are found with this model. Future research looking further into the extent and nature of damage using drones as well as to better understand the causes for the differences in results between respondents and non-respondents is currently taking place as the next step in this research project.

Keywords: wild boar, agricultural damage, Flanders, survey

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3.2 Spatio-temporal characteristics of crop damages caused by wild boar in north-eastern Poland

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The increase of wild boar damage to farmlands has resulted in a growing conflict between farmers and hunters in north-eastern Poland. Therefore, the objective of this study was to evaluate level of crop damage and compensation for wild boar damage as well as the fiscal balance of wild boar management over an area of 1,867.2 km², where fragmented forests constituted 27.4%. During the three years (2011 – 2013), the total area of farmland damaged by wild boar (1,365 cases) amounted to 1,000.4 hectares. In this period, farmers received 432,600 EUR as compensation for destruction of crops caused by wild boar. In the area of damaged crops, cereals predominated (50.2%), followed by grasslands (24.0%) and rapeseed (21.2%). The damages by wild boar were correlated with population density ($r=0.648$), forest cover ($r = -0.514$) and distance to forest-farmland border ($r=-0.918$). The net income per year from wild boar hunting was 163,100 EUR whereas the compensation paid amounted to 144,200 EUR. The issue of reducing the conflict between farmers and hunters through lowering the wild boar population density is discussed.

Keywords: damage, farmlands, hunters, stakeholders, wild boar

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3.3 Using stable isotopes to assess the feeding regime of wild boar from different areas of central Italy

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The utilization of isotopic signatures in animal tissue provides information about environment and notably on their diet. The stable carbon ($^{13}\text{C}/^{12}\text{C}$) and nitrogen ($^{15}\text{N}/^{14}\text{N}$) isotopes ratio in hair and muscles of animals can be useful for such investigations. Therefore, the $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ of wild boar sampled in November and December 2014 in three different areas within the Lazio Region, Italy (namely Rome close to the Tyrrhenian Sea (TS)), Southern Maremma (SM) and Central Maremma (CM) were determined. Wild boar from TS (n=5) differ according to the $\delta^{13}\text{C}$ values from animals sampled in CM (n=6) and SM (n=5) areas, while the samples from SM differed from the other two areas considering the $\delta^{15}\text{N}$ values. More pronounced isotopic values of hair ($\delta^{15}\text{N}$ and $\delta^{13}\text{C}$) in comparison with muscle suggest a protein enrichment in the diet of the wild boar in the short period (about 2-3 months of the hair growth). The land use of the study areas may explain differences in carbon and nitrogen isotopic signatures, suggesting different dietary regimes of the three investigated wild boar populations. The values confirm the herbivore behaviour of wild boar analysed, mostly characterized by C3 plants. However, the isotopic signature in TS area indicates the supplementary feeding: it can include the feeding of animal origin proteins, and suggest the supply of maize (C4 plant) to the local population of wild boars. Based on these preliminary results, the determination of stable isotopes in wild boar tissues can be a useful tool to reconstruct the diet, and to develop management strategies of wild boar populations.

Keywords: wild boar, feeding regime, $\delta^{13}\text{C}$, $\delta^{15}\text{N}$, agriculture.

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3.4 Main characteristics of wild boar-vehicle collision in Slovenia

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Worldwide, ungulate-vehicle collisions provoke a high risk for road safety and represent an important economic loss; moreover, they significantly contribute to wildlife mortality, and hamper the outcome of the population management. Contrary to deer-vehicle collisions, which have been intensively studied for decades, data on wild boar-vehicle collisions (WB-VC) are very scarce. However, a fast population growth has clearly increased the risk for WB-VC, and understanding of their basic characteristics/patterns, enabling implementation of adequate mitigation strategies/measures, would become one of crucial issues in wild boar management.

In Slovenia, an on-line available hunting information system, containing several data on every single ungulate or large carnivore that has been either harvested or died due to any other reason (including traffic-related mortality) was developed by population managers. Such a database enables studies across the whole gradient of species' distribution in the country. For the purposes of this study, we used data on all harvested and traffic-killed wild boar in Slovenia between 1 January 2006 and 17 July 2016. In this period, 83,754 wild boar were harvested (annual cull ranged from 4,610 individuals in 2006, to 12,837 in 2012), and additional 2,048 were registered to have died due to any other reason, including 951 cases of road-kill (66 in 2006, 143 in 2012), and 175 cases of railway-kill (5 in 2006, 36 in 2015), respectively. There is a highly significant correlation between annual harvest rate (as a rough indicator of population size) and road-kill ($r=0.93$, $p=0.0000$), indicating that number of road-related WB-VC is linearly dependent on the population size. However, this is not so much expressed in railway mortality ($r=0.58$, $p=0.0622$), which shows high stochasticity due to predominant massive kill of large groups. Indeed, while single animals ($n=815$, 85.7%) or pairs, primarily twins (42 cases, 84 individuals, 8.8%) prevail in road-mortality, the railway-mortality is much more group-related (single animals: 75 cases, 42.6%; pairs: 13 cases, 26 individuals, 14.8%; triplets: 7 cases, 21 individuals, 11.9%; groups of >3 animals: 9 cases, 54 animals, 30.7%), and even 15 individuals (!) were train-killed in a single collision in August 2007.

The following data will also be presented: (i) seasonal distribution of WB-VC with a very evident peak in October–December period, coinciding fairly well with the period of the most intensive drive-hunts; however, no day-dependent mortality was found in this period; (ii) bimodal daily distribution of WB-VC with two peaks during the night and early morning; (iii) sex-biased structure in traffic-related mortality of wild boar and reasoning for demographic differences (males prevail in subadults, and sows in adults); (iv) main environmental factors influencing the number of WB-VC. In conclusions, some possible mitigation measures and management implications for reducing the risk for wild boar-traffic collisions will be discussed.

Keywords: wild boar-vehicle collision, road, railway, road safety, traffic-related mortality

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3.5 Overview of mitigation measures to reduce wild boar-vehicle collision

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Wild boar populations are expanding all over Europe. The colonization of urbanized and cropland areas together with the population increase are posing a serious conflict to road traffic safety due to wild boar-vehicle collisions. The hazards can be significantly reduced by applying proper mitigation measures on roads and railways. Several projects developed in Catalonia (NE Spain) during the last 10 years have brought new information that can be applied to reduce collision numbers. Data from 2320 accidents involving ungulates (wild boar caused 85% of the total) registered in the Catalan road network during a five-year 2007 to 2011 were analysed to identify high-risk clusters and investigate the effects of landscape and road-related variables. Dense road verge vegetation was one of the variables consistently associated with increased probabilities of UVC clustering as well as the presence of garbage containers nearby roads. Those results suggest that road verges management can have a significant role on reducing the hazards. Several mitigation measures have been applied and monitored. Proper fauna passages combined with suitable fencing (which requires particular features to be effective to deter wild boar) allow to reduce the number of road traffic accidents involving wild boar. Nevertheless, those measures are suitable to be applied only in highways and other main roads. Proper design of fences and wildlife crossings to provide safe passages for wild boar across roads will be presented. In secondary roads where fencing is not possible or recommended due to landscape features or land uses beside the infrastructures, road verge management combined with reinforced temporary awareness signs show encouraging positive results. An overview of mitigation measures applied to reduce wild boar vehicle collisions and new technologies being tested will be presented.

Keywords: wild boar-vehicle collisions, fauna passages, fencing, traffic.

Acknowledgements: Department of Territory and Sustainability (Catalan Government) provided the data analysed and promoted the projects undertaken.

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Session 4: Management / Hunt

4.1 A new tool in the toolbox for controlling wild boar in Bavaria: hunting with night vision devices and artificial light sources

Hahn N.¹

In principle, the hunting and weapons' legislation does not allow the use of night vision devices or artificial light sources for hunting wild boar and other wildlife in Germany. Nevertheless, night hunting on wild boar is legal. Hunters, farmers and other stakeholders discussed the use of night vision scopes and flashlights controversially for years. The argumentation about the effects on the wild boar population, on damage mitigation, on animal behaviour, on animal welfare and on other aspects remained wild guesses until the practicability of night vision devices and artificial light sources for wild boar hunting was tested in the federal state of Bavaria within the project "Focus on wild boar - project to develop innovative regional concepts", led by the Bavarian State Institute of Forestry (LWF).

Based on two resolutions of the Bavarian state parliament and after a long mutual communication and coordination of the competent authorities the test of night vision devices and artificial light sources for wild boar hunting was run between January 2012 and November 2013. The open and unbiased test was restricted to 42 hunters in four pilot regions who volunteered on own choice. The hunters involved had an exceptional permission to use the night hunting equipment. 9 night vision scopes (generation II) were borrowed from the collections of the Bavarian State Office of Criminal Investigations (BLKA) and were fitted on regular hunting rifles. The artificial light sources (flashlights) are clipped at the own hunting rifles of the participating hunters.

In total, 179 wild boar were shot during the test, 139 with night vision devices and 40 with flash lights. Per each successful hunt with respective technique the hunters recorded several data and information (firing distance, vegetation cover, weather/light conditions, identifiability of age and social status of the shot animals, behaviour of accompanying animals etc.) on comprehensive tally sheets. This allowed to assess the strength, weakness and effects of using night vision devices and artificial light sources for wild boar hunting during the night. Meanwhile, based on the presented results and under restrictive legal conditions, the competent authorities in Bavaria enabled hunters of the federal state to use the new technical tool in "conflict regions" without changing the actual weapons and hunting legislation.

Keywords: night vision devices, artificial light sources, legislation, practicability, Bavaria

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4.2 Wild boar status, necessity of controlling the growth of its population and inefficient contribution from the hunting activity. The case of the Province of Rieti (Italy).

ADRIANI S.¹, BELLEZZA P.², BONANNI M.³, CAVAGNUOLO L.², MORELLI E.³

The wild boar, reintroduced in many areas of Italy for hunting between 1960 and 1970, has shown a growth in population number of 400% over the last 15 years. At present the number of animals is estimated to be around 1 million. Despite the huge number of annual harvest (60% of the population), a remaining estimate of 400,000 wild boar which are active in reproduction replenishes the population (estimated yearly increase of 180%). The current hunting activity is not sufficient to contain the species within limits sustainable for agricultural ecosystems.

The management plans in the province of Rieti establish the culling of 5,000 animals/year, distributed among the dog drive hunting teams. In the last 3 hunting seasons the culling plans were never completed. In addition, hunters on average declare only 64% of the animals actually harvested, impairing the possibility for the technicians to work on robust statistics. Hunters do not pay attention to the overall wild boar population but rather try to keep in their hunting areas a number of reproductive animals sufficient to guarantee plenty of animals to hunt in the following season. This in practice consists in preserving the females, especially if pregnant, at the end of each hunting season. This behaviour is clearly in contrast with the management plans that are consequently never realised and are as such unhelpful for solving the conflict with the agricultural sector.

As a solution, hunters should be responsible and charged for the damage to crops happening in their specific hunting area, and teams that do not realize the assigned culling-quotas should be penalised by moving their hunting rights to less populated areas.

Keywords: *Sus scrofa*, management, Rieti, dog drive hunting

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4.3 Wolf poaching in areas of wild boar hunting. A case study in Central Italy.

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Many wild boar hunters think of the wolf as a competitor stealing the prey from the hunting. The only available estimate reports wolf predation on wild boar about 50 wild boar/year/wolf. This conflicting situation leads to predisposition to wolf poaching. Some authors estimate the yearly rate of wolf poaching in Italy to be between 10 and 20% of the entire wolf population, and most of the cases are associated to wild boar dog drive hunting. This work provides the first estimates for the extent of wolf poaching in some areas in the province of Rieti. The data are obtained from hunters operating in a random sample of 15 teams (of the 132 active hunting teams, 11.4%). These informers, particularly sensitive to the preservation of the fauna, declare confidentially the poaching actions against the wolf (and roe deer) and the true number of wild boar harvest.

During the five years in the period 2003-04 till 2007-08 there were reports on 46 illegal wolf killings in the study area, with a yearly mean number of 9.2 animals (S.D.=±1.9; min. 7 - max. 12), and a mean number of 3.1 per team (S.D.=±2.4; min. 0 - max. 7).

Within the 15 teams included in the survey, only 4 rejected any type of poaching on wolf, even if they considered the wolf excessively present and competing with the hunters for wild boar. The other 11 teams did not condemn poaching. All the teams declared that roe deer is a disturbing factor for wild boar dog drive hunting.

Preventing and diminishing the negative attitudes that wild boar hunters have against wolf (and roe deer) is a priority, and it can be achieved by providing affordable data on the actual influence of wolf predation on wild ungulates' population.

Keywords: *Sus scrofa*, wolf, hunting, poaching

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4.4 How does the hunting method affect the trophy value of wild boar?

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In recent years, wild boar has recorded trends of growth in population number and cull in whole of Europe. Similar situation is also in Croatia where the population number has almost doubled in the last ten years. This paper examines how the increased population number of wild boar reflects on the proportion of trophy individuals as well as on the average trophy value of culled boars. The period 1999 - 2014 we analysed structure and trophy value of culled wild boar in two hunting grounds in central Croatia (IV/22 "Petrova gora", and IV/9 "Pokupski bazen"), which are managed by Hrvatske šume d.o.o., a government owned company, and therefore the management strategy is identical in both hunting grounds. Information needed for the research were taken from forms that had been filled in accordance with valid Croatian regulations. Through analysing sex and age structure and trophy value of culled animals in the observed period, we wanted to determine trends and correlation of different researched parameters. Results show that in younger age categories both sexes form equal percentages in the cull. Number of females increases over males in middle-aged and mature individuals. In the last ten years' trophy values have been stagnant or slightly decreasing. Reasons for this trend can be found in changes of hunting methods, since drive hunt has become dominant and therefore selection of the animal before culling is not usual. This hunting method results in increased ratio/proportion of adult female in cull, particularly because typically older females are herd leaders and are therefore often the first culled in drive hunts. On the other hand, these hunts are more interesting to hunters and much more cost effective to hunting right holders.

Keywords: wild boar, trophy value, wildlife management, population density, drive hunt

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Session 5: Spatial behaviour

5.1 First study on the endangered Bawean warty pig *Sus blouchi*: population size, ecology, behaviour and conservation

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The Bawean warty pig (*Sus blouchi*) is endemic to Bawean, a 200 km² island located 150 km from East Java in the Java Sea. Despite the fact that the species is listed as Endangered on the IUCN Red List due to habitat loss and persecution as a crop-pest, it is not protected by Indonesian law, and remains understudied. Between November 2014 and December 2015 we conducted the first ecological study of Bawean warty pigs. We used camera traps, placed randomly in the island's forested areas to estimate population size and to increase our knowledge of habitat preferences and behaviour of the species.

We collected 985 independent videos of Bawean warty pigs during 4516 camera-trap days. By using a Random Encounter Model, which does not require the identification of individual animals, we estimated a total population size of 172–377 individuals. Generalized linear models indicated that animals are more abundant nearer to the forest border and prefer community forest over other forest types, probably due to the higher abundance of food or more energy-rich food. Group sizes varied between 1 and 9 individuals, with a mean group composition of 2.1 ± 1.5 SD (average male to female ratio 1:2). Average litter size was 2.2 individuals (range 1-6). The distribution of piglet presence over time indicated a main breeding season between April and July. Males were observed to join groups, roam alone or in bachelor groups, with no apparent seasonal patterns. *Sus scrofa* is apparently absent from Bawean.

Our results confirm the Red List Status Endangered, based on the very small population size of Bawean warty pigs. Although it seems to be safe from the threat of hybridization, due to its isolated population, the population is vulnerable to increased levels of threats or unforeseen catastrophes. Accordingly, we recommend the legal protection of Bawean warty pigs and the cooperation with local people to develop non-lethal crop-protection measures.

Keywords: breeding season, camera trapping, habitat preferences, protection, random encounter model, social behaviour,

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5.2 Occupancy and factors affecting habitat use of sympatric populations of bush pigs *Potamochoerus larvatus* and warthogs *Phacochoerus africanus* in a Miombo woodland ecosystem in western Tanzania

FISCHER C.¹, MOLNAR B.¹, HAUSSER H.¹

Extended areas of Western and South-Western Tanzania are still covered by natural habitats, within the Miombo woodland biome. These woodlands are characterized by a succession of rainy and dry seasons, the latter lasting for 6 to 7 months. They are dominated by trees of the genus *Brachystega* and *Jubernardia* that shed their leaves for a short period at the end of the dry season. The understory is largely dominated by grasslands and this kind of habitats is actually also known as wooded savannahs.

The Miombo woodlands are home of a large biodiversity, with a mix of forest and savannah species and in addition species that are endemic to the Miombo. The Suids are interesting in this respect as the bush pig (*Potamochoerus larvatus*), a forest dweller, and the warthog (*Phacochoerus africanus*), which is more adapted to open habitats, meet in this ecosystem. In the frame of a larger project aiming at determining the impact of governance and human activities on the biodiversity of the community of medium to large sized mammals we obtained a large data set on both Suid species. In this paper we propose to assess how these species share the ecosystem and if this can be explained only by natural factors or also by anthropogenic ones.

We considered two protected areas (PA) of different conservation status, a game reserve (IUCN status IV) and a forest reserve (IUCN status VI). In each of these PAs we monitored medium to large sized mammals using camera traps. In our sampling protocol we chose 4 squares of 10x10 km in each PA. Each square was further divided into squares of 2x2 km, giving grids with 36 intersections. A camera trap was set at each intersection for a period of 21 days.

With an effort of 4834 camera trap days, we generated 4781 pictures of 43 mammal species. Warthogs generated 100 independent pictures distributed over 53 different camera trap locations, and bush pigs generated 38 independent pictures distributed over 34 camera trap locations. The warthog was the second most frequent species and the bush pig the third.

This data set allows performing an analysis of occupancy taking into account various environmental covariates. This analysis is now in progress.

Keywords: camera trapping, occupancy, warthog, bush pig

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5.3 Warthog, landscape of fear, and leopard predation risk

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Animal distribution in the landscape is driven by resource selection patterns that depend on factors other than resource availability. Animals need to balance the trade-off between the benefits of exploiting resources and the costs associated with accessing them. Distribution in the landscape is therefore driven by the need to balance access to limiting resources, and avoidance of predation risk. Heterogeneous landscapes provide solutions to the risk-forage trade-off. In this study, we investigated the drivers of warthog (*Phacochoerus africanus*) distribution in Phinda Game Reserve, South Africa. Specifically, we modelled warthog distribution using occupancy modelling with data collected along road transects. We explored the effect of landscape covariables such as topography, vegetation types, and access to water sources in the dry and the wet seasons. We also used an existing leopard (*Panthera pardus*) resource selection function (RSF) as a putative explanatory variable of warthog distribution. We validated the warthog distribution model with reserved data collected along the same transects at different occasions. We then contrasted warthog distribution with warthog mortalities recorded in the same landscape to highlight the possible mismatch between the perceived landscape of fear through leopard habitat used and the realised mortality risk. Warthog were mostly distributed in the most open vegetation types of the reserve, although presence data were also recorded in closed-canopy habitats. In contrast, leopards were most likely present in closed habitats, and less so in open habitats like grasslands. We recorded 53 warthog killed by leopards, mostly in open habitats. We conclude that although warthog avoided leopard at the landscape scale, their preferred habitat does not exempt them from leopard predation risk. Future analyses will have to include predation risk by other large predators, such as spotted hyena (*Crocuta crocuta*) or lion (*Panthera leo*) which use other habitats than leopards, to get a complete understanding of warthog landscape of fear and distribution.

Keywords: landscape of fear, leopard occupancy, resource selection function, warthog

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5.4 Characteristics of the use of potentially damaged agricultural areas by wild boar

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The wild boar population has increased steadily in Hungary and the rest of Europe since the beginning of the 1980s. One of the main factors increasing population recruitment are the mild winters caused by climate change; however, the density growth within the population is mainly due to under-harvesting. The density increase of wild boar and the expansion of human settlements both lead to the synurbanization of the species. We investigated the phenomenon in a heavily developed tourist area in the highlands of Lake Balaton. The tourist area here is enclosed by reeds on the lake shore from one side and by a forest of the Bakony Mountains from the other; wild boar use both of these habitats. We trapped wild boar females in a shrubland habitat on the edge of the reeds and equipped them with GPS collars. We investigated the seasonal change of the home ranges, the activity patterns, and the habitat preference. Habitat use was determined by direct GPS position tracking in the field. We surveyed the failures of the fences on the estimated tracks of the wild boar. Factors affecting urban area use and preferred habitat types were determined, and the damages caused by wild boar were assessed. Recommendations to decrease the presence of wild boar in the urbanized area were suggested.

Keywords: wild boar, damage, synurbanization, habitat preference, activity

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Session 6: Urban issues

6.1 Wild boar becomes a citizen in Barcelona

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Wild boar numbers are increasing all over Europe, accompanied by habituation to urban habitats in several European cities. In the urban area of Barcelona (Spain), the Collserola massif (CM) is the main source for wild boar entering the city.

The objectives of this study are 1) identifying the factors explaining the localization of urban wild boar incidences within the urban area of Barcelona; 2) modelling the evolution of the CM wild boar population; 3) assessing management measures for the CM wild boar population through statistical modelling.

Boosted regression trees were used to assess the relationship between wild boar presence in the urban area of Barcelona and eight predictor variables. Stochastic models for the CM wild boar population were developed through Population Viability Analysis using Vortex software.

Wild boar presence was positively associated with low distance to CM and watercourses entering the urban area of Barcelona, as well as green area surface, proximity to cat colonies and fragmentation. Wild boar presence was more common from March to October, with high temperatures and periods without rain. Wild boar population in the CM exceeds the carrying capacity of the natural environment, probably due to anthropogenic food resources. The most efficient measures to reduce wild boar abundance and the related conflicts were reducing carrying capacity, as well as juvenile and yearling survival rates of both male and female.

Keywords: urban wild boar, boosted regression trees, population viability analysis, urban factors, modeling

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6.2 Understanding urban wild boar populations: do cities represent sources or sinks?

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Urban sprawl has resulted in the permanent presence of some large mammal species in and around urban areas, leading to human-wildlife conflicts. Wild boar (*Sus scrofa*) are establishing a permanent presence in many cities in Europe, with the largest German urban population occurring in Berlin. However, the lack of knowledge of colonisation processes, dispersal patterns and connectivity of urban populations is hampering the development of effective management plans.

We used 13 microsatellite loci to genotype 387 adult and sub-adult wild boar from urban Berlin (forested and built-up areas) and from the surrounding rural forests in Brandenburg. We used genetic clustering algorithms to analyse the population genetic structure of the animals and Approximate Bayesian Computation to infer the colonisation history of the city. Finally, we used assignment tests to determine the origin of the wild boar hunted in the urban built-up areas.

The animals in three urban forests formed distinct genetic clusters, with the remaining samples all being assigned to one rural population. One urban cluster was founded by individuals from another urban cluster rather than by rural immigrants. The wild boar that had been harvested within urban built-up areas were predominantly assigned to the rural cluster surrounding the urban area, rather than to one of the urban clusters. Our results are likely to have an immediate impact on management strategies, because they show that there are not only distinct urban clusters, but also sink source dynamics between urban and rural areas. It is therefore essential, that Berlin and Brandenburg develop common hunting plans to control the population and reduce conflicts in urban areas.

Keywords: urban ecology, urban-rural gradient, human wildlife conflict, microsatellites, Berlin

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6.3 Secrets of success in synanthropic mammals: spatiotemporal adjustment of wild boar to urban environments

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Simultaneously to the rise of urban environments, the occurrence of synanthropic, well adjusting mammals is a worldwide phenomenon. We use wild boar (*Sus scrofa*) as a model species to analyse spatial and temporal adjustments of movement behaviour to life in the city. Understanding the use of human-modified environments and processes how animals adjust to novel habitats is not only an ecologically relevant topic, but can also be used to optimize management of conflict species.

We analysed movement behaviour of wild boar trapped and collared in urban areas of Germany's capital Berlin in comparison with rural wild boar from the neighbouring federal state Brandenburg (n=11). Home range size and shift as well as the shift of resting sites were compared in different seasons among the two groups with help of linear mixed models (LMMS) including different landscape variables. We also calculated generalized linear mixed models (GLMMs) comparing possibly available locations based on a movement process (correlated random walks CRW) with the used wild boar tracks – and in a second model set active and inactive locations - to determine differences in spatio-temporal behaviour in urban and rural environments.

Urban wild boar had smaller home ranges and more stable resting sites than rural wild boar that had larger home ranges when the coverage with housing areas was high. The distance to houses, forest, water, roads and the amount of vegetation (measured by the normalized density vegetation index (NDVI)) is different among wild boar populations: In urban areas wild boar select areas close to houses and roads but with a higher NDVI than rural wild boar. Urban individuals are more likely to select areas with a larger distance to forests and water when they are active and avoid these patches when they rest.

Wild boar exhibit a high behavioural plasticity regarding space use that helps them adjusting to novel habitats such as urban environments. They learn to predict human activity and presence and therefore select areas with a low disturbance, even if these are located next to or within human dominated landscape structures.

Keywords: urban ecology, movement, behavioural plasticity, habitat use, spatio-temporal adjustment

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Workshop session on census methods

Using camera traps to monitor wild boar management in a National Park

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Wild boar made their reappearance in Flanders, northern Belgium, in 2006. Given the highly fragmented landscape structure of the region, small scale landownership and linked hunting rights, the intermixture of small nature, agriculture and urbanized areas there is a high potential for human-wildlife conflicts.

In order to contribute to the management of the wild boar population the Nature and Forest Agency (ANB) started to lease hunting licenses in National Park Hoge Kempen (NPHK). Given that hunting in a national park, and nature reserves in general, is often debated in Flanders, ANB asked the Research Institute for Nature and Forest to monitor both hunting efforts and the results. As part of this project the feasibility of using camera traps to monitor changes in the wild boar population was evaluated.

Within a 470 ha zone of the park, 12 camera traps were placed at random locations within each of four habitat types, each time for a period of 2 weeks and this was repeated several months during 2014 -2016. The images were stored and scored within the camera-trapping database system 'Agouti' (WUR). Angle and distance to the camera were measured in the field to quantify the effective sampling area for all animals observed. Data were analysed using a combination of Random Encounter Modelling and Distance Sampling.

We recorded a non-neglectable number of wild boar – contrary to what was expected – although densities were still low. We also found large variation in the number of observations and detection distances between habitat types as well as between plots within the same habitat type. The results show that random-encounter modelling is very promising as an index method to monitor the wild boar management, although measuring the effective sampling area and daily distance travelled seem too labour-intensive for use in a management context.

Keywords: camera traps, management, National Park, REM, Flanders.

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Poster session

On the causes of why the management of the wild boar is missing in areas with overabundance and subject to damage. A case study in a protected area in Central Italy

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In the natural reserve of lakes Lungo and Ripasottile (Rieti, Italy) there are extended intensive corn crops constantly damaged by an unknown number of wild boar. This situation is unbearable both for economic reasons and for the social conflict with the farmers. To reduce the damage and to minimize the controversy, for over 10 years in this protected region there have been specific plans for wild boar culls. These plans have, however, never reached the desired goals, mostly because harvesting of the animals is impeded and much lower than planned. This study aims to identify the reasons behind the impediments to the culling. It is based on the analysis of the records registered at the reserve and on interviews to the stakeholders: park guards, officers and directors of the area, farmers and hunters.

The killings are prevented by actions disturbing the boar, tampering of the traps, false and pressing inspections from the police, and anonymous complaints.

The interest of hunters to keep a high number of wild boar in the protected area to guarantee an adequate availability of animals in nearby regions during the hunting season, is in fact antithetical and dominates over the farmers' interest in having a stable minimal presence of wild boar. Therefore, recreational hunting outside the reserve is *de facto* oppressing the agricultural activity inside the reserve.

Keywords: *Sus scrofa*, hunting, damage, capture

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Structural and functional connectivity of wild boar (*Sus scrofa*) along agro-forested areas, relationship to crop damage

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The increase of agricultural lands on the natural habitats of wild boar (WB) occurs widely throughout Europe, and the species is adapting to new agro-forest landscapes. In fact, the species has sustained population increases over the past three decades, corresponding to increasing crop damage too. The present work shows that the structure and configuration of the new agro-forested landscapes and its connectivity have potential for use as a predictor of crop damage by WB. Several Spanish agro-forest landscapes or “Scenarios”, were defined to develop a network connectivity model to determine the capability to correlate crop damage, -by identifying critical nodes based on graph theory-, species suitable habitat and WB dispersal capacity. The study shows that an integrated analytical framework provided by a Probability of Connectivity index can be used to evaluate how habitat patches from different agro-forest landscapes have an impact on WB population and determine their role in crop damage. A Spearman’s rank correlation shows a relationship between higher levels of connectivity among habitat patches with high levels of crop damage by each Scenario. Thus, connectivity models are useful in order to establish integrated management strategies, with potential use by farmers or wildlife managers as support tools in establishing measures to mitigate conflicts with WB on agricultural lands or in the planning of conservation strategies. The approach could be extended to other conflicts involving WB such as other wild ungulates, detecting risk areas for vehicle collisions, contact between wildlife and livestock, and the spreading of diseases.

Keywords: *Sus scrofa*, graph theory, landscape connectivity, habitat quality, crop damage.

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The activity of genital glands of piglets during the reproductive period of wild boar

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Density of wild boar (*Sus scrofa* L.) in Central Europe has unprecedentedly increased in recent decades, as a result of changed environmental conditions which comply with specific characteristics and demands of wild boar. The knowledge on the reproductive capability is very important for the understanding of population growth of the species in the current cultural landscape. Therefore, the aim of this study was to assess the reproductive activity of glands, i.e. the status of reproductive organs of harvested wild boar juveniles of both genders. The collecting of genital glands was conducted during the main hunting season from November 2014 to January 2015 (females and males), and from October 2015 to January 2016 (only females). The glands of piglets (1–12 months old) were removed at common hunts (battues) across the Czech Republic. Age, body mass and sex were determined as soon as possible after the shooting. Histological assessment, inclusive of biometrical and microscopic analyses, of testicles and ovaries were realized in laboratory conditions.

We obtained 344 samples of piglets, 66% of them were females. Follicles reached of ovulatory dimensions already from 4 months of age, but confirmed ovulations by presence of corpora lutea (*Corpora lutea*) were observed from 6 months of age and pregnancy from 8 months of age. Threshold of body mass needed for ovulation and pregnancy of females was 20–30 kg. 10% of hunted females were pregnant, the mean (potential) litter size was 4.45, and average embryonal mortality was 12%. Almost 90% of these pregnant females were inseminated during December and January. This corresponded with the peak of births in March and April. No ovarian activity was found in 25% of females hunted in November, 21% in December and only 14% in January, respectively. In males, the impact of environmental quality on the presence of sperm in testicles and epididymes was confirmed. Sperm was detected from 5 months of age onward, while all the males in the reach environment had sperm in the glands after 8 months of age and in a low quality environment they had sperm in the gland at 9 months of age. Every male whose body mass exceeded 29 kg of live weight produced sperm in the testicles.

Keywords: *Sus scrofa*, testicle, ovary, pregnancy, sperm

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Connectivity of urban and rural wild boar (*Sus scrofa*) populations: does the city of Rostock generate isolated populations or act functionally as an attractive sink for rural dispersers?

DRYGALA F.¹, ZOLLER H.², FRANTZ A.¹

Population growth of wild boar (*Sus scrofa*) over recent decades has led to an increase in the permanent presence of the large ungulate in and around the city of Rostock (North-Eastern Germany). By digging for invertebrate the species is known to cause extensive damage since the 1980th. In order to minimize human-wildlife conflicts, effective long-term management plans require knowledge of colonization processes, dispersal patterns and connectivity of urban populations.

Between 2013 and 2015 we collected tissue samples of 739 adult (age class 1 to 4) individuals. Very recently, genotyping was performed using 19 microsatellite loci in three multiplex PCRs.

As the next steps, we will analyse the population genetic structure and the genetic diversity to assess i) the degree of connectivity between urban and rural populations, ii) to reconstruct the colonization history of the city of Rostock and iii) to determine the genetic origin of the so-called 'city-boars' boars hunted in the urban settlement areas.

Different (Bayesian) genetic clustering methods will be used to analyse the population genetic structure of Rostock's wild boars. The relationship between genetic and geographical distances of sub-populations and individuals will be examined to assess isolation-by-distance (IBD) pattern. To confirm the pattern of the colonisation of urban areas, we also intend to compared competing scenarios regarding population history using Approximate Bayesian Computation (ABC). Moreover, we will perform a FCA-analysis to visualize the genetic distances between individuals.

Keywords: wild boar, urbanisation, population connectivity, microsatellites

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Status and management of wild boar populations in Serbia

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In the last two decades, like in many other European countries, wild boar has become an important species in most forest hunting grounds of Serbia, inhabiting about 2.5 million hectares or 30% of the total hunting territory. The aim of this study was to analyse the current situation and management of wild boar populations in hunting grounds managed by hunting associations and public enterprises ("Vojvodinašume", "Srbijašume" and national parks), with an emphasis on the measures of health care for wild boar populations in Serbia.

Official figures show that the spring number of wild boar in Serbia increased almost twice in the 1995-2013 period (from 12,390 to 23,160 individuals), but is still lower than the optimum, which is estimated at about 30,000 individuals. The annual number of registered harvested wild boars increased from 1,365 individuals in the hunting year 1994/95 to a total of 6,475 individuals in 2012/13. The main problem in the management of wild boar populations is damage to agricultural crops, mainly maize, and to a much lesser degree damage to forestry (e.g. increased costs of forest regeneration). In addition, a specific and permanent problem is illegal hunting, and a high predation of a large number of wolves exceeding 1,400 individuals (with an annual harvest of about 200 individuals).

In accordance with the veterinarian legislation, all animal health measures for wildlife including wild boar are performed by official veterinarians and local veterinarians in the field. Active surveillance is based on sampling blood and tissues planned by estimated sampling intensity in specific sampling units. In the aim of early detection of diseases and rapid response, passive surveillance is performed as well as sampling of every dead individual found, killed in a car accident or recognized to be sick, and each susceptible individual is shot in case of clinical signs related to certain contagious animal diseases.

Keywords: management, damage, active surveillance, passive surveillance

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Habitat preference and damage caused by wild boar in an urban area

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The wild boar population has increased steadily in Hungary and the rest of Europe since the beginning of the 1980s. One of the main factors increasing population recruitment are the mild winters caused by climate change; however, the density growth within the population is mainly due to under-harvesting. The density increase of wild boar and the expansion of human settlements both lead to the synurbanization of the species. We investigated the phenomenon in a heavily developed tourist area in the highlands of Lake Balaton. The tourist area here is enclosed by reeds on the lake shore from one side and by a forest of the Bakony Mountains from the other; wild boar use both of these habitats. We trapped wild boar females in a shrubland habitat on the edge of the reeds and equipped them with GPS collars. We investigated the seasonal change of the home ranges, the activity patterns, and the habitat preference. Habitat use was determined by direct GPS position tracking in the field. We surveyed the failures of the fences on the estimated tracks of the wild boar. Factors affecting urban area use and preferred habitat types were determined, and the damages caused by wild boar were assessed. Recommendations to decrease the presence of wild boar in the urbanized area were suggested.

Keywords: wild boar, damage, synurbanization, habitat preference, activity

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Using aerial photography and drones to map agricultural damage by wild boar

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Wild boar can cause economic losses due to severe agricultural damage. Mapping this agricultural damage to calculate the yield losses in a damaged field by ground visits is time consuming, difficult to standardise, non-repeatable and damage spots can be overseen in fields with high crops like maize.

Therefore, we test a new method using drones (or UAV, unmanned aerial vehicles) and the processing of aerial photographs to assess crop damage in Flanders (Belgium). The method should allow to assess the impact by wild boar in an objective and standardised manner. Since 2015, more than 100 damaged agricultural plots with damage due to wild boar activity (maize, cereals and grasslands) have been photographed using a drone. Using photograph sequences with 60-70% overlap allows us to make an orthomosaic of each damaged field. The damaged area in these orthomosaics can be objectively calculated using Object Based Image Classification (OBIA). The results of the first season are very promising though some technical problems such as making orthomosaics of highly homogeneous photographs still have to be solved.

Keywords: wild boar, agricultural damage, drone, aerial photography

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Analysing wild boar hunting bag in Flanders, northern Belgium

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In Flanders, since 2008 a harvest report is mandatory for each wild boar shot as well as keeping the lower jaws. The Research Institute for Nature and Forest (INBO) analyses these reports and collected jaws to monitor the numbers harvested, the age distribution of the harvest and its geographical distribution. The collected information is also used to describe several characteristics of the Flemish population.

In Flanders, wild boars were shot for the first time outside of their restricted usual range in 2006. Since then, the number of municipalities in which wild boar are hunted increased, along with the number of animals shot per municipality. The hunting bag increased from two in 2006 to 596 in 2014. The yearly hunting bag composition showed no large differences between the years and consisted on average of about 60% juveniles, 30% yearlings and 10% adults. Sex ratios in the hunting bag for juveniles and yearlings were about 1:1 (although more recently more males were shot), while for adult animals a greater proportion of females (63%) was shot. Based on the reported eviscerated weights of all wild boar with known sex and age class (n = 1665), mean weights can be compared between age and sex classes. For juveniles <6 months the mean weight is 15.6 kg for both sexes. Juveniles >6 months weigh 34.5 kg for females and 36.8 kg for males. Male yearlings (53.2 kg) and adults (78.5 kg) weigh more than females yearlings (47.3 kg) and adults (60.3 kg), respectively. Based on the analysed data, wild boar in Flanders reach the threshold eviscerated reproduction weight of 20-25 kg at the age of 5-6 months. This implies that juvenile wild boars can produce their first litter at the age of 9-10 months.

After a strong increase in both hunting bag and distribution since their reappearance in Flanders, both statistics now seem to stabilise. It is unclear whether this a true reflection of the population trend or if it is biased by changing hunting legislation (temporarily ban on night hunting) or by diminishing efforts by the Flemish administration to collect the harvest reports.

Keywords: hunting bag composition, geographical distribution, game bag, *Sus scrofa*, population characteristics

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Emerging foodborne pathogens: non-O157 STEC in wild boar (*Sus scrofa*) in Portugal

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In the last decades, wild boar (*Sus scrofa*) has increased in abundance and range throughout Europe and Portugal is no exception. This scenario poses a serious public health concern, as this ungulate is a reservoir of some zoonotic pathogens. Non-O157 Shiga toxin-producing *Escherichia coli* (STEC) are foodborne pathogens, and ungulates are known reservoirs. Here, we determined the prevalence of non-O157 STEC in wild boar from two regions in Portugal (Lousã and Idanha-a-Nova), from 2013 to 2014. In addition, antimicrobial resistance and virulence factors were assessed. 21 wild boar faecal samples were collected, directly from the rectal area of hunted animals.

The enriched samples positive for stx genes by real-time PCR were plated in CHROMagar STEC. Following this approach, two isolates were recovered. They were non-O157 STEC as both were positive for stx₂, but negative for rfbE gene. stx₁ gene was not identified. Their antimicrobial susceptibility profile and virulence genes profile were also distinct: i) the isolate recovered from Lousã presented resistance to ampicillin, piperacillin and tetracycline, while the other recovered from Idanha-a-Nova was susceptible to all the antibiotics tested.

In conclusion, 9,5% of wild boar of this study were carriers of non-O157 STEC. To the best of our knowledge, this is the first report of STEC occurrence in wild boar from Portugal. Although limited information is available about non-O157 STEC associated with venison consumption, wild boar can act as STEC transmission vectors to and from domesticated animals.

Keywords: *Escherichia coli*, public health, pathogen reservoirs, Portugal, wild boar

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Puzzling genetic structure in the wild boar population of Umbria, Italy

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Over the past 50 years the number of wild boar in Italy has dramatically increased, possibly as a consequence of massive releases of animals of different origins for hunting purposes. The aim of our study was to characterize genetic diversity and structure of the wild boar population in Umbria, Central Italy, based on nuclear STR data.

A total of 248 wild boar tissue samples, collected in different hunting areas, and 31 samples from commercial pigs, were analysed with a set of 18 STR loci. For population genetics analyses different statistical approaches were used.

Both non-spatial (STRUCTURE) and spatial (GENELAND) Bayesian analyses pointed to the Umbrian wild boar population as structured into three geographically coherent clusters. The observed pattern suggested different ancestries in the population, in agreement with the high observed variability. As data showed limited signatures of recent admixture with domestic pigs (only two clear cases), in a second step, we compared the Umbrian samples with a set of Italian and European wild boar populations in STRUCTURE (in total 609 individuals with a subset of 14 loci).

None of the three abovementioned clusters turned out to have non-Italian origin. While two of them resembled other Italian populations, the third was peculiar to Umbria.

The obtained results give relevant insights into the genetic composition of a Central Italian wild boar population, whose gene pool was arguably shaped by a combination of different anthropogenic factors (animal releases and artificial barriers, respectively).

Keywords: wild boar, STRs, genetic structure, Bayesian analysis, Italy

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Genetic diversity and population structure of Lithuanian wild boar (*Sus scrofa*)

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Wild boar (*Sus scrofa*) is the most widespread ungulate/large mammalian in the world. In many European countries, remarkable decline of wild boar populations had been registered during previous centuries, but in the middle of the 20th century wild boar population recovered and is still increasing. Number of wild boars in Lithuania declined twice: before the Second World War because of extensive hunting (280 individuals were counted in 1934), and in 1994 after the first Classical swine fever (CSF) outbreak. During the period 1994 - 1996 about 80 % of wild boar died, but population recovered from CSF survivors to approx. 62000. In 2014, first swine with CSF case was registered again in Lithuanian territory and extensive hunting was allowed in order to prevent population from repeatable outbreak. Over the past two years Lithuanian wild boar population decreased twice.

The rapid increase of population size after 1994 CSF outbreak led to the efforts to evaluate genetic diversity and population structure of wild boar population, with the main aim to develop adequate management strategies of the species in future. Genetic diversity and population structure was evaluated using random amplified DNA and microsatellite loci markers. Wild boar muscle tissue samples were collected in regular hunts from six different regions: one in the central part of the country, two in the north side near Latvian border, and three in the south near the Polish and Belarusian borders. Tissue samples were taken from a total of 106 individuals.

All markers were highly polymorphous and showed that Lithuanian wild boar population is highly variable. No significant genetic differences were detected in the subpopulations of different regions, and these results suggest an intensive migration among close locations. The significant historical decline in wild boar number caused by CFS outbreak in 1994 had no influence to intra-population genetic variability. High genetic variability and intensive gene flow ensure the stable growth of wild boar population in Lithuania.

Keywords: Gene diversity, RAPD, microsatellite, wild boar, Lithuania

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Session 7: Management / Hunt

7.1 Comparative analysis of wild boar harvest in Serbia and Slovenia, with an emphasis on hunter safety

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Wild boar is a widespread and important game species in Serbia and Slovenia, which differ according to many indicators such as total area (88,361 km² vs. 20,273 km²), forest cover (30% vs. 60%), the number of hunters (75,000 vs. 20,000), wildlife monitoring system, as well as the harvest of wild boar (6,500 vs. 8,605 individuals in 2013). The aim of this study is a comparative analysis of wild boar management in Serbia and Slovenia, with an emphasis on legislation related to the safety of hunters, hunting methods and the use of hunting firearms.

In Serbia, hunting is regulated by a large number of laws and bylaws, for example the Law on Wildlife and Hunting (2010), the Law on Arms and Ammunition (2015), and Regulations on security measures in the hunting grounds (2011). The harvest of wild boar is still lower than the potential of the habitat, especially outside the fenced hunting grounds. In recent years, the number of hunters has declined due to the unfavorable economic situation. In the period 2002-2015, seven unintentional deaths were caused by firearms during wild boar hunting. The age of the victims varies between 34 and 67 years (mean = 48 years). All shooters were men between 27 and 63 years of age (mean = 40).

In Slovenia, the umbrella document in the field of hunting is the Law on Wildlife and Hunting (2004), considering hunters' safety, a very important document is in the Law on Arms (2005, 2009), and some important bylaws governing the conduct of hunting are the Regulation on the definition of wildlife and hunting seasons (2004, 2014) and the Ordinance on the type and power of hunting weapons and ways of searching for wounded game (2005). Hunting in Slovenia has a long tradition and security measures have always been highlighted in the process of hunter education, as well as in the performance of the hunt. The number of accidents caused by hunting firearms is therefore very low, and deaths occur very rarely, but as a rule, always during the hunting of wild boar. Due to the small number of cases, official statistics are not kept, and the last two cases, according to media reports date back as early as 2005.

Keywords: hunting accidents, management, firearms, legislation

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7.2 What drives wild boar populations?

HOHMANN U.¹

Indicated by increasing harvest rates the populations of wild boar seem to grow all over Europe. Obviously this species encounters favourable habitat conditions. But which factors drive the wellbeing of this fairly large ungulate? Changes in nitrogen inputs, climate, agriculture, hunting management, forest ecosystems e.g. were the most often mentioned causes. For a better understanding, it might be beneficial to have a closer look on populations in which single factors can be ruled out like in a huge field experiment.

The Vosges du Nord in France and the Palatinate Forest in Germany form with approx. 300000 ha one of the largest closed, mixed hilly forest blocks in Central Europe and are practically lacking any agriculture inside. Within this forest the wild boar has to cope with two different hunting management systems due to national/federal hunting legislations. The most striking difference is that in the French part (130,000 ha) baiting and feeding is not limited, whereas in the German part (170,000 ha) baiting is strongly limited and partly even ceased. Besides this, the hunting practice in the two areas is quite similar. Thus we can compare three ecological situations for the wild boar: a) forest (90 % coverage) with supplemental feeding and no access to crops, b) the same forest type with limited baiting and no access to crops and c) agricultural landscape with some forests (40 % coverage) in the surroundings and with access to crops (e.g. maize, other cereals or rape).

By taking annual harvest rates (harvest per area per year) from 2005 to 2014 as a proxy of population status and development we found relatively low to moderate harvest rates (average 2.4 wild boar per 100 ha forest area) in the central parts of the forest with limited baiting. In the neighbouring central forest parts with unlimited feeding, harvest rates were manifold threefold higher (approx. 5 wild boar per 100 ha forest area). The same holds true for the more open agricultural areas where harvest rates were similarly high.

These findings indicate that more global factors like changes in nitrogen input, climate or forest ecosystems (e.g. mast events) were of lower relevance for wild boar population increase at least in Central Europe. More local factors like extent of supplemental feeding or access to crop fields seem to drive the wild boar populations more effectively.

Keywords: wild boar, habitat factors, population increase, forest, agriculture, supplemental feeding.

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7.3 Wild boar population characteristics: result of hunters' management?

KAMLER J.

Population characteristics of wild boar have significantly changed in the last decades. The sex structure of adults is often biased, and current populations are characterized by high proportion of females and very low proportion of adult males. Also, age structure is unfavourable from hunting point of view, dominated by young animals, which also start their reproduction at very young age. Moreover, the reproductive season has considerably extended. All these features may be the result of many environmental factors, but hunting seems to be an important factor for population regulation.

The fundamental difference between the management of wild boar and other species of large mammals is that the wild boar is not subjected to selective trophy hunting. This fact significantly affects the structure of harvested animals and leads to changes in demographic characteristics and life-history traits of populations.

The predominance of females in populations of wild boar from the age of 12 months can be provoked by selective hunting of yearlings. Indeed, sub-adult males disconnect from the family groups and are intensively hunted, while primiparous females remain in groups and are protected because they could be pregnant or already have piglets. To balance the sex structure among adults, one of solutions would be to increase harvesting of sub-adult females regardless their reproductive status.

Reproduction of young females is also the result of selective pressure of hunters. In natural conditions, the reproductive success of females at a young age would be very low due to predation and lack of food. The recent hunting selection in our study area seems to be the opposite. On the one hand, females with small piglets are protected regardless of the age and their survival is supported by the increased food availability. On the other hand, non-reproducing females and males are removed from the population. By this selection, the ability of early reproduction in the wild boar populations is supported. The solution is the selection for longevity, i.e. again in intensive hunting of young females that entered into reproduction.

Extending the reproductive season is again the result of interference in wild boar populations (protection of young females and their late offspring). Under natural conditions such animals would have very low survival possibilities. The solution is very simple - the intensive harvesting of individuals which were born outside the main reproductive period /season, regardless of their size (body mass).

Keywords: wild boar reproduction, management, seasonality, selective hunting



7.4 Towards a qualitative management of a Belgian wild boar population

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The military camp of Marche-en-Famenne (Belgium-Wallonia) is submitted to an annual harvesting plan for wild boar. This is quite unique in Wallonia. It is the consequence of a large density of this species within this very sensitive area in terms of nature conservation. Since 2007, a capture-mark-recapture (CMR) study has been used to estimate the population size. Each year, before the hunting season, a preliminary harvesting plan based on the hunting bag statistics of previous year together with an observed reproduction rate is assigned to the hunters. At mid-season, a definitive harvesting plan is fixed, based on the history of recaptures of tagged animals during the first period of hunting. The hunters have then to adapt their hunting effort during the second part of the hunting season to achieve the quota. This quantitative management only assigns a minimum number of animals to be shot without any distinction between sexes or weight classes.

In 2016, as the current population density still impacts exaggeratedly the environment, the forest administration decided to significantly reduce the wild boar population. Unfortunately, the hunting effort (hunting days x hunters) cannot be enhanced because of military constraints. Regarding the current pattern of hunting focusing mainly on the small-sized animals (juveniles), it seems impossible to slow down the growth of the population without targeting the harvest effort to specific weight classes of females.

We used a harvest model designed for wild boar by Gamelon et al. (2012) with demographic parameters and values adapted to our study site to better control the relative importance of each body weight class of females in the overall growth rate of the population thanks to a sensitivity analysis. Indeed, the relative importance of the proportion of females killed by hunting for the growth of the population varies according to their weight class. Therefore, we computed the equivalence between small (SF<30 kg), medium (30<MF<50 kg) and large females (LF>50 kg). In our case, MF is equivalent to 2.15 SF and LF to 2.18 SF, respectively.

The harvest plan will optimize the number of females from each weight class to be shot to efficiently reduce the growth rate of the population. This qualitative management should help controlling the population growth without modifying the hunting effort.

Keywords: harvest plan, capture-mark-recapture, hunting effort, Belgium

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Session 8: Diseases

8.1 African swine fever in wild boar population: Lithuanian experience.

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So far, 235 cases of African Swine fever virus (ASFV) infection in wild boar have been recognized in Lithuania. The methods used for ASFV detection included highly real-time PCR (RRT-PCR), enzyme-linked immunosorbent assay (ELISA), and an immunoperoxidase test (IPT) for identification of anti-ASFV antibodies.

First two cases of African swine fever (ASF) in Lithuania were detected on the 24 January 2014, when a hunted wild boar and a wild boar found dead were confirmed to be positive for ASF at the National Food and Veterinary Risk Assessment Institute in Vilnius. Immediately after that, intensive wild and domestic animal monitoring program was started and 234000 animals (>10000 domestic pigs, > 13000 wild boar) had been tested for ASF before August 2014, when the next positive cases in wild boar were found in Ignalia district. Before that, disease reappeared on the 23 July 2014 in Ignalina district at a large commercial pig farm (with approx. 20000 pigs), in spite of the highest biosecurity. 290 pigs were sampled from the infected farm, and 102 were found ASF positive. 19217 pigs were killed and destroyed by burying on the territory of the farm. Despite all efforts, no clear conclusions could be made about the source of infection or possible ways of virus introduction to the farm. During 2014, ASF outbreaks continued to appear, the very next one occurred in same county in a backyard farm two weeks later. During August 2014 ASF outbreaks in domestic pigs were detected in three district municipalities of Lithuania, bordering each other (9 domestic pigs were ASF positive). Approx. 29000 (in 2014) and 25600 (in 2015) domestic pigs were tested for ASF; In 2015, 27 of them were ASF positive.

During 2014, approx. 16500 wild boar were tested for ASF; a total of 45 locations where ASF positive wild boar were found dead (25 locations, 54 animals) or were hunted (20 locations, 22 animals) were determined. During 2015, +/-13000 wild boar were tested and 140 were found ASF positive. During 2015, 47 668 samples were tested for ASF by RRT – PCR. and 157 samples were positive.

Keywords: African swine fever, RRT-PCR, ELISA, IPT, wild boar, Lithuania

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8.2 Impact of extreme weather conditions on wild boar mortality in lowland forest ecosystems in Croatia.

UGARKOVIĆ D.¹, ŠPREM N.², ORŠANIĆ M.¹

The main large game species raised in the lowland hunting grounds of Croatia are red deer (*Cervus elaphus* L.), roe deer (*Capreolus capreolus* L.) and wild boar (*Sus scrofa* L.). The hydrological regime in this region is dependent primarily upon the microrelief and the water levels of the Sava River. The objective of this study was to determine the impact of extreme weather conditions, flood and drought, on wild boar mortality. The research was conducted in lowland Croatia, area of Lonjsko polje. The impact of extreme weather events on wild boar mortality was analysed for a ten-year period. Mortality data were collected from the hunting management plans and the game damage records. Wet and dry years were determined using the percentile method. Flood duration was collected from hunting chronicles, while drought duration was determined using the climatogram method. Spearman's correlation was used to determine an association between weather conditions and wild boar mortality. Floods lasted from 14 to 198 days at the annual level, most often in March and November, while the level of floodwaters was up to 4 metres in some places. Wild boar mortality was recorded for all age groups. The highest mortality was recorded in the juvenile age class. With regard to the sex ratio, mortality was recorded for both males and females (1:1.3). In the lowland hunting grounds, the mortality ratio in planned culling of wild boar ranged from 0 to 63%. With an increase in the number of flooded days, mortality of wild boar increased significantly ($r=0.60^*$). This is important since several lowland hunting grounds, such as the area of Lonjsko polje, are natural retention areas used for the purpose of protecting agriculture ecosystems and urban areas from flooding. Based on the expected climate changes, it can be concluded that floods as an extreme form of weather, will have a substantial impact on wild boar mortality in lowland hunting grounds in the future.

Keywords: wild boar, floods, drought, lowland forests, Sava River

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8.3 Slow spread of the African swine fever in Poland – the role of wild boar behaviour and management

PODGÓRSKI T.¹

African Swine Fever (ASF) is a highly infectious viral disease of wild and domestic suids. It results in high lethality and has severe socio-economic consequences. Thus, emergence of the ASF in the wild boar population in eastern European Union in 2014 raised serious concerns about its further spread westwards. Given the previous rapid spread of epidemic in eastern Europe, high contagiousness of ASF virus, and abundant wild boar populations, further rapid spread of the ASF was anticipated. However, the ASF expanded slowly in time and gradually in space during two years following its first detection in the wild boar population in Poland. In 2014 - 2015, 139 wild boar were diagnosed positive for ASF, with the mean prevalence of 5%. Most infected animals (81%) were located <15km from Poland-Belarus border, indicating potential source of infections. Epidemic frontline has shifted away from the border steadily at the rate of 1.5 km/month. The size of the infected area increased sharply during the first 6 months of the epidemic (from 34 to 360 km²), continued expanding with a slow but steady rate of 100km²/month, and reached the size of 2060 km² by the end of 2015. The rate of spread observed in Poland is much lower than previously recorded, e.g. in Russia (25km/month). This can be attributed to several factors related to wild boar behaviour and management. Cohesive and stable social groups, site fidelity and limited dispersal of wild boar, combined with short incubation time and high virulence of the ASF virus, reduce the chances of ASF spread over large distances through movement of sick animals. Additionally, intensive wild boar management reduced wild boar numbers in the infected area, and sanitary preventive measures helped to minimise the risk of human-mediated transmission. It thus seems that spatio-temporal patterns of the ASF spread currently observed in Poland represent the natural course of the disease in the wild boar population. Current epidemiological situation indicates that wild boar behaviour alone does not contribute to rapid expansion of the ASF in the susceptible population.

Keywords: ASF, disease, epidemic, hunting, social behaviour, space use

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Session 9: Genetics

9.1 Polymorphisms in *mc1r* and *nr6a1* genes in wild boar from South-Eastern Europe

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Traditional rearing of pigs in the outdoor system is present in South-eastern Europe and it is well documented in certain areas on the Balkans (e.g. Bulgaria and Croatia) -. Hybridization with wild boar may occasionally occur and even be deliberately human mediated. The objectives of this study were to detect polymorphisms of MC1R and NR6A1 genes in wild boar from the South-eastern Europe (the Balkan region) and to examine the level of introgression of domesticated alleles into wild boar population in this area. Wild boar were sampled from the western and central Balkans and genotyped for 5 polymorphisms in two genes using PRC-RFLP method. In MC1R gene, the most frequent allele was the wild type allele (E^+) and its frequency was 0.87. Two domesticated alleles were identified, E^{D2} and E^P , in frequencies 0.11 and 0.02, respectively. Four different genotypes were detected at MC1R locus: E^+/E^+ (genotype frequency: 0.74), E^+/E^{D2} (0.20), E^+/E^P (0.05) and E^{D2}/E^{D2} genotype (0.01). The C allele was the most frequent one (0.93) at NR6A1 locus, while the T allele frequency was 0.07. Wild boar from the Balkans showed one homozygous T/T (domesticated allele) genotype (0.01) and 10 heterozygous specimens (C/T; 0.11), while the most frequent was C/C genotype (0.88) at NR6A1 locus. Domesticated alleles for both analysed loci, MC1R and NR6A1, were detected in wild boars from the South-eastern Europe. Moreover, for two individuals domesticated alleles were detected in both loci. The level of introgression of domesticated alleles into wild boar population in the Balkan area, calculated as the percentage of wild boar with a signal of introgression from domesticated genes, was 34.44%. This high introgression of domesticated alleles represents a potential problem that can accelerate the existing expansion of the wild boar population in the analysed area. Therefore, it is necessary to take active measures to prevent mating between wild boar and domestic pigs, and to prevent the practice of the rural method of free rearing of pigs, which is common in the area.

Keywords: MC1R, NR6A1, domesticated alleles, introgression, *Sus scrofa*

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9.2 Genetic variability of wild boar populations in the northern Dinaric Balkans: how does it fit in European context?

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Wild boar in the Balkans represents one of the most widespread and most popular game species. Since the wild boar populations in the Balkans and Europe are continuously expanding, management strategies of this species should be based on a complete understanding of the factors determining its adaptation to a wide range of environmental conditions. Therefore, a detailed insight into the genetic diversity of wild boar is of great importance, and it is particularly important to understand how the Quaternary fluctuations in the past and anthropogenic factors during the last century, influenced the genetic diversity and demographic structure of this important wildlife species.

In this research we aimed to assess the wild boar genetic structure and phylogeography based on the analysis of microsatellites and CR-1 region of mitochondrial DNA. Polymorphism of eleven tetranucleotide microsatellites was determined in a sample of 259 wild boar samples from the Northern Dinaric (ND) Balkan region. Bayesian cluster analyses revealed two main genetic clusters present in wild boar populations in the ND Balkans: western (littoral) and eastern (continental) cluster, and basic parameters of intra- and interpopulation variability were estimated. It was shown that gene flow between defined subpopulations is relatively low since estimated genetic distances between subpopulations indicated a moderate to high genetic differentiation.

According to derived data, high genetic diversity is present in wild boar populations in the ND Balkans, indicating high genetic potential of the species. In the analysis of mtDNA control region sequences in 351 wild boar samples from the Balkan Peninsula unique haplotypes were found and population structure was observed. The combined analyses of wild boar mtDNA sequences from the Balkans and Europe revealed that a similar phylogeographic pattern emerges in all southern European peninsulas, arising from post-LGM expansion, and that all three peninsulas had a similar role in the wild boar post-glacial recolonization of Europe. Based on the results of this research, it was recommended that for each defined subpopulation adequate management strategies should be defined and each subpopulation should be managed separately in order to preserve their evolutionary potential and to secure the long-term stability of wild resources.

Keywords: *Sus scrofa*, Balkans, microsatellites, mtDNA

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9.3 Development of wild boar species-specific DNA markers

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Wild boar has a key role in Hungarian hunting and venison production; over 140.000 individuals are harvested and processed annually. Wild boar venison products are high price premium products, and as a result became the target of adulteration. Due to the economic value of animals, their genomics are important issues. Such studies have already had an impact and will continue to do so in terms of controlling the production of meat, milk, fiber and other products, environmental effects of animal husbandry, breeding, animal health, feeding, and even human medical issues. Aim of this study was to develop and validate new DNA markers feasible for simple species identification.

We compared sequence data of 59 total pig genomes for sequence differences between individuals of wild boar and domesticated pig breeds. PCR primers were designed on the regions showing potential diagnostic differences. Primer sequences were verified on samples of different pig breeds and wild boars. PCR products were separated on agarose gel to genotype individuals; and genotypes were used to breed assignment of animals.

The bioinformatics predictions gave four wild boar specific genomic loci, from which three are suitable for breed identification based on agarose gel electrophoresis. In breed assignment tests, based on individual genotypes, these markers had a combined probability of identification wild boar of about 0.99.

Our markers are suitable for faster, easier and more cost efficient DNA diagnostics for the identification of wild boar meat products. This could be useful for the control of meat products as well as in case of controlling carcasses before processing.

Keywords: wild boar, species identification, DNA marker, venison, traceability

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9.4 SNP data in the detection of hybridization levels between wild boar and domestic pig in Europe

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Introgression of domestic genes into wild populations is considered to be a threat to biodiversity leading to loss of local adaptation and spread of human selected gene variants. Additionally, the contact between wild and domestic stocks can result in the transmission of infectious diseases. Thus, a better understanding of hybridization patterns in Europe might have important implications for conservation and management of both wild populations and local breeds, as well as for the contingency of infectious diseases.

We present the results for the analysis of 235 wild boar (WB; from 22 areas) and 149 domestic pigs (DP; 49 from 5 commercial lines and 100 from 9 local breeds) with the Porcine SNP60 Beadchip.

Principal component analysis shows a clear separation between domestic pigs and wild boar populations. The network analysis concordantly identifies two main clusters (corresponding to WB and DP) but, additionally, highlights the presence of several individuals, of both ancestries, with intermediate positions. This result was confirmed by Admixture analysis that detected the presence of hybrid individuals in both WB and local domestic pig breeds.

The introgression level varies considerably among populations, from non-detectable to very high. This result might be due to breeding practices, population history and WB management, but it arises questions on domestication and selective processes as well. Additional analyses to identify the presence of human or naturally selected genomes are needed to disentangle the observed results.

Keywords: wild boar, domestic pig, SNP, hybridization, introgression

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9.5 Assessing rates and patterns of hybridization between wild boar and domestic pig in Europe

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Introgressive hybridization between wild boar and domestic pig has unpredictable evolutionary consequences and has the potential to alter reproductive, immunological and behavioural traits, influencing individual fitness and possibly increasing species' invasiveness.

Though of great interest, reconstructing patterns of gene flow between wild and domestic form of *Sus scrofa* is arduous. In fact, hybridization patterns may differ greatly with respect to time (ancient vs. recent), source (intentional in captivity vs. unintentional in the wild), spread (extensive vs. occasional) and directionality (i.e. involved sexes of the two forms). This is likely to produce a puzzling scenario, where close populations may show contrasting signals of genetic introgression. Whether and how much this can impact the dynamics of local populations remains unproven. Diagnosing hybrids is the first step to address the issue. However, despite the availability of multiple molecular markers, with different inheritance systems and undergoing different selective pressures, the analysis on the extent and impact of introgressive hybridization in Europe remains challenging.

Here we show the outcome of the application of different genetic marker systems and the potentiality of newly developed markers across a range of European wild boar populations.

Maternally inherited mitochondrial DNA alleles are by large shared between wild and domestic stocks, and the most reliable indicator of introgression is commonly considered the presence of East Asian haplotypes, which are found at a very low frequency in European wild boar. Variation at the *MC1R* and *NR6A1* nuclear genes - influencing coat colour and number of vertebrae, respectively, and under strong artificial selection during domestication - revealed higher levels of a bidirectional gene flow. Unlike previously used Y-chromosome markers, which seem to suffer low variation, new polymorphic Y-linked microsatellites represent a promising tool to disclose the paternal contribution to gene flow, but should be tested on a larger sample of domestic and wild *Sus scrofa* to identify actual diagnostic alleles.

Keywords: wild boar, domestic pig, introgression, wild x domestic hybridization

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Session 10: Reproduction and diet

10.1 Investigation factors affecting multiple

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Understanding how species are able to deal with hunting pressure is of prime interest in evolutionary biology and wildlife management. The wild boar displays a high environmental plasticity and is an important game species. It is the perfect model species to study evolutionary responses to anthropogenic factors. Among population characteristics impacted by both intensive and selective hunting, mating system is expected to shift from polygyny to promiscuity as long as old and dominant males are hunted. As a consequence, high rates of multiple paternity should be commonly observed in intensively hunted wild boar populations. However, the factors, including hunting pressure, influencing the multiple paternity rates (MPR, proportion of litters with more than one sire) across populations remain poorly known.

We investigated factors affecting MPR collecting data from five French wild boar populations with contrasting resource availability, harvesting pressure, and hunting practices for three and up to eight years of sampling. Data were collected from harvested pregnant females. The microsatellite genotypes were obtained for 12 polymorphic loci for all females-foetus pairs. Using genetic data, the number of sire per litter was estimated using several paternity analysis methods. We observed variation in MPR depending on the population, suggesting wild boar mating system varies depending on population characteristics.

Special thanks to technicians helping us in the sampling process on the different territories.

Keywords: mating system, polyandry, genetics, microsatellites

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10.2 Sex ratios revealed by non-invasive genetics as an important factor in wild boar management

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For an effective ungulate management, not only knowledge on the size of populations is important. Indeed, – without information on the sex ratio, it is difficult to evaluate the reproductive potential of any ungulate population. Among adults, overall sex ratios in wild boar populations in general tend to be female-biased. However, the extent of this bias is very difficult to estimate with traditional approaches like e.g. hunting bag statistics. To calculate an approximation of the reproductive output of a wild boar population, in most cases a nearly balanced sex ratio is used. Together with lacking information about juvenile mortality, lack of knowledge on the true sex ratio increases the uncertainty of reproductive predictions.

We estimated wild boar population size and sex ratio in two different study areas based on non-invasive genetics: in study area 1 (Palatinate Forest), we collected and genotyped faecal samples over approx. 4700 ha, and in study area 2 (Saarkohlenwald) over 3700 ha, respectively. In study area 1, based on 244 successfully genotyped samples, faeces of 149 different wild boar individuals were sampled (66 males and 83 females), corresponding to a sex ratio of 1 : 1.26. In study area 2, based on 269 successfully genotyped samples, 181 different individuals were recorded (76 males, 104 females, 1 failed sex marker), corresponding to a sex ratio of 1 : 1.37. Based on these findings and the estimated population sizes, we try to model the reproductive potential of the two studied wild boar populations. The aim of the contribution is to compare conventional and genetic estimates of reproductive output and to evaluate the practical implications of non-invasive genetics techniques for wild boar management.

Keywords: wild boar, population dynamics, microsatellites, genotyping, faeces

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10.3 Activity of wild boar sows during the reproductive period

JEŽEK M.¹, HOLÁ M.¹

Over the last decades, human activity has influenced behavior of many wildlife species. As a consequence, many large mammals became nocturnal with peak activity during hours of darkness. Such behaviour has been intensively studied in many ungulates, but little is still known about activity patterns of wild boar (*Sus scrofa*) in human dominated landscapes.

Therefore, we used telemetry data collected during 2012-2016 from 19 wild boar females equipped with GPS collars and activity sensors in order to evaluate activity of wild boar sows within 24 hours during the reproductive period. Moreover, we evaluated the possible changes of activity before giving birth to piglets and after it. The period of giving birth was defined as a precipitous decline of moving activity for 3 consecutive days. Particularly, the hourly moved distance and activity data from 2 axis activity sensors were used for the analyses.

Our results show that females are mainly nocturnal throughout the year, but they rapidly change their circadian rhythms after giving birth to piglets. Most of the studied sows became strictly diurnal for 3-4 months after giving birth, and then they slowly moved their activity back to the dark part of the day. This behaviour was confirmed by both the hourly moved distance, as well as the activity measured by activity sensor.

Keywords: activity pattern, farrowing, GPS, activity sensor

This study was supported by the Ministry of Agriculture of the Czech Republic, Grant No. QJ1220314.

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10.4 Dietary items as possible sources of ^{137}Cs in wild boar from the forest ecosystem, western Croatia

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The mountain forest ecosystem of Gorski Kotar is distant from any significant sources of environmental pollution, though recent findings have revealed that this region is among the most intense radionuclide contaminated area in Croatia. Forests are very complex natural ecosystems where radionuclides persist longer among plants, mushrooms and animals. Therefore, the aim of this study was to investigate caesium (Cs) and potassium (K) load in wild boar muscle tissue and their content in different dietary items approximately a quarter of century after the Chernobyl accident. Radionuclides mass activities were determined by the gamma-spectrometric method in the muscle tissue of 19 wild boar and 61 dietary samples. The average concentration of ^{137}Cs found in wild boar was $25.0 \pm 19.6 \text{ Bqkg}^{-1}$ (maximum 58.7 Bqkg^{-1}), while average concentration of ^{40}K was $113 \pm 4 \text{ Bqkg}^{-1}$. Estimated effective equivalent dose for wild boar meat was $0.325 \mu\text{Sv}$ and in some cases it can represent a risky foodstuff. Activity concentration of ^{137}Cs in 12 soil samples from the Gorski Kotar region varied between 19 Bqkg^{-1} and 346 Bqkg^{-1} , with a mean value of 109 Bqkg^{-1} . The most important source of radionuclides for the higher parts of the food-chain from the study area were found to be the mushroom species wood hedgehog (*Hydnum repandum*), with a transfer factor (TF) of 5.166, and blueberry (*Vaccinium myrtillus*) as a plant species (TF = 2.096). Food items of animal origin, especially ants (larvae and mature animals) had a slightly higher mean caesium mass activity of 24.1 Bqkg^{-1} and therefore are possible moderate bioindicators of environmental pollution. The results also revealed that possible unknown wild animal food sources are a caesium source in the study region, and further study is required to illuminate this issue.

Keywords: *Sus scrofa*, radionuclides, mountain forest ecosystem, environment pollution

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