Abstracts

Zbigniew Borowski, Wanda Olech, Agnieszka Suchecka (eds.)

11th European Vertebrate Pest Management Conference

September 25–29, 2017, Warsaw, Poland

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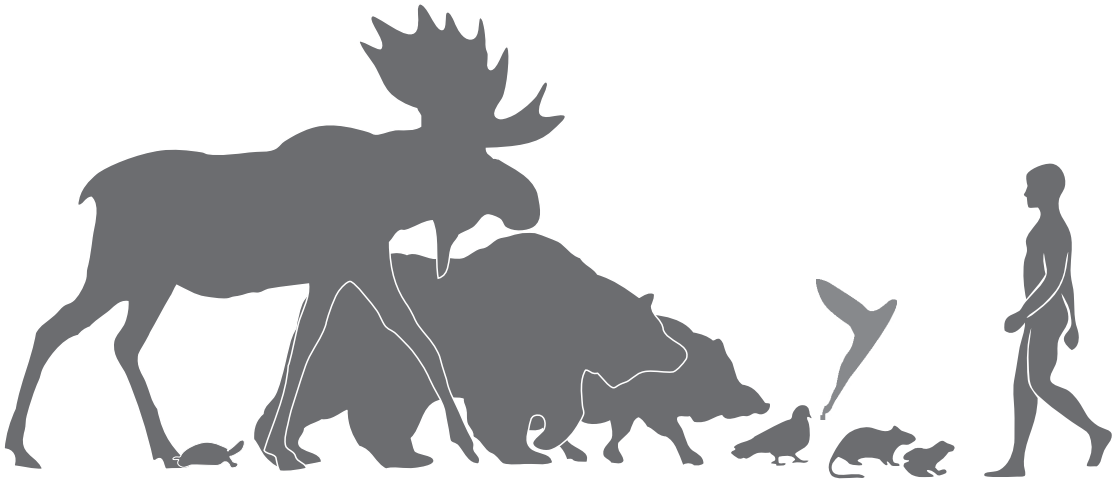

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SCIENTIFIC PROGRAM

MONDAY 25th SEPTEMBER 2017	
16:30–18:30	Registration

TUESDAY 26th SEPTEMBER 2017	
8:00–10:00	Registration
10:00–10:15	Opening words, Zbigniew Borowski and Wanda Olech
10:15–11:15	**PLENARY,** Infecting pathogen research with rodent ecology and evolution **Gerald Heckel**
11:15–11:30	COFFEE
	ECOLOGICALLY BASED PEST MANAGEMENT AND SILVICULTURAL PEST MANAGEMENT
11:30–11:50	Young conifer stands form a deer browsing refuge for an oak admixture: silvicultural implications for forest regeneration under herbivore pressure **Jakub Borkowski**
11:50–12:10	Predicting forest rodent population dynamics **Jens Jacob**
12:10–12:30	The Eurasian pygmy owl (Glaucidium passerinum) as a biological control agent for small rodent pests in Boreal silviculture **Otso Huitu**
12:30–12:50	Presence of small rodent species in oak forests under replanting **Goran Jokić**
12:50–13:20	Who is worse? Impact of Common Vole (Microtus arvalis) and European Hare (Lepus europaeus) on apple trees by bark gnawing **Josef Suchomel**
13:20–15:00	LUNCH
15:00–16:00	**PLENARY,** Conflict between humans and large carnivores **Henryk Okarma**
16:00–16:20	The role of large predators in forest regeneration – the wolf example **Adam Wójcicki**
16:20–16:40	What factors are responsible for the summer tree bark stripping by deer? **Andżelika Haidt**

16:40–17:00	Does winter supplementary feeding increase or decrease damages caused by deer in forest ecosystem? – the field test conducted on areas with different deer densities **Zbigniew Borowski**
17:00–17:20	Factors associated with wild boar damage in agro-systems at large spatial and temporal scale in France **Mickaël Sage**
17:20	COFFEE

WEDNESDAY 27th SEPTEMBER 2017

09:00–10:00	**PLENARY,** African swine fever in Poland. Current challenges and future perspectives **Grzegorz Woźniakowski**
10:90–10:20	COFFEE

ECOLOGICALLY BASED PEST MANAGEMENT AND AGRICULTURAL PEST MANAGEMENT

10:20–10:40	Towards a way to improve the second generation rodenticides based on the concept of stereochemistry – Generalization of the concept to all molecules **Etienne Benoit**
10:40–11:00	Rodenticide resistance of Norway rats (Rattus norvegicus) in Denmark: monitoring and development of national control strategy **Ann-Charlotte Heiberg**
11:00–11:20	RRAC: Interactive advice on rodenticide resistance management **Stefan Endepols**
11:20–11:40	Monitoring and quantification of (1R,3R)(1S,3S) and (1R,3S)(1S,3R) diastereoisomers of second generation anticoagulant rodenticides in wildlife **Virginie Lattard**
11:40–12:00	Between benefits and risks: The use of agricultural rodenticides by pest management professionals in pig farming in Germany **Odile Hecker**
12:00–12:20	Project DevelOPAR – Development of a plant based avian repellent **Joanna Dürger**
12:20–12:40	Amphibians – the new species group within the risk assessment of plant protection products **Alexandra Esther**
12:40–13:00	Management of some rodent pests with the trap barrier system in canal irrigated plantations of central Punjab, Pakistan **Hammad Khan**
13:00–14:30	LUNCH

14:30–14:50	Integrated rodent pest management in the campaign against voles in the local board of plant health in El Valle Del Fuerte, Sin. Mexico **José Antonio Orozco**
14:50–15:10	Rodent control in sugar cane on the Reunion Island – Exposure and resistance of the target species to rodenticides and implication for the Maillard's Harrier (Circus maillardi) **Anne Sophie Pingon**
15:10–15:30	Development of an odorous repellent against common voles (Microtus arvalis) **Annika Schlötelburg**
15:30–15:50	First report for Anticoagulant rodenticide resistance in Turkish Norway rat **Derya Çetintürk**
15:50–16:10	Residual activity of diflubenzuron on mosquito larvae and its effects on acetylcholinesterase (EC 3.1.1.7.) activity and liver ultrastructure of rats **Nuri Yiğit**
16:10–16:30	Histochemical Effects of Brodifacoum on Rat Spleen **Hakan Eskizengin**
16:30–16:50	Genetic insights into common vole (Microtus arvalis) population recovery after rodenticide application **Susanne Hein**
16:50–18:00	COFFEE AND POSTER SESSION
20:00	Conference banquet, on the campus near the conference venue
	THURSDAY 28th SEPTEMBER 2017
10:00–15:00	Mid-conference excursion to The Royal Castle in Warsaw
	URBAN PEST MANAGEMENT
15:00–15:20	Colonization of Warsaw by red fox (Vulpes vulpes) – is it aready a problem? **Jakub Gryz**
15:20–15:40	Stone marten (Martes foina) in Warsaw – fluffy neighbour or annoying pest? **Karolina Jasińska**
15:40–16:00	Wild boars in Warsaw – an increasing management challenge **Piotr Kowal**
16:00–16:20	The management of brown rat (Rattus norvegicus Berk.) in Palaearctic **Valentin Rylnikov**
16:20–16:40	COFFEE

16:40–17:00	Do anticoagulant rodenticides affect the seasonal population dynamics of small mustelids? **Javier Fernandez-de-Simon**
17:00–17:20	Free-roaming cats and their impact on wildlife in central Poland – origin of the problem **Dagny Krauze**
17:20–17:40	Zoonotic rabbit hepatitis E virus in two wild rabbit populations in and around Frankfurt/ Main, Germany **René Ryll**
17:40–18:00	Corvid trapping with the Larsen mate **Steve Campbell**
18:00	COFFEE

FRIDAY 29th SEPTEMBER 2017

10:00–11:00	**PLENARY,** What do we know and what do we need to know to mitigate human--wildlife conflicts: Populations, diseases and decision making **Graham C Smith**
11:00–11:20	COFFEE

HUMAN – ANIMAL SOCIAL CONFLICT

11:20–11:40	In situ sterilization of eggs in high nests – Indian House Crows **Yoav Motro**
11:40–12:00	Attacks on humans and property damage by relocated rhesus monkeys (pest primate) and mitigation strategies in suburban areas of Delhi NCR **Ishita Ganguly**
12:00–12:20	Mediterranean versus Atlantic Monk Parakeets: towards a differentiated management at the European Scale? **Jose-Luis Postigo**
12:20–12:40	Modelling the current habitat use of coypu (Myocastor coypus) in Europe and potential future spread under climate change **Anna Schertler**
12:40–13:00	European level mammal data and the need for harmonisation **Graham C Smith**
13:00–13:20	Effect of climate change and human activity on small mammal populations in NE Poland **Karol Zub**
13:20–13:50	COFFEE
13:50	CLOSING REMARKS

SATURDAY 30th SEPTEMBER 2017

Excursion to the Białowieża National Park

ACCEPTED POSTERS

1. Pattern of vole gnawing on clearings in Central European managed forests
   J. Krojerová-Prokešová, M. Homolka, M. Barančeková, M. Heroldová, P. Baňař, J. Kamler, R. Modlinger, L. Purchart, J. Zejda, J. Suchomel
2. Acceptability of wheat baits pre-treated with high temperature and humidity to commensal rodent species
   T. Blažić*, G. Jokić , M. Vukša, S. Đedović
3. Residues of pesticides in amphibians – results of one-time sampling
   D. Schenke, G. Bischoff, A. Esther
4. Individual based modelling to investigate effects of management measures on population dynamics of resistant Norway rats (Rattus norvegicus)
   A. Esther, L. Braun, H. Weise
5. Procedures for anticoagulant applications to control rats (Rattus norvegicus) in face of resistance, mitigation of environmental risk and country specificities
   A. Esther, A. C. Heiberg, N. Klemann, H. J. Pelz
6. Avoidance-test procedure to evaluate consumption of treated seeds by birds
   A. Esther, A. an der Heiden, J. Dürger, M. Shadid
7. Current investigation on the resistance of Norway rats to anticoagulant rodenticides in Hungary
   D. Bajomi, B. Tánczos, Z. Kiss, J. Schmidt
8. How accessible are carcasses of poisoned Norway rats for predators?
   B. Walther, E. Hendrik, G. Anke, J. Jens
9. Risk assessment for plant protection products: What do we know about frugivorous mammals in commercially managed orchards in Europe?
   S. Kragten, F. von Blanckenhagen, M. Ebeling, J. Hahne
10. The House Mouse (Mus Musculus domesticus) as a real sanitary threat
    A. Marquez, A. Kodjo, V. Lattard
11. Alien fish in the diet of the indigenous Eurasian otter Lutra lutra in the urban sections of Vistula River Poland
    L. Orłowska, J. Romanowski
12. Vkorc1 mutations in wild Rattus rattus in France and Spain - comparative conclusions in term of evolution with Rattus norvegicus and Mus musculus species
    E. Benoit, A. Hammed, L. Giraud, V. Lambert, V. Lattard
13. Behavioural responses to a ubiquitous plant chemical and predator olfactory stimuli in the house mouse
    C. Grau, J. Leclercq, E. Descout, C. Bienboire-Frosini, P. Pageat

CURRENT INVESTIAGATIONS ON THE RESISTANCE OF NORWAY RATS TO ANTICOAGULANT RODENTICIDES IN HUNGARY

Daniel Bajomi[1], Balázs Tánczos[2], Zoltán Kiss[1], József Schmidt[1]

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Investigations on the resistance of Norway rats (*Rattus norvegicus*) to anticoagulant active substances in Hungary started more than a decade ago. Comparative SNP analyses of the VKORC1 locus were conducted by Dr. Hans-Joachim Pelz (Germany) on 28 samples collected in 2006 and 2007. Hetero – (5) and homozygous (6) carriers of the Y139C mutation were identified in 11 samples (39.3%).

Comparative SNP analysis of the VKORC1 3rd exon (Rost et al. 2004) was elaborated in Hungary in 2014. Analysed was a non-representative set of 64 rat corpses, collected in the capital of the country and in the countryside in 2014 and in the first half of 2015. Only Y139C mutation was identified again in 41 (64%) samples. Out of these 17 and 24 were hetero – and homozygous, respectively. Results were demonstrated as a poster at the 10thEVPMC (in 2015 Sevilla, Spain).

Further investigations were carried on in the second half of 2015, in 2016 and in the first half of 2017. In total 60 rat corpses were analysed, of which 27 (45%) proved again to be carriers of Y139C only. Out of these, 14 and 13 were respectively hetero – and homozygous.

No occurrence of other mutations of the monitored locus – e.g. Y139F, L120Q, L128Q and L128S, which are known to be prevalent in different parts of Europe – were found in the current study.

Our poster shall demonstrate in detail the prevalence of Y139C mutation carrier rats. The samples are not representative in general but show from which habitat they were collected in Hungary. In the future analyses of mutation occurrence, its relation to habitats shall be investigated.

HISTOCHEMICAL EFFECTS OF BRODIFACOUM ON RAT SPLEEN

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Histochemical effects of Brodifacoum on rat spleen were examined under light microscope by using histochemical staining method. Rats were divided into five groups (n:6 individual): control group, 24 hours, 72 hours, 14 days and 30 days of Brodifacoum application. Single dose of 0.2 mg Brodifacoum was given orally to mature male rats. Spleen samples were collected under ether anaesthesia. The tissues were fixed, dehydrated and embedded into paraffin and taken sections examined.

It was observed that capsule, white pulp and red pulp zones in the spleen of control rats were constructed normally and in their natural structure were few primary and secondary follicles (germinal center). Also, CD4 and CD8 lymphocytes were spherically structured. In the 24 hours Brodifacoum applied rat spleens, the diameters of germinal centers were expanded and deterioration of the structure of CD4 and CD8 cells was observed. Related to the increase in time (72 hours and 14 days Brodifacoum application) it was determined that primary follicles increased in number and the diameters of germinal centers expanded. In addition to this, after 30 days, the rate of CD4:CD8 of the brodifacoum applied rat spleens was approximate to the rate of the control group and the improvement of the structures of the cells were reported as an effect of regeneration.

According to results of this study, the brodifacoum caused immunohistochemically abnormalities in rat spleen including T lymhocytes structure and numbers.

VKORC1 MUTATIONS IN WILD *RATTUS RATTUS* IN FRANCE AND SPAIN – COMPARATIVE CONCLUSIONS IN TERM OF EVOLUTION WITH *RATTUS NORVEGICUS* AND *MUS MUSCULUS* SPECIES

Etienne Benoit, Abdessalem Hammed, Ludivine Giraud, Véronique Lambert, Virginie Lattard

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USC 1233 RS2GP, INRA, VetAgro Sup, Univ Lyon, F-69280, Marcy l'Etoile, France

Target resistance to anticoagulant rodenticides associated with *Vkorc1* mutations has been largely described worldwide in brown rats (*Rattus norvegicus*) and house mice (*Mus musculus)*. On the contrary, it has been poorly documented in black rats (*Rattus rattus*) while resistance among these populations is often suspected by Pest Control Operators. A total of 219 tail samples (181 from France and 38 from Spain) were sent by pests control operators from 18 administrative departments (15 French and 3 Spanish administrative area). Coding sequences of *Vkorc1* gene were sequenced in order to detect mutations. Consequences of the observed mutations were evaluated by the use of recombinant VKORC1. Among the 219 tails, 151 samples presented at least one missense mutation in the coding sequences of *Vkorc1* gene (*i.e*. 69.0% of the rats tails sent by PCO). Eight single mutations (Y25F, A26P, R40G, S57F, W59R, W59C H68N and K152T) and two double mutations (Y25F/W59R and Y25F/K152T) were observed in black rats. Interestingly, catalytic characterization of mutants showed that these mutations are associated with very low resistance factor, comparatively to the mutations encountered in brown rats or in house mice. The resistance factors measured are equivalent to those found in humans who are considered resistant when it is necessary to increase the doses by a factor of 2. Despite these low resistance factors, the PCOs describe a low efficiency of the chemical management against black rats. That is certainly due to the extreme neophobia of black rats leading to an absence of consumption or a low consumption of the baits exacerbated by the acquisition of a weak genetic resistance.

MONITORING AND QUANTIFICATION OF (1R,3R)(1S,3S) AND (1R,3S)(1S,3R) DIASTEREOISOMERS OF SECOND GENERATION ANTICOAGULANT RODENTICIDES IN WILDLIFE

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The persistence of second generation anticoagulant rodenticides (SGAR) in rodents is responsible for secondary exposure or poisoning of predators and scavengers, and is of ecological concern for the conservation of endangered species. Commercial formulations of SGAR are always a mixture of two diastereoisomeric forms (*i.e.*, (1R,3R)(1S,3S) and (1R,3S)(1S,3R) forms) with different biological properties. In laboratory rats, one of the diastereoisomers is always more persistent than the other. What about the field samples? A multi-residue LC-MS/MS method for the quantification of the diastereoisomers of SGARs has been developed to investigate their proportions in field samples. This method was applied in various biological samples collected from wild rats, red kites and red foxes. This quantification provides important information about the persistence of isomers in wildlife, and taking into account of this information may allow to reduce the ecological risk associated with SGAR.

TOWARDS A WAY TO IMPROVE THE SECOND GENERATION RODENTICIDES BASED ON THE CONCEPT OF STEREOCHEMISTRY – GENERALIZATION OF THE CONCEPT TO ALL MOLECULES

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Second generation anticoagulant rodenticides (SGAR) are generally highly efficient for rodent management even towards warfarin-resistant rodents. Nevertheless, because of their long tissue-persistence, they are very often associated with non-target poisoning of wildlife. Because of the presence of two stereogenic centers in all SGAR, commercial baits containing SGAR contain systematically a mixture of two diastereoisomeric forms (*i.e.*, (1R,3R) (1S,3S)-isomers and (1R,3S)(1S,3R)-isomers), and both forms are present in baits in proportions that are controlled by authorities. In order to limit non-target poisoning of wildlife associated with the use of SGAR, and to develop more ecofriendly rodenticides, biological properties of diastereomeric forms of SGAR were compared by determining their ability to inhibit the VKOR activity involved in the activation of vitamin K dependent-clotting factors and their toxicokinetic properties. Systematically for each SGAR, both diastereomers are equally effective to inhibit the VKOR activity. On the other hand, their toxicokinetic properties are very different with one of the two always more rapidly cleared than the other one. For all SGAR except flocoumafen, the less persistent diastereomer is always the less predominant isomer present in the current mixture. Therefore, in order to limit the ecotoxicological risk associated with their use, SGAR must be enriched with the least persistent diastereisomer. However, monitoring of their level in wildlife must be done before definitively modifying SGARs.

ACCEPTABILITY OF WHEAT BAITS PRE-TREATED WITH HIGH TEMPERATURE AND HUMIDITY TO COMMENSAL RODENT SPECIES

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Extreme environmental conditions, i.e. high humidity and temperature, rapidly degrade baits, which results in failed eradication programmes. The present study aimed to determine the time period over which grain maintains freshness after exposure to detrimental environmental conditions, and acceptability of such baits to house mice and brown rats.

Ten wild-born house mice (*Mus musculus*) and eight wild-born brown rats (*Rattus norvegicus*) were used in a choice-test. Placebo and challenge baits were offered daily. Broken wheat was used in placebo bait, while challenge bait had the same component but was pre-exposed to 32º C temperature and 80–95% humidity. Challenge bait pre-treated for 24 h with high temperature and humidity was offered on the first day, while pre-treatment of baits laid on each consecutive day was successively 24 h older.

The average acceptability of baits offered to house mice and rats in the first four days ranged from 23.69% to 72.23%, and from 75.94% to 82%, respectively. Acceptability by mice was merely 4.66% on the fifth day, and decreased further to 0.44% on the following day, while the consumption was terminated on the seventh day. Acceptability by rats on the fifth day was 12.38%, and consumption of the bait ceased on the sixth day.

Additives suppressing mold and decay will significantly improve effectiveness of baits used in control programs, but the issue requires further research.

YOUNG CONIFER STANDS FORM A REFUGE FOR AN OAK ADMIXTURE AGAINST DEER BROWSING: SILVICULTURAL IMPLICATIONS FOR FOREST REGENERATION UNDER HERBIVORE PRESSURE

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There is little knowledge on a possibility how ungulate pressure on forest regeneration may be mitigated by silvicultural methods. Such knowledge is especially needed for artificially regenerated, deciduous tree species. We studied factors affecting browsing incidence by deer in the Pisz Forest District in Poland, within area of 10,000 ha of the forest damaged by a 2002 hurricane. In 2006 we established three experimental plots (in total, 22.6 ha), in which the main species was Scots pine (*Pinus sylvestris*) admixed with pedunculate oak (*Quercus robur*). The data on browsing were collected in 2008–2015.

In general, oak browsing incidence was unrelated to oak planting density. On a plantation scale, it was significantly affected by the age of pines. Although in each variant all the oaks were browsed for four consecutive years (2009–2012), in 2013 browsing incidence began to decrease. When the pines grew higher and formed a physical barrier, it was harder for browsers – roe deer (*Capreolus capreolus*), red deer (*Cervus elaphus*) and moose (*Alces alces*) – to move through and locate the oaks. Moreover, within plantations, oak browsing incidence was higher in the patches with lower pines. Browsing of individual saplings or small groups of saplings was also negatively affected by the height of neighbouring pine saplings. Oak density influenced deer selectivity depending on the tree height. In a low oak tree density, browsing incidence was unrelated to oak height, while in higher tree density, deer selected oaks of the height between 40 and 100 cm. We sugest that deciduous admixture in a coniferous (unattractive) stand can be planted with a few year delay. Older coniferous trees should impede locating of attractive tree species by deer and thus decrease browsing incidence.

DOES WINTER SUPPLEMENTARY FEEDING INCREASES OR DECREASES DAMAGES CAUSED BY DEER IN A FOREST ECOSYSTEM? – THE FIELD TEST CONDUCTED WITHIN AREAS WITH DIFFERENT DEER DENSITIES

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Supplementary feeding is a widespread, but controversial practice in game management. It is commonly applied across Europe and North America to support wildlife populations (in particular ungulates) during the winter time. Additional feeding is mainly justified by a need to secure sufficient densities of wildlife for hunting or by the reduction of wildlife impact on ecosystem. Whereas supplementary feeding may positively affect the winter survival in game populations, it may also reduce the health of ungulates and locally increase forest damage. While many studies on the impact of artificial feeding on wildlife populations have been conducted, there is very few information as to how feeding affects damages caused by wildlife.

Presented study was focused on the level of damages caused by red deer in forests located in three mountain regions in Poland with different deer densities. We analysed the level of tree damages caused by deer during the winter near the permanent feeding places and randomly selected locations.

The impact of additional feeding was clearly visible in one mountain region only, where red deer density and the level of damages was the highest. The presence of supplemental winter food did not increase the level of tree damages as expected, but reduced those damages. However, the role of winter supplementary feeding was strictly related to the distance from the forest edge (pastures, farmlands). Feeders located less than 1000 m from the edge of the forest did not mitigate the pressure of deer on forest ecosystem.

CORVID TRAPPING WITH THE LARSENMATE

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Corvid trapping is legal in the UK under certain circumstances, for example to protect crops or livestock. The two most commonly used traps; the Larsen trap and the large multi catch cage trap have recently been joined by a smaller 'clam' type trap often referred to as the Larsenmate.

This paper provides an introduction to the Larsenmate and discusses the results of a trial involving corvid traps on a lowland arable farm and the findings as they relate to the Larsenmate.

The Larsenmate had a reasonable capture rate and low rate of target (*Corvidae*) escapes compared to the established trap types. The capture rate of non-targets was much lower than that of target species despite more non-target visits to the trap, subsequently most non-targets escaped. Several buzzards (*Buteo buteo*) were caught in the traps but only when meat baits were used.

Video observations suggested that the likelihood of trap closure injuries was very low, but there was a minor risk of some birds becoming 'entangled' in the trap either during closure or subsequent escape attempts.

Minor injuries were found on 58% of birds examined, none of these were considered serious enough to compromise survival if the bird had been subsequently released. Birds from Larsenmates typically exhibited fewer abrasions to the head and less claw damage, but they did have more damage to feathers. This is probably due to the size of the wire mesh and the space available in the trap.

PROJECT DEVELOPAR – DEVELOPMENT OF A PLANT BASED AVIAN REPELLENT

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Treatment of seeds and baits is a common method in pest control to avoid damages and unintentional intoxications. In the project DevelOPAR a plant based avian repellent shall be developed for plant and bird protection. Repellent plant extracts have already been identified in a former project by a systematical screening of 30 various plant extracts. They were used as a treatment of maize seeds in choice tests with pigeons and pheasants in aviaries. In field experiments the repellent effect could not be verified and persistence of extracts on seeds remained unknown. In the project DevelOPAR the persistence of plant extracts shall be improved by designing appropriate formulations for the instable and complex natural chemicals. Experimental results of recent tests with birds as well as with target species of baits, i.e. snails and rodents, in enclosures and field trials will be presented and discussed.

The project is supported by funds of the German Government's Special Purpose Fund held at Landwirtschaftliche Rentenbank (28RZ-4IP.016).

RRAC: INTERACTIVE ADVICE ON RODENTICIDE RESISTANCE MANAGEMENT

Stefan Endepols

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CLI-RRAC

The Rodenticide Resistance Action Committee (RRAC) is a working group within the framework of CropLife International. Participating companies include: Bayer AG, BASF, LiphaTech S.A., Pelgar, Rentokil, Syngenta and Zapi. Senior technical specialists, with specific expertise in rodenticides, represent their companies in this committee. Through their website, the group seeks to provide guidance to advisors, authorities, professionals and others, on the nature of anticoagulant resistance in rodents, on the application of rodenticide use strategies that will avoid the development of resistance, the recognition of anticoagulant resistance and how to manage it. Experienced co-authors were invited to contribute to a comprehensive guidebook on rodenticide resistance management. The content of this guidebook, extended by additional data on the occurrence of resistance was transformed into an interactive website, where users of rodenticides and advisors can get information on how to manage the resistance. The website will be introduced at the 11th EVPMC.

AMPHIBIANS – THE NEW SPECIES GROUP UNDER THE FRAMEWORK OF THE RISK ASSESSMENT OF PLANT PROTECTION PRODUCTS

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Amphibians are the most endangered vertebrate group in Europe with faster declining rates than mammals and birds. Pest control measures count are among of the main causes for the amphibian decline. Permeable skin and changing habitat use between aquatic and terrestrial environments make amphibians susceptible to teh exposure at pesticide applications. The first version of the scientific opinion of the EFSA highlights the need to include amphibians in the risk assessment performed for plant protection products. Hence, biological and ecological data are missing on this issue and specific research is necessary.

Amphibian research at the JKI has started in 2014. The first laboratory test that was conducted investigated the effects of glyphosate exposure on the development of common toads. In addition to this, enclosures for keeping and breeding amphibians were installed. Migration behavior and habitat preferences of common toads and common frogs are the foci of the current study AmphiMove.

Study approach and first results are presented.

AVOIDANCE-TEST PROCEDURE TO EVALUATE CONSUMPTION OF TREATED SEEDS BY BIRDS

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Seed consumption by granivorous birds can be affected by seed treatment with plant protection products (PPP). The quantification of treatment effects on consumption has been ignored up until now and a test procedure is missing, although a comparative exposure risk assessment is mandatory for seed treatments to birds. We developed an indoor seven-phase test procedure considering different alternative food availability, differences in species' requirements and the latest animal welfare standards. Feeding effect was quantified by the comparison of consumption rates of seeds with and without treatments.

We present the procedure with untreated and with fungicide treated rape seeds and quantified avoidance effects for greenfinches (*Carduelis chloris*) and quails (*Coturnix japonica*). The test procedure is suitable for highlighting differences in feeding effects of treatment variants. Animals were not negatively affected by the test procedure.

Alternative food was clearly preferred to rape seeds. Strong avoidance effects suggest avoidance of rape seeds as well as PPP treatments in the open field even in case of low food availability for birds. The procedure is appropriate as a basis for the development of standard tests and should be extended to a field test procedure to validate exposure risk for birds under natural conditions.

INDIVIDUAL BASED MODELING TO INVESTIGATE EFFECTS OF MANAGEMENT MEASURES UPON POPULATION DYNAMICS OF RESISTANT NORWAY RATS (*RATTUS NORVEGICUS*)

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The Westphalia resistant rat strain is marked by the Y139C polymorphism of the *vkorc1* gene, which leads to practical resistance against less toxic anticoagulants. Effects of using these anticoagulants on population dynamic and frequence of the polymorphisms are unknown and impossible to investigate by field trials due to the complexity of the ecological system. We developed an individual based model (RaSys) to investigate the effects of Coumatetralyl and Difenacoum for which the phenomenon of resistance was observed and Brodifacoum which is effective in case of resistance. For populations with different Y139C simulated were all biological and management processes such as reproduction and application of anticoagulant inclusive toxic effects and residues. Beside the model approach, first results are represented for a single population. The next necessary step will be the calibration and validation of the model as well as the implementation of migration processes to receive useable data. Hence, by now it appears that the initial model well reflects the complexity of the system, allows on the understanding of the system and fills up gaps in the knowledge of management of resistant rats.

PROCEDURES FOR ANTICOAGULANT APPLICATIONS TO CONTROL RATS (*RATTUS NORVEGICUS*) IN FACE OF RESISTANCE, MITIGATION OF ENVIRONMENTAL RISK AND COUNTRY SPECIFICITIES

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In both European countries, Germany and Denmark, Norway rats resistant to rodenticides are marked by the Y139C polymorphism of the vkorc1 gene. According to monitoring data, resistant rats are found in the northwest of Germany and countrywide in Denmark. Occurrence of Tyr139Cys may be a reason of ineffective population control if less toxic anticoaguants are used. Hence, the most toxic anticoagulants have to be used but only in case of resistance to mitigate the environmental risks. We present management approaches in the form of flow charts indicating how rat control should be conducted when resistance and environmental risk are considered. The approach is presented for Denmark and Germany considering country specific requirements. The poster shall inspire conference participants to discuss specific practicable management solutions suitable for current situations.

DO ANTICOAGULANT RODENTICIDES AFFECT THE SEASONAL POPULATION DYNAMICS OF SMALL MUSTELIDS?

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Prey controlled with pesticides can indirectly poison predators. However, pesticides' effects on predator dynamics has not been well documented.

Temporal variations of abundance of small mustelids (weasels, stoats) follow those of voles, their main prey. Grassland voles show population cycles, damaging pastures/hay fields. Some farmers control voles using anticoagulant rodenticides (ARs), poisoning non-target species feeding on intoxicated voles, like small mustelids. However this impacts upon their populations is not well known.

We studied whether bromadiolone (an AR) affects small mustelid population abundance (SMA). Our hypothesis was that ARs decrease SMA. Using data of bromadiolone use (2008–2016), we surveyed 6 sites with no/very low treatment frequency, and 4 with high frequency. We estimated SMA, water vole (WVD) and common vole (CVD) densities in spring and autumn 2016, treatment periods. We estimated the abundance of foxes (FA) as small mustelids' superpredators.

We calculated seasonal population changes (SPC) of small mustelids as

SPC = Ln (autumn /spring SMA)

SPC was modelled against bromadiolone treatments and other species' abundance.

All sites with high bromadiolone use showed negative SPC i.e. decreases in population abundance (mean SPC high bromadiolone use= – 4.52, mean SPC no/low bromadiolone use= 0.4, $p=0.005$). Additionally, SPC was positively associated to WVD ($p=0.002$) and its interaction with bromadiolone ($p=0.01$). Small mustelid abundance decreased with low water vole density at frequently treated sites but at sites with low treatment frequency small mustelid abundance remained stable i.e. SPC close to 0, regardless WVD changes. Our results suggest that ARs may affect small mustelid population dynamics.

ATTACKS ON HUMANS AND PROPERTY DAMAGE BY RELOCATED RHESUS MONKEYS (PEST PRIMATE) AND MITIGATION STRATEGIES IN SUBURBAN AREAS OF DELHI NCR

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In India, rhesus macaques (*Macaca mulatta*) live in urban, suburban areas and forest-agriculture mosaics, and are fed regularly by public to fulfil religious sentiments. Rhesus macaques have been trans-located to Asola-Bhatti wildlife sanctuary, southern forest range of Delhi. Locally overabundant population of monkeys due to lack of predators, degradation of forests, rapid urbanization, open garbage disposal system, roadside feeding of monkeys and persisting human settlements in proximity to the sanctuary, turned aggressive and was causing severe economic loses and threats to human health in suburban areas of national capital region, India. The number of cases of human-monkey conflict was recorded from May, 2016 to April, 2017 with qualitative and quantitative questionnaire survey .We selected 7 localities in and around the sanctuary to study the nature and extent of monkey menace. On average 14.74% cases of attack, 12.01% cases of injury, 11.15% cases of bites, 15.56% cases of snatching foods, 11.23% cases of threatening, 11.49% cases of entering into the houses, 11.36% cases of property damage and 8.27% of littering were found. The result of One –way ANOVA ($\alpha = 0.05$) shows the number of conflict cases varies significantly among localities of suburban areas (df = , F = 5.02, p value <0.001) and it shows significant difference (p value <0.05) among different sites of incidence (N = 13). Age-class distribution of victims exhibits that the individuals are affected chronologically from age class 16–30 years (33.68%), 0–15 years (24.49%), 31–45 years (19.86%), 46–60 years (14.04%) and lastly 61–75 years (7.91%). Mitigation strategies for human-monkey conflict and action plan have been suggested.

BEHAVIOURAL RESPONSES TO A UBIQUITOUS PLANT CHEMICAL AND PREDATOR OLFACTORY STIMULI IN THE HOUSE MOUSE

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Mice are macrosmatic animals that use olfaction as their main source of information for primary behaviours such as risk avoidance, foraging and reproduction. This chemical form of communication crosses boundaries between species and kingdoms, as it can be observed in mammalian predator-prey relationships and the relations between herbivorous or frugivorous mammalian species and plants.

In this study, we examined the effects of ethanol, a ubiquitous plant chemical associated with ripening and rotting, and mice predator chemical cues on avoidance, locomotor activity, and stress related behaviour, measured by the production of faecal boli. Our results showed that mice clearly avoided ethanol and decreased their locomotor activity when ethanol was present. The molecule TMT, used as our positive control, was the most avoided, reducing locomotor activity and increasing the number of faecal boli.

Our results highlighted the relevance of ethanol as a probable cue for fruit ripening, in the wild, this chemical cue could convey primordial information about the ripening state of fruits, allowing animals to avoid over-ripe, unhealthy fruits.

COLONIZATION OF WARSAW BY RED FOX *VULPES VULPES* – IS IT ALREADY A PROBLEM?

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In the 1970s, red fox was present only in the outskirts of Warsaw. Our aim was to assess how advanced is the process of its colonisation of Warsaw, what is the current density of red fox population ,and which habitats it penetrates.

We used: a/ records of foxes (direct and indirect observations, 2011–2012) in the whole city divided into 1 km x 1 km grid net. Each grid was systematically searched for i.e. tracks, dens, direct observations; b/ records of foxes encountered by city citizens, reported to the City Forests of Warsaw (1998–2015), assigned to the net grid; c/ snow-tracking on transect routes (in total over 352 km) across various habitats (2015–2017).

Results: a/signs of red foxes were found in all grids (in the whole city); b/ according to data from the City Forests of Warsaw foxes were recorded in 282 out of 593 grids. The number of records varied in years and among grids, but was distributed evenly across the city. Grids with presence of foxes were dominated by an urban fabric (51.7%), forests and other green areas covered 37%); c/ according to snow tracking fox density was 1.2 ind./100 ha, with highest values for forests and open areas (1.5 ind./100 ha).

Conclusions: The whole city was already colonized by the red fox but its density is still rather low, and the species inhabits habitats typical for rural populations. We expect further increase in the density and colonization of suboptimal habitats. Therefore, more encounters with human i.e. more conflicts can be expected.

WHAT FACTORS ARE RESPONSIBLE FOR THE SUMMER TREE BARK STRIPPING BY DEER?

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There is a general agreement that bark-stripping by red deer is observed mainly during the winter period and it is related with lower availability of food resources. However, in this study we observed bark-stripping in beech forest during summer time. Moreover, there were distinct differences in a probability of occurrence such damages in various beech stands. In some places bark stripping in a thicket was repeated every year, whereas in other places similar forest remained almost undamaged.

That is why we analyzed the following factors that could affect deer foraging behavior in damaged and undamaged beech forests: 1) predation risk from wolves, 2) anthropopressure (distance to villages, houses, roads and forest edge), 3) impact of agricultural food (distance to crop fields and forest edge), 4) availability of food and 5) content of minerals (Ca, P, K) in beech bark.

Places with high intensity of bark stripping were characterized by over 80% tree damages, whereas nearby located similar stands were almost free from any damage (<15%). From all of the factors which were analysed in this study, only the mineral's content differs between damaged and undamaged forests. However, we found that in one forest district the beach bark consumed by red deer contained more calcium, whereas in another forest district more phosphorus and potassium.

Our study shows that damages caused by deer in forest could be related not only to food scarcity but also to the local availability of minerals. Therefore, foresters may mitigate bark stripping by supplementing an additional mineral-rich foods.

INFECTING PATHOGEN RESEARCH WITH RODENT ECOLOGY AND EVOLUTION

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The ecology and physiology of host species provide the general framework for the epidemiological and evolutionary scope of their parasites but zoonotic events show clearly that many pathogens have the potential to break the limits of the original host. It remains unclear for most systems to which extent evolutionary processes and/or ecological conditions govern the transmission and establishment of pathogens among natural host populations and species. This presentation will focus on the interactions between regional and local rodent and pathogen populations and their evolutionary trajectories. Longitudinal and spatial investigations of vole populations and their hantavirus pathogens demonstrate that ecological factors together with local stochasticity can play major roles in shaping the structure and dynamics of both rodent and parasite populations. However, deeper evolutionary trajectories within the reservoir hosts have the ability to override microevolutionary processes in viral pathogens and restrict their evolutionary potential in spite of extremely high mutation rates. I conclude that the tight integration of ecological and genetic information at different geographic scales is a challenging but necessary step for a deeper understanding of not only the evolution and spread of pathogens or resistance mechanisms but also very fundamentally of the interactions and dynamics between natural (pest) populations.

BETWEEN BENEFITS AND RISKS: THE USE OF AGRICULTURAL RODENTICIDES BY PEST MANAGEMENT PROFESSIONALS IN PIG FARMING IN GERMANY

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Research focused on rodent control practices, usage of anticoagulant rodenticides and the acceptance of pest management professionals (PMPs) in pig farming in Germany is limited. In the present study, operation managers were offered the possibility for two years outsource rodent control to PMPs, supported by financial contribution of the North Rhine-Westphalian Animal Disease Fund (TSK). For this study, data were collected from monitoring records of PMPs (2014–2016) and personal on-site interviews with farmers and PMPs. Out of 47 farmers being offered this opportunity, 33 participated in the project. The monitoring analysis revealed an almost continuous pest infestation. SGARs are mainly used to control these commensal rodent populations, notably Brodifacoum. Remarkably, the quantity of Brodifacoum used seemed to be farm and PMP-dependent, suggesting that a moderate application of SGARs could also lead to a success while minimizing the risk of secondary poisoning to non-target species. Despite of the limitations of this study due to a small sample size, the project must be considered as a success since approximately two-thirds of operation managers would employ PMPs permanently, even beyond the end of the project. Keeping in mind that many farmers bait for prolonged periods and almost never remove poisoned carcasses, the application of PMPs offers advantages in regards to both prophylactic measures for epizootic diseases and for protection of non-target wildlife.

RODENTICIDE RESISTANCE OF NORWAY RATS (*RATTUS NORVEGICUS*) IN DENMARK: MONITORING AND DEVELOPMENT OF NATIONAL CONTROL STRATEGY

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Since 2010 the numbers of rat notifications in Denmark have increased by more than 50% from approx. 130.000 to approx. 200.000 cases per year in 2016.

Even though use of anticoagulants for controlling rats in Denmark are under pressure, due to environmental concerns, they are still used in more than 70 % of all treatments.

Earlier monitoring programs in Denmark (since 1962 until 2008) have demonstrated that phenotypic resistance to bromadiolone or difenacoum (second generation anticoagulants) occurred in one third of the Danish municipalities. Current preliminary genetic data show that the Tyr139Cys mutation is prevalent in Denmark. It was found in more than 50 % of 107 sampling locations. These findings together with the increase in notifications has led to a revision of the Danish control strategy approved by the Danish authorities, who are responsible for all rat control in Denmark.

The national control strategy has been a stepwise model, where anticoagulants are used according to their toxicity from low to highest potency. There has been no differentiation between the resistance affected and resistance unaffected anticoagulants, what could explain the widespread occurrence of Tyr139Cys in Denmark. Results of the evaluation of the present stepwise strategy and the future strategy focusing on using resistance breaking compounds and non-toxic methods are presented.

GENETIC INSIGHTS INTO COMMON VOLE (*MICROTUS ARVALIS*) POPULATION RECOVERY AFTER RODENTICIDE APPLICATION

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Regulation of common vole (*Microtus arvalis*) populations is of major interest in the regard of pest management, since they cause significant destruction of crops during population outbreaks. After an outbreak, populations crash to a minimum and need several years to recover. The mechanisms of these boom and bust dynamics are only little understood. However it seems clear that each collapse leads to a genetic bottleneck scenario resulting in decreased genetic variation within those populations.

We conducted a live trapping study and artificially created a population collapse by rodenticide application in July 2014 and March 2015. We took tissue samples from trapped individuals and used extracted DNA in microsatellite analysis to compare population genetic structure among control and treatment plots (n=4) before and after treatment, and among monthly trapping sessions in 2014 and 2015.

We found differences between 32 of 190 paired plots (16.8%) when comparing trapping sessions with each other from June to October 2014 and March to October 2015. There was no difference between populations from control and treatment plots which we sampled immediately before and after rodenticide application in July 2014. Analysis could not be conducted for treatment in March 2015 due to very low sample size. 38 individuals were determined as migrants hinting to the conclusion that dispersal is a more important recovery mechanism than reproduction of remaining survivors.

THE EURASIAN PYGMY OWL (*GLAUCIDIUM PASSERINUM*) AS A POTENTIAL BIOLOGICAL CONTROL AGENT FOR SMALL RODENT PESTS IN BOREAL SILVICULTURE

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Voles are regarded as serious pests in boreal forests, inflicting millions of euros worth of damage to silvicultural operations in years when population densities are high. In this study we investigate the efficacy of biological control by the Eurasian pygmy owl as a novel method for mitigating vole damage to spruce (*Picea abies*) seedling stands. Of all boreal owl species, the pygmy owl has the highest potential to reduce vole population size locally, as unlike other species, it hoards voles in nest boxes and cavities before the onset of winter. The study was conducted as a field experiment in central Finland during a major vole abundance peak between autumn 2008 and spring 2009. The experiment consisted of 98 recently planted seedling stands, half of which were randomly designated as treatment stands and half as control stands. Treatment involved erecting two pygmy owl nest boxes in summer 2008 in mature forests adjacent to the seedling stand. In each study stand we marked and measured 50 undamaged spruce seedlings, as well as quantified grass cover and vole abundance. During the winter, pygmy owls hoarded voles in 18 out of 49 box stands. The degree of vole damage to seedlings did not differ between stands where pygmy owls had and had not hoarded. Vole damage was inversely related to mean seedling size but not affected by grass cover. The inability of pygmy owls to reduce vole damage to seedlings may have been due to the exceptionally high numbers of voles. Its effects may also have been masked by predation by other avian and mammalian predators, whose numbers were not estimated. We conclude that pygmy owls hold the potential to control vole damage at moderate vole densities and at local, smaller than landscape scales.

PREDICTING POPULATION DYNAMICS OF FOREST RODENTS

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Microtus and *Myodes* species are particularly abundant in Central Europe where their population dynamics are characterized by multi-annual fluctuations. During population outbreaks, field voles (*Microtus agrestis*) and bank voles (*Myodes glareolus*) can affect silvicultures because of damage to trees and human health because of the transmission of rodent-borne zoonotic diseases.

Predictive models based on easy to obtain parameters could help to take timely action in case of an upcoming outbreak of forest rodents. We used long-term time series covering several decades of rodent abundance to assess abundance correlation between rodent species, the effect of rodent abundance on rodent-related damage and on hantavirus epidemiology, as well as the effects of weather conditions on vole abundance.

Abundance fluctuations were positively correlated between field voles and bank voles. The higher the abundance of forest voles the higher was tree damage, and the higher the bank vole abundance the higher was the hantavirus sero-prevalence/incidence. Weather conditions were highly correlated to outbreak risk/abundance in forest voles. There were delayed effects in bank voles and field voles densities, which responded to weather parameters affecting seed mast of forest trees in the previous year.

Weather parameters can be easily obtained and can be used as a basic parameter to develop predictions of outbreaks of forest rodents if the correlations found are valid across forest systems. Early warning tools can help to inform plant protection and health officials, medical practitioners and risk groups well before vole outbreaks may occur.

STONE MARTEN (*MARTES FOINA*) IN WARSAW – FLUFFY NEIGHBOUR OR ANNOYING PEST?

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Stone marten might be a pest in urban areas, which transfers zoonoses and parasites, and causes material losses (damaged cars or ruined attics), but for wildlife lovers it is a valuable component of urban biodiversity. When it is very common, human-marten conflict management may be necessary. Our aim was to determine which habitat stone marten penetrates, and determine the current density of its population in Warsaw.

We used two methods: (1) records of martens encountered by city citizens and reported to the City Forests of Warsaw (1998–2015). The city was divided into 1 km x 1 km grid net where the records were assigned; (2) snow-tracking (2015–2017) on transect routes (over 352 km) in various city habitats.

Martens were registered in 93 out of 593 grids, mostly in central part of Warsaw. Grids with presence of martens were dominated by urban fabric (61%), other habitats covered: forests (11%), remaining green areas (19%), industrial areas (8%), water bodies (1%). Martens were recorded on average 6.8 km from the city centre, this value did not change in years. According to snow-tracking, the density of stone marten was 0.33 ind./km^2, the highest in build-up areas (1.1 ind./km^2) and other green areas (e.g. parks, cemeteries; 0.9 ind./km^2).

Our results confirm that stone martens are urban-adapters. In Warsaw they occur in habitats typical for urban populations, close to humans. Nevertheless, their abundance in human-transformed habitats of Warsaw is much higher than in rural areas and its further increase (therefore more conflicts with human) is expected.

PRESENCE OF SMALL RODENT SPECIES IN REPLANTED OAK FORESTS

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Forests are complex ecosystems rich in a variety of plant and animal life. Ecological characteristics of oak forests undergoing reforestation make them appropriate for colonization of different rodent species.

Oak's specific growing technology requires a variety of activities to secure a sufficient number of trees for a period of planned thinning. From the moment of sowing to fully stabilized ecosystem, rodent activities may cause significant losses in replanted oak forests. By damaging roots, root collars or trunks of oak saplings, which is especially evident and visible in early spring, rodents cause unwanted thinning out of oak stands and expansion of clearings. Data obtained so far indicate, that the most extensive damage is caused in plantations up to five years old. Sporadic damage has also been observed in seven or eight year old stands.

In order to maximize effects in preventing economic losses through the expansion of clearings in oak forests under reforestation it is essential to know the population size and species of rodents affecting them.

Presence of small rodent species were monitored for three years in oak plantings of various age. The data revealed the presence of common voles (*Microtus arvalis*), striped field mice (*Apodemus agrarius*), wood mice (*Apodemus sylvaticus*) and yellow-necked field mice (*Apodemus flavicolis*). The age of oak stands was found to affect the numbers of small rodent species. In the first and second years of oak plantation, common voles were dominant over other rodent species. Striped field mice populations expanded and took over the lead in the succeeding years.

Acceptable protection of oak forests from harmful rodent species preceding any protective treatment should therefore include an inventory of present species, knowledge of their biology and competition. Protection measures based on such information should then be prepared and conducted as either preventive or immediately implemented.

MANAGEMENT OF SOME RODENT PESTS WITH THE TRAP BARRIER SYSTEM IN CANAL IRRIGATED PLANTATIONS OF CENTRAL PUNJAB, PAKISTAN

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This paper presents information on the management of four important rodents: *Mus musculus, Rattus rattus, Bandicota bengalensis* and *Nesokia indica* in Faisalabad and Jhang, Pakistan. Both cities are situated in Central Punjab, where predominant agricultural crops are grown. Farmlands in both localities were canal-irrigated and comprised wheat, maize, rice, sugarcane and fodders.. The region provides more than 30% of the agricultural requirements of the country. Variety of vertebrate pests (rodents, porcupine, wild boar and birds) due to suitable ecological conditions, always remains a serious threat and deters the crop sustainability. Ecologically based rodent management strategies (EBRM) through the incorporation of trap barrier system (TBS), in the randomly selected sites in both cities in (2012) and (2013), significantly reduced the depredations caused by all four rodents, without interfering with the sustainability of existing agro-ecosystems. Trap barrier system comprised recyclable poly-ethylene sheets, hinged together with wooden bamboos, at 25m from the ground surface, with four small inlets, provided with moistened mud and single, double and multiple capture traps with oil immersed baits (four on each corner of the field) to lure the rodents. The results confirm high effectiveness of the trap barrier system with lowered trap success ratios (TSRs) for all the sampled crops among tested sites in relation to the control plots. Demonstrated methodology may be equally effective for other agricultural and horticultural crops, through the decrease the rodent-related damages without any impacts on the agro-ecosystem sustainability.

Certificate: This is to certify that the present work has been conducted in the sub-habitats of both the major habitats, and that, has not been submitted anywhere.

URBAN WILD BOARS IN WARSAW – AN INCREASING MANAGEMENT CHALLENGE

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In recent years population of wild boar *Sus scrofa* in Poland increased, including colonization of urban habitats. Here we show changes in the number of encounters with wild boars, their distribution in the city, and factors influencing risk of wild boar-vehicle collisions (WBVC) in Warsaw. We used data from the City Forests of Warsaw (2000–2015), i.e. records of wild boars reported by city citizens. We assigned them to the net grid (1 km x 1 km, 593 grids in total).

The number of encounters with the species increased over time: between 2000–2003 21 cases were recorded, in the years 2010–2015 this number rose from 63 to 251. Consequently, between 2000–2003 wild boars were recorded in just 20 grids, recently (2012–2015) in 205 grids. Grids with records of wild boar were dominated by human-transformed habitats (55%; mostly discontinuous urban fabric) while forests and rural areas covered 33%. Recently animals were recorded in grids with higher coverage of rural areas and less forests than in previous years. In total, over 200 WBVCs were recorded, their probability rose with an increasing coverage of discontinuous urban fabric and distance to the city centre.

Our study shows an ongoing process of colonization of the city by wild boars, which is driven by an influx of animals from green areas in the north and east-south of Warsaw. Therefore, the number of human-wildlife conflicts increases. Effective management of urban population of wild boar is an important challenge, possible mitigation measures are discussed.

RISK ASSESSMENT FOR PLANT PROTECTION PRODUCTS: WHAT DO WE KNOW ABOUT FRUGIVOROUS MAMMALS IN COMMERCIALLY MANAGED ORCHARDS OF EUROPE?

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According to EU Regulation 1107/2009, the effects of plant protection products (PPPs) on wild mammals have to be assessed. For frugivorous mammal species the ecotoxicological risk assessment is required in orchards (e.g. pome fruit, stone fruit, citrus, nuts) as they can be exposed to PPPs by consumption of over-sprayed fruits. According to the EFSA Guidance Document for Birds and Mammals Risk Assessment the garden dormouse (*Eliomys quercinus*) is the representative of fruit eating species in orchards for risk assessment.

In this project we aimed at summarizing the available information on frugivorous mammals (garden dormouse and other dormouse species) in commercially managed orchards of Europe. We focussed on the occurrence of these species in commercially managed orchards, their diet composition and use of orchards as foraging habitat. Different sources of information were consulted: (1) publically available scientific literature, (2) publically available evaluations of frugivorous mammalian risk assessments by EFSA and Member States and (3) mammal expert opinions on the potential relevance of the frugivorous scenario risk assessments.

Garden dormouse and edible dormouse (*Glis glis*) are considered as causing a damage to fruits, and could therefore potentially qualify as frugivorous focal species for risk assessment purposes. However, only for the garden dormouse some quantitative data on its diet from commercially managed orchards (citrus) are available. Overall, it can be concluded that quantitative data on the occurrence, diet and habitat use of dormice in commercially orchards is limited and more quantitative data are therefore needed to enable better assessment of the risk of plant protection products towards these species.

FREE-ROAMING CATS AND THEIR IMPACT ON WILDLIFE IN CENTRAL POLAND – ORIGIN OF THE PROBLEM

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Population density of free roaming house cats reflects the density of humans providing supplemental food. Consequently, in the vicinity of buildings cat populations reach high densities and they impose strong hunting pressure on prey populations.

The threat that free roaming cats pose to wildlife in rural areas is serious and has gained increased recognition by researchers and conservationists. A set of mitigation measures can be considered but application of any of them requires cooperation with cat owners.

Our studies showed that cat density estimated along transect routes distributed in rural areas of central Poland exceeded that of wild living terrestrial predators (i.e. foxes and martens). Abundance of free-roaming cats decreased with a distance from settlements and the numbers of cats observed changed seasonally and during a day (reaching its highest in warm months and at night). Cats' hunting activity changed over the year, most intensively they prey in autumn, mainly upon common species of rodents, yet, some rare species were also recorded. On the basis of gathered data some robust estimation of cats' hunting pressure was provided. According to door-to-door survey carried out in villages cats were kept in the majority of households, were poorly fed or did not get any food, reproduction was not controlled and their movements were not restricted.

Cats in farms are kept as mousers rather than pets and little attention is paid to their welfare. Therefore, any educational actions to promote spaying/neutering and keeping cats inside are unlikely to work.

PATTERN OF VOLE GNAWING ON REFORESTED CLEARINGS IN CENTRAL EUROPEAN MANAGED FORESTS

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Sustainable management of European forests aims to ensure economic targets (timber production) as well as ecological role of the forest (maintenance of biodiversity). Smaller-sized clear-cutting followed by prescribed replanting, predominantly used in Central Europe, creates a mosaic of small forest patches suitable for many species including three possible pest species – the bank vole (*Clethrionomys glareolus*), the field vole (*Microtus agrestis*) and common vole (*Microtus arvalis*). During autumns 2007 – 2010 the abundance of all three voles species was assessed on a number of small-sized clearings (up to 2 hectares) in 10 study areas of managed forest in the Czech Republic. The complete trapping effort was 63,342 trap-nights. At each clearing, the line of 50 saplings was controlled during following springs 2008 – 2011. Altogether 31 050 saplings on 621 clearings belonging to 10 different tree species was controlled, and the bark gnawing intensity was measured. According to results of this study the vole gnawing regularly occurred almost in all study areas on clearings covered predominantly by grasses. The clearings situated in mixed and coniferous forests were damaged in similar extent. The field vole was identified as the main pest species in Central European managed forests even though its density on clearings was usually lower than that of the bank vole. Deciduous trees were damaged significantly more than coniferous ones with rowan (*Sorbus aucuparia*) and beech (*Fagus sylvatica*) to be mostly preferred. The vole gnawing causes direct mortality of saplings more frequently than other biotic factors including deer fraying and browsing; however, the natural regeneration of saplings seems to be able to repress the effect of gnawing, and the majority of damaged saplings survived, including girdling ones, even though with significant stem deformations. In contrast to strong inter-annual

variation in damage rate previously described in northern Europe, damage rate in Central European managed forests is lower; however, it occurs regularly with only moderate inter-annual variation. As a result, relatively low annual number of damaged saplings (3.5%) can significantly accumulate during several years after planting with significant economic implications for forestry management in Central Europe. Unfortunately, the occurrence of vole-induced damage is really site-specific and almost unpredictable. Only the field vole abundance seems to be the main predictor of damage occurrence and its intensity.

TOWARDS A WAY TO IMPROVE THE SECOND GENERATION ANTICOAGULANT RODENTICIDES BASED ON THE CONCEPT OF STEREOCHEMISTRY – CONCEPT AND PROOF OF CONCEPT

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A carbon is in the center of a tetrahedron of which each vertex has to be occupied. When all 4 vertices are occupied by different ligands, such carbon is asymmetric with 2 possible isomers: R and S. These structures are not superimposable and have pharmacokinetic and pharmacological properties that are often different. In the family of derivatives of 4-OH coumarin or 4-OH thiocoumarin, these aspects related to the existence of asymmetric carbons have been studied for warfarin only, which possess an asymmetric carbon and exists in the form of two R and S enantiomers.

In second-generation of VKA molecules, two asymmetric carbons are observed. Consequently, each VKA corresponds to the sum of four (RR, RS, SR and SS) stereomers. By the use of conventional chromatography (CLHP) two peaks only are observed representing RR and SS and RS and SR isomers. While using, for instance, asymmetric stationary phases, these four isomers can be separated. The toxicological consequences of the presence of these asymmetric carbons will be demonstrated in this presentation based on the example of difenacoum.

THE HOUSE MOUSE (*MUS MUSCULUS DOMESTICUS*) AS A REAL SANITARY THREAT

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Rodents are known to be the main reservoir of pathogenic leptospires which are responsible for leptospirosis, a worldwide zoonosis. The main way to control rodent populations all over the world is the use of anticoagulant antivitamine K (AVKs) which induces haemorrhage leading to the death of the rodents. Vitamin K epoxyde reductase enzyme (VKORC1) involved in vitamin K cycle is inhibited by AVKs. Intensive use of first generation AVKs provoked selection of resistances in rodent populations. The House Mouse (*Mus musculus domesticus*) is a worldwide rodent species presenting phenotypes resistant to first generation AVKs induced by single or multiple mutations in the *vkorc1* gene. In the present study, we have investigated by PCR and sequencing methods, both leptospires carriage and *vkorc1* gene mutations in 12 mice captured in a French farm were human and cow leptospirosis were detected. Five mice were found to carry pathogenic leptospires for which antibodies were also detected in cows. In addition 7 mice had various known *vkorc1* gene mutations associated to resistance to first generation AVKs. These results underline the persistent sanitary risk associated to such animals and the need for the use of second or third generation AVKs.

IN SITU STERILIZATION OF EGGS IN HIGH NESTS – INDIAN HOUSE CROWS

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The Indian House Crow (*Corvus splendens*) is an invasive bird in Eilat region in southern Israel. In attempt to control its populations, in-situ egg oiling technique was developed and applied.

Egg oiling, using vegetable cooking oil, physically blocks pores in the shell and prevents gas exchange with the environment. This inhibits embryo development, while maintaining the egg's external form. Studies have shown that most birds incubate the sterile, oiled eggs and that replacement clutches are rare. This method is target specific, non-toxic, safe and environmentally friendly.

We developed and implemented a method of real-time nest viewing and egg oiling in-situ without human contact in nests located up to 18m high. The device invented (patented PCT/IL2017/050838) consists of an extending pole with a real-time broadcasting camera on top and an internal tube that dispenses oil simultaneously from the ground.

In 2016 and 2017 we checked all nests found in Israel (300–400 nests) and oiled their eggs (or removed nests with hatched chicks). Of the 91 oiled nests revisited, none (except four nests hatching during treatment) hatched; 45% were abandoned; and in 55% treated eggs were incubated at least three more weeks.

The current crow population is reduced by 19%, compared to population dynamic model predictions. Assuming the younger cohorts are deficient in representation, population decrease will accelerate in the future.

In the light of these results, this method was further implemented on Monk Parakeets (*Myiopsitta monachus*) showing good results (87% hatching prevention), but was less effective on Rose-ringed Parakeets (*Psittacula krameri*).

CONFLICT BETWEEN HUMANS AND LARGE CARNIVORES

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Various species of large carnivores inhabit naturally all continents, except Australia. Everywhere, they have been an object of controversy from humans' point of view. There are three main fields of conflict between humans and large carnivores. First, large carnivores are potentially dangerous animals and may pose a direct threath to human life. There are many examples of fatalites caused by large carnivores in Africa, Asia, North America, South America and Europe. Secondy, large carnivores kill livestock and losses in animal husbandry are main reason of generally low social acceptance of these animals. Thirdly, large carnivores are considered by hunters to be serious competitors for game resources, and as a result they are often overhunted or illegally killed if protected. The last but not least is intrahuman conflict in which large carnivores are used as a tool to reach specific interests of a given social group.

ALIEN FISH IN THE DIET OF THE INDIGENOUS EURASIAN OTTER LUTRA LUTRA IN THE URBAN SECTIONS OF VISTULA RIVER, POLAND

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Biological invasions are considered a major threat to biological diversity. Most studies focus on negative effects of alien species on native species and communities. However the interactions of non-native species in new ecosystems are more complex and involve their role as a prey of indigenous predators. The Vistula, one of the largest semi-natural rivers in Europe, was invaded in last decades by several fish species, including the Round goby *Neogobius melanostomus*, Topmouth gudgeon *Pseudorasbora parva* and Amur sleeper *Perccottus glenii*. Field study of the diet of Eurasian otter was undertaken in Warsaw from 2012 to 2016 and in Kraków in 2015. The diet was dominated by fish in both locations. The analysis of 152 otter spraints collected in Kraków documented the presence of following fish families: Cobitidae, Cyprinidae, Percidae, Esocidae and Salmonidae. Among Cyprinidae Topmouth gudgeon was detected. The analysis of 89 spraints collected in Warsaw revealed the presence of Cyprinidae, Percidae, Esocidae and Round goby, the last being the most numerous fish species preyed on by otters (RFO=21,6%). The relative frequency of occurrence of Roud goby in the diet of otters increased from 14% in 2012 to 24% in 2016. The data collected indicate that in inland waters otters may preferably feed on Round gobies, however their potential limiting effect on distribution and numbers of this invasive species require future studies.

INTEGRATED RODENT PEST MANAGEMENT IN THE CAMPAIGN AGAINST VOLE BY THE LOCAL BOARD OF PLANT HEALTH IN EL VALLE DEL FUERTE, SIN. MEXICO

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The Valle del Fuerte, Sinaloa has 150 thousand arable hectares where 3 million tons of foods are produced, with a value of 600 million US dollars. The valley it is characterized by the use of high agricultural technology and the availability of water for irrigation. The main crops are: corn, beans, sorghum, vegetables and chickpea.

Vertebrate pests often cause significant damage limiting the agricultural production if not handled properly. There are 11 species of rodents associated to crops in the valley but only 3 are considered as plague: *Sigmodon arizonae*, *Peromyscus sinaloensis* and *Oryzomys couvesi*. In Mexico, the Campaign Against Vole was ordered by public utility in 1960, since the Local Board of Plant Health was empowered by the Ministry of Agriculture to carry out the campaign. In 2009 the local Sugar Company Mill bankrupted and abandoned more than 20 thousand hectares of sugarcane fields causing a major outbreak of rodents that affected other crops. Therefore as a solution an Integrated Rodent Management program was implemented, mainly using chemical and mechanical ways of control, as well as a permanent monitoring system allowing to manage control actions efficiently, and consequently act with utmost care to the environment and protection of non-target wildlife.

RODENT CONTROL IN SUGAR CANE ON THE REUNION ISLAND – EXPOSURE AND RESISTANCE OF THE TARGET SPECIES TO RODENTICIDES AND IMPLICATIONS FOR THE MAILLARD'S HARRIER (*CIRCUS MAILLARDI*)

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With a population of less than 200 pairs, the Maillard's Harrier (*Circus maillardi*) is confined to the Réunion Island. Classified as « Endangered », is the last breeding raptor in this area. Simultaneously, invasive rodents cause damage in crops by direct consumption of sugar cane or fruit, carry several zoonotic diseases and are predators of several endemic birds. To control rodent population, anticoagulant rodenticide baits are distributed on the island especially by the farmers, but no information is available on treatment efficiency and particularly the presence of resistant strains. Additionally, consumption of poisoned rats has not been documented previously while it is supposed to be one of the main causes of Maillard's Harrier mortality.

In this study, we measure the exposure of the target species (Brown Rat, Black Rats and House Mouse) following a treatment of sugar cane with bromadiolone baits. The presence of resistance to anticoagulants in the trapped rodents was also checked.

We found a high persistence of both undamaged baits in the field and of the active substance in baits (decrease from 41.6 ± 5.6 at day 0 to 38.5 ± 6.1 mg.kg^{-1} at day 25). From data modelling, concentrations were maximal in rodent population 9.5 days after the treatment (mean liver concentration 11.4 mg.kg^{-1}). No resistance was found in rats (n=4), but 62% of mice (n=21) carried the homozygous or heterozygous Y139C VKORC1 mutation.

Those results are discussed regarding their implication for treatment efficiency and the secondary poisoning of Maillard's Harrier.

MEDITERRANEAN VERSUS ATLANTIC MONK PARAKEETS: TOWARDS A DIFFERENTIATED MANAGEMENT AT THE EUROPEAN SCALE?

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The Monk parakeet *Myiopsitta monachus* is an invasive species widely distributed across the world. Its invasive populations have been reported from several European countries, but data on population sizes and trends are few and often outdated. From 2015 to 2017, we have conducted a census across Europe to update Monk parakeet population sizes and analyze, whenever possible, their growth trends. Results show than in some countries commonly cited as invaded by Monk parakeets, such as Germany or Czech Republic, the species is actually not present. Furthermore, some countries where few data were available before our census, were revealed to harbor large parakeet populations. For example, the monk parakeet population in Greece turned out to be not only Europe's third largest, but also the one with the highest growth rate ever registered in Europe. Mediterranean populations typically are larger than Atlantic ones, growing exponentially and showing signs of fast range

expansion compared to the those from the Atlantic part of Europe. Given the differences we found in population size, growth rate and the rate of range expansion, we suggest the development of a differentiate monk parakeet management policy at the European scale. Mediterranean countries may consider the inclusion of this parakeet species on the list of 'European Alien Invasive Species of Regional Concern' in order to coordinate mitigation strategies. The fact that some management is necessary is illustrated by the case of monk parakeets in Spain, where the population has reached at least 20.000 individuals, and is starting to cause non-negligible damage to agricultural crops.

ZOONOTIC RABBIT HEPATITIS E VIRUS IN TWO WILD RABBIT POPULATIONS IN, AND AROUND OF FRANKFURT/ MAIN, GERMANY

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Rabbit hepatitis E virus (HEV) has a high zoonotic potential and belongs to the human pathogenic HEV-genotype 3 (HEV-3). It was reported for the first time in rabbits from China, thereafter in rabbits from USA, France, Italy, Germany, and recently in patients from France.

During winter 2012, 72 European rabbits (*Oryctolagus cuniculus*) were trapped in the city center and in the surroundings of Frankfurt/Main. Liver samples of these animals were investigated by HEV-specific reverse transcription-polymerase chain reaction (RT-PCR) assays, namely quantitative RT-PCR (RT-qPCR) and conventional RT-PCR. In addition, blood samples were tested for HEV-reactive antibodies by a commercial antibody ELISA kit.

In 25 of 72 animals HEV-specific antibodies were detected with 12/13 originating from the urban/rural regions, respectively. HEV RNA was detected in 13/18 of 72 animals by RT-qPCR/conventional RT-PCR, respectively, again with animals being positive at both habitats. Seven animals were antibody and HEV-RNA-positive at the same time.

Phylogenetic analysis of rabbit HEV sequences revealed a close similarity among the sequences from urban rabbits, whereas the sequences from rural sites were more divergent. Complete genome analysis revealed the expected clustering of German sequences in one clade within the rabbitHEV-clade of HEV genotype3.

In conclusion, the identification of a zoonotic HEV-strain in two rabbit populations in, and close to a human high-density area indicates a potential health threat. Further investigations will have to evaluate the potential transmission of this virus to humans by molecular investigations in hepatitis E patients from this region.

THE MANAGEMENT OF BROWN RAT (*RATTUS NORVEGICUS* BERK.) IN PALAEARCTIC

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Presented are the details of rodents' population dynamics parameters depending on their geographical location, habitat and season, as well as the resistance of rodents' populations to efforts towards their extirpation. Their resistance to measures of population control decreases from the south to the north, from summer to winter, as well as from the best habitats to those of worse conditions. On the basis of this data it is possible to calculate the effort factor which allows to achieve the desired value of the death rate in rodents' populations, which would make possible to reach the admissible level of rodents' populations.

FACTORS ASSOCIATED WITH WILD BOAR DAMAGE IN AGRO-SYSTEMS AT LARGE SPATIAL AND TEMPORAL SCALE IN FRANCE

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Crop damage by wildlife causes human–wildlife conflicts and severe economical losses. Identifying the factors linked to damage intensity is required for the development of effective management strategies.

Using General Additive Models fitted, we investigated how environmental factors, mitigation measures and hunting practices were associated, or not, with wild boar damage upon crops in French departments for the most important types of cultivation impacted (wheat, maize and grassland) over a 7-years period (2005 – 2012)

Taking into account all considered cultivation types and years of the study, the crop protection effort explained the largest part of the variability of damage, followed by the land use, the intensity of forest fructification and incidence of hunting wild boar with bloodhounds. The effects of variables differed regarding the type of cultivation; the crop protection effort being significant irrespectively from the culture type.

Model fitted for annual data showed a high variability of crop damage among years per a department. The hunting bag of wild boar determined per the forest area appeared significant for all types of cultivation, as well as the mast productivity in the preceding year (except grasslands). The intensity of hunting wild boars with bloodhounds was inversely correlated with crop damage while the relationship between the crop protection effort and damage was not linear, exhibiting a threshold value.

The numbers of hunters decrease in several European countries and the budget spent each year to prevent crop damage is considerable. Thus, our study may help to develop advanced tools and strategies to improve the prevention of crop damage caused by wild boars.

RESIDUES OF PESTICIDES IN AMPHIBIANS – RESULTS OF ONE-TIME SAMPLING

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Pesticides are commonly used for plant protection purposes. This can lead to exposure risk of protected species such as amphibians. Permeable skin and changes in habitat use between aquatic and terrestrial habitats make amphibians susceptible for the exposure to pesticides but realistic exposure data are missing. We present results of residue analysis of fresh cadavers of common toads (*Bufo bufo*) collected in spring 2016 in Münster (Germany). All have been road casualties crossing a street during migration to ponds within a region of residential and agricultural used areas.

The 9 cadavers were picked up from the street and frozen at – 20°C until analysis. Each amphibian was separately shock frozen in liquid nitrogen and homogenized. 1.5 to 2 g of each sample was extracted with a mixture of 30 ml methanol-water and after addition of a saturated sodium chloride-solution followed by a clean-up step with a solid supported liquid/liquid extraction. The analyses of **(i)** rodenticides brodifacoum, bromadiolone, chlorophacinone, coumatetralyl, difenacoum, difethialone, flocoumafen and warfarin was carried out with a LC-MS/MS. Analysis for

(ii) further 280 pesticides and metabolites were done by three analytical runs with LC-MS/MS and two analytical runs with GC-MS DSQ II. We found residues of both imidacloprid (12 ng/g) and thiamethoxam (25 ng/g) in one individual. Residues of nicotine (77 ng/g) and of spirotetramat (11 ng/g) were found in one individual each. Findings highlight the requirement of monitoring data to achieve a survey about realistic exposure risk of amphibians based on their behavior and spatial-temporal factors in agricultural landscape.

MODELLING THE CURRENT HABITAT USE OF COYPU (*MYOCASTOR COYPUS*) IN EUROPE AND ITS POTENTIAL FUTURE SPREAD UNDER CLIMATE CHANGE

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The coypu (*Myocastor coypus*) is a semi-aquatic rodent native to South America which has been introduced by the fur-industry to nearly every continent. Escaped and deliberately released animals became a source for wild populations. Contemporary, the species occurs in many European countries. Negative impacts like destruction of river embankments and water control structures due to their burrowing activity, as well as agricultural damage and influence on native species led to its classification as invasive species. Therefore, efforts to eradicate or control coypu have been undertaken. The regulation (EU) No 1143/2014 on the prevention and management of the introduction and spread of invasive alien species lists the coypu as one of currently 49 alien species of union concern. Consequently, all EU countries must implement measures for detection, management and monitoring of the coypu. To implement adequate measures, a better understanding of its distribution and influencing factors is needed. By now, there is no comprehensive work that deals with the distribution of coypu in Europe and its associated factors. The aim of this master thesis is to improve the current knowledge about habitat use and distribution of coypu in Europe. Therefore, obtained records of coypu across Europe and environmental factors will be used to build species distribution models. Suitable habitats will be identified and their possible increase under climate change will be assessed. Priority regions for management and key migration routes may be detected.

DEVELOPMENT OF AN ODOROUS REPELLENT AGAINST COMMON VOLES (*MICROTUS ARVALIS*)

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The common vole (*Microtus arvalis*) is the most abundant mammal in European agriculture. Consequently, it plays an important role in ecosystem processes but it can also cause severe damage in crops. Especially during their regularly occuring outbreaks, the management method of choice is often the application of rodenticides. However, behavioral effects, rapid recovery of populations and legal restrictions can hamper efficacy of such measures, and there may be risk to non-target species. A long-term management with a combination of sustainable methods may lead to an ecologically based management with minimised rodencide exposure of non-target wildlife. One approach could be the use of naturally occurring compounds as a repelling odour-barrier along field margins to decrease immigration of common voles to crops. Several rodent species adjust their spatial and/or feeding beaviour to predator scents and secondary plant metabolites. We screened seventeen compounds repelling rodents in previous studies. In T-maze trials, common voles could choose between boxes where a certain compound or water (experimental control) was presented. Essentials oils were significantly more effective than single substances or predator scents and were tested further under semi-natural conditions. In enclosures, we measured the number of passages between enclosure compartments through an entrance treated with a compound in comparison to an untreated entrance. In addition, we quantified the amount of rolled oats eaten in the treated and untreated compartments. Testing different combinations and concentrations of the most successfully repelling compounds, different dispensers and applications we identified a feeding deterrent and application form that repelled common voles.

EUROPEAN LEVEL MAMMAL DATA AND THE NEED FOR HARMONISATION

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Effective pest management and risk assessments require good population level data. Many European countries record presence data, and many report national mammals population size. However, distributions within countries, or abundance across countries, can be difficult to quantify given the variety of methods for population assessment and the lack of data in many areas. For this reason, EFSA (European Food Safety Authority) have funded a 6-year programme to improve and harmonise the 'denominator' data for selected mammals across Europe: including carnivores, ungulates, lagomorphs and rodents.

I report on how we have used a suite of Species Distribution Models to plot geographical abundance within Britain, based on presence and density data and how this approach can be used to identify priority areas for data collation and for collection of new data. I also report on two recent studies that demonstrate how new data can be obtained and validated with the use of modern camera traps. These estimate mammal populations in Kosovo and separately are a platform for citizen science picture collection and identification. The ENETWILD consortium will have a web-site and full data standards in the near future Users and researchers can be confident that the data repository can be readily used, and public authorities will be able to make more informed decisions and at the right time. I encourage anyone with geo-located presence or density data to get in touch with this truly European project.

WHAT DO WE KNOW AND WHAT DO WE NEED TO KNOW TO MITIGATE HUMAN-WILDLIFE CONFLICTS: POPULATIONS, DISEASES AND DECISION MAKING

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Whenever wildlife comes into conflict with our desires, tension is generated as we designate them as 'pests'. There are three main areas of human-wildlife conflict (1) zoonotic disease that threatens our health, (2) disease and damage to livestock, crops and businesses that threaten our economics and (3) negative effects on other species or the environment that threatens our own welfare. Although we can manipulate the environment to reduce damage, or influence human attitudes to reduce the perception of damage, we most often try to reduce the pest species density (either for population control or disease management). Ideally we seek to understand host density and the relationship between density and damage. I present examples where this is clearly non-linear and describe some models to illustrate what information is required and where such input data can come from. In general input data relating to species biology is more readily available than data about control efficacy. I also present a simple way to take account of how control efficacy varies as population density is reduced. In the last part of the talk I look at who makes decisions on mitigating human-wildlife conflict, when should governments get involved and what is the best form of data or model output to use in such decision making.

WHAT IS WORSE? IMPACT ON APPLE TREES BY BARK GNAWING BY COMMON VOLE (*MICROTUS ARVALIS*) OR EUROPEAN HARE (*LEPUS EUROPAEUS*)?

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In the Czech Republic, orchards are often damaged due to bark gnawing by mammals. However, regular monitoring of this damage or research on affecting factors are lacking. Extensive damage of young apple orchard due to bark gnawing and girdling by voles and hares was recorded in central Moravia in April 2017. A total of 1012 trees of two varieties , namely Melodie/Unigold (spreading shape of the crown) and Red Spring (columnar shape of the crown) were examined, with 506 trees in each group. Both mammal species altogether damaged 95.7 % of trees while only 4.35 % remained unharmed. The Red Spring variety was damaged more often with only 0.4 % of trees left unharmed and 99.6 % of trees damaged. In Melodie/Unigold variety, 8.3 % of trees were unharmed and 91.7 % of trees were damaged. According to the size of tooth marks, damage caused solely by voles could be distinguished from damage caused solely by hares. However, many trees were damaged by both species. Trees with girdled bark were assessed as dead. The rate of trees death was not significantly different between both tree varieties ($p>0.05$). The common vole caused death of trees by gnawing significantly more often than the European hare ($p<0.001$). In case of the European hare, no significant difference between both tree varieties was found regarding trees mortality rate ($p>0.05$). In the case of the common vole, significantly more trees of the Red Spring variety were damaged to death comparing to the Melodie/Unigold variety ($p=0.04$). Based on the multiple means comparison test, a significantly higher impact leading to tree death was found as a result of the damage caused by the common vole ($p<0.001$) and due to the combined damage by both vole and hare ($p<0.001$) than by the hare alone. This pilot study has demonstrated the massive damage of fruit orchards by voles and hares with dominant role of voles (89% share in tree death rate). Main

cause of damage was a combination of factors which were long lasting snowy winter and high autumn densities of the common vole. Even the orchard was fenced, high snow allowed hares to jump over and grassy surroundings of trees were ideal for voles. To prevent such orchard damages the urgent need of more extensive research allowing for methodical recommendations for growers is obvious.

AFRICAN SWINE FEVER IN POLAND. CURRENT CHALLENGES AND FUTURE PERSPECTIVES

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African swine fever (ASF) is one of the most important infectious diseases of domestic swine and wild boar, notified to the World Organization for Animal Health (OIE), subjected to official eradication. ASF occurrence in affected territories results in trade restrictions of pigs and pig products and consequently important negative economic impact.

Forty-four months of Polish experiences with ASF in Poland showed that the process of country release from ASFV can be a long-lasting procedure. Today, it can be stated that the primary objective of the multidirectional efforts of institutions involved in ASF eradication program should be focused on prevention of disease spread in swine population as well as in limitation of ASF spread among wild boars. So far, none of these goals have been achieved. From the epizootic data collected by the veterinary service, it has been shown that the most common vector in ASF spread among pig holdings in Poland was green forage, hay and straw. The results of epizootic treatment, in this respect, differs fundamentally from the data presented by other countries. On the basis of data collected in Europe, it is generally accepted that the above-mentioned vectors are possible, however the real source of ASF spread in pig population remains unclear.

THE ROLE OF LARGE PREDATORS IN FOREST REGENERATION – AN EXAMPLE OF THE WOLF

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The density of ungulates in European forests increased significantly in the last thirty years. Therefore, their impact on forest regeneration has also intensified. For the last several decades ungulates have not had any natural predator, but since the wolf *Canis lupus* population has started to spread significantly they had to modify their anti-predator responses. Information obtained from protected areas (national parks, nature reserves) indicates that the high predation risk from apex predators may reduce the browsing intensity through increasing the prey vigilance. However, it is still unknown what is the role of large predators (including wolf) on deer foraging behaviour in a commercial forests.

That is why, we tested, how different levels of predation risk affects the ungulates reactions and a degree of damage to seedlings in managed forests in two experiments: in forests with and without wolf population, where we simulated different levels of predation risk by exposition of predator or control odours.

Stronger prey reactions occurred in ecosystems with constant wolf presence. In these habitats, within plots exposed to high predation risk we observed increasing deer vigilance and decreasing browsing intensity. Contrary to ecosystems, where wolves were absent, these reactions were less clear. That is why, the proportion of seedlings damaged by deer was higher in wolf-absent ecosystems. We analysed also the spatial pattern of seedlings browsing within forest plantations. However, we did not detect any differences.

Hence, we conclude, that antipredatory deer reaction towards the presence of wolves is much stronger in habitats with permanent wolf population than in wolf free habitats. Additionally, the presence of this predator generate a strong impact on the whole trophic cascade and may help to regenerate young forest ecosystems.

FIRST REPORT ON ANTICOAGULANT RODENTICIDE RESISTANCE IN TURKISH NORWAY RAT

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Some mutations in Vkorc1 gene are known to inhibit anticoagulant rodenticides through binding the enzyme "vitamin K epoxide reductase". First and second generation of anticoagulant rodenticides have been commonly used in rodent management in towns of Turkey. Norway rat "*Rattus norvegicus*" is widely distributed in Turkey, especially in north and north-western parts of the country. In this study, the rat tissues stored in Ankara University Mammalian Research Collection (AUMAC) were used to analyse exon 3 of Vkorc1 gene. Only one mutation "Leu120Gln" in a sample from European part "Thrace" of Turkey were found to be heterozygous for c.359CTG>CAG nucleotide leading to amino acid substitution.

RESIDUAL ACTIVITY OF DIFLUBENZURON ON MOSQUITO LARVAE AND ITS EFFECTS ON ACETYLCHOLINESTERASE (EC 3.1.1.7) ACTIVITY AND LIVER ULTRASTRUCTURE OF RATS

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The chronic and sub-acute doses effects of diflubenzuron on mixed mosquito larvae (*Culex* sp., *Anopheles* sp.) and its degradation in aquatic system were studied. In the HPLC analyse performed in time intervals, diflubenzuron degraded by 30 percent by the end of a month. First, 1,9 g/0,15 m^2 dose was applied to mixed larvae and caused 100 % mortality in 96 hrs. Then the application dose was reduced by 30 percent and then applied again. The larvae mortality was estimated as 80% in 96 hrs. This finding proved that the residual effect of diflubenzuron lasted up to 30 days in the clean water.

In chronic exposure (0, 08 mg/ l dose/ days in 6 months) of diflubenzuron, blood serum AChE activity showed similarity to control group, enzyme activity of samples exposed to sub-acute dose (25 mg/ 10 days) of diflubenzuron was observed to decline. After sub-acute dose exposure was terminated, AChE activities were measured again in the intervals of 5^{th}, 10^{th}, 15^{th} and 45^{th} days. The enzyme activity was observed to slightly increase at the end of 45th day.

Sub-acute dose of diflubenzuron caused enlarged mitochondria and abnormall ultrastructural nuclei in hepatocytes. Chronic dose critically affected the rat liver ultrastructure such as numerous mitochondria in the hepatocytes and many lipid droplets in the sinusoids. After termination of the application of sub-acute dose , the damages in the liver were still observed in 5^{th}, 10^{th}, 15^{th} days, but histological recover of the liver was observed on 45^{th} day.

EFFECT OF CLIMATE CHANGE AND HUMAN ACTIVITY ON SMALL MAMMAL POPULATIONS IN NORTH-EASTERN POLAND

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Global climate warming has various impact on small mammal populations, causing shift of species range (both altitudinal and latitudinal), affecting population density and dynamics, and modifying species composition. Here we provide some examples of transformations in small mammal populations in NE Poland caused by climate change and human activity. According to our observations outbreaks of forest rodents become more frequent, mainly due to more regular abundant crop of seeds. In open grasslands, cycles of Microtinae ceased to exist and have been replaced by less regular fluctuations, affected mainly by the climate. Mild weather conditions are favoring Muridae rodents, which are becoming a dominant group, both in the forest and grasslands. In open ecosystems this process is constrained by intensive farming, because shorter season and not permanent vegetation cover is more suitable for voles than for mice. On the other hand more frequent or delayed mowing of grasslands causes changes in species composition within Microtinae communities. Unpredictable weather conditions also directly affect winter mortality of seasonally molting mammals, e.g. weasels, causing shift of their geographic range. Transformations of small mammal communities are likely to influence e.g. changes in the incidence and distribution of zoonotic diseases, introducing serious treats to human health. Observed changes, influence also predator-prey relationships, altering functioning of entire ecological systems.

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