IUGB 2017

MONTPELLIER - FRANCE

33rd International Union of Game Biologists Congress

14th Perdix Congress
Montpellier
France – 2017, August 22-25

ABSTRACT BOOK

Office National de la Chasse et de la Faune Sauvage

www.iugb2017.com

IUGB 2017

MONTPELLIER - FRANCE

33rd IUBG Congress
14th Perdix Symposium

22-25th August, Montpellier, France

Wildlife under human influence: what can we do?

Contents

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Preface

In the IUGB pioneers' footsteps: gathering together for fruitful discussions!

The International Union of Game Biologists was initiated on 17 October 1954 during a conference held in Düsseldorf (Federal Republic of Germany). Right from the start, IUGB aimed at gathering scientists willing to facilitate and improve research on wildlife and hunting, as stated by Professor Fritz Nüsslein from the Hann-Münden Institute of Hunting Science, one of the « fathers » of IUGB. During the second IUGB Congress in October 1955 in Graz (Austria), the activities of the organisation were formalized, with two major principles still in force today: congresses would be held every second year in a different country, and a committee of "Liaison officers" representing each member state would then meet to decide where to organize the next conference. During the 7th Congress in Belgrade (ex-Yugoslavia) in 1961 then during the 28th Congress in Uppsala (Sweden) in 2007, the Liaison Officer Committee worried that IUGB actually existed only during the Congresses, and did not have a proper legal status. Some were pleading for IUGB to become a « Wildlife Society » for Europe. IUGB eventually became a non-governmental organization under Swiss law in 2007, whose statutes followed the initial principles set during the early congresses.

Such a simple yet efficient organisation has been able to organise without any discontinuity a long suite of 32 international congresses in 25 different countries over the last 63 years: 22 in Europe and 3 in North America. Seven countries (Germany, Belgium, Spain, France, Portugal, Russia and Sweden) organised two such congresses. This 33rd IUGB Congress, associated with the 14th Perdix Symposium, will be the third to be organised by France. As the French Liaison Officer I volunteered during the Brussels congress in 2013. This edition will follow those organised in 1971 in Paris and in 1997 in Lyon. These events have all been organised by the French national institution in charge of applied game research. This organisation has evolved since 1971, and is now called the Office National de la Chasse et de la Faune Sauvage (ONCFS). It is focused on improving knowledge and management of wildlife populations and habitats. The numerous collaborations between ONCFS and universities and research institutes in the country and abroad, some initiated during former IUGB congresses, have greatly facilitated the organisation of the present event.

The sustained interest for IUGB Congresses should not decline this year in Montpellier, as can be judged from the 157 oral presentations – 34 for Perdix – and 89 posters in the programme. The many workshops dealing with current hot topics, often organised by scientists from several different countries, should foster fruitful discussions and pave the way for future research for a sustainable use of wildlife resources. In this context, the general theme of the congress this year "Wildlife under human influence" seems particularly timely. The excursions should allow our foreign visitors discovering the birdlife and remarkable wetlands of Camargue and the surroundings of Montpellier, the very typical Mediterranean habitats of red-legged partridges, or the great mountain mouflons.

Beyond the exchanges during the proper congress sessions, the less formal discussions outside the official programme or during the excursions also contribute to the establishment of friendly relationships that are key to scientific partnerships. I have so many nice memories of the 7 IUGB Congresses I attended between 1987 and 2013 (in particular the great gala evening in Uppsala in 2007…) ! As stated by Paul Reydellet, co-founder of IUGB, during the 1971 Congress in Paris « IUGB once was a small group of friends who knew each other well, and met « as a family » with renewed pleasure and interest every second year ».

I wish the 2017 IUGB Congress to also bring the same feeling among the participants.

Dr **Pierre Migot**
IUGB Liaison Officer for France (2005-2015)
ONCFS Research Director (2008-2016)

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Dear attendees,

It is our pleasure to welcome you in Montpellier for this 33rd IUGB Congress and 14th International Perdix Symposium. This 2017 edition is dedicated to the general theme “Human and wildlife: what can we do?”, which is of utmost importance given global changes that people, wildlife and landscapes currently have to face together. Climate change as well as the exploitation of natural resources – among which hunting – and the generalized degradation of the natural environment have large-scale effects, some of which we only begin to evaluate.

International conferences like IUGB and Perdix provide us with the opportunity to meet, connect and learn from each other, share our latest research results, and eventually envisage feasible means of conciliating human development with wildlife conservation. In addition to the strict theoretical and academic aspects, the aim of these gatherings is also to promote collaboration among stakeholders and encourage practical wildlife management. We are therefore delighted to see a good mixture of scientists, practitioners and managers in the list of participants. This 2017 edition has been successful in building up a large and diverse audience, bringing together hundreds of participants from Europe, North America, Africa and Asia to present 157 oral communications and 89 posters.

As you will see, a wide range of topics will be covered during the Congress. As in former editions the program is built around the latest knowledge about the ecology of wildlife and the management of game populations. Beyond that, however, it will also address a wide range of topics ranging from practical use of new technology to the almost philosophical implications of human/wildlife coexistence. We do hope that each participant will find what they attended the Congress for, but will also learn most unexpected things!

We are very grateful to the members of the two Scientific Committees who evaluated hundreds of abstracts, to the chairpersons contributing to attractive sessions and interesting discussion, and to all of those organising the field excursions to some of the most beautiful places around Montpellier. We also wish to thank the Organising Committee as well as our PhD squad who all did a tremendous job to ensure everyone has a great time during the Congress. As IUGB President and Chairs of the 33rd UIBG Congress and 14th Perdix symposium, it was a pleasure to work with such enthusiastic people. We wish to express our deepest thanks to the 12 leading scientists who accepted to give inspiring plenary lectures and keynote talks on topical issues, and thank you all for your numerous and interesting contributions.

We hope you will enjoy this new edition of the IUGB Congress and Perdix Symposium, on scientific as well as social grounds. Make sure you take full advantage of the formal and less formal exchanges with the wonderful colleagues from all disciplines and geographic horizons!
We wish you a fruitful and stimulating meeting.

Elisabeth Bro, Chair of the 14th Perdix Symposium
Matthieu Guillemain, Chair of the 33rd IUGB Congress
Nirmala Séon-Massin, IUGB President
Yves Lecocq, Former IUGB President

It is with great sadness that the IUGB and Perdix team learned about the death of Dr. Dick Potts on March 30th, aged 78. Dick, the former Director General and Director of Research of the now Game and Wildlife Conservation Trust in the UK, was a world authority on the ecology and conservation of the grey partridge, and on the management of arable farmland (having introduced essential concepts such as* conservation headlands *and* beetle banks*). He was a long-time IUGB supporter and will be missed by numerous colleagues and friends.

G Richard (Dick) Potts, 1939-2017
Game biologist and grey partridge guru

Dick was born in 1939 to a farming family in North Yorkshire, England. From an early age, he showed a keen interest in wildlife, and was struck by the bird mortality caused by the harsh 1947 winter. He studied zoology at Durham University, specialising in ecology and entomology, as well as participating in two expeditions to the Faeroe Islands to study seabirds. After graduation, he undertook a PhD on the breeding ecology of Shags on the Farne Islands, Northumberland. He witnessed at first hand the devastating impact of a toxic algal bloom on seabirds, which reinforced an interest in environmental poisons and led to a lifelong fascination with the processes that regulated bird populations.

He joined The Game Conservancy in 1968, tasked with investigating why the grey partridge was in decline. With his farming background and ecological insight, Dick realised that to understand changes in partridge abundance, he needed to understand changes in the partridge environment. He identified three main causes of partridge decline: reduced chick survival through herbicide-induced reduction in chick-food invertebrates, lack of suitable nesting habitat reducing settling density, and poor nesting success due to predation – a trio he dubbed the "three-legged stool" on the grounds that if one leg failed, the partridge stool would collapse. His farmland work was ground-breaking because previous conservation thinking concentrated on pristine habitats, not man-made ones.

Dick Potts in Sussex, © Charlie Pye-Smith

Dick became The Game Conservancy's Director of Research in 1977. Through experimental work, he verified the Sussex conclusions and developed practical solutions compatible with modern farming, like selectively sprayed field margins ("Conservation Headlands") and midfield tussocky grass strips ("Beetle Banks"). His Salisbury Plain Experiment demonstrated conclusively that generalist predators affected partridge breeding abundance as well as breeding success, in contradiction with accepted ecological wisdom. Dick also turned his skills to the conservation of other species including brown hare, red grouse, woodcock and lapwing. As Director-General of the Game Conservancy Trust from 1993 until he retired in 2001, he transformed Lord and Lady Allerton's gift of Loddington Farm into an influential demonstration farm. The combination of applied farmland research and tangible evidence of conservation success that he fostered played a large part in shaping set-aside rules and agri-environment schemes in the UK for the benefit of wildlife.

Dick believed that scientific evidence was vital in wildlife conflict resolution. He initiated the Joint Raptor Project, which quantified the impact of hen harriers on red grouse at Langholm Moor, Scotland. The project demonstrated that, at high harrier densities, August grouse density was 50% lower than in the absence of harriers, an impact that meant that driven shooting ceased, moorland management for grouse ceased, breeding wader numbers fell by over 50% while fox and crow abundance more than doubled. Dick's pragmatic solution, a quota scheme that limits breeding harriers to a pair per 25 km^2 of moorland, is still the subject of intense debate today.

Dick was passionate about partridges throughout his life. He wrote two partridge monographs and, in retirement, he helped bring about a remarkable grey partridge recovery on the Norfolk Estate in Sussex. He also worked with the World Pheasant Association, the Cranborne Chase Area of Outstanding Natural Beauty and the International Council for Game and Wildlife Conservation. His drive, enthusiasm and vision will be sorely missed.

Nicholas Aebischer
Game & Wildlife Conservation Trust

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A big thanks to our partners!

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LA FONDATION FRANÇOIS SOMMER POUR LA CHASSE ET LA NATURE S'ENGAGE POUR LA PROTECTION DE L'ENVIRONNEMENT

FSC

La Fondation François Sommer, créée en 1964 et reconnue d'utilité publique, oeuvre à la recherche permanente d'un équilibre harmonieux entre la préservation de la nature sous toutes ses formes (et en particulier la sauvegarde de la faune sauvage) et l'encouragement d'une chasse rationnelle et sportive, soucieuse des bonnes pratiques et participant aux équilibres naturels.

Dans la continuité des missions dont ses fondateurs (François et Jacqueline Sommer) lui ont donné la charge, la Fondation a aujourd'hui la particularité d'être au cœur d'un écosystème d'acteurs mêlant l'art, la nature et la science.

Depuis 1967, la Fondation présente les collections d'art ancien, moderne et contemporain réunies par François et Jacqueline Sommer au sein du musée de la Chasse et de la Nature, dans les hôtels de Guénégaud et de Mongelas.

Au delà des murs du Musée, et du Club de la Chasse et de la Nature qui y est également hébergé, la Fondation à ciel ouvert c'est le domaine et l'école de Belval, espace naturel dédié à la découverte de la nature, à la recherche scientifique et à l'encouragement artistique. Ce domaine est aussi un support pédagogique pour l'école de chasse, lieu d'apprentissage et de réflexion ayant pour mission la promotion d'une chasse moderne, responsable et impliquée dans la préservation de la faune sauvage et de ses habitats.

LA FONDATION C'EST AUSSI

Billebaude

Lancée en 2012 par la Fondation François Sommer et les Éditions Glénat, Billebaude est une revue d'exploration et de réflexion sur les usages et représentations de la nature. Billebaude est une revue semestrielle qui propose, autour d'un thème – le loup, la forêt, la ruralité, le climat, le lapin, l'ours –, des contributions de chercheurs, journalistes, acteurs de terrain, artistes.

Dans le cadre de ses missions et activités, la Fondation a toujours souhaité s'appuyer sur la connaissance, l'observation, les faits, la réalité "du terrain".

Le pôle Nature de la Fondation François Sommer est donc engagé dans l'amélioration de la connaissance des écosystèmes en interaction avec l'homme et ses activités. Il apporte une contribution importante à une large gamme de travaux destinés à mieux comprendre le fonctionnement des espaces naturels et des espèces sauvages utilisés par l'homme.

La Fondation ne s'en tient pas au soutien à la recherche, elle est aussi engagée dans l'amélioration de la gestion concrète des écosystèmes. Elle agit en véritable acteur de terrain, en partenariat étroit avec l'ensemble des parties prenantes. La finalité est simple : la quête de progrès dans les connaissances et pratiques en matière de gestion durable des ressources naturelles sauvages.

sensibiliser connaître
CULTURE valoriser écosystèmes
FAUNE débattre ART
émouvoir science flore conserver


La chasse
alliée de la biodiversité
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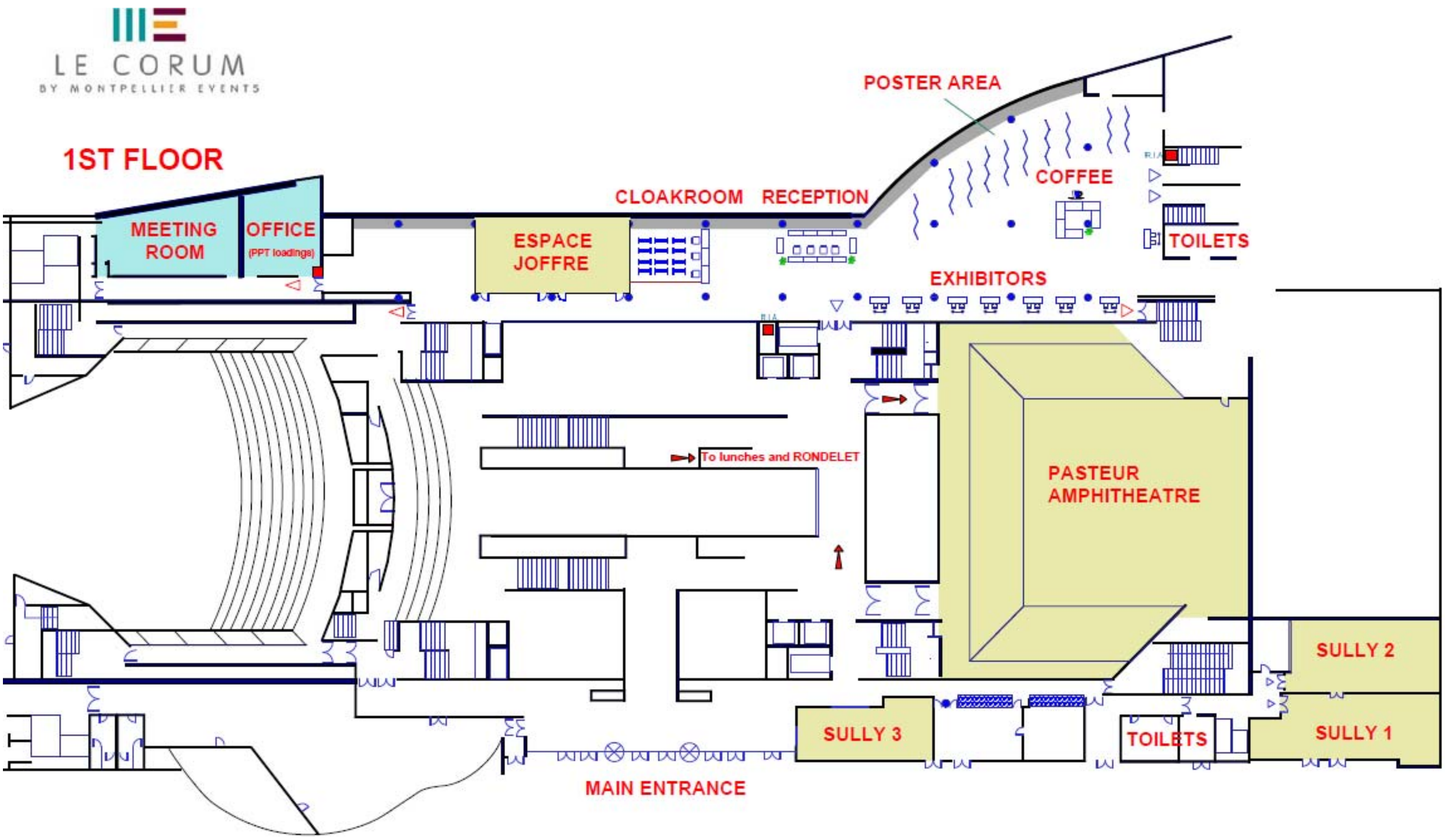
The venue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POSTER AREA
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TOILETS
ESPACE JOFFRE
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To lunches and RONDELET
PASTEUR AMPHITHEATRE
SULLY 2
SULLY 1
SULLY 3
TOILETS
MAIN ENTRANCE

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Nirmala SEON-MASSIN (IUGB President 2015-2017), ONCFS

Yves LECOCQ (Former IUGB President), FACE

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Nicholas AEBISCHER, Game & Wildlife Conservation Trust, UK

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Jörg TILLMANN, DBU Natural Heritage GmbH, Germany

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AWARDS

The Jan van Haaften IUGB Award for Wildlife Management in Europe

One of the first supporters of IUGB back in the fifties, acting for almost four decades as national *IUGB Liaison Officer* for the Netherlands, and an active participant in virtually all IUGB Congresses until 2011, **Professor Jan van Haaften** (1927 – 2012) was without any doubt an important steering force in our organisation.

His professional career included research on roe deer (the subject of his 1965 PhD thesis "*Das Rehwild in verschiedenen Standorten der* Niederlande und Slowenien"), seals, wolf and brown bear in Europe (the Netherlands, Portugal, Slovenia, Romania…) and abroad (Mongolia), and contributed greatly to our current understanding of the relationship between large carnivores and their prey. Jan van Haaften advocated the wise and sustainable use of wildlife resources, and emphasized the importance of scientific research to improve our knowledge on wild "game" populations and their management. As a Professor "Game biology & Nature conservation", he was an excellent tutor, as his many students from the renowned University of Wageningen in the Netherlands, but also other academic institutes in Europe, will testify. Last but not least, Jan had a charming personality, offering friendly advice and support when needed, and to many of us he was a true friend and companion.

*****

When the IUGB Presidency learned, during the preparatory stages for the 2013 Brussels' Congress, about Jan van Haaften's accidental death during a summer holiday in his beloved Slovenia, the decision was taken to create a special honour to commemorate his significance for the wildlife management profession in Europe. This initiative resulted in the ***Jan van Haaften Award for Wildlife Management in Europe*** (hereafter the "***Jan van Haaften IUGB Award***"), as a distinction bestowed by the *International Union of Game Biologists* **IUGB** for eminent service to applied wildlife research in Europe, contributing to the best possible management and conservation.

The basic selection criterion for the ***Jan van Haaften IUGB Award*** is the significance and impact of an individual's or a team's contribution(s) to the field of wildlife research, undertaken in Europe and having resulted in application of management and conservation "on the ground".
This work should be characterised by a sustained record of productivity in applied wildlife research over a substantial period of time, with a direct value for managing and conserving wild birds and/or mammals, in particular when these efforts have influenced public opinion in a constructive manner.

*****

Recipients receive a unique bronze sculpture, created by Dutch wildlife artist Pieter Verstappen exclusively for IUGB, representing a roe buck, a European species of particular interest to Jan Van Haaften. Pieter Verstappen (°1952) is a highly successful self-taught artist for 30 years, painting realistic canvases of wildlife he observes near his home in the Dutch Province of Limburg and its Peel moorland area, as well as bronzes and lately also more impressionistic work. He was selected several times to participate in the prestigious "Birds in Art" exhibitions at the Leigh Yawkey Woodson Art Museum (US). See also **www.pieterverstappen.com**

*****

The recipient of the first ***Jan van Haaften IUGB Award*** in 2013 was Professor Harto Lindén whose long career at the *Finnish Game and Fisheries Research Institute* covered research on a wide range of species, from voles to large carnivores, and in particular on grouse. He also developed the Finnish "wildlife triangle census" scheme, often described as the best game monitoring scheme in Europe. Harto was also founding Editor-in-chief of the leading "*Wildlife Biology*" journal, President of the *Finnish Ornithological Society* and, last but not least, IUGB *Liaison Officer* for Finland from 1987 until 2007.

Nomination & selection procedure

The nominee should have a well-established and distinguished career that has been of undoubted significance, in particular through research leading to significant improvements in wildlife management and conservation, on-the-ground management practices, or wildlife policies.

The ***Jan van Haaften IUGB Award*** is given to a living individual, or team of individuals, with an international reputation for excellence in applied wildlife research undertaken in Europe. Representatives of research bodies may be eligible for the Award if they were intellectually involved in the research, i.e. contributed to the development, experimental design, analysis, and/or application of said research.

A nomination statement that clearly outlines the nominee's contributions to wildlife management and applied research in Europe, providing an explicit link between the nominee's career and a serious track record relative to wildlife management and research findings, recognised success, and application of results that have high importance in the field of conservation and/or wildlife management, is to be presented by Email to the Chair of the *Scientific Committee* of the 2017 IUGB Congress: matthieu.guillemain@oncfs.gouv.fr

Alternatively such nomination may also be presented as a hard copy at the latest on Tuesday 22nd August – the first day of the IUGB 2017 Congress in Montpellier.

A Judging Panel, chaired by IUGB Past President Yves Lecocq, and consisting *inter alia* of members of the Congress *Scientific Committee* and the European IUGB Presidents (past, acting and elect), will meet on Wednesday 23rd August to carefully examine all nominations and select the winner for the 2017 ***Jan van Haaften IUGB Award***, to be announced the next day at the Closing ceremony of the Congress.

Young Scientists Awards

The IUGB strongly values the scientific contributions of our youngest colleagues.

Prizes for the best communications by young scientists will therefore be awarded during the congress. These will be composed of **several 500 Euros cheques and books offered by our kind sponsors**.

To apply to these awards, you have to be from Bachelor till the third year after your PhD defense. Judgement will be based on the soundness of the scientific contents as well as the general quality of the presentations. **There will be several awards each for the best oral and best poster presentations.**

A Judging panel will attend the oral presentations by competing young scientists and visit their posters: if you want to compete for the awards make sure to stand by your poster and talk with the judging panel!

Members of the Judging panel will be:

Jocelyn CHAMPAGNON, Institut de Recherche de la Tour du Valat, France
Matt ELLIS, BASC, UK
Johan ELMBERG, Kristianstad University, Sweden
Matthieu GUILLEMAIN, ONCFS, France
Roxane LEVERRIER, ONCFS, France
Ilse STORCH, University of Freiburg, Germany
Barbara ZIMMERMANN, Hedmark University of Applied Sciences, Norway

Young scientists shall have indicated their willingness to compete for the awards directly onto their abstracts, but it will still be possible to enter the competition until the beginning of the Congress: contact matthieu.guillemain@oncfs.gouv.fr

Winners for the IUGB33 Young Scientists Awards will be announced and presented their prizes during the closing ceremony of the Congress.

The Young Scientists Awards were only possible thanks to the generous donations of our sponsors:

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IUGB Green Travel Award

To promote low-carbon travel, we will recognize the attendee whose trek to Montpellier emitted **the lowest level of carbon**.

Have you ever thought about travelling (partly) to a conference by bike, sailboat or even a canoe? Here's your chance!

The International Union of Game Biologists wants to walk its talk and is committed to reducing the carbon emissions of the 33rd IUGB Congress.

The rules of the game are easy: the person who travels the longest cumulative distance to the conference without using fossil fuels wins the competition. We invite all participants to think of ways they can diminish their traveling footprint.

Distance travelled by each transport method must be documented and proof must be presented by interested participants during the check-in period.

A Judging Panel, consisting *inter alia* of members of the Congress Organizing Committee will meet on Wednesday, August 23rd, to carefully examine all nominations.

The most inventive ideas and the winner will be presented on Thursday, August 24th, at the Closing ceremony of the Congress.

The Green Travel Award is kindly supported by "Au vieux Campeur"

Au Vieux Campeur

Programme at a glance

SESSIONS IN ROOM RONDELET WILL BE TRANSLATED INTO FRENCH, THANKS TO FINANCIAL SUPPORT FROM THE FRENCH NATIONAL FEDERATION OF HUNTERS

LES SESSIONS DANS LA SALLE RONDELET BENEFICIERONT D'UNE TRADUCTION SIMULTANEE, GRACE AU SOUTIEN FINANCIER DE LA FEDERATION NATIONALE DES CHASSEURS

Fédération Nationale des Chasseurs

	MONDAY 21st AUGUST
18h00-22h00	**Ice-breaking cocktail**

	TUESDAY 22nd AUGUST			
08h00-10h00	**Registration desk opens** **Coffee available**			
10h00-11h00	**Opening talks (Pasteur plenary amphitheater)** **Tribute to Dick Potts**			
11h00-12h00	**Opening plenary (Pasteur plenary amphitheater)** Jean-Dominique Lebreton *"To be or not to be a sustainable game: a demographer's point of view"*			
12h00-13h30	**Lunch**			
	Rondelet *(Management-concertation)*	*Sully 2* *(Mountain wildlife)*	*Espace Joffre* *(Diseases & intoxication)*	*Sully 1* *(Perdix-Recovery of grey partridge)*
13h30-14h10	**Keynote LINNELL**	**Keynote CORLATTI**	**Keynote RYSER & ROBIN**	Hajas & Farago Ewald et al.
14h10-14h30	Wellig et al.	Toigo et al.	Lambert et al.	Homberger et al.
14h30-14h50	Nyman & Karppinen	Portanier et al.	Muir et al.	Buckley et al.
14h50-15h10	Alhainen	Náhlik & Dremmel	Konig	Manzer et al.
15h10-15h30	Daim et al.	Deschamps et al	Van de Wiele	Ewald et al.
15h30-16h10	**Coffee break - Posters**			
	(continued)	*(Harvest and pop size in migratory birds)*	*(continued)*	*(Perdix-Population monitoring)*
16h10-16h30	Bunnefeld et al.	Moreno et al.	Vittecoq et al.	Jimenez-Blasco et al.
16h30-16h50	Talvi	Lormée et al.	Caizergues et al.	Puigcerver et al.
16h50-17h10	Mathisen & Skarpe	Le Rest et al.	Miller	Canonne et al.
17h10-17h30	Strauss et al.	Patrelle & Coquatrix	Cromie et al.	Malone et al.
17h40-19h00	**Posters**			

	WEDNESDAY 23rd AUGUST				
	Rondelet	*Sully 2*	*Sully 1*	*Sully 3*	*Espace Joffre*
	(Human-wildlife conflicts)	*(Predator-prey)*	*(Perdix-Population dynamics)*	*(Lagomorphs)*	*(Sustainable waterbird harvest)*
08h40-09h00			McConnell et al.		
09h00-09h20	**Keynote MASSEI (228)**	**Keynote ANDREN**	Terhune et al.	Alves	**Keynote MADSEN**
09h20-09h40			Baines et al.	Bouche et al.	
09h40-10h00	Cappa et al.	Letty et al.	Guzman & Arroyo	Hackländer et al.	Le Maresquier
10h00-10h20	Hahn	Jacquier et al.	Buner	Discussion	Trouvilliez
10h20-11h00	**Coffee break - Posters**				
11h00-11h20	*(continued)*	*(continued)*	*(Perdix-Habitat)*	*(continued)*	*(continued)*
11h00-11h20	Rutten et al.	Braunisch et al.	Hagen et al.	Lombardini et al.	Johnson
11h20-11h40	Belova & Tarvydas	Gastineau et al.	Elmore et al.	Strauss / Mauvy	Scallan & Nagy
11h40-12h00	Pokorny et al.	Elmhagen	Schöll & Hille	Letty et al. / discussion	Williams et al.
12h00-12h20	Battoraro & Illarietti	Michler et al.	Burnett et al.	Discussion	Round table
12h20-13h40	**Lunch - With the support of the European Federation of Associations for Hunting and Conservation / FACE**				
	(Human & wildlife sharing habitat)	*(Ungulate ecology)*	*(Perdix-Management)*	*(camera traps)*	*(Private Lands)*
13h40-14h00	**Keynote GEHRT**	**Keynote GAILLARD**	Jackson et al.	**Opening (Massei & Beatham)**	Hewitt
14h00-14h20			Olsen et al.	Huber	DeYoung
14h20-14h40	Peerenboom et al.	Debeffe et al.	Ludwig & Baines	Mengulluoglu et al.	Ortega
14h40-15h00	Rouco et al.	Harper et al.	Green et al.	Lombardi et al.	Fulbright et al.
15h00-15h20	Thompson et al.	Ofstad et al.	Powell	Ngama et al.	Grahmann
15h20-15h40	Tari et al.	Bonnot	Souchay / Fruitet	Beatham et al.	Harveson
15h40-16h20	**Coffee break - Posters**				
	(Waterbird breeding ecology)	*(continued)*	*(Perdix-Workshop)*	*(continued)*	*(continued)*
16h20-16h40	Pöysä et al.	Markussen et al.	**Patridge releases**	Mengulluoglu & Ambarli	Strickland et al.
16h40-17h00	Folliot et al.	Vanpe et al.	*(5 min talks+discussion)*	Arlettaz et al.	Demarais
17h00-17h20	Clark et al.	Ebert et al.		Fischer & Félix	Reilly
17h20-17h40	Selivanova & Mikhantyev	Pedersen et al.		Discussion	Discussion
17h40-19h00	**Posters**				
19h00	**Bus departs - Gala diner**				

	THURSDAY 24th AUGUST				
	Rondelet	*Sully 2*	*Sully 1*	*Sully 3*	*Espace Joffre*
	(Waterbird management)	*(Movement & hab. use)*	*(Perdix-Ecotoxicology)*	*(Learning from hunted animals)*	*(Ungulate communities)*
08h40-09h00			**Keynote BRO**		
09h00-09h20	Champagnon et al.	Hofman et al.		Landry et al.	Cromsigt et al.
09h20-09h40	Dalby et al.	Walton et al.	Mougeot et al.	Miller et al.	Spitzer
09h40-10h00	Holm et al.	Ranc et al.	Barfknecht et al.	König et al.	Pfeffer et al.
10h00-10h20	Therkildsen et al.	Zimmermann et al.	Millot et al.	Hackl et al.	Chassagneux et al.
10h20-11h00	**Coffee break - Posters**				
	(continued)	*(Ungulate breeding ecology)*	*(Perdix-Animal & pop biology)*	*(Releases and reintroductions)*	*(continued)*
11h00-11h20	Sorrenti et al.	Sandor et al.	Kallioniemi et al.	Fusari et al.	Burrell et al.
11h20-11h40	Galia et al.	Lombardi et al.	Gottshalk & Beeke	Sabalinkiené et al.	Bernard et al.
11h40-12h00	Solokha & Gorokhovsky	Gamelon et al.	Olesen	Rousteau et al.	Discussion
12h00-12h20	Christensen	Gayet et al.	Bernard-Laurent et al.	Bacon et al.	
12h20-13h40	**Lunch - With the support of the Tour du Valat, Institut de recherche pour la conservation des zones humides méditerranéennes**				
13h40-14h40	**Closure plenary (Pasteur plenary amphitheatre)** Ken Williams *"Connecting science and decision making in the management of natural resources"*				
14h40-15h00	**Awards ceremony** *(Van Haaften Award, Best Young Scientist Award and Green Travel Award)*				
15h00-15h40	**Closing speeches**				
15h40-16h30	**Coffee - End of congress**				

	FRIDAY 25th AUGUST			
08h00-12h00	**Field excursions** **Estagnol marshes**	**Camargue** **RAMSAR site**	**Crau Nature** **Reserve and** **Alpilles Regional** **Parc**	**Caroux mountains**
12h00-17h00				

Detailed programme
(abstracts in alphabetic order from page 45 onwards)

Tuesday 22nd August morning

Opening Plenary (Pasteur amphitheater)

10:00-11:00 Opening talks and tribute to Dick Potts

11:00-12:00 **Lebreton:** ***To be or not to be a sustainable game: a demographer's point-of- view*** **(Plenary)**

Tuesday 22nd August afternoon

Concertation, conflict resolution and Wildlife Management (Room Rondelet)
Chair: Philippe Chardonnet, Fondation François Sommer, France

13:30-14:10 **Linnell:** ***Coexistence between wildlife and humans: contrasting insights from wildlife management and conservation biology*** **(Keynote)**

14:10-14:30 Wellig et al.: *Reactions of red deer (*Cervus elaphus*) to recreational and hunting activities*

14:30-14:50 Nyman & Karppinen: *How to promote the cooperation of wildlife management by using inclusion as a tool in collaborative management*

14:50-15:10 Alhainen: *Working with the landowners and local stakeholders for wildlife habitats*

15:10-15:30 Daim et al.: *Integrative sustainable wildlife management: principles, criteria and indicators for hunting, forestry, agriculture and recreation*

15:30-16:10 *Coffee break*

16:10-16:30 Bunnefeld et al.: *Conflict in conservation and management of wildlife: connecting ecological and socio-economic data across Europe*

16:30-16:50 Talvi: *Conflicts between large predators and farmers in Estonia: value of different conservation tools*

16:50-17:10 Mathisen & Skarpe: *Moose-adapted winter harvesting of Scots pine for integrated wildlife and forest management*

17:10-17:30 Strauss et al.: *Dispersal of wolves and lynx and their perceived effects on roe deer in the hunting districts of Lower Saxony, North Germany*

Mountain wildlife (Room Sully 2)
Chair: Raphaël Arlettaz, University of Bern & Swiss Ornithological Institute

13:30-14:10 **Corlatti: *What are men to mountain mammals?* (Keynote)**

14:10-14:30 Toïgo et al.: *Climate change and biodemographic performance in a mountain ungulate: warm temperatures are bad for Alpine ibex (*Capra ibex*)*

14:30-14:50 Portanier et al.: *Evidences of sex-specific impacts of landscape on gene flows in a Mediterranean mouflon population*

14:50-15:10 Nahlik & Dremmel: *Competition between a native and a non-native ungulate – is mouflon an invasive species within Hungarian fauna?*

15:10-15:30 Deschamps et al.: *Capercaillie: is it a meaningful indicator for French central Pyrenees forest biodiversity?*

15:30-16:10 *Coffee break*

Harvest and population size in migratory birds (Room Sully 2)
Chair: David Scallan, FACE, Belgium

16:10-16:30 Moreno et al.: *Do hunting bag changes match the population trends of Turtle Dove? The case of Spain*

16:30-16:50 Lormée et al.: *Assessing the sustainability of European Turtle-dove (Streptopelia turtur) hunting along the European western flyway*

16:50-17:10 Le Rest et al.: *Joint modelling of data from multiples sources: an application to abundance indexes of woodcock wintering in France*

17:10-17:30 Patrelle & Coquatrix: *Presentation of the French National Management Plan for the Eurasian Curlew (Numenius arquata arquata) 2015-2020*

Wildlife diseases and intoxication (Room Espace Joffre)
Chair: Yves Lecocq, IUGB President 2013, Belgium

13:30-14:10 **Ryser-Degiorgis & Robin: *From wildlife population management to planetary health – a multidisciplinary challenge* (Keynote)**

14:10-14:30 Lambert et al.: *"Do nothing" as a disease management strategy for pestivirus infection in Pyrenean Chamois?*

14:30-14:50 Muir et al.: *Sarcocystosis in European wildfowl and the hunters' role in surveillance of an apparently emerging wildlife infection*

14:50-15:10 König: *Scabies in Bavarian Chamois* (Rupicapra rupicapra) *population: or why haven't Chamois in Bavaria Scabies?*

15:10-15:30 Van de Wiele: *Bird flu in France since 2015: a disease of wild birds or livestock?*

15:30-16:10 *Coffee break*

16:10-16:30 Vittecoq et al.: *Modeling the spread of avian influenza viruses in aquatic reservoirs: a novel hydrodynamical approach applied to the Rhône delta (southern France)*

16:30-16:50 Caizergues et al.: *Shot-at Tufted ducks avoid hunted areas: evidence from long term-monitoring of embedded and ingested lead shot*

16:50-17:10 Miller: *Beliefs and support for use of nontoxic shot among Mourning Dove (*Zenaida macroura*) Hunters in Illinois, U.S.A.*

17:10-17:30 Cromie et al.: *Approaching a tipping point for transition to non-toxic ammunition?*

Perdix: Recovery of grey partridge (Room Sully 1)
Chair: Nicholas Aebischer, Game & Wildlife Conservation Trust, UK

13:30-13:50 Hajas & Farago: *Recovering grey partridges: A genuine intersection of sustainable farming, wildlife conservation and management*

13:50-14:10 Ewald et al.: *Shoot management for grey partridge recovery over 15 years and its effect on arable flora and cereal invertebrates*

14:10-14:30 Homberger et al.: *Reintroduction of grey partridges: lessons from the Swiss recovery project in Geneva*

14:30-14:50 Buckley et al.: *The Demise and Recovery of the Grey Partridge* Perdix perdix *in the Wild in Ireland*

14:50-15:10 Manzer et al.: *Life on the Fringe - can grey partridge thrive on a modern farm?*

15:10-15:30 Ewald et al.: *Conserving ecosystems through sustainable use: solutions from the internet*

15:30-16:10 *Coffee break*

Perdix: Population monitoring – abundance, trend (Room Sully 1)
Chair: Manel Puigcerver, University of Barcelona, Spain

16:10-16:30 Jimenez-Blasco et al.: *Increase of over-wintering individuals in Spain of a transaharian migratory game bird: the Common Quail (*Coturnix coturnix*)*

16:30-16:50 Puigcerver et al.: *Population trends of the Common quail (*Coturnix coturnix*) in France and Spain conflicting data or controversial census methodologies*

16:50-17:10 Canonne et al.: *Spatio temporal demographic trends of Black Grouse in the French Alps*

17:10-17:30 Malone et al.: *Integrating harvested wing data and mark-recapture data for age-specific abundance estimates of Northern Bobwhite populations*

Wednesday 23rd August morning

Human-wildlife conflicts (Room Rondelet)
Chair: Laurent Courbois, Fédération Nationale des Chasseurs, France

09:00-09:40 **Massei:** ***Mitigating human-wildlife conflicts in an overcrowded continent: is fertility control a solution?*** **(Keynote)**

09:40-10:00 Cappa et al.: *Distribution and factors affecting wild boar (*Sus scrofa*) damage in a lowland area in northern Italy*

10:00-10:20 Hahn: *Success and failure of a stakeholder based approach mitigating human-wild boar conflicts in rural areas in Bavaria (South East Germany)*

10:20-11:00 *Coffee break*

11:00-11:20 Rutten et al.: *Using an Unmanned Aerial Vehicle (UAV) and Object Based Image Analysis (OBIA) to map agricultural damage by wild boars in Flanders, Belgium*

11:20-11:40 Belova & Tarvydas: *Assessment of wild boar damage in Lithuania*

11:40-12:00 Pokorny et al.: *A razor-wired border fence as a threat for wildlife in Southeast Europe*

12:00-12:20 Battoraro & Illarietti: *Evaluation of the impact of winter recreational activities on a Black Grouse (Lyrurus tetrix) population in the Gran Paradiso National Park*

Predator-prey relationships (Room Sully 2)
Chair: Christophe Duchamp, ONCFS, France

09:00-09:40 **Andrén:** ***Predator – prey interactions in human dominated landscapes*** **(Keynote)**

09:40-10:00 Letty et al.: *Exploring predator-prey relationship through experimental reduction of red fox and its effect on brown hare population dynamics*

10:00-10:20 Jacquier et al.: *'Chicken-eating' foxes: isotopic evidence of individual specialisation in a rural population of red fox (*Vulpes vulpes*)*

10:20-11:00 *Coffee break*

11:00-11:20 Braunisch et al.: *Red deer abundance drives the establishment of wolves in the Western Swiss Alps*

11:20-11:40 Gastineau et al.: *Spatial and temporal variability of depredation on livestock by brown bear,* Ursus arctos*, in the Pyrenees, France*

11:40-12:00 Elmhagen: *Global change and the Scandinavian wildlife community - answers provided by long-term hunting bag data*

12:00-12:20 Michler et al.: *Unsuspicious immigrant or ecological threat – a long-term field study on the introduced raccoon (*Procyon lotor, Carnivora: Procyonidae*) in Germany*

Workshop: Lagomorphs in Europe: Conservation and Population dynamics (Room Sully 3)

09:00-09:20 Alves: *Non-invasive genetic sampling: a tool for wildlife management and conservation*

09:20-09:40 Bouche et al.: *Monitoring mountain hares (*Lepus timidus*) population by collecting faeces in winter. Developing management tools in the Ecrins national park*

09:40-10:00 Hackländer et al.: *Coat colour change pattern in Alpine mountain hares (*Lepus timidus varronis*) along an altitudinal gradient in Grisons, Switzerland: implications for game management*

10:00-10:20 Discussion

10:20-11:00 *Coffee break*

11:00-11:20 Lombardini et al.: *Ecology of the European hare in a farmland area of Northern Italy*

11:20-11:30 Strauss et al.: *Long-term Population Trends on Brown Hare in Intensively Used Agricultural Landscape*

11:30-11:40 Mauvy et al.: *Declining breeding success in European hare (*Lepus europaeus*) populations in France*

11:40-11:50 Letty et al.: *Impact of an outbreak of RHDV2 on a semi-natural population of European rabbits in France*

11:50-12:20 Discussion

Workshop: Sustainable waterbird harvest (Room Espace Joffre)

09:00-09:40 **Madsen: *Getting started with adaptive management of migratory waterbirds in Europe: the challenge of multifaceted interests* (Keynote)**

09:40-10:00 Le Maresquier: *Adaptive Harvest Management (AHM) of waterbirds in the context of the EU Birds Directive*

10:00-10:20 Trouvilliez: *Waterbird conservation and sustainable use under AEWA*

10:20-11:00 *Coffee break*

11:00-11:20 Johnson: *Harvest management of Taiga Bean Geese in the face of demographic uncertainty*

11:20-11:40 Scallan & Nagy: *Information requirements and data availability to support adaptive harvest management in Europe*

11:40-12:00 Williams et al.: *Managing geese and the influence of different hunter typologies: hunting behaviour and motivations of Danish goose hunters*

12:00-12:20 Round table

Perdix: Demography & population dynamics (Room Sully 1)
Chair: John Carroll, University of Nebraska, USA

08:40-09:00 McConnell et al.: *Estimating northern Bobwhite recruitment using integrated population models*

09:00-09:20 Terhune et al.: *Novel Methods for Estimating Neonate Survival of Northern Bobwhite*

09:20-09:40 Baines et al.: *Respiratory cryptosporidiosis: lethal and sub-lethal impacts of infection on Red Grouse, a wild gamebird of economic importance*

09:40-10:00 Guzman & Arroyo: *Red-legged partridge* Alectoris rufa *productivity in relation to weather and land use*

10:00-10:20 Buner: *Causes of grey partridge overwinter losses on lowland farmland in England*

10:20-11:00 *Coffee break*

Perdix: Habitat occupancy (Room Sully 1)
Chair: Julie Ewald, GWCT, UK

11:00-11:20 Hagen et al.: *Multi-scale occupancy models provides insights to landscape conservation needs of Lesser Prairie-Chicken*

11:20-11:40 Elmore et al.: *Extreme weather events create pinch points for northern bobwhite*

11:40-12:00 Schöll & Hille: *The grey partridge (*Perdix perdix*) in Vienna: population trends and habitat preferences*

12:00-12:20 Burnett et al.: *Gray Partridge Distribution in North America: Changing Landscapes and Environment for an Introduced Species*

Wednesday 23rd August afternoon

Human & wildlife sharing habitat (Room Rondelet)
Chair: Anders Lundvall, Swedish Environmental Protection Agency

13:40-14:20 **Gehrt: *Carnivores among people: urban ecology of carnivores with insights from coyotes in Chicago* (Keynote)**

14:20-14:40 Peerenboom et al.: *Rather talk than trap - why we need to change wildlife management concepts for urban areas*

14:40-15:00 Rouco et al.: *Just follow the road to find European rabbit causing damage to agriculture in southern Iberian Peninsula*

15:00-15:20 Thompson et al.: *Ecosystem services provided by beavers (*Castor *spp.)*

15:20-15:40 Tari et al.: *Reasons of the synurbanization of wild boar in the region of Lake Balaton*

15:40-16:20 *Coffee break*

Waterbird breeding ecology (Room Rondelet)
Chair: Johan Elmberg, Kristiantad University, Sweden

16:20-16:40 Pöysä et al.: *Habitat change and population decline in breeding wigeon* Anas penelope

16:40-17:00 Folliot et al.: *Precocity as a major determinant of Common Pochard (*Aythya ferina*) nesting success*

17:00-17:20 Clark et al.: *Northern pintails in agroecosystems: resolving trade-offs between competing conservation goals*

17:20-17:40 Selivanova & Mikhantyev: *Influences of climate oscillations on population dynamics of nesting ducks in the south of Western Siberia*

Ecology of ungulates (Room Sully 2)
Chair: Patrick Duncan, CNRS, France

13:40-14:20 **Gaillard: *How do ungulates respond to environmental changes in temperate ecosystems?* (Keynote)**

14:20-14:40 Debeffe et al.: *Activity pattern of partially migratory male and female deer: the forage maturation hypothesis meets sexual segregation theory*

14:40-15:00 Harper et al.: *Seral Stage Manipulation Increases Nutritional Carrying Capacity for Cervids*

15:00-15:20 Ofstad et al.: *Location, location, location! Fitness consequences of choosing among habitats*

15:20-15:40 Bonnot: *Individual variation in stress reponse in Roe deer*

15:40-16:20 *Coffee break*

16:20-16:40 Markussen et al.: *Causes and consequences of age at first reproduction in male moose*

16:40-17:00 Vanpe et al.: *Old roe deer females avoid mating with old males*

17:00-17:20 Ebert et al.: *Sex-specific estimation of red deer population size – using non-invasive genetic sampling*

17:20-17:40 Pedersen et al.: *Use of DNA technology to define moose populations for management*

Perdix: Management – habitat, predators, harvest, releases (Room Sully 1)
Chair: Jérôme Duplain, Swiss Ornithological Institute, Switzerland

13:40-14:00 Jackson et al.: *Partial meso-mammal predator removal positively affects northern bobwhite reproduction*

14:00-14:20 Olsen et al.: *Landscape-scale removal of conifers to improve sage-grouse vital rates*

14:20-14:40 Ludwig & Baines: *Can the restoration of heather habitat mitigate the impact of raptor predation on red grouse?*

14:40-15:00 Green et al.: *Adaptive harvest and habitat management of Northern Bobwhites: balancing population recovery and cultural heritage*

15:00-15:20 Powell: *Game bird harvest on private lands in the USA: should we manage pheasants like fish?*

15:20-15:30 Souchay et al.: *Investigating survival of wild and hand-reared red-legged partridges in Southern France*

15:30-15:40 Fruitet et al.: *Use of water troughs by the wild red-legged partridge,* Alectoris rufa*, in the south of France. Results of 2 years of camera-trapping*

15:40-16:20 *Coffee break*

Perdix: workshop (Room Sully 1)

16:20-17:40 *How to release partridges for conservation and shooting in the 21st century?*

Workshop: Camera traps and their use (Room Sully 3)

13:40-14:00 Massei & Beatham: *Camera traps in wildlife research: a look to the future*

14:00-14:20 Huber: *Lepus: introducing an all-in-one software for camera trap data treatment (from data input to analysis)*

14:20-14:40 Mengulluoglu et al.: *Prey preferences of Anatolian lynx in three different ecosystems of Turkey*

14:40-15:00 Lombardi et al.: *An Integrated method for evaluating density of Roe Deer based on camera trapping and capture-mark-recapture in a forested area of high mountain*

15:00-15:20 Ngama et al.: *Video and camera traps to investigate animal ecophysiology and enhance wildlife management: case study on bees and elephants interactions in Gabon*

15:20-15:40 Beatham et al.: *Measuring the distributions and densities of wild mammals in Kosovo using camera traps and local hunting community engagement*

15:40-16:20 *Coffee break*

16:20-16:40 Mengulluoglu & Ambarli: *Is there a real conflict of interest between hunters and caracals in the Mediterranean Turkey?*

16:40-17:00 Arlettaz et al.: *Abnormally low lynx density in the SW Swiss Alps points to poaching, what targeted inquiries confirm…*

17:00-17:20 Fischer & Félix: *MCR-system: combining passive marking and MR models to evaluate wild boars (*Sus scrofa*) abundances.*

17:20-17:40 Discussion

Workshop: Conservation and management on private lands (Room Espace Joffre)

13:40-14:00 Hewitt: *Welcome and Introduction: Wildlife Management in the Shadow of the Human Footprint*

14:00-14:20 DeYoung: *Intensive Management of Native Ungulates: Conservation Success Inside a Pandora's Box*

14:20-14:40 Ortega: *Livestock-Wildlife Disease Interactions in the Rural Landscape*

14:40-15:00 Fulbright et al.: *Managing Thermal Landscapes for Quail: An Increasingly Hot Topic*

15:00-15:20 Grahmann: *Working across boundaries to conserve upland gamebirds in Southern Texas: a case study*

15:20-15:40 Harveson: *Value in the eye of the beholder: landowner-driven restoration of Pronghorn*

15:40-16:20 *Coffee break*

16:20-16:40 Strickland: *Effective strategies for wild pig management in the southeastern U.S.*

16:40-17:00 Demarais: *Private landowners as a source of data for research and management evaluation: deer management assistance program*

17:00-17:20 Reilly: *The South African game ranching industry: Quo Vadis*

17:20-17:40 Discussion

Thursday 24th August morning

Waterbird population management (Room Rondelet)
Chair: Jean Jalbert, Tour du Valat, France

09:00-09:20 Champagnon et al.: *Effects of restocking for hunting purpose: the Mallard case*

09:20-09:40 Dalby et al.: *Predicting outcomes of management actions using individual-based modelling within adaptive management framework*

09:40-10:00 Holm et al.: *Status of the Danish action plan to reduce wounding of game by shotgun hunting*

10:00-10:20 Therkildsen et al.: *Status of the implementation of the AEWA International Single Species Action Plan for the Taiga Bean Goose*

10:20-11:00 *Coffee break*

11:00-11:20 Sorrenti et al.: *Waterbirds hunting harvest in Italy: results from the seasons 2003-2012*

11:20-11:40 Galia et al.: *Trends in Teal bag in the Camargue: impact of weather and multi-scale abundance*

11:40-12:00 Solokha & Gorokhovsky: *Estimating waterbird harvest in Russia*

12:00-12:20 Christensen: *Using stable isotope analyses to assess the impact of hunting on the breeding population of Common Snipe in Denmark*

Movement and Habitat use (Room Sully 2)
Chair: Sandrine Ruette, ONCFS, France

09:00-09:20 Hofman et al.: *The performance of satellite telemetry in wildlife research: what does the evidence show?*

09:20-09:40 Walton et al.: *Here, there and everywhere: Spatial ecology of the red fox (A project overview)*

09:40-10:00 Ranc et al.: *The golden jackal (*Canis aureus*) in Europe: predicting habitat suitability of a rapidly establishing carnivore*

10:00-10:20 Zimmermann et al.: *Who is outside the door? Wolf movement in relation to human settlements*

10:20-11:00 *Coffee break*

Ungulate breeding ecology (Room Sully 2)
Chair: Sonia Saïd, ONCFS, France

11:00-11:20 Sandor et al.: *Characteristics of fallow deer reproduction and time of conception*

11:20-11:40 Lombardi et al.: *Generalized Structural Equations improve sexual-selection analyses*

11:40-12:00 Gamelon et al.: *Reproductive allocation in pulsed-resource environments: a comparative study in two populations of wild boar*

12:00-12:20 Gayet et al.: *SNPs or Microsatellites? Assessing the reliability of different molecular markers to identify wild boar × domestic pig hybrids*

Learning from hunted animals (Room Sully 3)
Chair: Craig Miller, Illinois Natural History Survey, USA

09:00-09:20 Landry et al.: *Population demographics of West Virginia bobcats using age-at-harvest data*

09:20-09:40 Miller et al.: *Treasure in the Bag – Analysis of hunting statistics and trophies proves unsustainable management of Chamois (*Rupicapra rupucapra *L.) in Bavaria, Germany*

09:40-10:00 König et al.: *Plasticity of roe deer on annual changes of energy and quality in their diet*

10:00-10:20 Hackl et al.: *Non-Invasive monitoring of glucocorticoid metabolite response in* Capreolus capreolus *- Impact of a drive hunt*

10:20-11:00 *Coffee break*

Releases and reintroductions (Room Sully 3)
Chair: Roger Draycott, Game & Wildlife Conservation Trust, UK

11:00-11:20 Fusari et al.: *Reintroduction of large game species to Gilé National Reserve, Mozambique*

11:20-11:40 Sabalinkiené et al.: *Population quality of free–ranging European Bison in Lithuania*

11:40-12:00 Rousteau et al.: *Dynamics and viability of a reintroduced population after 24 years of release: the case of the cinereous vulture* Aegypius monachus *in France*

12:00-12:20 Bacon et al.: *Age-dependent breeding performances of a reinforced bird population in the wild*

Perdix: Ecotoxicology (Room Sully 1)
Chair: Anouk Decors, ONCFS, France

08:40-09:20 **Bro: *Pesticides and farmland Galliformes: new concerns for an old issue? Overview and perpectives of research* (Keynote)**

09:20-09:40 Mougeot et al.: *Pesticide-coated seeds as a threat to red-legged partridges and other granivorous farmland birds: evidence from studies conducted in Spain*

09:40-10:00 Barfknecht et al.: *Post-registration field monitoring studies during drilling with imidacloprid-dressed winter cereal seeds to assess the acute risk to birds*

10:00-10:20 Millot et al.: *Field evidence of neonicotinoid direct toxic effects on birds*

10:20-11:00 Coffee break

Perdix: Animal and population biology (Room Sully 1)
Chair: Beatriz Arroyo, IREC, Spain

11:00-11:20 Kallioniemi et al.: *Who took the eggs - an experimental wildlife camera trap survey*

11:20-11:40 Gottschalk & Beeke: *Reducing nest predation in partridges by adaption of landscape elements*

11:40-12:00 Olesen: *New findings in dispersal, habitat related breeding success and predation in Danish grey partridge*

12:00-12:20 Bernard-Laurent et al.: *The reproductive biology of Rock partridge (*Alectoris *graeca saxatilis) in the southern French Alps: first evidence of double nesting behaviour*

Workshop: Ecology and Management of multispecies ungulate communities in Europe (Room Espace Joffre)

09:00-09:20 Cromsigt et al.: *Beyond Moose – the ecology and management of multispecies ungulate systems*

09:20-09:40 Spitzer: *Trophic interactions in Sweden's diverse ungulate communities*

09:40-10:00 Pfeffer et al.: *Impacts of diverse ungulate communities on forestry in different land-use settings*

10:00-10:20 Chassagneux et al.: *Does hunting affect red deer (Cervus elaphus) and wild boar (Sus scofa) spatial behaviours in the same way?*

10:20-11:00 *Coffee break*

11:00-11:20 Burrell et al.: *Current distributions of wild-ranging deer species in the United Kingdom*

11:20-11:40 Bernard et al.: *Are plant – ungulates interactions related to climate? Comparison of consumption indexes along elevation gradients across a latitudinal gradient of European sites*

11:40-12:20 Discussion

Thursday 24th August afternoon

Closing Plenary (Pasteur amphitheater)

13:40-14:40 **Williams:** ***Monitoring, modelling and managing natural resources in the face of uncertainty and environmental fluctuations – a synthesis view*** **(Plenary)**

14:40-15:00 Awards ceremony

15:00-15:40 Closing speeches

WORKSHOP – Wednesday 23 August – 09:00-12:20, Room Sully 3

Management and monitoring of Lagomorph species populations in Europe

Chairs: Klaus Hackländer [1], Paulo C. Alves [2], Jean-Sébastien Guitton [3], Jérôme Letty [4], Stéphane Marchandeau [3] and Heiko G. Rödel [5]

1. Institute of Wildlife Biology and Game Management, University of Natural Resources and Life Sciences (BOKU), Vienna, Austria
2. CIBIO, Vairão & Faculty of Sciences, University of Porto, Portugal
3. ONCFS, DRE, Unité Faune de plaine, F-44000 Nantes
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5. Université Paris 13, Laboratoire d'Ethologie Expérimentale et Comparée EA 4443, F-93430 Villetaneuse

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Heiko G. Rödel: heiko.rodel@leec.univ-paris13.fr

Abstract (reasons for organising a sessions/workshop, aims, possible outcomes):

Lagomorph species populations may be threatened in Europe by diseases epidemics, agriculture management or climate change.

Who should attend this special session / workshop?

Lagomorph and wildlife management biologists

How many participants do you expect?

50 persons

How do you plan to organise the workshop: invited talks, possibility for participants to submit an abstract (length of possible communications), round table, etc.?

Atfer a general introduction the session will have two sections on Ecology and Population Dynamics and on Lepus timidus, comprised of regular talks and poster presentations, followed by discussions (see detailed programme).

WORKSHOP – Wednesday 23 August – 09:00-12:20, Room Espace Joffre

Ensuring sustainable waterbird harvest

Chair: Richard Hearn
(Duck Specialist Group/Waterbird Harvest Specialist Group Group of Wetlands International)

Contact: Richard Hearn: richard.hearn@wwt.org.uk

Abstract (reasons for organising a sessions/workshop, aims, possible outcomes):

Waterbird hunting is a long established and accepted tradition in Europe, e.g. provisional estimates suggest in excess of 5 million ducks are harvested annually across the continent. Equally well established and accepted is the concept of wise use and sustainability. This is enshrined in a number of relevant directives and agreements, most notably the EU Birds Directive and the African-Eurasian Migratory Waterbird Agreement (AEWA). Despite this, some European countries lack a robust system for estimating harvest rates, and there is no centralised flyway-scale management system for collating harvest and other population data and ensuring sustainability of harvests.
During recent decades, the increasing population trends of most huntable waterbirds have provided a proxy confirmation of sustainability. However, more recently, the trends of a number of huntable waterbirds have deteriorated, some to the point that they have been listed as globally threatened by IUCN, e.g. Common Pochard. For such species, there is a legal requirement to set up Adaptive Harvest Management (AHM) systems in order for hunting to continue. Nevertheless, unquantified levels of hunting continue and no attempts to assess sustainability are being made.
The reasons for this are complex. However, the AEWA Guidelines on Sustainable Harvest of Migratory Waterbirds demonstrate that the requirements of AHM systems are not technically complicated and can be readily implemented. This is demonstrated by the significant progress made with managing goose harvests by AEWA's European Goose Management Platform. The main barriers to progress are predominantly political, arising from insufficient trust and cooperation between stakeholders.
The aim of this workshop is to bring together these stakeholders to appraise the current status of huntable waterbirds and the state of harvest management, in order to determine what collaborative steps can now be taken to improve flyway-scale assessments of harvest sustainability, such that harvests can continue without posing a threat to the conservation of waterbirds.

Who should attend this special session / workshop?

Scientists/biologists, politicians, hunting representatives, etc.

How many participants do you expect?

50 to 80 persons

How do you plan to organise the workshop: invited talks, possibility for participants to submit an abstract (length of possible communications), round table, etc.?

The session will comprise six invited presentations followed by a roundtable discussion (see detailed programme). The invited talks will be the keynote talk by Jesper Madsen (Getting started with adaptive management of migratory waterbirds in Europe: the challenge of multifaceted interests), followed by major contributors from the scientific, administrative and management spheres involved in the management of waterbird harvest, especially in Europe.
By the end of the session it is hoped that a consensus may arise on the benefits that could be expected from more harmonized and collaborative data collection and harvest management within the waterbird flyways, and momentum towards the setting up of such schemes.

WORKSHOP – Wednesday 23 August – 13:40-17:40, Room Sully 3

The use of camera traps as new revolutionary monitoring tool

Chairs: Giovanna Massei and Claude Fischer
(National Wildlife Management Centre, Animal and Plant Health Agency, York, UK
and
University of Applied Sciences of Western Switzerland, Geneva)

*Contacts: Giovanna Massei: giovanna.massei@apha.gsi.gov.uk
Claude Fischer: claude.fischer@hesge.ch*

Abstract (reasons for organising a sessions/workshop, aims, possible outcomes):

The assessment of spatial distribution and abundance of mammal species are key information for conservation and management strategies. They are however often very difficult to estimate with methods that are affordable for managers, for extended study areas, or when densities are expected to be low. The use of camera traps is an interesting alternative under these conditions. In addition, camera traps can be used to assess densities or presence of multiple species, to study wildlife behaviour at feeding stations and to monitor population ecology. The sampling strategy can be standardised and replicated, allowing researchers to monitor changes in distribution and abundance over space and time, and to compare between study areas using adapted models to analyse the data (CMR, Occupancy, RAI, REM). In our Workshop we aim at showing the extent of different purposes camera traps can be used for, as well as presenting the most up to date methods of analysis of the data, also considering the issue of analysing the increasing amount that can be generated in a single study. We will also discuss pitfalls and drawbacks of camera traps and practical implementations in field studies.

Who should attend this special session / workshop?

Any researcher or manager interested in monitoring mammals or already using this method but wanting to learn more about other applications.

How many participants do you expect?

40 persons

How do you plan to organise the workshop: invited talks, possibility for participants to submit an abstract (length of possible communications), round table, etc.?

Invited talks and submitted abstracts; each 15 min talk (+ 5 min for questions), followed by aeneral discussion and conclusions at the end of the session (see detailed programme).

WORKSHOP – Wednesday 23 August – 13:40-17:40, Room Espace Joffre

Conservation and Management on Private Lands: Challenges and Success Stories

Chairs: J. Alfonso "Poncho" Ortega and Randy De Young
(Texas A&M University-Kingsville, 700 University Blvd. MSC 218, Kingsville, TX 78363, USA)

Contacts: J. Alfonso Ortega-S: poncho.ortega@tamuk.edu
Randy DeYoung: Randall.DeYoung@tamuk.edu

Abstract (reasons for organising a sessions/workshop, aims, possible outcomes):

During the past century, the human footprint has advanced in a relentless onslaught, steadily encroaching on wildlife and their habitats. However, history teaches us that preservation alone is often inadequate. If people value wildlife as a renewable natural resource, conservation can occur in conjunction with economic, recreational, and aesthetic returns. Private land stewardship can advance conservation, but requires a delicate balance of cooperation and incentives. The symposium presenters will outline challenges and success stories in private lands management, and give their views on the present and future of management on private lands.

Who should attend this special session / workshop?

Professionals, students, and conservationists interested in management in private lands.

How many participants do you expect?

Depending on overall congress attendance

How do you plan to organise the workshop: invited talks, possibility for participants to submit an abstract (length of possible communications), round table, etc.?

Invited and submitted presentations (15-min talk + questions) followed by a discussion. See detailed programme.

WORKSHOP – Wednesday 23 August – 16:20-17:40, Room Sully 1

How to release partridges for conservation and shooting in the 21st century

Chairs: Dr. Carlos Sánchez-Garcia [1] and Dr. Francis Buner [2]
1. Fundación Artemisan, 13003, Ciudad Real, Spain
2. The Game & Wildlife Conservation Trust, SP6 1EF, Fordingbridge, United Kingdom)

Contact: Carlos Sánchez investigacion@fundacionartemisan.com

Abstract (reasons for organising a sessions/workshop, aims, possible outcomes):

The workshop's key objective is to promote a knowledge exchange between conservation scientists and practitioners about partridge releasing for conservation and shooting purposes, aiming to bring together experts and knowledge from different countries.

This workshop will examine the topic in the light of recent re-introduction publications and practical partridge recovery projects that aim to balance shooting with conservation interests. We aim to highlight and show-case good working examples based on scientific approaches and identify challenges and knowledge gaps.

We would like to record this workshop and publish the conclusions in the congress proceedings or alternatively in a scientific journal (through a letter to the Editor).

Who should attend this special session / workshop?

Small gamebird experts are invited to share their scientific and practical management experience, but all attendees interested in gamebird management are welcome to join us.

How many participants do you expect?

Hopefully 12-15 experts and all attendees from the Perdix Congress.

How do you plan to organise the workshop: invited talks, possibility for participants to submit an abstract (length of possible communications), round table, etc.?

The experts are invited to share their knowledge and experience through 'Rapid fire talks' (5-minutes), which will be followed by extensive plenary discussions, in which all the people taking part are invited to participate. The summaries of these rapid fire talk are, at the time of printing:

Arroyo, Beatriz (IREC-Spain)

Recent studies have shown that current releases of red-legged partridges in Spain are mostly inefficient and even detrimental to the recovery of wild red-legged partridge populations. They are associated with spread of diseases to wild partridges and (at least in certain cases) with overhunting of non-released ones. On the other hand, they are considered by game managers to be necessary for the maintenance of hunting. The spread of partridge farms has also allowed the spread of put-and-take estates (called "intensive" estates in Spain), which are regarded with ambivalence by hunters, and negatively by non-hunters. It is important to develop the discussion about how to improve the situation of wild red-legged partridge populations, the profitability of hunting estates based on wild populations, and how to differentiate more clearly estates using small-scale releases in a put-and-take objective from those making more efforts for improving wild partridge populations.

Bro, Elisabeth (ONFCS-France)

In France, the grey partridge experienced several poor reproductive successes the last few years and its spring densities sharply declined. After several years of low or no hunting pressure to adapt to this situation, releases for shooting are increasingly practised by local hunting associations. Hence the challenge is to conciliate this practice and the conservation of wild populations. Indeed some studies show that if shot birds are mainly released ones at the opening, the ratio of released birds over wild birds in the hunting bag decreases over time. In this context, released birds should be marked and quantitative rules should limit hunting bags to avoid overhunting the wild population and accelerate its decline - given that one released bird surviving the hunting season will not survive and reproduce as well as a wild bird. A field survey is being implemented to increase our expertise on this topical issue and refine quantitative rules.

Buckley, Kieran (National Parks and Wild Life Service, Republic of Ireland)

Releasing grey partridge trapped from the wild and bred in captivity has played a pivotal role in the conservation of the species in Ireland. However, this approach only offered significant potential for the recovery of low density populations when it is re-enforced with predator management and the creation of suitable habitats.

Buner, Francis and Sánchez, Carlos (GWCT-United Kingdom and Fundación Artemisan-Spain)

Considering research and practical examples of grey partridge and red-legged partridge re-introduction experiments and projects across Europe, combined with our own research in the UK, Switzerland and Spain, we summarize the key points that should be considered for any successful reintroducing of the two species for conservation and shooting purposes within their natural range.

Duplain, Jérôme (Swiss Ornithological Institute-Switzerland)

Grey partridges that are reared in order to be released are generally facing predictable conditions, especially with ad-libitum food. This might be contra-productive. In Switzerland, we found that food unpredictability in early life in captivity increases survival of captive grey partridges after release.

Draycott, Roger (GWCT-United Kingdom)

The GWCT Advisory Dept works with many farmers and hunters to improve both hunting returns the viability of surviving birds to produce their own offspring the following year. Critical to both of these objectives is to ensure that survival of birds post-release is as high as possible. Research and practical experience shows that attention to detail in the release period through correct provision of habitat, food, water, protection from predation, nurturing natural behaviours, reducing stress and choosing the most suitable release site all combine to influence post release survival. I will highlight key factors and practical solutions to some of these issues which can improve post release survival in partridges and pheasants.

Powell, Larkin (University of Nebraska, USA)

The wildlife management profession in the United States generally opposes, with vigor, the annual release of birds for shooting. I will describe current dynamics in game bird conservation and management in the US that may lead to greater support for releases of game birds for conservation and shooting in the future.

Souchay, Guillaume and Ponce-Boutin, Françoise (ONCFS-France)

We aimed to recall last estimates of survival of wild and released red-legged partridges in Southern France and to present outcomes of population projections based on population matrix models following several management scenarios of partridges in a given hunting district in France: with or without releases, with or without hunting management.

WORKSHOP – Thursday 24 August – 09:00-12:20, Room Espace Joffre

From one towards many - Ecology and Management of multispecies ungulate communities in Europe

Chairs: Navinder J Singh and Joris Cromsigt
(Department of Wildlife, Fish and Environmental Studies, Swedish University of Agricultural Sciences, Umeå, SE 90183)

Contacts: Navinder J Singh: navinder.singh@slu.se
Joris Cromsigt: joris.cromsigt@slu.se

Abstract (reasons for organising a sessions/workshop, aims, possible outcomes):

During the last three decades populations and distribution of ungulate species have increased and changed rapidly across Europe. Species such as roe deer, red deer, fallow deer, wild boar and moose have expanded their ranges and increased in numbers. In many areas, where only one species existed in the past, it now shares the niche with several others and higher numbers. Climate change and supplementary feeding are facilitating this expansion along with other modifications such as hunting practices, creation of game fields, and forestry practices that increase food availability for ungulates. These multi-species ungulate communities may generate novel interactions among species, such as competition for food, and affect ecosystems as well as population dynamics of each ungulate species. Moreover, these interactions could be further modified by the novel landscape that the ungulates face through effects of active game management and other land use practices. Currently, we lack a comprehensive understanding and empirical data on the functioning of these new diverse ungulate communities and the role of different management actions, because past studies have mainly focused on one or two species at a time. Such understanding is essential to find a balance among competing ecosystem services such as game meat and recreation from hunting vs. fiber from forests and food from crops. As a result, important questions arise that require immediate attention: A) How do species in these diverse communities interact over food and how do human actions modify these interactions? B) How do these interactions influence individual and population performance of different species as well as their environmental impacts? C) How do we implement answers to these questions in the sustainable management of these novel and diverse ungulate communities and their habitat?
Aim: *To bring together researchers at the forefront of community ecology of European ungulates, to share the progress in knowledge for better management of European multispecies ungulate communities and the ecosystems they live in.*
Possible Outcomes: *Formation of a European wide network of researchers and practitioners that can share novel research outcomes on the ecology and management of multispecies ungulate systems. One important aspect is to learn from each other's experiences across Europe in terms of how we monitor the populations of these diverse ungulate species and their impact on the landscape. Currently, many different monitoring methods exist, often tailored towards one species, but how well do they work for other species? And can we come with one system of monitoring all species, their numbers and impact?*

Who should attend this special session / workshop?

Researchers, Managers, Agencies and Authorities, Stakeholders such as hunters, foresters, conservationists.

How many participants do you expect?

8 +… Speakers, 30-40 delegates

How do you plan to organise the workshop: invited talks, possibility for participants to submit an abstract (length of possible communications), round table, etc.?

15-minute talks + questions and a final discussion, see detailed programme

List of posters
(abstracts in alphabetic order from page 45 onwards)

1. ADEIKIS et al.: Semi-naturally bred and released to the wild Eurasian eagle owls' (*Bubo bubo* L.) migration peculiarities, experience in Lithuania

2. ARZEL et al.: Cost of being paired in males: a comparison of the behaviour of paired and unpaired male Teal prior to nesting

3. BECH et al.: Quantifying genetic distance between wild and captive strains of grey partridge *Perdix perdix* in France

4. BEUGIN et al.: A single multiplex of twelve microsatellite markers for the simultaneous study of the brown hare (*Lepus europaeus*) and the mountain hare (*Lepus timidus*)

5. BLANCHETTE: Factors influencing hunter success for small games in the province of Québec, Canada

6. BUCKLEY: The breeding productivity of lapwing on a post-industrial peat bog managed for conservation of the grey partridge in Ireland. Ecological serendipity – or the law of un-intended consequences

7. CARRO et al.: Long-term patterns in Red-legged partridge population dynamics in a protected area (Doñana Nature Area) in the SW Iberian Peninsula

8. CHASSAGNEUX et al.: Effects of hunting on the spatial behaviour of wild boar (*Sus scrofa*)

9. CLARK et al.: Drivers of duck population synchrony on two continents: is climate important?

10. COHOU et al.: Dietary compositions and winter habitats of the woodpigeon in southwestern France

11. DAMI et al.: Overview of national IWC schemes around the Mediterranean: a call for more pan-Mediterranean collaboration

12. DRAYCOTT & SÁNCHEZ-GARCÍA: Survival, breeding success and causes of mortality of wild hen pheasants Phasianus colchicus in Norfolk, England

13. ERAUD et al.: The contribution of climatic conditions to population changes in the declining European Turtle dove in France

14. FARAU: Involving and retaining hunters in the management of migratory birds and their habitats: concertation and networking to "act local"

15. FARAU et al.: Operational experimentation of management methods on the Breton Marsh (Marais breton, Vendée, France) for breeding waterbirds: method and first results.

16. FERRARIO et al.: Population Dynamic of Roe Deer (*Capreolus capreolus*, L. 1758) in the Ticino River Natural Park (Northern Italy): from the reintroduction to nowadays

17. FLUHR et al.: Assessing the risk for an obligate scavenger to be dependent on routinely supplemented feeding sources

18. GARCÍA-SOLÓRZANO & LÓPEZ-GONZÁLEZ: Conservation without borders in jeopardy? The Mexico–United States cross wall border affair

19. GARCÍA-SOLÓRZANO et al.: Conservation and utilization of the white-tailed Mexican deer (*Odocoileus virginianus mexicanus*) as a detonator of social welfare in the Sierra de Huautla, Biosphere Reserve, Central Mexico

20. GARCÍA-SOLÓRZANO et al: Monitoring of the endangered masked bobwhite quail population in Mexican desert shrubland

21. GERMAIN & CHARBONNEL: The "Programme Lynx Massif des Vosges": improving the conservation status of the boreal Lynx in the French Vosges Mountains through a concerted and shared approach with local stakeholders

22. GIZEJEWSKI et al.: Captive breeding as a valuable tool to achieve the recovery of the endangered huemul deer (*Hippocamelus bisulcus*)

23. GUILAIN et al.: Wintering habitat used by Wood Warbler (*Phylloscopus sibilatrix*) influenced by habitat characteristics and wintering period in centre region of Cameroon

24. GUILLEMAIN & HEARN: Protection status of critical duck sites in Europe: are we ready for climate change?

25. GUILLEMAIN et al.: A new analytical technique for statistical delineation of migratory bird flyways

26. GUILLEMAIN et al.: How rice cultivation can benefit wintering waterfowl… and vice-versa

27. GUITTON et al.: Habitat shift in European hare (*Lepus europaeus*) resting sites selection during spring and summer in France

28. GUZMAN & ARROYO: New technologies for monitoring abundance and harvest of game species: App “Becada”

29. GYÜRE & JUHÁSZ: Habitat use by migrating and wintering geese in the Hortobágy (Hungary)

30. HADJISTERKOTIS et al.: Resolutions of the 6th World Congress on Mountain Ungulates and the 5th International Symposium on Mouflon and their effect on Mouflon taxonomy

31. HATLAUF et al.: Golden jackal (*Canis aureus*) occurrence in Austria: from first records to recent findings

32. HENRY et al.: Helping French wildlife researchers to comply with new animal welfare regulations

33. JANISZEWSKI: Practical innovations in construction and method of installing the water flow devices regulating the water surface in areas flooded by beavers

34. JASIŃSKA et al.: The influence of moon phases on activity of herbivores and carnivores in the vicinity of railway tracks

35. JOVANOVIĆ & MILOŠEVIĆ-ZLATANOVIĆ: Sexual dimorphism in two Alpine chamois (*Rupicapra rupicapra*) subspecies based on craniometric characters

36. JUHÁSZ & VARGA: Population dynamics of Eurasian Collared Dove populations in two Eastern Hungarian County seats

37. JUHÁSZ et al.: Great Cormorant (Phalacrocorax carbo) monitoring in the fishponds of Hortobágy

38. KISSLING et al.: Predation pressure of the Red fox on the Brown hare in the South and North West of Switzerland

39. KORSHUNOV: Dynamics of structure of mountain ungulate herds supporting the population homeostasis

40. KORSHUNOV & KORSHUNOV: The morphometric data of Arabian tahr (Arabitragus jayakari). Comparison of some morphometric data of different types of mountain ungulates occurred in the UAE

41. KÖVÉR et al.: Control possibility of corvids in urban environment – a trapping experiment

42. KRAUZE-GRYZ et al.: Development of the population of the red fox in Warsaw

43. MAILLARD et al.: Range expansion of the Raccoon (*Procyon lotor*) in France

44. MANDAS et al.: Current status, distribution and recovery plan of *Cervus elaphus corsicanus*

45. MARCHAND et al.: Sociospatial structure explains marked variation in brucellosis seroprevalence in an Alpine ibex population

46. MARCHANDEAU et al.: Spread of RHDV2 in rabbit and hare populations in France. Evidence for frequent species jumps

47. MARIN-CUDRAZ et al.: Using bioacoustics to estimate Rock ptarmigan (*Lagopus muta*) numbers in spring: comparison with the point count method

48. MAROUS et al.: On the hunt: Analysis of the behaviour of geocachers at the Untersberg (Salzburg, Austria)

49. MARTINOLI et al.: Where's the pulse to have the finger on? A retrospective analysis of Alpine Galliforms (Aves: Galliformes) census and game bag data in Italy

50. MAUVY et al.: The French Hare Network : a tool to study European hare populations dynamics on a large scal

51. MERIGGI et al.: Factors affecting habitat occupancy and densities of the Red-legged partridge in introduction areas of north-western Italy

52. MERIGGI et al.: Density and productivity of Roe deer in dry crop plain of North-western Italy

53. MICHAELIS et al.: Coexistence of Eurasian lynx and wolf with no dietary niche overlap in north-west Anatolia

54. MILLER et al.: The costs of wolves – Adaptive management for forest companies considering the comeback of large carnivores into Austria

55. MILOŠEVIĆ-ZLATANOVIĆ & JOVANOVIĆ: Sex and age structure of grey partridge (*Perdix perdix* L.) populations during different seasons of the year

56. MOHANRAJ & PANDIYAN: Invasion of Shorebirds into Inland Wetlands of Ayyanar Lake, Thanjauver, Southern India

57. NIEDERKOFLER & HACKLÄNDER: Magnetic alignment in European hares? Preliminary results on form direction

58. NUNINGER et al.: Effect of a conspecific's presence on grey wolf's (*Canis lupus*) reaction to novelty

59. NUNINGER et al.: Responses of captive wolves (*Canis lupus*) to novel visual, acoustic and olfactory stimuli

60. PACIOS-PALMA et al.: Effect of parasitosis and virosis on the physiologic condition and population dynamics of wild European rabbit (*Oryctolagus cuniculus*)

61. PATRELLE et al.: Spread and transmission dynamics of *Spiculopteragia spiloptera* (Gushansky, 1931) determined by population genetic structure study in roe deer from Champagne-Ardenne, France

62. PIETRI: Habitat suitability model for *Lepus corsicanus* in Corsica (France), implications for its conservation

63. PONCE-BOUTIN et al.: The red-legged Partridge *Alectoris rufa* network: A tool for conservation and research

64. PONCE-BOUTIN et al.: Annual diet of Red-legged Partridge in the French Mediterranean region

65. POWELL et al.: The Structural Complexity Index: a nonparametric descriptor of habitat heterogeneity for game bird research and management

66. RANZONI et al.: Assessing the functionality of wildlife corridors in an urban landscape with Red deer space use

67. REINECKE & REINECKE: Carnivorous birds and small mammals depend on invertebrates that are threatened by human activities in southern Africa

68. REITZ & BRO: Recent changes in grey partridge *Perdix perdix* demography in central northern France

69. RICCI & CAMOIN: Hunting and Scientific National Observatory Citizen: participatory science or just how hunting can be of use?

70. RIEGER et al.: Influence of large-scale conservation grazing projects on time-space-behaviour of Red Deer (*Cervus elaphus*) – first results from the Oranienbaumer Heide (DBU Naturerbeflächen)

71. ROSSA et al.: Monitoring of reintroduced population of roe deer (*Capreolus capreolus*) reintroduced in central Portugal

73. ROUCO et al.: Diversionary feeding does not reduce home ranges of European wild rabbits: implications to minimise damage in agricultural landscapes

74. SÁNCHEZ-GARCÍA & BUNER: Behavioural, survival and breeding success of parent-reared grey partridges *Perdix perdix* in English lowland farmland

75. SCHIFFERLE et al.: Comparing two different approaches for assessing red deer distribution: direct aerial survey and faecal pellet counts

77. SENCHIK et al.: History of hunting and current state of roe deer population in Amur region

78. SENCHIK et al.: Brown bear as a source of conflict situations with wild ungulates and humans

79. SKORUPSKI et al.: The attempt to use the empirical data for red deer (*Cervus elaphus* L.) population management

80. SKORUPSKI et al.: One year life of red deer (*Cervus elaphus* L.) stag

81. SOLOKHA: Status and possible restoration of North Caucasian Pheasant in Russia

82. SORRENTI & TRAMONTANA: Estimate of Turtle dove *Streptopelia turtur* harvest in Italy

83. ŠPINKYTĖ-BAČKAITIENĖ: Where are the Wolves and how many are out there?

84. STORCH: ConFoBi - Conservation of Forest Biodiversity in Multiple-use Landscapes of Central Europe: an interdisciplinary research training programme

85. SULTANA: Steps to reveal a general pattern in species diversity along gradients of urbanization across continents

86. TAJCHMAN et al.: Wildlife - vehicle collisions in urban area in Lublin

87. TORRETTA et al.: Behind wolf predation on wild ungulates: environmental factors influencing the distribution of kill sites in Northern Italy

88. TRÖGER et al.: Distance Sampling: Population estimations of roe deer in a heterogeneous forest

89. VECCHIO et al.: Preliminary study about seasonal spatial behaviour of reared Italian hares (*Lepus corsicanus* de Winton, 1898) and reintroduced on Elba Island

90. GANTNER et al.: Researching recreational activities on different scales with GIS-based modelling – key findings of two case studies in Austria

91. RONNENBERG et al.: Causes of grey partridge (*Perdix perdix*) decline in northern Germany

92. GRÄBER et al.: Assessment of the red and roe deer population density using thermal imaging and Distance Sampling in Lower Saxony, Germany

(poster #1)

Semi-naturally bred and released to the wild Eurasian eagle owls' (*Bubo bubo* L.) migration peculiarities, experience in Lithuania

Petras ADEIKIS, Kastytis ŠIMKEVIČIUS, Renata ŠPINKYTĖ-BAČKAITIENĖ * and Gediminas BRAZAITIS

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The state of the Eurasian eagle-owl (*Bubo bubo* L.) population in Lithuania is critical. According to current data, there were around 10-20 breeding pairs of Eurasian eagle-owls (year 2011-2013) in the territory of Lithuania. To improve the aforementioned population state it was decided to breed Eurasian eagle-owls in captivity, adapt them to natural living conditions and reintroduce the young birds into the wild.

While implementing the "Lynx and Eurasian eagle-owl breeding in captivity" project in 2011 – lynx enclosures and Eurasian eagle-owl aviaries, for the purpose of breeding, were set up in five different locations across Lithuania. During the project – 45 Eurasian eagle-owls were bred in four of the five aviaries. The bred Eurasian eagle-owls were relocated into a stationary adaptation aviary that was in one of the five locations. The aviary was constructed in a remote place to avoid imprinting. The gathered bird group was kept together. The young birds were being adapted for a month – they were being fed live meat (pheasants, rabbits) to stimulate their hunting instincts. Throughout the whole period bird behaviour and hunting instincts were monitored.

32 Eurasian eagle-owls were released into the wild – they were marked with GPS-GSM transmitters. The transmitters were equipped with temperature and tension detectors, which enabled to determine whether the marked bird was alive or not. The average operating time of the transmitter, according to the technical data provided by the manufacturer, was intended to be one year. During the project birds were being released in various places throughout the territory of Lithuania. The release-points were selected according to the landscape, forest coverage, diversity and abundance of fauna as well as anthropogenic factors or the area. During the project the birds were released while using the instant-release method.

The actual operating time of the 32 transmitters was significantly different – from 4 to 718 days (149 days on average). Half of the transmitters didn't exceed two months of operating time, however, three transmitters worked significantly longer than the expected period of one year. Respectively, the longest distance travelled (1850 km) was recorded by the transmitter that worked for the longest period. It is worth mentioning that the sum of distance travelled was only partially influenced by the operating time of the transmitter – for instance, one transmitter worked approximately 3,4 times shorter (209 days), yet the distance travelled by that particular Eurasian eagle-owl was 1573 km. The distance travelled by these two particular owls was significantly greater than that of the rest, which spanned from 2,9 km to 783 km.

An interesting observation is that on average all of the owls covered 2 km a day, however, when observed individually, 15 of the monitored owls covered only up to 1 km a day, 5 of the owls covered up to 3 km a day and one owl covered 7,5 km a day.

The owl migrations were also interesting due to the fact that some owls had a tendency of directional long-distance migrating, whereas a part of individuals occupied territories where they stayed for a longer period of time – registration-point concentrations emerged at such places. It was noticed that while migrating one individual made a huge (625 km) loop and practically came back to the release spot. Three owls migrated to the neighbouring Kaliningrad Oblast, however, one of them made four migrations Lithuania – Kaliningrad – Lithuania. One owl had a registration point in the city of Kaunas (the city has around 300 000 inhabitants).

Keywords: Eurasian eagle owl, *Bubo bubo* L., semi-naturally bred, GPS-GSM transmitters, migration, Lithuania

(oral)

Working with the landowners and local stakeholders for wildlife habitats

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In densely populated Europe wildlife is under constant human influence, and the effect is greater on species that use habitat patches at landscape level and are therefore more difficult to conserve than site-specific plants and insects for example. Even in sparsely populated Finland human influence is significant almost everywhere and the future of viable and huntable game bird populations rely on areas and management of agriculture and forestry.

The management of game species and their habitats in Finland is administered by Ministry of Agriculture and Forestry. Management plans for Grouse species and habitats, the Partridge and Wetlands and Waterfowl form the basis for combined habitat and harvest management approach of game birds.

The implementation of management plans is seconded to state agencies of which Finnish Wildlife Agency is working on private lands and Parks & Wildlife Finland is responsible for state land and nature conservation areas.

The objective of the Finnish Wildlife Agency, based on its Nature Management and Conservation Strategy, is to improve the habitats of game species by implementation of management plans and related development projects in wetlands, agriculture and forestry areas. The improvement measures are always implemented in cooperation with agricultural and environmental actors, the forest industry and the landowners. First large LIFE project to implement the management plans was carried out 2010-2015.

Return of Rural Wetlands LIFE+

Finland has experienced major loss of wetlands due to drainage for agriculture and forestry. The results of the drainage have provided income for nation, but with costs for nature as degradation of habitats, water quality and flood retention services. In many places where drainage has not provided expected results the sites can be restored to compensate for the lost habitats and ecosystem services. The Rural Wetlands project was a biodiversity project targeting the nature values outside of protection programs. The focus is in waterfowl habitats and brood production of quarry ducks.

The main objectives were: 1) to inspire people to take care of home village wetlands for the benefits they provide for recreational use, such as hunting and birdwatching, water protection and landscape, and 2) to demonstrate a landowner based frame for cost-effective wildlife habitat restoration working at local level and utilizing the Finnish tradition for voluntary work. This was achieved through building a network of demonstrative wetland sites with landowners and by active communication, education and awareness rising to all stakeholder groups.

Total of 48 demonstrative wetlands covering 340 hectares were restored in the project. Dozens of additional sites was done by people inspired by the project examples, education events, webpage www.kosteikko.fi and active media work. Waterfowl welcomed the sites well with high brood production already in the first summers and the general interest of landowners to wetland restoration has been clearly increased.

Finland is the key breeding area of EU waterfowl. The future of viable bird populations cannot rely on protected areas only, but we need active integrated approach in the areas of agriculture and forestry. If the projects successful working model is continued in a long term, it can have a meaningful effect on waterfowl populations and wetland biodiversity at landscape level.

Many common quarry ducks are currently declining with indications that reproductive success has declined due to problems in breeding areas. Waterfowl is a shared resource, yet flyway-level harvest and habitat management schemes are only taking the first steps in Europe. In North-America hunters are funding the habitat and adaptive harvest management of waterfowl through Duck Stamp and other funding channels. For the future of European waterfowl similar approach combining sustainable harvest opportunities and funding mechanism to restore and maintain habitats along the flyway could be a potential win-win working model shared by conservationist (hunters and birding community), landowners and administration.

Keywords: ducks, wetlands, habitat restoration, hunters, landowners, wildlife management

(oral)

Non-invasive genetic sampling: a tool for wildlife management and conservation

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Non-invasive genetic sampling (NIGS) enables assessing natural populations without handling or disturbing individuals [1]. The use of this tool in wildlife management and conservation is expanding, especially for monitoring rare or elusive species [2]. Though non-invasive genetic sampling has been widely used for monitoring large carnivores [e.g.3] and ungulates [e.g.4], its application in other groups is still limited [5]. Lagomorphs, small mammals and game birds are among those groups. While commonly abundant, easier to capture and handling, and less illusive than carnivores, they can also be difficult to sample or involve rare or threatened species in which ethical problems raise. In this talk, we will illustrate the application of non-invasive genetics in wildlife management and conservation, giving a particular focus on the lagomorphs, small mammals and game birds, and discuss its advantage in monitoring programs, as well as its efficacy in detecting hybridization, assessing population density, or evaluating species range shifts under climate change.

References

[1] **Beja-Pereira, A., R. Oliveira, P.C. Alves, M.K. Schwartz & G. Luikart** (2009). Advancing ecological understandings through technological transformations in non-invasive genetics. *Molecular Ecology Resources,* **9:** 1279–1301.

[2] **Waits, L. & D. Paetkau** (2005). Noninvasive genetic sampling tools for wildlife biologists: a review of applications and recommendations for accurate data collection. *The Journal of Wildlife Management*, **69:** 1419–1433

[3] **Rodgers, T.W. & J.E. Janečka** (2013). Applications and techniques for non-invasive faecal genetics research in felid conservation. *European Journal of Wildlife Research,* **59:** 1–16

[4] **Silva, T.L., R. Godinho, D. Castro, T. Abáigar, J.C. Brito & P.C. Alves** (2015). Genetic identification of endangered North African ungulates using noninvasive sampling. *Molecular Ecology Resources*, **15:** 652-661.

[5] **Barbosa, S., J. Pauperio, J.B. Searle & P.C. Alves** (2013). Genetic identification of Iberian rodent species using both mitochondrial and nuclear loci: application to non-invasive sampling. *Molecular Ecology Resources,* **13:** 43-56.

Keywords: Genetic monitoring, hybridization, lagomorphs, small-mammals, game birds

(keynote)

Predator – prey interactions in human dominated landscapes

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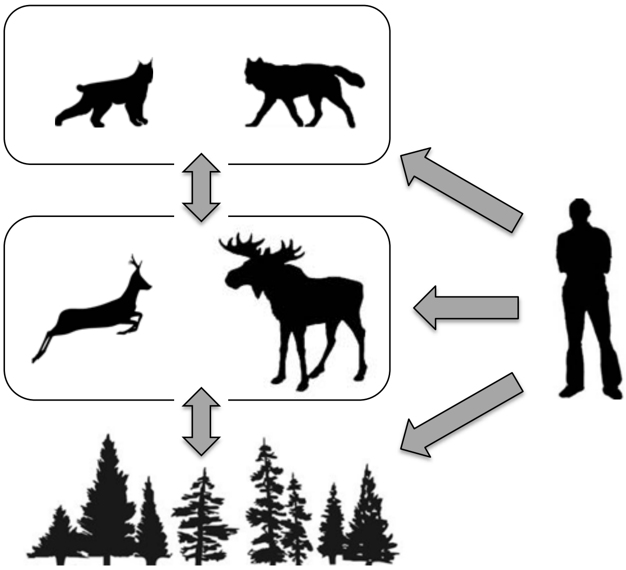
Classical predator - prey models usually do not include the influence of humans. However, the effect of large carnivores on their prey and potential trophic cascades might be very different in human dominated landscapes. Humans can limit the number of large carnivores by predator control, and can limit the herbivores by hunting and by different land use affect the amount of forage for the herbivores.
Large carnivores return in Europe in highly human-modified ecosystems. Lynx have recolonized central Sweden and the dynamics between Eurasian lynx and roe deer can partly be described as a classical predator - prey interaction, but humans have an impact as well. The numerical response in lynx (i.e. changes in lynx abundance) depends on both roe deer density and lynx density. However, the effect on roe deer density also depends on landscape structure. The re-colonization of wolves on the Scandinavian peninsula has not caused a decline in the moose population, the main prey for wolves, because human hunting of moose has decreased to compensation for the wolf predation. Thus, in both cases human activities clearly influence the predator – prey interaction. The interactions between predator, prey and plants will be context-dependent.

Figure 1. *Predator - herbivore - plant interactions. Human can influence all levels in the system by forest management, hunting for game and control of predators.*



References

[1] **Chapron et al.** (2014). Recovery of large carnivores in Europe's modern human-dominated landscapes. *Science,* **346:** 1517 – 1519.
[2] **Kuijper, D.P.J., E. Sahlén, B. Elmhagen, S. Chamaillé-Jammes, H. Sand, K. Lone, & J.P.G.M. Cromsigt** (2016). Paws without claws? Ecological effects of large carnivores in anthropogenic landscapes. *Proc. R. Soc. B,* **283:** DOI: 10.1098/rspb.2016.1625.

Keywords: lynx, wolf, roe deer, moose, large carnivores, hunting

(oral)

Abnormally low lynx density in the SW Swiss Alps points to poaching, what targeted inquiries confirm…

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The return of large carnivores to areas from which they had been eradicated generates some turmoil within local communities, especially among farmers and hunters. Low acceptance of carnivores by residents often leads to drastic measures to eliminate them, with the perpetrators sometimes even showing off with illegal trophies. Yet, poaching and its actual effects on demography remain intrinsically difficult to evidence. We assessed lynx occurrence in the SW Swiss Alps (Valais, ca 5000 km^2) and used alternative hypothesis testing to single out the reasons for an abnormally low density.

Lynx density was assessed during four successive winters (2011-2015) by means of 102 camera traps regularly spread across the study area. With an average of only 0.32 individual per 100 km^2 of suitable habitat, lynx density in Valais appeared abnormally low for the Alps, notably compared to 2.05 individuals/100 km^2 in the nearby, connected Northwestern Prealps (Vaud, Fribourg, Bern). Four alternative hypotheses were tested that may explain a lower lynx density in Valais: H1) an insufficient camera trap network; H2) different topographical and vegetation conditions at camera trap sites that may affect trapping probability; H3, lower density of the main prey (roe deer and chamois) in Valais compared to the Prealps; and H4) poaching.

To test the effectiveness of our camera trap network (H1) we compared our density estimates with those of an independent monitoring scheme carried out on one third of our own study area during one winter, but with a 40% higher camera trap density. Site-related factors affecting camera trap capture probability (H2) were assessed by mapping and comparing the topography and vegetation conditions at the camera trap sites and correlating them with lynx photographic capture rate. Data on prey relative abundance (H3, roe deer *Capreolus capreolus* and chamois *Rupicapra rupicapra*) were collected by means of snow-tracking along 218 (Valais) and 94 (Prealps) 1-km long transects, while correcting for detection probability using N-mixture models.

The two independent survey schemes (H1) revealed similarly low lynx density, meaning that camera trap density cannot explain a lower density in Valais. Moreover, camera trap surveys revelead an abnormally high turnover of individuals in a given area from year to year, suggesting low local survival. Topographic and vegetation conditions at camera sites (H2) actually differed between Valais and the Prealps, but lynx camera trap capture probability was predicted to be even higher in the more complex topography of Valais compared to the Prealps. Relative prey abundance and potential prey biomass (H3) were again found to be higher in Valais than in the Prealps. The second and third hypotheses were thus rejected in turn. Regarding poaching (H4), inquiries among residents revealed the existence of a sophisticated network of traps in the main corridor connecting the Prealps with Valais, through which lynx are known to transit. This points to a rampant lynx poaching in Valais.

Keywords: Camera traps, lynx, predator-prey relationships, poaching, ungulate prey density

(poster #2)

Cost of being paired in males: a comparison of the behaviour of paired and unpaired male Teal prior to nesting

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Background

When the time window for breeding or female receptivity are limited but predictable in time, precopulatory mate guarding is generally favored to ensure the fathering of offspring. In birds and mammals it mostly involves the close following of a receptive female by its male partner, resulting in a strong pair bond, which may also involve agonistic interactions with competing males. Male mate guarding represents a time investment and is, therefore, traded off against other activities critical for survival. Mate guarding imposes costs, such as reduced foraging efficiency and decreased energy intake for self, which may lead to a reduction in male body mass and condition. Accordingly, males may adjust their guarding effort in response to their physical capabilities so that better quality males invest more in mate guarding than lighter or smaller individuals, since better quality males are able to afford the higher energetic costs associated with mate guarding. The advantages of mate guarding will also therefore depend on the tactics adopted by other males in the population, within a game theory framework. The study of the costs and trade-offs of mate guarding is essential for understanding the role of this behaviour from an evolutionary perspective, moreover the study of variation in mate guarding behaviour at the individual level might provide insights into the evolution of male mating tactics in migratory birds.

Mate guarding is a strategy commonly used in male dabbling ducks, from the winter paring season through the period preceding incubation. In spring unmated males are commonly observed harassing paired individuals. The consequences of these alternative mating strategies in terms of foraging efficiency has not been addressed in dabbling ducks. We compared behaviours of paired and unpaired males teals (*Anas crecca*) at 4 different locations along the flyway (Normandy in Northern France, Öland in Southern Sweden, Andøya in Northern Norway and Brånsjön in Northern Sweden, see methods in [1] for the French and Swedish sites and [2] for Andøya) from early spring to just prior to the onset of nesting.

Predictions

We hypothesised that the closer the established pairs are to their breeding grounds the more time mated males would allocate to mate guarding as compared to other activities. Unpaired males do not have to guard a mate; hence we predicted that they would allocate more time to foraging thus improving their chances of survival. They could also adopt distinct foraging methods allowing higher intake rate compared to foraging paired males. Unpaired males have to adopt an aggressive strategy to gain access to mated females. Harassment is thus expected to increase closer to the breeding grounds (compared with the early phase of spring migration), unmated males trying to copulate with females just prior to incubation time.

Results

We first found that paired and unpaired males are using similar foraging tactics, therefore probably using the same food resources. It therefore does not seem to be through the choice of the foraging tactics that the cost of breeding is occurring, but rather through the allocation of time to different activities.

During the early stage of migration in Normandy, paired males spent more time in comfort behaviours than unpaired males. At Öland no difference between paired and unpaired individuals could be observed. At Andøya, which is a late staging site, unpaired males allocated more time to foraging as compared to paired males, less to vigilance, slightly more to social interactions, less to comfort activities, and they responded more to disturbances by predators. At arrival on the breeding ground in northern Sweden paired males foraged more and displayed less vigilance behaviours as compared to unpaired males but displayed more courtship behaviours.

Conclusion

We thus found that it is at the late stage of migration that the behaviour of teals followed the mate guarding strategy. This breeding tactic imposes costs, such as reduced foraging efficiency leading to decreased energy intake. At Andøya, ducks encountered harsh weather conditions and high predator level; White tailed eagles (*Haliaeetus albicilla*) were commonly observed at all studied wetlands across this island.

We conclude that teal being an income migrant and breeder, paired and unpaired individuals have similar energetic requirements limiting the amount of energy that they can allocate to mate guarding during spring migration. Nevertheless during the last stage of migration and under high abiotic and biotic constraints males teal are allocating more energy to mate guarding. As a consequence they probably need to allocate more time to foraging on arrival at their breeding site as compared to unpaired males to replenish their body reserve, thus allocating less time to vigilance. Courtship behaviours observed on the breeding ground are also important to monopolise the mate and thus as a way to prevent paternity loss, hence we also interpreted this behaviour as part of the mate guarding strategy.

References

[1] **Arzel C., J. Elmberg & M. Guillemain** (2007). A flyway perspective of foraging activity in Eurasian Teal Anas crecca. *Canadian Journal of Zoology*. **85:** 81-91.

[2] **Arzel C. & J. Elmberg** (2015). Time use and foraging behaviour in pre-breeding dabbling ducks Anas spp. in sub-arctic Norway, *Journal of Ornithology*. **156(2):** 499-513.

Keywords: pairing status, cost, teal, strategy, migration, spring

(oral)

Age-dependent breeding performances of a reinforced bird population in the wild

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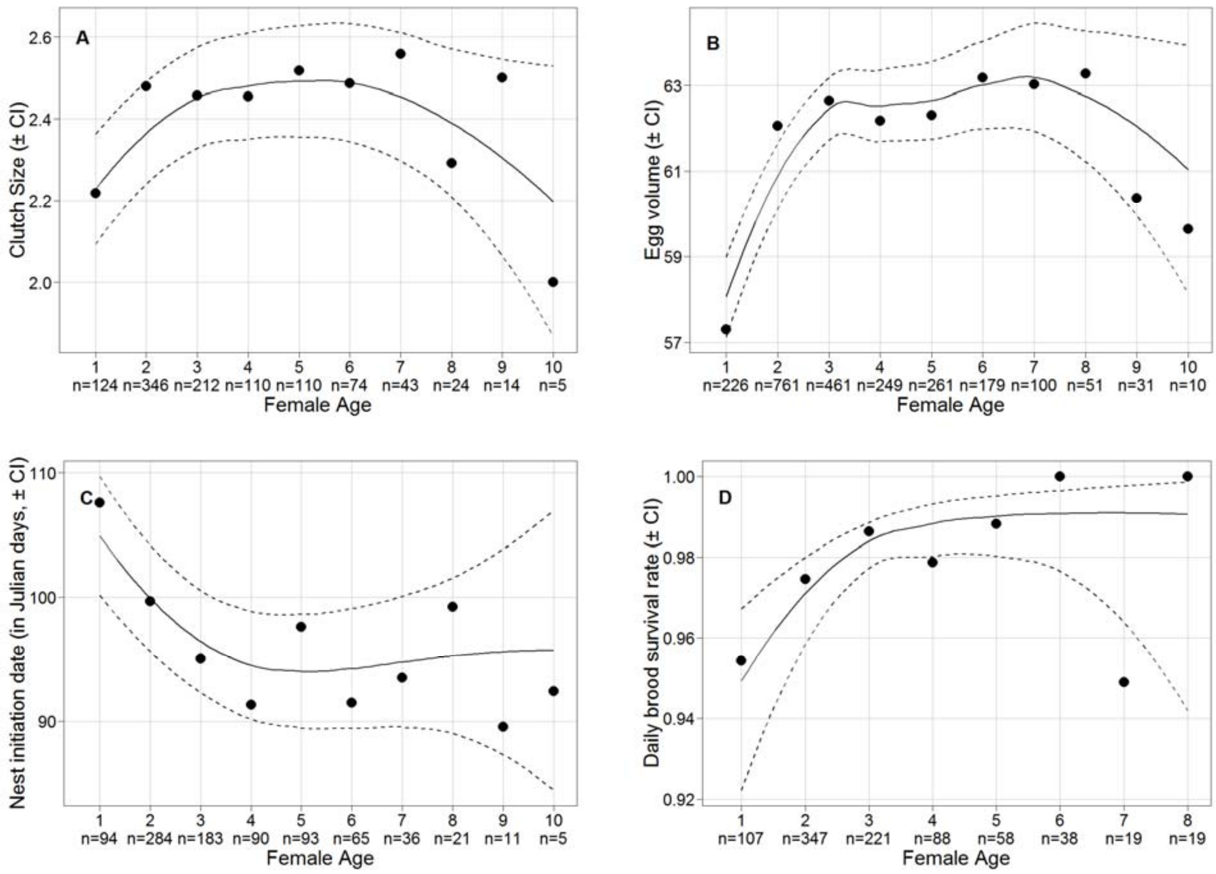
Knowledge on age dependence patterns in fitness related parameters in the wild has major implications in evolutionary ecology [1] as well as potentially strong influence on population dynamics assessments [2]. Recently, projections from population viability models have been shown to be highly sensitive to the integration of age effects [3]. Improving our understanding of age dependent demography is therefore essential in conservation, especially for small endangered populations and translocated populations [4].

Based on a 14 years nest survey of a North-African Houbara bustard (*Chlamydotis undulata undulata*, hereafter Houbara) population reinforced in Morocco, we investigated how breeding performances of captive born females nesting in the wild were varying depending on their age. In total we identified 781 females, from 1 to 10 years of age, on 1094 nests. We examined how age influenced the nest initiation date, clutch size, egg volume, daily nest survival and brood survival. In addition we investigated if age dependent patterns varied according to environmental conditions (seasonal precipitation and temperature).

Most breeding parameters (at the exception of the daily nest survival) consistently exhibited variations suggesting an increase of breeding performances with age in young females (between 1 and 3 years of age, fig 1). In older females (older than 7-8 years old), egg volume and clutch size, which are strongly related to physiological processes [5], also revealed a marked age related decrease, in agreement with theoretical expectations from senescence theories [6,7] and previous empirical results obtained in Houbaras in captivity [8,9]. Finally, our analysis uncovered a significant interaction between age and environmental conditions (amount of precipitation during the breeding season) on clutch size. In young females, clutch size was similarly small in rainy and dry breeding seasons, while the clutch size of mid-age (4-7 years old) females was significantly higher in favorable, rainy breeding seasons only.

Overall, our study revealed that individual age is a significant component of demographic heterogeneity for captive bred Houbara in the wild. Those results will give valuable insights for implementing age dependencies in upcoming population viability projections.

Figure 1. *Generalized Additive Mixed Model predictions (lines and dashed lines for± 95%) and observed averaged (points) of the clutch size (A), egg volume (B), nest initiation date (C) and daily brood survival rate (D) as a function of the age of the nesting female.*



References

[1] **Charmantier, A., C. Perrins, R.H. McCleery & B.C. Sheldon** (2006). Quantitative genetics of age at reproduction in wild swans: Support for antagonistic pleiotropy models of senescence. *PNAS*, **103:** 6587–6592.

[2] **Chantepie, S., C. Teplitsky, S. Pavard, F. Sarrazin, B. Descaves, P. Lecuyer & A. Robert** (2016). Age-related variation and temporal patterns in the survival of a long-lived scavenger. *Oikos,* **125:** 167–178.

[3] **Robert, A., S. Chantepie, S. Pavard, F. Sarrazin & C. Teplitsky** (2015). Actuarial senescence can increase the risk of extinction of mammal populations. *Ecological Applications*, **25:** 116–124.

[4] **Sarrazin, F. & S. Legendre** (2000). Demographic Approach to Releasing Adults versus Young in Reintroductions. *Conservation Biology*, **14:** 488–500.

[5] **Christians, J.K.** (2002). Avian egg size: variation within species and inflexibility within individuals. *Biological Reviews*, **77:** 1–26.

[6] **Forslund, P. & T. Pärt** (1995). Age and reproduction in birds — hypotheses and tests. *Trends in Ecology & Evolution*, **10:** 374–378.

[7] **Kirkwood, T.B.L. & S.N. Austad** (2000). Why do we age ? *Nature*, **48:** 233–238.

[8] **Chantepie, S., A. Robert, G. Sorci, Y. Hingrat, A. Charmantier, G. Leveque, F. Lacroix & C. Teplitsky** (2015). Quantitative Genetics of the Aging of Reproductive Traits in the Houbara Bustard. *PLoS ONE,* **10:** e0133140.

[9] **Preston, B.T., M. Saint Jalme, Y. Hingrat, F. Lacroix & G. Sorci** (2015). The sperm of aging male bustards retards their offspring/'s development. *Nature Communication*, **6**.

Keywords: Age, Houbara, reinforcement, reproduction, senescence, translocation

(oral)

Respiratory cryptosporidiosis: lethal and sub-lethal impacts of infection on Red Grouse, a wild gamebird of economic importance

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Respiratory cryptosporidiosis was first diagnosed in Red Grouse *Lagopus lagopus scotica* in 2010. In the next three years, respiratory infection by *Cryptosporidium baileyi* had manifested itself in Red Grouse on half the moors in northern England and 80% of moors in the North Pennine Hills. In this first account of the impact of respiratory cryptosporidiosis on the population dynamics of a wild bird we fitted 111 diseased and 67 healthy grouse with radio-transmitters at two North Pennine moors and monitored their survival and fecundity between autumn 2013 and autumn 2015. Six-month natural survival rates (excluding shooting) were 0.70 in healthy grouse, but only 0.34 in diseased birds. 39% of diseased birds died from their infection, whereas 28% of healthy birds were shot. A similar proportion of each group were killed by predators, either by Stoat *Mustela erminea* or raptors. Diseased females bred nine days later, laid clutches containing one less egg, but had similar mean egg volumes and hatching success as their healthy counterparts. Productivity was 43% lower amongst diseased than healthy birds, but was impaired only if the female was diseased, not the male. Differences in productivity were related to chick survival rather than the proportion of pairs that reared broods, with chick survival being lower in the 10 days after hatching and again when chicks were 20-50 days old. This latter period was when respiratory infection amongst chicks was first noticed and the on-set of infection may have been a contributing factor to higher mortality during this period. Described levels of respiratory infection reduced the number of birds available to shoot in the autumn by 6%, so is currently of relatively minor economic importance, but could escalate should prevalence increase. Infection is however a welfare concern and potentially a conservation concern should infection cross to other bird species occupying the same moors.

Keywords: *Cryptosporidium baileyi*, parasitic protozoan, *Lagopus lagopus scotica*, productivity, game shooting

(oral)

Post-registration field monitoring studies during drilling with imidacloprid-dressed winter cereal seeds to assess the acute risk to birds

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For the registration of a plant protection product regulatory authorities require comprehensive environmental risk assessments. First steps include desk work based on toxicological endpoints as well as theoretical exposure of the product to non-target organisms like birds. If the risk assessment under standard assumptions does not pass the required trigger more realistic higher tier assessments have to be elaborated with 'real-life data'. These may include realistic exposure assessments of birds and wild mammals to the product under field conditions as well as observations of effects/incidents and residue analysis to determine the probable cause of death if carcasses are found. Field monitoring after the authorization of the product ("post-registration monitoring") can be performed to prove the conclusion of acceptable risk or the effectiveness of risk mitigation measures in real agricultural practice. As stated in the guidance document on Birds and Mammals issued by EFSA [1], authorities may request more data to reduce uncertainty or counter this uncertainty by the implementation of specific risk mitigation measures.

In France, non-intentional acute effects of plant protection products on birds and mammals are recorded by the incident-based surveillance network (SAGIR) of the Hunting and Wildlife Agency (ONCFS). Recently, it was suggested that the observed incidences to birds from the use of imidacloprid treated seeds indicates an unacceptable risk [2,3]. Although a relatively low number of bird incidents with proven imidacloprid residues were detected (over a period of 20 years only 103 cases associated with exposure to imidacloprid from the reported 3130) compared to the cereal surfaces treated with imidacloprid each year which has increased over the years to > 2 million ha in 2014, it could be argued that the information of the SAGIR network is based on casual findings which might underestimate the actual risk to birds raising concern on the effectiveness of mitigation measures.

In 2011, the French Regulatory Agency (ANSES) assessed the registration dossier of the Imidacloprid FS 350 formulation (Gaucho® 350 or Ferial®) for an extension of use on barley seeds; ANSES concluded to an acceptable (acute) risk to birds if treated seeds are sown according to Good Agricultural Practices (Anses Opinion – dossier n°2010-0328 – Gaucho® 350) and considered bird incident recordings as accidental. Since uncertainties remained, the French Directorate General for Food (DGAL) from the Ministry of Agriculture, Agrifood, and Forestry requested a multi-annual post-registration monitoring program in order to get information *under practical conditions of use* on the efficacy of mitigation measures and get additional information on the non-intentional effects of the products on birds.

Since no guideline exists on how to implement such monitoring programs, different *complementary approaches* were therefore envisaged to get a comprehensive overview of a potential risk posed by the plant protection product and support the development of adequate stewardship actions at field level. In such context, 'intensive' and 'extensive' monitoring approaches were put in place during the drilling period of cereal seeds in the autumn seasons of 2011, 2012, and 2013 in France.

'Intensive' surveys were performed in 2011 and 2012 in different French Regions in order to determine bird exposure to imidacloprid-treated seeds by seed counting and assess potential effects on birds by repeated bird observations and carcass searches. Assessments were performed the day of the drilling (Day 0) and the following days until the fifth day by ornithologists and technicians after the cereal drilling on selected fields which correspond to the period of potential risk for granivorous birds. Compared to 2011, the intensive monitoring program of 2012 was performed in areas with high bird abundances. Forty cereal fields, freshly drilled with imidacloprid-treated seeds, were surveyed (200 surveys within 5 days after drilling). In total 16015 birds were recorded. Although cereal seeds are potential food items, there was no correlation in between bird abundances and the number of seeds which were counted on the soil surface after the drilling. Abnormal behaviors of birds like uncoordinated movement or immobilization were never observed on cereal fields in 2011 and 2012. As a result of carcass searches, only one skylark was found with a high concentration of imidacloprid in the liver leading to attribute the intoxication to the compound.

'Extensive' surveys were performed by 283 and 169 farmers in 2012 and 2013, respectively. In two years, 777 cereal fields (8905 ha) distributed in 13 French Departments were monitored by farmers who accepted to record their farming practice, assess the quality of their drilling and the non-intentional effects of imidacloprid based seed treatments on birds (by bird observations and carcass searches). Among birds visiting cereal fields sown with imidacloprid treated seeds, seven species were mainly recorded (grey partridge, wood pigeon, carrion crow, rook, skylark, starling, and lapwing). In 2012, very limited putative effects of imidacloprid treated seed use in the field were demonstrated: only 2 birds carcasses were found (one rook among 2268 observed and one grey partridge among 991 observed from quantitative estimates). Additionally, two birds showing abnormal flying behaviors were observed which may be attributed to the consumption of imidacloprid treated seeds. However, since no samples were taken for analyses from these live animals, the involvement of imidacloprid in these incidents was not proven. In 2013, only one carcass of meadow pipit (insectivore) was found dead in freshly drilled cereal fields. But, the carcass was in an advanced state of decomposition which did not allow toxicological analyses.

In general, results of this multi-annual monitoring program comply with our experience from the previous years that the use of imidacloprid treated seeds does not regularly cause bird incidents; however, accidental incidents in low numbers cannot be fully excluded. A concern in regard of bird populations and biodiversity is therefore not indicated.

References

[1] **European Food Safety Agency** (2009). Guidance Document on Risk Assessment for Birds and Mammals on request from EFSA (Sanco/10997/2009). *EFSA Journal 2009,* **7(12):** 1438 [358 pp.];

[2] **Mastain, O., F. Millot, A. Decors & P. Berny** (2011). Surveillance de la mortalité des oiseaux et des mammifères sauvages, Synthèse des cas enregistrés par le réseau SAGIR de 1995 à 2010 avec une exposition avérée à l'imidaclopride, 36 pages; https://www.google.fr/?gws_rd=ssl#q=mastain+2011+imidacloprid+mortalities

[3] **Millot, F., A. Decors, O. Mastain, T. Quintaine, P. Berny, D. Vey, R. Lasseur & E. Bro** (2016). *Environ Sci Pollut Res.,* doi:10.1007/s11356-016-8272-y

Keywords: post-registration study, monitoring, birds, imidacloprid, toxicity, seed consumption

(oral)

Evaluation of the impact of winter recreational activities on a Black Grouse (*Lyrurus tetrix*) population in the Gran Paradiso National Park

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Tourism and other outdoor activities have had a significant increase in the latest decades, causing an increasing pressure on the frail natural ecosystems, as for instance the mountain and alpine environment. Recent studies have proved that winter sports can cause stress to the wildlife. In this study we investigated the trouble caused to a population of Black Grouse (*Lyrurus tetrix*) by winter recreational activities in a ski area in Val di Rhêmes, in the Gran Paradiso National Park, Italy. As a method of quantification of the trouble we used the analysis of concentration of corticosteroids metabolites (FCM) which we extracted from fecal samples. These hormones are produced by the animals in response to disturbing events and their level shows the magnitude of the trouble. By means of subsequent statistical analysis, first of all some variables, both environmental and anthropic, which could influence this values were identified. Subsequently we identified some predictive models which could explain the results obtained by means of the laboratory analysis. As a result of this investigation it was proved that there is a positive influence of the human presence and activity on the hormonal levels of the animals, emphasizing in this way that anthropic trouble play a considerable role on the stress and well-being of the black grouse and, in general, of the whole alpine fauna. These results have important implications on the managerial and environmental policies, as they point out the necessity to reduce the impact of human activities on the wildlife in order to find a compromise between the environmental protection and the economic development of the alpine areas.

(oral)

Measuring the distributions and densities of wild mammals in Kosovo using camera traps and local hunting community engagement

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Understanding the distribution and density of wild mammals is integral to the implementation of wildlife management strategies, particularly for controlling diseases and conservation management. In Europe there are no countries that have accurate and comprehensive data on the distributions and densities of wild mammals. Recent advances in camera trap technology has led to their use with the Random Encounter Method (REM) for estimating mammal densities [1]. This study describes the data collected in a national camera trap survey and land manager survey, implemented across eleven Kosovo forest sites from 2014 to 2015 as part of the EU funded Control and/or eradication of animal diseases (DCE) project. The project was managed through a collaborative effort between the Kosovo Food and Veterinary Agency and the European Union Office in Kosovo and delivered through the engagement of local land managers including hunting associations and forest rangers. The aim of the study was to measure the distributions and abundance of medium to large wild mammals to help inform disease management and provide information on the species richness and conservation value of Kosovo forests. The study particularly focussed on the red fox (*Vulpes vulpes*) and grey wolf (*Canis lupus*) as potential vectors of rabies and wild boar (*Sus scrofa*) as a vector of Classical swine fever. These three species were found to be present at the majority of study sites at relatively high densities and were three of the most widely spread species in Kosovo. The camera survey also provided information on species of conservation concern such as the Eurasian brown bear (*Ursus arctos*) and European wild cat (*Felis silvestris*), and provided the first physical evidence of Eurasian golden jackal (*Canis aureus*) for Kosovo. This represents one of the first national camera surveys for the calculation of wild mammal densities and the findings of this study suggest that, with a moderate amount of development, camera trapping together with local community engagement can be used as an effective method to estimate national distributions and population sizes of medium to large sized wild mammals.

References

[1] **Rowcliffe, J.M., J. Field, S.T. Turvey & C. Carbone** (2008). Estimating animal density using camera traps without the need for individual recognition *J Appl Ecol,* **45:** 1228-1236 doi:10.1111/j.1365-2664.2008.01473.x

Keywords: density estimation, wild mammals, camera traps, local hunting communities, Kosovo

(poster #3)

Quantifying genetic distance between wild and captive strains of grey partridge *Perdix perdix* in France

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The grey partridge *Perdix perdix* is an important gamebird in Europe. Its numbers have dramatically declined during the XXth century together with farming intensification and increase in predation rates. As a consequence, a large numbers of hand-reared partridges are released annually in Western Europe to satisfy the hunting demand. This practice raises several concerns, among which a potential genetic introgression resulting from a hybridation between hand-reared and wild individuals. Based on mitochondrial molecular markers, such a genetic introgression has already been highlighted in *P. p. hispaniensis* [1] and in *P. p. lucida* [2] whose populations have experienced releases with hand-reared birds issued from a different subspecies. However, this conservation concern may also be raised with European western plain subspecies (*P. p. armoricana* / *P. p. perdix* – used as founders in farms) since farm birds may evolve in strains/lineages presenting some specific genetic profiles due to selection and some degree of inbreeding [3, 4].
Herein, we focus on the genetic structure of hand-reared grey partridges with regards to several French *P. p. hispaniensis* (Pyrenees) and *P. p. armoricana* (central northern France) subpopulations. Because mitochondrial markers have only a maternal inheritance and the signal of the genetic introgression is lost if wild females mate with farm males, we used molecular nuclear markers (i.e. microsatellite markers).

We sampled 605 grey partridges from 17 subpopulations in the Pyrenees and 149 from 5 subpopulations in the central northern France. We also collected 265 samples from hand-reared individuals released in the wild: 41 in the Pyrenees from two local breeders and 224 in central northern France from 13 breeders. Moreover, we integrated individuals from conservation breeding programs: 57 (F1/F2) in the Pyrenees and 11 individuals (F1) in central northern France [5]. Hence, a total of 1087 individuals was analysed using 12 microsatellites molecular markers. Through these analyses we estimated and compared genetic diversities of all sampled subpopulations (i.e. wild and farm). Moreover, we deduced also the risk of genetic introgression from the computed pairwise genetic differentiations between subpopulations.

We did not detect any significant difference in the genetic diversities between subpopulations (*i.e.* Pyrenees, central northern France; wild and farm) (heterozygotie: range=[0.232-0.944], P=0.34; allelic richness: range=[1.767-6.379], P=0.11). In contrast, Fst values combined with an AFC revealed a significant genetic differentiation between grey partridges from the Pyrenees and from the central northern France, namely between both subspecies (Fst=0.075, P=0.05). Afterwards, we use this result as a reference to interpret differences between hand-reared and wild birds. Behind this main genetic structure, we highlighted also a genetic difference between wild and farm birds. Indeed, since all farm individuals seem genetically close to those coming from wild subpopulations sampled in the central northern France, results suggest that farm individuals belong to the subspecies *P. p. armoricana*. This explains the significant genetic differentiation between captive and wild Pyrenean grey partridges (Fst=0.108, P=0.05). Within central northern France, the global genetic differentiation between farm and wild birds is lower but still statistically significant (Fst=0.026, P=0.05). This difference is however weak and varies between the wild subpopulations and the breeders that are considered (**table 1**). Besides, this observed level of genetic variability shows the same order of magnitude than the one found across wild subpopulations within the Pyrenees or central northern France. Thus, currently, in central northern France, releases of farm individuals are not prone to result in an important genetic pollution within wild populations. Based on the Fst values and their marginal positions on the AFC, the individuals from conservation breeding programs, seem to be genetically different than both wild and farm partridges (**figure 1**).

Figure 1: *Results from a factorial correspondence analysis (FCA). Circles, squares and stars represent the mean coordinates of each group of partridges on the two axes, whereas polygons show the distribution of the individual coordinates.*

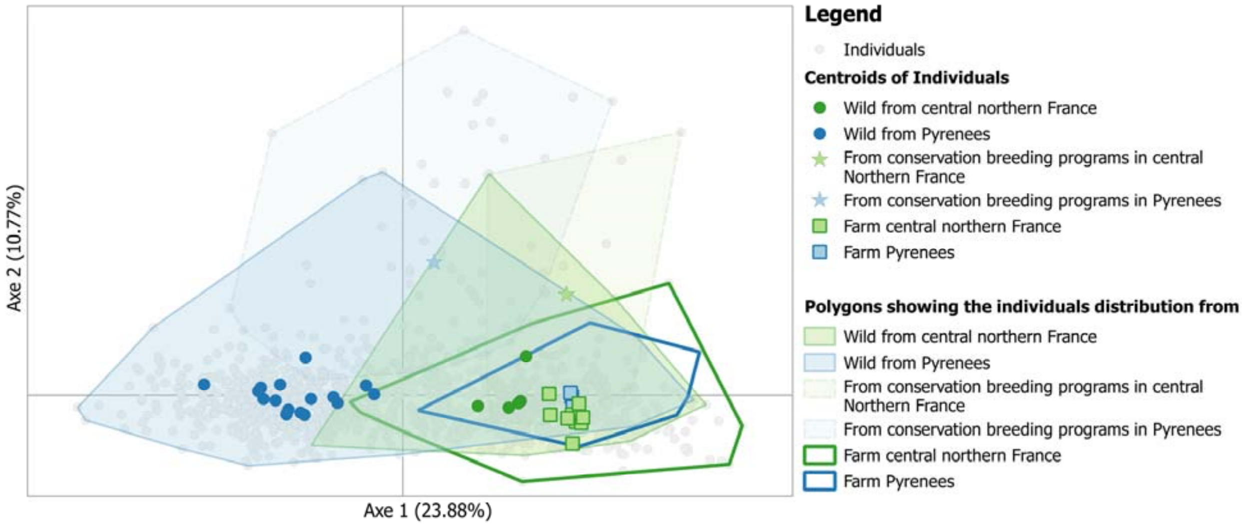

Table 2: *Below diagonal: Fst values for each pairwise populations comparison from central northern France (wild and breeder). Above diagonal statistical results (NS: non significant, *: statistically significant with a significance threshold (α=0.0001) adjusted with Bonferroni correction.*

	BP1	BP2	BP3	BP4	BP5	sauvages2014	conservatoire	09_Elvg25	09_El1_1	14-El1	14_60-El3	14_60-El4	14_35_El6	14_35_El7	14_35_El8	14_35_El9	14_41_El11	15_35_El13
BP1		*	NS	NS	*	NS	*	*	NS	*	*	*	*	*	*	*	NS	NS
BP2	0.0063		NS	NS	*	NS	NS	NS	NS	NS	NS	*	*	*	*	NS	NS	NS
BP3	0.0027	0.0138		NS	*	NS	NS	NS	NS	NS	NS	NS	*	*	*	*	NS	NS
BP4	0.0097	0.0161	0.0364		*	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
BP5	0.0218	0.0147	0.0206	0.0404		*	*	*	*	*	*	NS	*	*	*	*	NS	*
sauvages2014	0.0122	0.0082	0.0234	0.0229	0.0289		NS	NS	NS	NS	NS	*	*	*	*	*	NS	NS
conservatoire	0.0257	0.0172	0.018	0.0368	0.0273	0.0244		NS	NS	NS	NS	NS	*	*	*	NS	NS	NS
09_Elvg25	0.0304	0.0162	0.0246	0.0346	0.0093	0.0251	0.024		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
09_El1_1	0.0461	0.0284	0.0327	0.0316	0.0317	0.0371	0.0489	-0.0056		NS	NS	NS	NS	NS	NS	NS	NS	NS
14-El1	0.0186	0.0174	0.016	0.03	0.0091	0.0258	0.0301	-0.0009	0.0126		NS	NS	NS	NS	NS	NS	NS	NS
14_60-El3	0.0351	0.026	0.0329	0.0399	0.0156	0.0245	0.0301	-0.0006	0.0038	0.0077		NS	NS	NS	NS	NS	NS	NS
14_60-El4	0.0357	0.0393	0.023	0.0716	0.0133	0.0457	0.0467	0.0115	0.0465	0.0066	0.0331		NS	NS	NS	NS	NS	NS
14_35_El6	0.0264	0.0212	0.0209	0.0507	0.011	0.0351	0.0377	-0.0026	0.0179	-0.0054	0.0041	0.014		NS	NS	NS	NS	NS
14_35_El7	0.0372	0.028	0.0335	0.0511	0.0184	0.0353	0.0433	-0.0016	0.0083	-0.0024	0.01	0.0081	-0.0033		NS	NS	NS	NS
14_35_El8	0.0355	0.0191	0.0278	0.055	0.0085	0.0272	0.032	-0.0088	0.0066	0.0035	0	0.0097	-0.0043	-0.002		NS	NS	NS
14_35_El9	0.0263	0.0198	0.0267	0.0466	0.0182	0.0314	0.0233	0.0065	0.0146	-0.0001	0.0092	0.0197	0.0026	0.001	0.0056		NS	NS
14_41_El11	0.0214	0.0119	0.0161	0.0253	0.0109	0.0276	0.0287	0.0019	-0.0066	0.0001	0.0116	0.0175	-0.0009	0	0.0024	0.0005		NS
15_35_El13	0.0188	0.0171	0.0134	0.035	0.0133	0.0153	0.0272	0.0018	0.0109	0.0057	-0.0083	0.017	0.0055	0.0093	-0.0013	0.0021	-0.0094	

Our results do not show any significant difference in the genetic diversity of wild and farm partridges in the central northern France notably, demonstrating the current good breeding practices avoiding inbreeding and important genetic drift. We detected a slight but significant difference in the genetic structure between wild and hand-reared partridges. Whereas in the Pyrenees this difference reveals a risk of genetic introgression within wild population, in the central northern France, this difference seems not prone to alter the gene pool of wild birds if farm birds are released in the wild and reproduce. The difference observed between wild birds (F0) and Conservation farm birds (F1) may result from a founder-effect due to the challenges to obtain wild birds and to breed them successfully in captivity [5].

References

[1] **Martin, J.F., C. Novoa, S. Blanc-Manel & P. Taberlet** (2003). Les populations de perdrix grise des Pyrénées (*Perdix perdix hispaniensis*) ont-elles subi une introgression génétique à partir d'individus d'élevage? Analyse du polymorphisme de l'ADN mitochondrial. *Actes du Bureau des Ressources Génétiques,* **4:** 115-126.

[2] **Liukkonen, T.** (2006). Finnish native grey partridge (*Perdix perdix*) population differs clearly in mitochondrial DNA from the farm stock used for releases. *Annales Zoologici Fennici,* **43:** 271-279.

[3] **Blanc, P., P. Ledème & C.P. Blanc** (1986). Variation géographique de la diversité génétique chez la perdrix grise (*Perdix perdix*). *Gibier Faune Sauvage,* **3:** 5-41.

[4] **Liukkonen, T., L. Kvist & S. Mykrä** (2012). Microsatellite markers show distinctiveness of released and wild grey partridges in Finland. *Animal Biodiversity and Conservation,* **35:** 419-428.

[5] **Millot, F., R. Vannesson, A. Themée, T. Audibert, P. Mayot & E. Bro** (2012). Survie et reproduction de perdrix grises sauvages en captivité. Bilan de trois années à l'élevage conservatoire de l'ONCFS. *Faune Sauvage,* **296:** 10-14.

Keywords: genetic structure, microsatellite markers, *Perdix perdix*, wild birds, captive strain

(oral)

Assessment of wild boar damage in Lithuania

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Wild boar is the main object of game management in Lithuania. The high sociality, reproductive potential, adaptability, sinantrophy and other species specific features allow them adapting in the changeable environment. However, it causes a set of problems due damage to forest and agriculture and continuous increase in number. Recently, their overabundance exceeds permissible norms and cause emergency of contagious diseases in the absence of the natural predators (sparse large carnivores) and suitable climate changes. Unfortunately, quantitative population management is referred in danger of contagious diseases; the census actually is imprecise, integrated management and monitoring is missing. A methodology for the assessment of the damage caused by wild boar enables reducing damage. We aimed to assess wild boar damage caused by wild boar to agriculture and forestry, and methods of the management of wild boar population. The animal occurrence and damage on agricultural crops depending on the animal density were studied in the summer-autumn period mainly in the radius of 1 km from the forest edge. The sample belt was positioned at every 100 meters from the forest edge for all areas under agricultural crops. The size of belt unit is 0.1 ha (100 × 10 m). The number of belts depends on the length of certain plots. The intensity of the damage (such as “trampled”, “consumed” etc.) on the agricultural crops on the sample belt transects are estimated visually and by five- point system as follows (after Janulaitis and Padaiga 1983a, 1987): 0 - no damaged (intact); 1 - single damage, 5 %; 2 - less than half of all area damaged, 30 %; 3 - more than half of all area damaged, 75 %; 4 - all area is damaged, 100 %. The abundance of each agricultural crop (***A***) in their rotation, the average intensity (***I***) of the damage, the factor of the consumption (trampled, eaten away etc.), and the significance of each agricultural crop in the wild boar diet, the per cent of differently (i.e. 5, 30 or 75 %) damaged area of agricultural crops (***D***) and differently damaged (i.e. 5, 30 or 75 %) area of agricultural crops in hectares were calculated. We have assessed the effect of wild boar on the decrease in the yield of different agricultural crops using sample plots. The sample plot unit is 1 m^2. The sample plots were established directly on the belt transects where crops were differently damaged. The control plots were established on the area of intact agricultural crops. The difference between the cereal mass of the control and sample plots will allow us to calculate the amount of the trampled and consumed yield separately. This method enable to ascertain correctly the extent of the losses and predict certain preventive and precautionary means for restoration and maintenance of the balance between game animal number and the carrying capacity of their habitats. Wild boars attend the agricultural lands surrounded by forests depending on the crop rotation and animal density. Generally, one individual has rooted 1 ha in the forest and also ravaged 0.3-0.4 ha of the cereals from milky ripeness up to harvest and damages other crops yearly. The damage caused by wild boar to agriculture comprises 70-75 % (meanwhile, damage by deer amounts to 25-30 %) of total damage to agriculture. The wild boars trample, root and consume winter and summer cereals, root-crops, potatoes and damaged caraway etc.

The total annual (excepting autumn only) area of the forest litter rooted by wild boars is on average 0.4 % in the pine forests, 2.9 % in the spruce-pine forests, 0.9 % in the mixed spruce-deciduous forests and 2.4% in the deciduous forests. The damage caused by wild boars is strongly and positively related to the animal density ($r = 0.97$), including the stronger damage in winter and slightly less in summer ($r = 0.88$). If wild boar density reaches more than 100 animals per 1,000 hectares and more (e.g. up to 120/1,000 ha), wild boar visits 23-52 % of the agricultural crops within the radius of 1 km. If the density is 12 animals per 1,000 ha, wild boars attend 6 % of the agricultural crops, and when the density is only 6/1,000 ha -- 3 %. Due to the damage the wild boars considerably change the structure of the agricultural crops.

In Lithuania, foresters and game managers have dealt with a problem of the restraining and reduction of the damage by wild boars. The effective protection and decrease in losses are possible if the reasons of wild boar damage and factors necessary to improve methods of damage prediction and assessment are perfectly understood. The methodology of assessment damage caused by wild boars to agricultural crops and forests helps to make the wild boar management programme

References

[1] **Janulaitis, Z. & V. Padaiga** (1983). Some fundamentals of the damage caused by wild boar to agricultural crops]. In: *Ohotoustroistvo v specioalizirovanom lesnom hoziaistve*. Proc. Scientific Conference, Kaunas-Girionys, Nov. 1983: 43-44 (In Russian).

[2] **Janulaitis, Z. & V. Padaiga** (1984). Sustainable use of wild boar population in the South Baltic. Kaunas, 8 pp. (In Russian).

[3] **Padaiga, V.** (1996). Medžioklės ūkio biologiniai pagrindai [Biological fundamentals of the game management]. Vilnius. 212 pp. (In Lithuanian with English summary).

Keywords: wild boar, damage, forest, agricultural crops, assessment

(oral)

Are plant – ungulates interactions related to climate? Comparison of consumption indexes along elevation gradients across a latitudinal gradient of European sites

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The dramatic increase in deer densities, attributed to the extirpation of large predators [2] and changes in silviculture, agriculture and game management [5,16], is widely acknowledged. The excessive number of deer is considered a major threat on forest ecosystems, notably for stand structure and composition sustainability [13]. This issue concerns many regions worldwide as the Great Lakes region [17], Swiss and Italian Alps [7,9], Scandinavia [3] and Japan [15].

In addition to intense browsing, current forests are also threatened by global warming that affects forest community composition, tree species phenology and their distribution [1,8,10,11]. However, the relative impacts of browsing and global warming are very difficult to isolate from those of other variables [4,6] and little Is known about their potential interactions. In fact, if climate has been shown to strongly modulate insect herbivory [14], the relations between climate and ungulate browsing are still poorly understood.

This study thus aimed at filling this gap by comparing ungulate browsing pressure on forest regeneration under contrasted climates. More precisely, we tried to assess the effect of climate and herbivory by ungulates on the growth of the current year.

To do so, we used a consumption index (CI) as an indicator of browsing pressure exerted by ungulates on saplings of various tree species. This CI was measured in 9 sites along a European latitudinal gradient (from Spain to Sweden) at different elevations (Fig 1). We tried to assess the relative effects of climate and phenology on the CI, taking into account the ungulate species present on the site, and their estimated densities. To achieve this, we used respectively meteorological data of the sites, normalized difference vegetation index (NDVI) as an estimator of phenology, and a semi-quantitative index of ungulate densities that is categorized in 3 classes according to the amount of faeces. We tested whether:

H1: browsing intensity (taking into account the densities) differed between sites

H2: if so, the negative impact of ungulate browsing on tree regeneration was stronger in productive sites with low water and temperature stress (mid latitude)

H3: the difference of browsing intensity between sites is related to plants defensive strategies.

Figure 1: *the European gradient of sites. (Source: Rabasa et al., 2013)*

References

[1] **Bertrand, R., J. Lenoir, C. Piedallu, G. Riofrio-Dillon, P. de Ruffray, C. Vidal, C., et al.** (2011). Changes in plant community composition lag behind climate warming in lowland forests. *Nature,* **479:** 517–520.

[2] **Breitenmoser, U.** (1998). Large predators in the Alps: The fall and rise of man's competitors. *Biol. Conserv.,* **83:** 279–289.

[3] **Edenius, L., G. Ericsson, G. Kempe, R. Bergström & K. Danell** (2011). The effects of changing land use and browsing on aspen abundance and regeneration: a 50-year perspective from Sweden. *J. Appl. Ecol.,* **48:** 301-309.

[4] **Fisichelli, N.A., L.E. Frelich & P.B. Reich** (2013). Climate and interrelated tree regeneration drivers in mixed temperate–boreal forests. *Landsc. Ecol.,* **28:** 149–159.

[5] **Van Hees, A.F.M., A.T. Kuiters & P.A. Slim** (1996). Growth and development of silver birch, pedunculate oak and beech as affected by deer browsing. *For. Ecol. Manage.,* **88:** 55–63.

[6] **Heuzé, P., A. Schnitzler & F. Klein** (2005). Is browsing the major factor of silver fir decline in the Vosges Mountains of France? *For. Ecol. Manage.,* **217:** 219–228.

[7] **Kupferschmid, A.D., U. Wasem & H. Bugmann** (2014). Light availability and ungulate browsing determine growth, height and mortality of Abies alba saplings. *For. Ecol. Manage.,* **318:** 359-369.

[8] **Morin, X., J. Roy, L. Sonié & I. Chuine** (2010). Changes in leaf phenology of three European oak species in response to experimental climate change. *New Phytol.,* **186:** 900–910.

[9] **Motta, R.** (2003). Ungulate impact on rowan (*Sorbus aucuparia* L.) and Norway spruce (*Picea abies* (L.) Karst.) height structure in mountain forests in the eastern Italian Alps. *For. Ecol. Manage.,* **181:** 139–150.

[10] **Penuelas, J. & M. Boada** (2003). A global change-induced biome shift in the Montseny mountains (NE Spain). *Glob. Chang. Biol.,* **9:** 131–140.

[11] **Piedallu, C., V. Perez, J.C. Gégout, F. Lebourgeois & R. Bertrand** (2009). Impact potentiel du changement climatique sur la distribution de l'Epicéa, du Sapin, du Hêtre et du Chêne sessile en France. *Rev. For. Française,* **LXI :** 567–593.

[12] **Rabasa, S.G., E. Granda, R. Benavides, G. Kunstler, J.M. Espelta, R. Ogaya et al.** (2013). Disparity in elevational shifts of European trees in response to recent climate warming. *Glob. Chang. Biol.,* **19:** 2490-9.

[13] **Rackham, O.** (2008). Ancient woodlands: Modern threats. *New Phytol.,* **180:** 571–586.

[14] **Rasmann, S., L. Pellissier, E. Defossez, H. Jactel & G. Kunstler** (2014). Climate-driven change in plant-insect interactions along elevation gradients, *Funct. Ecol.,* **28:** 46–54.

[15] **Takatsuki, S.** (2009). Effects of sika deer on vegetation in Japan: A review. *Biol. Conserv.,* **142:** 1922–9.

[16] **Waller, D.M. & W.S. Alverson** (1997). The white-tailed deer: a keystone herbivore. *Wild. Soc. Bull.*, **25:** 217–226.

[17] **Waller, D.M., S. Johnson, R. Collins & E. Williams** (2009). Threats posed by ungulate herbivory to forest structure and plant diversity in the Upper Great Lakes Region-with a review of methods to assess those threats., Nat. Resour. Rep. NPS/GLKN/NRR2009/102, US Dep. Inter. (2009).

Keywords: Ungulate browsing, latitudinal gradient, elevation, consumption index, phenology, climate variability

(oral)

The reproductive biology of Rock partridge (*Alectoris graeca saxatilis*) in the southern French Alps: first evidence of double nesting behaviour

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Breeding system of *Alectoris* partridges is of peculiar interest because of the potential occurrence of double nesting within the same breeding season: double nesting refers to females laying two successive clutches in two different nests without interruption. When both clutches are laid, the first one is incubated by the male and the second one by the female. If this behaviour has already been demonstrated in Red-legged partridge *Alectoris rufa rufa*, its existence remained unknown in Rock partridge *Alectoris graeca saxatilis* until now. The rock partridge population of Dévoluy, in the southern French Alps, inhabits open mountainous habitats with relatively short breeding seasons constrained by date of snowmelt and spring temperatures. Occurrence of double-nesting behaviour could be highlighted for the first time thanks to radiotelemetry of radio-equipped birds. Reproductive behaviour of 61 birds were monitored thoroughly during breeding seasons 2012 to 2016, to record data about breeding phenology, clutch size, hatching success, nest survival and parental care. Owing to the tagging of both partners of 14 pairs in 2015-2016, we examined characteristics of double nesting behaviours, in particular between-sex differences in breeding parameters.

Participation of males in incubation begins at subadult age and was fairly similar for males and females. Proportion of males incubating was high, amounting 77 %. Clutch size was larger for nests incubated by males than by females. The overall apparent nest success of 48 nests was 52 % and fell to 44 %, if we consider that all females attempted to nest. Male nest survival (0,37) tended to be less than female nest survival (0,62), although not significantly, possibly because of a low sample size. Mammal predation on eggs was the major source of nest failure.

Male or female uniparental care of chicks predominated at least during the 3 weeks after hatching and sometimes even longer.

The reproductive biology of Rock Partridge contrasts in some breeding traits (phenology, clutch size, between-sex nesting survival) with congeneric populations of Red-legged and hybrid populations. Such contrast might be due to climatic differences between (low *vs.* high elevations) habitats occupied by both species. However the behavioural features of double-nesting are similar between species. Some hints suggest that occurrence of double-nesting behaviour could depend on previous winter and spring weather conditions influencing body condition of females. Future studies are needed to support this hypothesis.

Finding of double nesting in Rock partridge population suggest that climatic constraints inherent to its environment did not act as an impediment to emergence of double nesting behaviour. Breeding system might have been constrained more by habitat or food availability than by time.

Keywords: breeding, double clutching, parental care, French Alps, rock partridge, *Alectoris graeca saxatilis*

(poster #4)

A single multiplex of twelve microsatellite markers for the simultaneous study of the brown hare (*Lepus europaeus*) and the mountain hare (*Lepus timidus*)

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The management of hunted species is challenging, as it must conciliate the conservation of species and their sustainable exploitation. Non-genetic tools are widely used in this context but they may present limitations notably when species can hybridize or when large-scale spatial monitoring is required to establish optimal management actions. This is why genetic tools have been more and more integrated in wildlife management practices. However, the markers proposed are often amplified in small multiplexes when larger ones could allow to better cope with the small quantities of DNA obtained with non-invasive sampling methods. Here, we propose a unique multiplex of 12 autosomal microsatellite markers for the study of two hare species that exist in sympatry in some areas in Europe and are hunted notably in France: the brown hare *Lepus europaeus* and the mountain hare *L. timidus*. We tested 17 markers previously used in these two species or other lagomorph species, from which 12 were included in this single multiplex. Diversity was between 4 and 30 alleles per locus totalling 126 alleles and we showed that these markers possess appropriate genetic resolution for individual and species identification for the populations under study. This multiplex panel represents the largest number of microsatellites amplified in one reaction proposed for these two hare species and provides a cost-effective and valuable tool for further hybridization studies and the management of hares.

Figure 1: *Geographical locations of sampling areas. Grey circles and white triangles represent brown and mountain hares, respectively.*

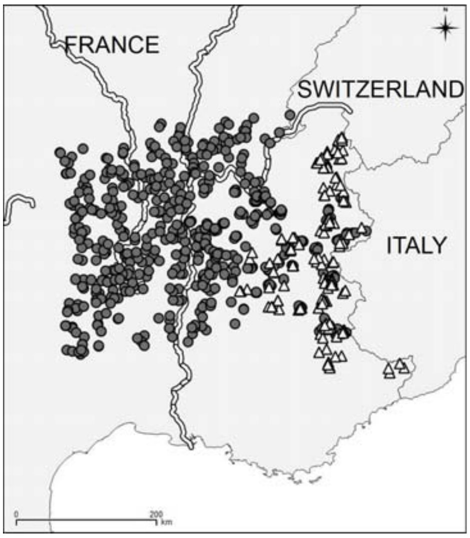
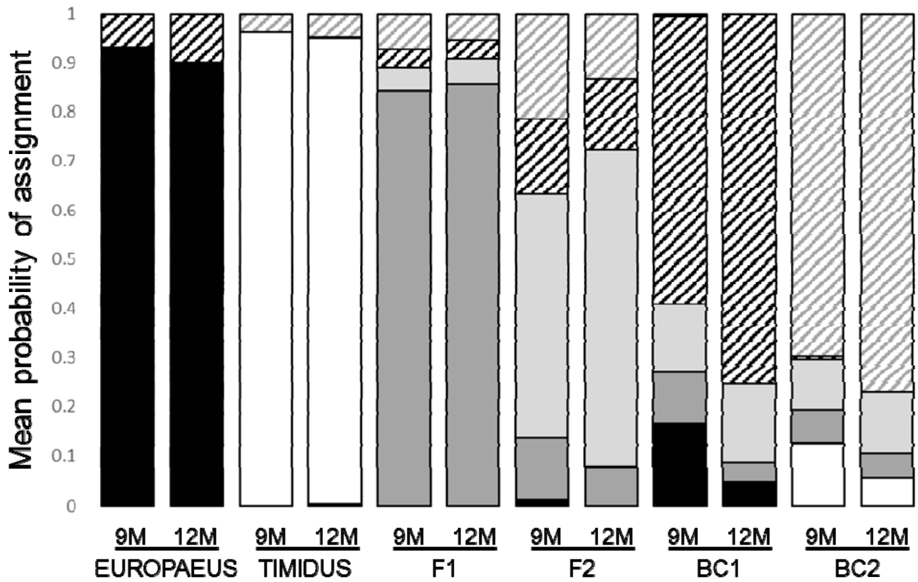


Figure 2: *Mean probability of assignment of each simulated categories to the six parental and hybrid classes tested with NEWHYBRIDS. Both results obtained with the whole microsatellite panel (12M) and the reduced panel of 9 markers (9M) are represented. Black bars represent brown hares, white bars mountain hares, dark grey stands for F1, light grey for F2, black stripes for F1*brown hare and grey stripes for F1*mountain hare.*



Keywords: Species identification, hybridization, hare species, microsatellites, individual identification

(poster #5)

Factors influencing hunter success for small games in the province of Québec, Canada

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Harvest statistics are frequently used by wildlife managers as an index of population changes and may provide valuable information about fluctuations of some grouse species [1,2]. However, the strength of the relationships between harvest statistics and populations abundance may vary among game species and the validation of some underlying assumptions is necessary before using harvest records as a proxy of population trends [3]. In Québec, bag statistics for some territories are available and could be used as indicators of provincial or regional population trends. Before using hunting statistics, managers need to identify the factors that could influence hunter success to better explain annual trends. The aim of this study is to investigate factors that influence hunter success for the most popular small games in Québec. Specifically, the objective is to model annual hunter success (i.e. harvest / hunter-day) for two forest grouses (Ruffed grouse *Bonana umbellus*, and Spruce grouse *Falcipennis canadensis*) and for snowshoe hare (*Lepus americanus*). Different examples of delegated management of hunting activities occur in Québec public land. The Zones d'exploitation contrôlées (ZECs) are managed by volunteers grouped in a non-profit corporation, and are responsible for ensuring that the general public also has access to the territory [4]. The Réserves fauniques (RFs) are managed by a governmental agency which makes sure that general public has access to the territory for fishing and hunting activities. In these two types of territories, hunters must report daily bag records by species or group of species (e.g. « grouses »). We used statistics of bag records from 1984 to 2014 (annual harvest and hunting – days) from 62 ZECs (mean area = 760 km^2) and 13 RFs (mean area = 2 836 km^2) totalling 88 546 km^2, (figure 1). We used harvest bag of forest grouses (ruffed and spruce grouse together) and harvest bag of snowshoe hare as dependent variable. We investigated factors influencing hunter success using generalized linear mixed models (GLMM) with years nested in the territory ID as random effects. Independent variables were chosen based literature review and our knowledge of the ecology of the species studied. They included indices of predation risk, harshness of weather conditions, forest composition, and characteristics of the hunting territory. Since our objective was to determine the model with the best predictive power possible, we used backward stepwise selection method that consists in removing the least significant variable with $P > 0.05$ among those available for modeling. To limit the initial number of variables and the occurrence of spurious results, we pre-selected variables to be included in the modelling procedure by removing those variables that were found to be poorly related (i.e., $P > 0.25$) to the dependent variables using a univariate analysis ($P < 0.25$). The final model of forest grouse hunter success had a good fit ($R^2 = 0.63$). Grouse hunter success was influenced by territory type (figure 2), being higher in RFs than in ZECs. We found a positive relationship between hunter success and the territory area, the proportion of forest being 40 to 60 years old, the mean temperature in June of the year during which harvest took place and the density of mesocarnivors trapped in the territory. Grouse hunter success was, however, negatively influenced by hunting pressure (no. hunting days / km^2) and its quadratic term and a Shannon diversity index of forest stand types. The final model of snowshoe hare hunter success also had a good fit ($R^2 = 0.67$). Hunter success was significantly influenced by territory type but, unlike for forest grouses, it was higher in ZECs than in RFs (figure 2). Snowshoe hare hunting success was positively related to the proportion of young forests (0-40 years old) and negatively related to the proportion of old forests (> 60 years old), road density (km / km^2), hunting pressure, and the density of mesocarnivors (no. / km^2) trapped the year before harvest took place. Our results confirm that hunter success results from a complex process and is influenced by various factors ranging from habitat, weather conditions, density of predators, hunting intensity and management regime. We discuss different hypotheses that could explain these results and propose avenues to provide managers with tools before they use hunter success as a proxy of forest grouse or snowshoe hare population trends.

Figure 1 : *Localisation of ZECs and RFs in the Southern Québec province, Canada.*

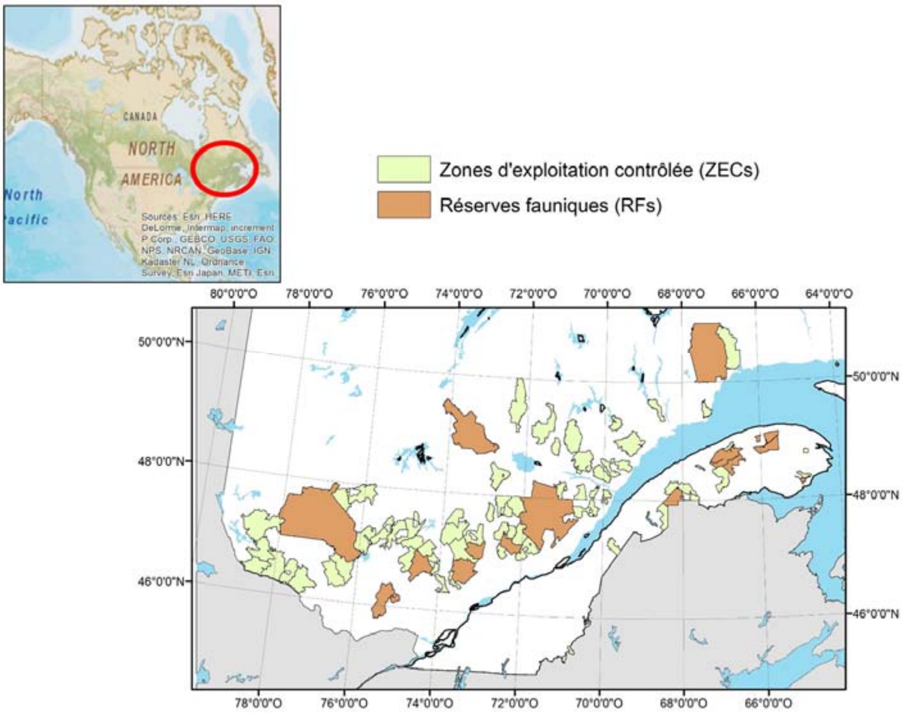
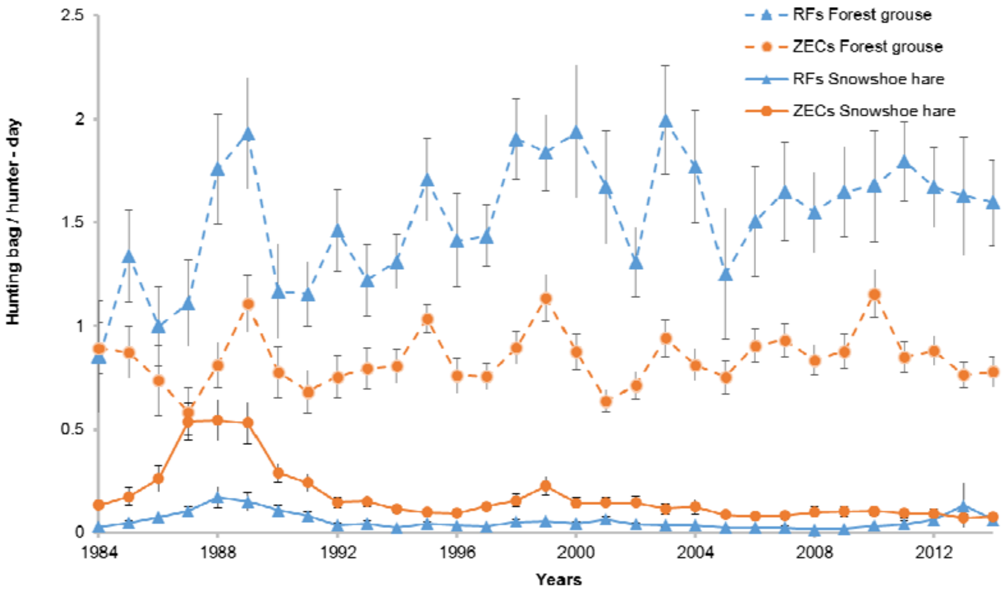


Figure 2 *: Forest grouses and snowshoe hare hunter success from 1984 to 2014 in the ZECs and RFs, Québec, Canada. Bars are standard errors.*



References

[1] **Cattadori, I.M., D.T. Haydon, S.J. Thirgood & P.J. Hudson** (2003). Are indirect measures of abundance a usefull index of population density? The case of red grouse harvesting. *Oikos,* **100:** 439-446.

[2] **Lande, U.S., I. Herfindal, M.H. Finne & L. Kastdalen** (2010). Use of hunters in wildlife surveys : does hunter and forest grouse habitat selection coincide? *Eur. J. Wildl. Res.,* **56:** 107-115.

[3] Kahler, J., A.D. Fox, H. Heldjerbg, T. Asferg & P. Sunde (2015). Functional responses of human hunters to their prey – why harvets statistics may not always reflect changes in prey population abundance. *Wildl. Biol.,* **21:** 294-302.

[4] **Pearse, P.H. & J.R. Wilson** (1999). Local co-management of fish and wildlife: The Quebec experience. *Wildl. Soc. Bull.,* **27:** 676-691.

Keywords: hunter success, *Bonasa umbellus*, *Falcipennis canadensis*, *Lepus americana*, monitoring, Québec

(oral)

Individual variation in stress response in Roe deer

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In predator-prey interactions, predators affect the demography of their prey directly through predation (lethal effects), but also through risk effects (i.e. indirect and non-lethal effects of predation risk) because prey adopt costly behavioural responses to avoid or reduce exposure to predators. Although these risk effects are common and often have greater impact than lethal effects, they are rarely considered. We studied the indirect effects of risk and their impact on individual fitness by investigating the behavioural and physiological responses to a stressful capture event of 320 roe deer (Capreolus capreolus) in two wild populations in Sweden. The roe deer is a highly flexible species and the most common ungulate in Europe, and is intensively predated and hunted in most countries, and thus represents a good study model for such questions. Our results showed a marked decrease in the levels of struggling (intensity of behavioural response) and cortisol (stress hormone) with the number of captures, suggesting a high level of behavioural and physiological habituation to repeated stressful events. Despite this clear general pattern, our results also showed high among-individual variability in the intensity of response and the degree of habituation to stress. Indeed, the levels of struggling and cortisol were both highly repeatable, suggesting that these responses represent personality traits. The manner an individual copes with a stressful event also appeared to be correlated to individual survival. Such evidence of among-individual differences in the stress response and their consequences for individual fitness are particularly rare in wild populations.

(oral)

Monitoring mountain hares (*Lepus timidus*) population by collecting faeces in winter. Developing management tools in the Ecrins national park

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The mountain hare (*Lepus timidus*) shows an artic-alpine distribution. It is abundant in the north of the Palaearctic inducing that most of the scientific literature focus on this part of its distribution. In the Alps, studies are far scarcer, and if its ecology and behavior are fairly well known, no demographic studies has been conducted up to now.
In the context of global warming, it is suspected that this game species will suffer from a reduction of its habitats and from an increasing competition with the European hare (*Lepus* europaeus) from a spatial but also from a genetic point of view through introgression.

Since 2011, the development of genetic markers had allowed the identification of individuals through collection of faeces in the field. Since 2013, the Ecrins National Park has started developing a protocol for collecting faeces during winter season in order to estimate the population sizes of the studied areas through non-capture- recapture approaches. The winter collection has many advantages compare to sping or summer ones: snowfalls ensure the independence of collecting from sessions to sessions as it clear the field and allow to date faeces deposition, cold conserves the DNA (95% of the samples were successfully identified), faeces are easier to detect. Outside the breeding season, population are more likely to be considered as closed (no reproduction), a situation that Capture-recapture models to estimate population-size simpler. This method appears non-invasive, reliable and repeatable. Using classical as well as spatially-explicit capture-recapture models, our results indicate numbers varying between 10 and 23 different mountain hares depending on the studied area, corresponding to densities estimated between 0.6 and 1.7 animals per square kilometer. It is still too early to note a demographic trend. Inspite of population size, this method provides information about :
- cohabitation between mountain and european hares. For instance in 2016 an individual of european hare is detected in winter between 1900 and 2400 m altitude for the first time,
- use of space in winter: individuals seems non-territorial but appears relatively confined throughout the winter (polygons observed up to 190 ha) and seems faithful to these areas from year to year. It is quite ubiquitous (forest, alpine pastures, sparse wood...) but it is absent from some very open areas.
- using several years of monitoring and robust-design capture-recapture methods local survival rates were estimated to 0.5-0.6. The local populations are on average renewed by half each year and the life span can exceed 4 years.

Next step is to enroll more partners to enlarge the geographic scale of monitoring and to standardize estimating method in order to compare density.

(oral)

Red deer abundance drives the establishment of wolves in the Western Swiss Alps

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Wolves recolonizing the human-dominated landscapes of Central Europe generate some turmoil among local communities, especially among sheep breeders and hunters. Yet, settlement decisions of the spreading wolves remain largely unknown. We hypothesided that wolves would settle in priority in areas where red deer abound because this large-sized ungulate is likely to represent the most optimal prey for wolf packs in Central European mountain ecosystems.
Data on wolf's potential wild prey (red deer *Cervus elaphus*, roe deer *Capreolus capreolus*, chamois *Rupicapra rupicapra,* ibex *Capra ibex* and wild boar *Sus scrofa;* but the latter two species did not yield sufficient data for modelling) were collected from snow track surveys along 218 1-km long transects scattered across our study area in the SW Swiss Alps (Valais, ca 5000 km^2). Each transect was surveyed twice between December and March during 4 winters (2012/13 – 2015/16). Using N-mixture and generalized linear models, we predicted ungulate relative abundance, corrected for detection probability, throughout the study area. These modelled prey relative abundance and estimated biomass, as well as several other environmental predictors, were spatially related to ascertained wolf observations (genetic identification, camera traps) in order to model wolf's habitat selection pattern.
Red deer relative abundance (corrected for probability of detection) increased slightly during the study period, while relative abundance of roe deer and chamois showed small non-directional variation. Furthermore, all three species showed only slight spatial fluctuations. Red deer relative abundance was by far the most important predictor of winter wolf occurrence (24.6% contribution), followed by a low amount of winter precipitation (15.8%) and distance to lakes (14.6). Roe deer and chamois relative abundance contributed much less, with 10.3 and 3.2%, respectively.
These results corroborate our initial prediction that the relative abundance of wolf's most profitable prey locally (red deer) is the key driver of their ongoing settlement in the Northern Alps. The resulting spatial projection for wolf occurrence allows anticipating areas of future population installation, where human-wildlife conflicts are likely to arise, i.e. were classical sheep-protection measures should be deployed.

Keywords: Camera traps, large carnivores, predator-prey relationships, recolonization, snow tracking, spatial modelling, ungulate densities

(keynote)

Pesticides and farmland Galliformes: new concerns for an old issue? *Overview and perpectives of research*

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My talk will aim to provide an overview of ecotoxicological concerns with regard to the use of plant protection products (hereafter "pesticides") on farmland birds – focusing on Galliformes –, sharing my experience on this topic based on my own & colleagues research, as well as works carried out by teams in other institutes. The ultimate objective will be to i) highlight gaps of knowledge and draw some perspectives of research, and ii) stimulate new studies and international collaborations on this issue.

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Many farmland birds are declining as a result of various threats, with habitat changes and farming practices still being important drivers [1]. Non intentional effects of pesticides on non target wildlife have the potential to contribute to this decline, as suggested by some field works [2-4]. However, tracking such effects at a population level remains a challenge [5-6] and further comprehensive works are required, associating field surveys [7-11], semi-natural and lab experiments [12-16], and modelling [15, 17-18].

Non intentional effects of pesticides have been studied for a long time, but concerns have evolved with the physico-chemical, biological and ecotoxicological properties and modes of action of active substances [19].

In the past, many insecticides and herbicides were highly hazardeous for Galliform species (DL_{50} < 30 or even 5 mg/kg bw) [21-22]. However, a causal link between death and exposure to substances has not been formally demonstrated in operational conditions due to the lack of benchmark liver concentration - response data. Most of these substances are prohibited today and, except for some specific chemicals [8, 23], most of the ones currently used are not judged to have unacceptable adverse effects on bird survival according to their hazard (DL_{50} / CL_{50}, $HD_{5\%}50$, NO(A)EL) and/or ecological risk (acute and short term Toxicity-to-Exposure Ratio) [15, 19]. Nowadays, there are particular concerns about sub-lethal effects of chronic exposure on behaviour, immunity and body condition, and reproductive success, and would require in-depth studies using realistic field exposure conditions (*i.e.* "the true world") [12-14, 25]. Effects on the breeding success may occur indirectly through a reduction in food abundance [7, 26], but also directly through oral, air or contact contamination. In this case, reproductive disorders may be potentially as diverse as anomalies in courtship behaviour or in gonad anatomy; a decrease in chick production rate through reduced clutch size, clutch abandonment, reduced fertility, teratogenicity; reduced chick survival and poor chick condition [13-14, 24-25]. Despite contamination of breeding birds and their eggs indeed occur in the field [8, 10, 15], such effects are globally poorly documented – thorough studies are only available at this time for a small number of active substances and bird species [e.g. 12-14, 24-25]. Additional works are therefore needed to consolidate the results, including:

- a characterisation of contaminations in the field through residue analyses, with regards to the environmental fate of substances and their metabolism in birds;
- an assessment of contamination effects on individuals, screening a diversity of endpoints;
- the identification of route(s) of exposure and risk factors;
- an evaluation of population level effects through modelling studies, or large scale correlative analyses between bird demographic parameters or population trends and pesticide use;
- the development of global bird risk assessment rankings of active substances, integrating an array of biological and toxicological endpoints.

This knowledge would be highly valuable for regulatory authorities to efficiently guide their efforts to reduce the risks related to pesticide use for Humans, Wildlife and the Environment (OneHealth concept).

References

[1] **BirdLife International** (2015). European red list of birds. Luxembourg: Office for official publications of the European Communities. doi:10.2779/975810

[2] **Hallmann, C.A., R.P. Foppen, C.A. van Turnhout, H. de Kroon & E. Jongejans** (2014). Declines in insectivorous birds are associated with high neonicotinoid concentrations. *Nature*, **511:** 341-343.

[3] **Mineau, P. & M. Whiteside** (2013). Pesticide acute toxicity is a better correlate of U.S. grassland bird declines than agricultural intensification. *PLoS One,* **8:** e57457.

[4] **Geiger, F., J. Bengtsson, F. Berendse *et al.*** (2010) Persistent negative effects of pesticides on biodiversity and biological control potential on European farmland. *Basic Applied Ecology,* **11:** 97-105.

[5] **Hill, J.M., J.F. Egan, G.E. Stauffer & D.R. Diefenbach** (2014). Habitat availability is a more plausible explanation than insecticide acute toxicity for U.S. grassland bird species declines. *PLoS One,* **9:** e98064.

[6] **Köhler, H.R. & R. Triebskorn** (2013). Wildlife ecotoxicology of pesticides: can we track effects to the population level and beyond? *Science*, **341:** 759-765.

[7] **Rands, M.R.W.** (1985). Pesticide use on cereals and the survival of grey partridge chicks: a field experiment. *Journal of Applied Ecology,* **22:** 49-54.

[8] **Millot, F., A. Decors, O. Mastain, T. Quintaine, P. Berny, D. Vey, R. Lasseur & E. Bro** (2017). Field evidence of bird poisonings by imidacloprid-treated seeds: a review of incidents reported by the French SAGIR Network from 1995 to 2014. *Environmental Science and Pollution Research,* **24:** 5469-5485.

[9] **Turaga, U., S.T. Peper, N.R. Dunham, N. Kumar, W. Kistler, S. Almas, S.M. Presley & R.J. Kendall** (2016). A survey of neonicotinoid use and potential exposure to northern bobwhite (*Colinus virginianus*) and scaled quail (*Callipepla squamata*) in the Rolling Plains of Texas and Oklahoma. *Environmental Toxicology and Chemistry*, **35:** 1511-1515.

[10] **Bro, E., J. Devillers, F. Millot & A. Decors** (2016). Residues of plant protection products in grey partridge eggs n French cereal ecosystems. *Environmental Science and Pollution Research*, **23:** 9559-9573.

[11] **Bro, E., F. Millot, A. Decors & J. Devillers** (2015). Quantification of potential exposure of grey partridge (*Perdix perdix)* to pesticide active substances in farmlands. *Science of the Total Environment*, **521–522:** 315-25.

[12] **Gobeli, A., D. Crossley, J. Johnson & K. Reyna** (2017). The effects of neonicotinoid exposure on embryonic development and organ mass in northern bobwhite quail (*Colinus virginianus*). *Comp Biochem Physiol C Toxicol Pharmacol.*, **195:** 9-15.

[13] **Lopez-Antia, A., M.E. Ortiz-Santaliestra, E. García-de Blas, P.R. Camarero, F. Mougeot & R. Mateo** (2015). Adverse effects of thiram-treated seed ingestion on the reproductive performance and the offspring immune function of the red-legged partridge. *Environmental Toxicology and Chemistry*, **34:** 1320-9.

[14] **Lopez-Antia, A., M.E. Ortiz-Santaliestra, F. Mougeot & R. Mateo** (2013). Experimental exposure of red-legged partridges (*Alectoris rufa*) to seeds coated with imidacloprid, thiram and difenoconazole. *Ecotoxicology*, **22:** 125–138.

[15] **Millot, F., P. Berny, A. Decors & E. Bro** (2015). Little field evidence of direct acute and short-term effects of current pesticides on the grey partridge. *Ecotoxicology and Environmental Safety,* **117:** 41-61.

[16] **Johnston, G., A. Dawson & C.H. Walker** (1996). Effects of prochloraz and malathion on the red-legged partridge: a semi-natural field study. *Environmental Pollution*, **91:** 217-225.

[17] **Saxena, A.K., J. Devillers, S.S. Bhunia & E. Bro** (2015). Modelling inhibition of avian aromatase by azole pesticides. *SAR and QSAR in Environmental Research*, **26(7-9):** 757-782.

[18] **Potts, G.R. & N.J. Aebischer** (1995). Population dynamics of the grey partridge *Perdix perdix* 1793–1993: monitoring, modelling and management. *Ibis*, **137(suppl.1):** 29-37.

[19] **EFSA – European Food Safety Authority** (2009). Guidance Document on Risk Assessment for Birds and Mammals on request from EFSA. *EFSA Journal*, **7(12):** 1438.

[20] **PPDB – Pesticide Properties DataBase**. http://sitem.herts.ac.uk/aeru/ppdb/en/index.htm

[21] **Grolleau, G & J.L. Caritez** (1986). Toxicité, par ingestion forcée, de différents pesticides pour la perdrix grise, *Perdix perdix* L., et la perdrix rouge, *Alectoris rufa* L. *Gibier Faune Sauvage*, **3:** 185-196.

[22] **Schaefer, E.N., W.A. Bowles Jr. & J. Hurlbut** (1983). The acute oral toxicity, repellency and hazard of 998 chemicals to one or more species of wild and domestic birds. *Archives of Environmental Contamination and Toxicology*, **12:** 355–382.

[23] **Gibbons, D., C. Morrissey & P. Mineau** (2015). A review of the direct and indirect effects of neonicotinoids and fipronil on vertebrate wildlife. *Environmental Science and Pollution Research*, **22:** 103-118.

[24] **Nitu, K., L.Shahani, N. Taparia & P. Bhatnagara** (2012). Teratogenic and biochemical effects of a formulation containing dicofol in the chick embryo. *Toxicology and Environmental Chemistry*, **94:** 1411-1421.

[25] **Kitulagodage, M., W.A. Buttemer & L.B. Astheimer** (2011). Adverse effects of fipronil on avian reproduction and development: maternal transfer of fipronil to eggs in zebra finch *Taeniopygia guttata* and *in ovo* exposure in chickens *Gallus domesticus*. *Ecotoxicology*, **20:** 653-660.

[26] **Potts, G.R.** (2012). Partridges – countryside barometer. The new naturalist library. Collins, London, 465 p.

Keywords: farmland, Galliformes, hazard, mortality, pesticides, reproduction, risk, sub-lethal effects, toxicity

(poster #6)

The breeding productivity of lapwing on a post-industrial peat bog managed for conservation of the grey partridge in Ireland
Ecological serendipity – or the law of un-intended consequences

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The Northern lapwing (*Vanellus vanellus*) in Ireland is a red-data species of conservation concern. Despite extensive conservation measures, including agri-environmental measures and limited predator control at breeding sites, Irish populations of breeding lapwing have declined by an estimated 88% from 1993 to 2008. More recently, there is evidence to suggest that this decline continues. In the Republic of Ireland, the National Parks & Wildlife Service, (NPWS), manages 260 ha of a post-industrial peatland for the conservation of the grey partridge (*Perdix perdix*). Fortuitously these lands have also delivered a significant conservation outcome for breeding lapwing that was not envisaged. Since the inception of the grey partridge project, the number of breeding pairs of lapwing has grown from 0 in 1996 to 94 in 2015. The empirical evidence suggests that the breeding productivity of the initial colonizing lapwing is a by-product of habitat management and the systematic control of predators, for the grey partridge. The positive response of the breeding lapwing was recorded, however, information on the average number of lapwing chicks to fledge successfully was not known. To fill this information gap a two year radio-tracking study was undertaken by the Irish Grey Partridge Conservation Trust. Monitoring lapwing chick survival is more difficult than the monitoring of nest. But understanding how to increase brood survival is crucially important for the long-term maintenance of breeding lapwing populations.

Over a period of two years 41 chicks from 41 broods of lapwing were fitted with radio-tags. These chicks were radio-tracked until fledging or tag recovery. The probability of daily survival was calculated using the Kaplan-Meier estimator incorporating Pollack's staggered entry design *(Pollack, 1989).* The Kaplan-Meier estimator is an ideal method for estimating a survival distribution where the fate of the individuals can be assigned on each sampling occasion, i.e. in this case living, dying or censored (unknown fate, e.g. radio signal failure). The cumulative survival distribution is calculated by sequential multiplication of daily survival probabilities. Incorporating Pollack's staggered entry design allowed for the tagging of chicks over a period of several days rather than all having to be tagged on a single occasion

The assumptions of the Kaplan-Meier estimator relevant to this study were as follows:

(1) That chicks could be correctly aged when first found;

(2) That chick fates were correctly determined;

(3) That radio-tracking did not influence survival;

(4) That chick fates were independent;

(5) Homogeneity of daily chick survival rates.

With one exception, there was no evidence that lapwing chick mortality was caused by anything other than predation. Despite 950 predator control traps, an estimated 2,334 hours spent by the keepers culling 1,656 egg and chick predators during the breeding season; 46.5 % of the tagged sample was predated. Radio tracking evidence suggests that c. 3 adult foxes were responsible for the mortality of all tagged lapwing chicks predated by mammals. Of the chicks predated, foxes accounted for 47%, avian predators 32% and unknown predators 16%. One chick (5% of the failed chicks) died of a naturally occurring disease (colisepticemia).

In terms of the overall population, the average number of chicks fledged per pair was 0.86. There was no statistical relationship between average range of movements and habitats, and no detectable pattern of movement relative to a habitat type. There was a substantial difference in the range of movements of chicks: from 0.002 ha to 5.682 ha. Chick survival to fledging was independent of the habitat type. There was no evidence that the levels of chick predation were influenced by the size of the range used by foraging broods of chicks.

Although this study took place over a two year period, the data from it provides a plausible explanation as to why a positive but un-expected outcome for breeding lapwing was achieved. In wildlife management there is often an assumption that certain bird species are fixed or "pigeon holed" into certain habitat types. Yet in this case a breeding wader species associated with wet grassland habitats is now thriving in a post-industrial peat-bog managed for the conservation of the grey partridge. This was never expected. In the case of breeding lapwings in Ireland, serendipity triumphed over assumption and the fixed mind position. Thus, the capacity of a species to recover can be hampered through a lack of human imagination.

(oral)

The Demise and Recovery of the Grey Partridge *Perdix perdix* in the Wild in Ireland

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In recent decades there has been a widespread and rapid decline in bird species considered farmland specialists across Europe. One of these species is the grey partridge *Perdix perdix*. The decline of naturally occurring grey partridge in Ireland was first documented in the early years of the 20th century. Towards the end of that century, grey partridge survived in only two small populations in the midlands of Ireland; these were Lullymore, Co Kildare and Boora, Co Offaly. At both locations the grey partridge population survived on post-industrial peatland habitat. In the early years of the 21st century radio-tracking research indicated that the breeding productivity of the grey partridge at Lullymore had dropped to an unsustainable level. In 2001 the species was declared extinct in Lullymore. The National Parks & Wildlife Service then focused its attention to saving the last remaining wild population at Boora, which by that time had declined to an estimated 10 breeding pairs. Managing the species in a post-industrial peatland habitat presented a distinct conservation challenge. Post-industrial peatlands undergo a rapid process of habitat succession; from open sparsely vegetated areas to dense scrub. In the absence of management intervention, a landscape hostile to the continuing survival of the grey partridge emerges. Given finite resources, it was our view that the best way to overcome these challenges was to combine traditional partridge management methods of game keeping with an adaptive management approach.

Over the duration of the project an evolution of ideas, combined with iterative processes, yielded the desired conservation outcome. Other indirect but important factors that supported the recovery of the species, included the close integration of the game-keepers with the research staff and the local farming community, coupled with a programme of outreach to the representatives of the hunting and the ornithological communities. After securing the viability of the wild population at Boora, attention then turned to the development of an agri-environmental policy to support the recovery of the species in its more traditional farmland habitat. This approach formed the basis of a National Conservation Strategy. After twenty-years of endeavour the grey partridge was added to the national list of priority bird species in Ireland. In effect, another state agency (Ireland’s Department of Agriculture and Food & Marine) was, for the first time, empowered to include a package of habitat measures for grey partridge on farmland. These habitat measures are now delivered through the Green, Low-Carbon, Agri-Environment Scheme – GLAS, which is co-funded by the European Union and by Irelands Department of Agriculture, Food & Marine. Since the inception of the GLAS agri-environmental scheme, a further three grey partridge conservation projects have been established in the Republic of Ireland - and one in Northern Ireland. At all of these sites wild birds from the captive breeding programme at Boora are been used as source stock. The combination of all of these factors averted the extinction of the grey partridge in the wild in Ireland.

(oral)

Causes of grey partridge overwinter losses on lowland farmland in England

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Despite the grey partridge *(Perdix Perdix)* being one of the best studied farmland birds in Europe, its winter ecology remains poorly understood. The Game and Wildlife Conservation Trust's grey partridge count scheme data suggests that average winter losses of grey partridges across Britain are around 53%. To better understand the factors affecting this high loss rate, we studied dispersal and mortality of wild grey partridges at three different sites in lowland England during two consecutive years each, between 2008-2014, using radio telemetry. We aimed to catch entire coveys during the day and radio-tag six individuals per covey (adult male and female, two juvenile males and two juvenile females). Each radio-tagged bird was tracked once a week from late November till the end of May. In total we radio-tagged 360 birds (66 ad males, 48 ad females, 132 juv males and 114 juv females) and ring colour marked a further 167 individuals.

Dispersal at all three sites commenced shortly after covey break-up in mid-January/early February, depending on winter temperature. At all sites the majority of birds remained within 1km (avg. 84%). Juveniles dispersed more and further than adults and males generally further than females with unpaired juvenile males moving the furthest. The maximum distance for males recorded was 4.7km and 2.7km for females, both juveniles.

Mortality was lowest during the covey period between Dec-Jan (avg. 6.4%), highest during the pairing period in Feb-Mar (avg. 12.8%) with continued high mortality rates during the pre-breeding period in Apr-May (avg. 11.6%). However, mortality rates varied considerably between years and sites and were highest at the site with the highest partridge density (20.2% during Feb-March). At all sites, males suffered from higher mortality than females, mainly caused by raptors (predominantly sparrowhawks, *Accipiter nisus*), followed by mammals (predominantly foxes) and other causes, mainly human inflicted.

Therefore, grey partridge winter loss in England seems mainly caused by late winter mortality inflicted by sparrowhawks, a highly protected raptor species in the UK. To reduce grey partridge winter loss rates caused by raptors we recommend improved habitat provision, especially late winter cover.

Keywords: Grey partridge, *Perdix perdix*, overwinter loss, spring dispersal, winter mortality

(oral)

Conflict in conservation and management of wildlife: connecting ecological and socio-economic data across Europe

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Conflicts between wildlife conservation and agricultural practices have serious consequences for biodiversity and human wellbeing globally. Conflicts might emerge because of a perceived mismatch between the timing of ecological processes causing damage to agricultural production and that of management actions it. Here, we assess contemporaneous and lagged cross-correlations between time series of ecological indicators (population size and spatial distribution) and management effort (culling, non-lethal scaring, monitoring and compensation payments) collected from four ongoing conflicts between agriculture and herbivorous waterfowl in northern Europe. We find contrasting patterns across the four case studies, with efforts to manage pink-footed geese in Denmark and common cranes in Sweden showing strong correlations with ecological indicators of impacts measured during the previous or current year. In contrast, the management of barnacle and greylag geese on the Scottish isles of Islay and Orkney, respectively, showed either little cross-correlation with ecological indicators or a time lag of up to three years. In addition, funding for the management of geese on Islay appeared to decrease with increasing local population size and a more diffuse distribution across agricultural land. Our social-ecological approach to the analysis of conflict time-series highlights differences in the management of herbivorous waterfowl in northern Europe. We discuss the role of robust scientific research and communication as well as the provision of reliable and consistent funding for species management in enabling critical changes in ecological processes underlying conservation conflicts to be met with appropriate changes in management effort.

Keywords: Conflict, management actions, time lags, hunting, culling, geese, cranes

(oral)

Gray Partridge Distribution in North America: Changing Landscapes and Environment for an Introduced Species

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The gray partridge *Perdix perdix* was introduced to North America in the early 20th Century to create hunting opportunity. After periods of expanding distribution and abundance through WWII, eventually encompassing more than 20 US states and Canadian provinces, the species has retracted from much of eastern North America. Shifting agricultural practices have been linked to gray partridge population declines and range constriction across its native range. Naturalized North American gray partridge populations are experiencing similar population declines and range constriction, exacerbated on this continent by loss of grassland habitat, intensified production methods, and shifting crop patterns. Core abundance of the gray partridge has shifted north and west in the Great Plains (North Dakota, Saskatchewan, Alberta) with losses of populations in the Central Plains (Nebraska, Wisconsin) and Eastern Corn Belt (Illinois, Indiana, and Ohio). We used Bayesian implementation of occupancy modelling to estimate the effects of crop cover type and changes in crop cover on the probability of survival (persistance when observed on a transect) and colonization (detection on a transect when not previously found) of sites in the Central United States (North American Breeding Bird Survey). Colonization probability was positively related to an increase in percent land area in cover crops, short grasses, and soybeans, and negatively related to corn (maize). Probability of survival was postively related to the amount of short grasses and soybeans present, and negatively related to corn (maize), cover crops, and sunflower. Our study suggests gray partridge population declines and range shift in North America may be attributed to farming dynamics following westward and northward expansion of soybeans and corn (maize) into the Wheat Belt of the United States and Canada.

Keywords: agriculture, distribution, gray partridge, habitat, introduced, North America

(oral)

Current distributions of wild-ranging deer species in the United Kingdom

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In recent decades, distributions of free-ranging deer in Europe have been expanding, a trend which is mirrored in the United Kingdom. The impacts of this expansion are mixed. Deer can provide income, through hunting and the sale of venison, and, at moderate densities, deer pressure can positively impact ecosystems. However, at high densities, large herbivores have the potential to cause cascading effects, typically driven by alterations to vegetation abundance, diversity and structure. Range expansion has the potential to increase competition between sympatric deer species and due to the presence of non-native species, to affect the genetic integrity of native deer. As a result, current distributions of deer species are an essential asset to ensure appropriate management to minimise negative outcomes. Since 1972, The British Deer Society (BDS) has sought to monitor the distribution of deer populations in the United Kingdom, initially by collating incidental records with concentrated efforts in 1993 (Scotland only), 2000 (Great Britain; Ward 2005), then recently with the Deer Distribution Survey 2008, 2011 and 2016 (United Kingdom; Ward 2008). Survey data is collected from BDS members, other non-governmental organisations and statutory agencies on the six species of deer considered to be wild-ranging in the United Kingdom. Of these, two are native species (roe deer *Capreolus capreolus* and red deer *Cervus elaphus*), one is naturalised (fallow deer *Dama dama*) and three are non-native species introduced in the late 19th and early 20th centuries (Japanese sika *Cervus nippon*, Reeves' muntjac *Muntiacus reevesi* and Chinese water deer *Hydropotes inermis*). Previous analyses have compared distributions from BDS surveys to identify the expanding ranges of all six species and highlight the potential for further expansion. This study draws on records obtained between 2012 – 2016; it provides updated distribution maps for each species, makes comparisons to previous surveys and comments on future changes in range.

References

[1] **Ward, A.I.** (2005). Expanding ranges of wild and feral deer in Great Britain. *Mammal Review*, **35:** 165-173.
[2] **Ward, A.I., T. Etherington & J.A. Ewald** (2008). Five years of change. *Deer*, **14:** 17-20.

Keywords: species distribution, Cervidae, non-native species, invasive species

(oral)

Shot-at Tufted ducks avoid hunted areas: evidence from long term-monitoring of embedded and ingested lead shot

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Ingested and embedded lead shot have long been suspected to negatively affect wildfowl fitness, although their effects have rarely been quantified in the wild. We assessed the impact of ingested an embedded lead pellets in Tufted ducks ringed and X-rayed as part of a long-term monitoring scheme conducted in the Camargue wetlands from 1957-58 to 1973-74. Prevalence of ingested and embedded lead shot, which were among the highest ever reported in any duck species (respectively 0.08 to 0.5 and 0.19 to 0.9), increased over the study period probably as a result of increasing hunting pressure. A negative relationship between ingested and embedded lead pellet prevalence suggesting that shot-at individuals avoided hunted areas was found. Individuals with embedded lead-shot suffered from lower body condition, which could be the consequence to such avoidance of hunted albeit good trophic quality areas. Individuals with embedded lead shot did not display higher survivorship than those without but had lower recovery rates and therefore lower hunting mortality. In contrast, individuals with ingested lead shot displayed slightly lower survival than those without. However, compared to other ducks the effects of lead ingestion on survival were moderate. Furthermore, increasing prevalence of ingested lead shot over the study period did not preclude an increase in Tufted duck survivorship. Implications of these results are discussed.

(oral)

Spatio temporal demographic trends of Black Grouse in the French Alps.

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Knowing populations growth rates is crucial to assure long-term viability of a metapopulation and is especially relevant for fragmented alpine species like the Black Grouse. Because they are adapted to mountain climate, alpine species are particularly vulnerable to environmental changes and anthropogenic activities. Understanding the consequences of habitat loss, disturbance, harvest and climate change on the dynamic of these populations is essential to avoid extinction. We took advantage of repeated counts of Black grouse singing males, conducted yearly since 1996, to model the trends of populations divided on 47 sites distributed across the French Alps. To take into account the detection variability, we used state-space models that allow us to separate the ecological process from the observation process. We also tested various environmental variables and checked for synchrony between series in different spatial units. Our results give us an accurate view of Black grouse populations' trends. It allowed us to retrieve mean growth rates for each site, as well as its probabilities to be over 0 based on its credible interval. We thus calculated the ratio for each growth rate: % over 0 / % under 0 giving us a relative proportion index of increase and decrease. Our study also brought us some insights on the possible causes of local and global decline. This analysis is a necessary step towards adaptive management of this exploited species, bringing a better understanding of processes altering dynamic.

Keywords: Hierarchical models, Black grouse, trends, Alps, count data.

(oral)

Distribution and factors affecting wild boar (*Sus scrofa*) damage in a lowland area in northern Italy

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Damage to croplands by wild boar is globally taking dramatic proportions and causing considerable economic losses. Conflicts between wild boars and agricultural activities show themselves in different ways: damage, in fact, can be caused by rooting looking for food (invertebrates, bulbs or tubers), by direct feeding on whole plants or vegetative parts, and by trampling [1]. In Italy, the wild boar has recently colonized intensively cultivated lowlands, including western Po Plain. In this work, we first provide a general description of wild boar damage to croplands in "Lomellina", an intensively cultivated portion of the western Po Plain (province of Pavia, northern Italy). We then used these data to build a distribution model, to identify which factors determine the distribution of damage and to define the areas where the risk of damage is highest. Wild boar damage data were collected over a period of 3 years, from 2013 to 2015. Two different types of data were used: requests of refund arrived at the Wildlife Service of the Province of Pavia, and data obtained through direct meeting with landowners and/or farmers; thus, it was possible to identify which types of crops were sensitive to damage. To evaluate the existence of monthly differences in the number of events, a Chi-square goodness-of-fit test was performed. The areas with the highest presence of damage events were defined with a 50% Kernel Analysis. To build the model, we analyzed the relationship between damage and 11 different predictors: distance from water, distance from woodlands, distance from continuous hedges and rows, distance from discontinuous hedges and rows, distance from urban settlements, human population density, distance from primary roads, distance from secondary roads, distance from railways, area and fractal dimension of damaged fields. For modeling, we randomly selected the same number of pseudo-absences as there were presences. The model was built following a use-versus-availability approach, with a Binary Logistic Regression Analysis [2]. "Damage" was set as the binary dependent variable (damage locations = 1, random locations = 0), and landscape variables previously listed were set as predictors. The response variable was modelled for dependence on predictor variables using the model selection procedure based on the Akaike Information Criterion (AIC) [3]. For all possible models, we calculated AIC values corrected for small sample size (AICc). Models were ranked and scaled by the differences with minimum AICc (ΔAICc) and Akaike weights (ωi) for each i-model [4]. The relative importance of predictor variables (ω) was measured by the sum of Akaike weights of the models in which each variable appeared [4]. The model containing all the variables with a ω value ≥ 0.50 was considered the best one [5]. Damage events almost exclusively involved maize, and, a lesser extent, rice, sorghum, wheat and soya bean. In all years, monthly damage distribution was not random (Chi-square test, P always < 0.05), with a peak in May and a minimum in late autumn and in winter. From the spatial analysis of damage distribution, we observed a different distribution of damage among years; in 2013 damage occurrence was mainly concentrated in the Eastern part of the study area, bordering the "Ticino Valley Regional Park". In 2014, the distribution of damage was quite uniform in the whole study area, whereas in 2015 the highest proportion of damage was recorded in the Western part of the study area, coinciding with the Special Protection Area "Risaie della Lomellina". The Binary Logistic Regression model had an excellent predictive power (AUC = 0.96). The risk of damage was highest in fields close to woodlands (which ensure the availability of cover), far from urban settlements and primary roads, and where human population density is low. Furthermore, the model showed a positive effect of the distance from continuous hedges and rows. The geometry of the fields did not have a significant effect on the risk of damage, probably because of the high homogeneity of field structure in the study area. The analysis of boar-induced damage, together with the identification of factors that increase the risk of damage, provides information contributing to the development of an effective plan for managing wild boar populations, which could be important not only to prevent damage to croplands, but also to reduce any adverse effect that boars have on physical and biological components of ecosystems.

References

[1] **Massei, G. & P.V. Genov** (2004). The environmental impact of the wild boar. *Galemys*, **16:** 135-145.

[2] **Boyce, M.S., P.R. Vernier, S.E. Nielsen & F.K.A. Schmiegelow** (2002). Evaluating resource selection functions. *Ecological Modelling*, **157:** 281-300.

[3] **Akaike, H.** (1973). Information theory as an extension of the maximum likelihood principle. In: Petrov B.N., Csaki F., (eds.), 2nd International Symposium on Information Theory. Budapest: Akademiai Kiado, 267-281.
[4] **Burnham, K.P. & D.R. Anderson** (2002). Model Selection and Multimodel Inference: A Practical Information-Theoretic Approach. 2nd edition. New York: Springer.
[5] **Barbieri M.M., & J.O. Berger** (2004). Optimal predictive model selection. *The Annals of Statistics*, **32:** 870-897.

Keywords: human-wildlife conflict, risk modelling, *Sus scrofa*, wild boar management

(poster #7)

Long-term patterns in Red-legged partridge population dynamics in a protected area (Doñana Nature Area) in the SW Iberian Peninsula

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The Red-legged partridge (*Alectoris rufus*) is the most important bird game species and also its role as important prey for a species of many Mediterranean predators. The population is declined in recents years. Some of the factors proposed to explain these negative tendencies include hunting and predator pressure, agricultural intensification, pesticide management, hybridization with another species of partridge and emerging diseases.

The relative abundance and population trends of the Red-legged partridge were studied during the period of 2005–2015 in a protected area (Doñana Nature Area) by transect before sunset and in good weather conditions of seasonal field. We survey in eight permanent itineraries covered optimal habitats for partridges in spring, summer and autumn. The total sampling effort covered 3520 km and 2941 partridges were counted in total.

Relative abundance was estimated by means of KAI (kilometric abundance index) and also we calculated absolute density by distance sampling. Our results revealed that the population of wild red-legged Partridge showed fluctuation in abundance index in this period. The better index was in 2006 (mean 1.91 ± 0.86. partridge/km), while 2015 was the year of lower estimates (mean 0.29 ± 0.05 partridge/km).

Annual population declined by a 11% since 2005 to 2015. Therefore, we can conclude that these populations are quickly declining, thus continued monitoring and management measures are highly important.

(oral)

Effects of restocking for hunting purpose: the Mallard case

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"Restocking" stands for reinforcement of natural populations by the release of individuals of the same species, either originating from captivity or from wild populations. Restocking is increasingly used in the management of flora and fauna, and in a variety of contexts. Besides conservation purposes, it is used worldwide in the management of harvested fish and game populations to augment//increase harvest opportunities. Release of captive-reared game animals into the wild is a common and growing management practice in Europe. Restocking of game species may have desired beneficial effects such as increased harvest bags, and redirection of harvest pressure from wild to captive-bred individuals. However, restocking may also have negative effects like changes in behaviour, morphology, and demography in recipient populations, as well as enhancement of pathogen spread. There are also possible negative genetic effects on recipient populations including homogenization, introduction of non-native genes, and loss of local adaptation.

In Europe, several million captive-reared Mallard *Anas platyrhynchos* are released annually since the mid-1970s to supplement hunted populations. The present study considers this model species to assess the consequences of such massive releases. A clear genetic differentiation allows discrimination of released and wild Mallards. Hybridization with wild Mallards exists, but has not so far resulted in significant introgression. Generally, genetic contributions of captive-bred birds to the natural population is still limited owing to the domestication process in game farm facilities leading to very high post-release mortality of these Mallards compared to their wild counterparts.

Contribution of captive-bred birds to hunting bag is regionally significant. A simulation suggests that in the context of the Camargue population (located close to Montpellier), the increase in Mallard harvest without apparent reduction of population size was only possible thanks to the release of captive-reared individuals.

Among other issues linked to Mallard restocking, caution should be upheld on the possible transmission of pathogens as a high prevalence (up to 99 %) of low pathogenic avian influenza was observed in some game Mallard farms. In addition, the global ecological impact on wetland biodiversity remains to be assessed but is probably negative. Finally, from a social perspective, hunting associated with the release of gamebirds is controversial because it is ethically questionable.

Keywords: Biodiversity conservation, harvest, pathogens, population dynamics, population genetics

(poster #8)

Effects of hunting on the spatial behaviour of wild boar (*Sus scrofa*)

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In recent decades, wild boar populations have drastically increased in the northern hemisphere, resulting in extensive damage to vegetation and crops [1]. Therefore, studies have recently focused on hunting as a management tool to control populations [2]. Indeed, wild boar are also known as popular game species and hunting can act as a predation process affecting space use and activity patterns [3,4]. But today, we still need more information about how hunting affects the spatial behaviour of wild boar and what are the determinants of the responses.

Here, we assess the effects of hunting on wild boar based on three major metrics which may be influenced by disturbance: movement pattern (described by speed and distance covered), activity pattern and habitat use. These data were collected on 40 GPS-collared wild boar from two contrasted hunted areas: National Hunting and Wildlife Reserve of La Petite Pierre (LPP-NHW; 48°51’41″ N, 7° 19' 15″ E; 2670 ha) and National Forest of Chateauvillain-Arc en Barrois (48°02 N, 4°56 E; 8500 ha).

Two different reactions were observed in response to hunting disturbance: wild boar chose to either hide or flee. Both behaviours were marked with a shift in movement and activity patterns. Flight decision appeared to be related to habitat characteristics. During their flight, wild boar appeared to favor covered areas which may possibly offer them better refuge.

References

[1] **Apollonio, M., R. Andersen & R. Putman** (2010). *European ungulates and their management in the 21st century*. Cambridge University Press.

[2] **Hothorn, T. & J. Müller** (2010). Large-scale reduction of ungulate browsing by managed sport hunting. *Forest Ecology and Management*, **260(9):** 1416-1423.

[3] **Keuling, O., N. Stier & M. Roth** (2008). How does hunting influence activity and spatial usage in wild boar Sus scrofa L.?. *European Journal of Wildlife Research*, **54(4):** 729-737.

[4] **Saïd, S., V. Tolon, S. Brandt & E. Baubet** (2012). Sex effect on habitat selection in response to hunting disturbance: the study of wild boar. *European journal of wildlife research*, **58(1):** 107-115.

Keywords: Hunting management, GPS, activity pattern, *Sus scrofa*

(oral)

Does hunting affect red deer (*Cervus elaphus*) and wild boar (*Sus scofa*) spatial behaviours in the same way?

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Animal movement depends on three major factors: environment, species-specific traits and risk of predation [1]. Therefore, as hunting can act as a predation process, ungulates adjust their habitat use [2] and movement patterns in response to human predation [3,4]. But species may perceive a risk differently and then differ in terms of spatial response and antipredator strategy [5]. Our study aims at comparing the reactions of two popular game species (red deer and wild boar) in a context of hunting and understanding the determinants underlying their movement decisions. As these decisions are highly related to environment, we focused on one forest area, the National Hunting and Wildlife Reserve of La Petite Pierre (LPP-NHW; 48°51’41″ N, 7° 19' 15″ E; 2670 ha), where red deer and wild boar occur in sympatry and have the same chances of being hunted.

We expect that both species will have two different reactions in response to hunting disturbance: individuals will choose to either hide or flee and adjust its home range size accordingly. We also expect that flight distance and speed will be higher for red deer compared with wild boar. Lastly, during their flight, we assume that wild boar will favor covered areas which may offer a better refuge, whereas red deer will prefer open areas which may possibly offer them good visibility and better escape cover.

We used data collected on 103 GPS-collared females red deer and 25 GPS-collared females wild boar over the period from 2000 to 2016. We quantified three major metrics which may be influenced by hunting disturbance: movement patterns (described by speed and distance covered), activity patterns and habitat use.

References

[1] **Nathan, R., W.M. Getz, E. Revilla, M. Holyoak, R. Kadmon, D. Saltz & P.E. Smouse** (2008). A movement ecology paradigm for unifying organismal movement research. *Proceedings of the National Academy of Sciences*, **105(49):** 19052-19059.

[2] **Saïd, S., V. Tolon, S. Brandt & E. Baubet** (2012). Sex effect on habitat selection in response to hunting disturbance: the study of wild boar. *European journal of wildlife research*, **58(1):** 107-115.

[3] **Root, B.G., E.K. Fritzell, & N.F. Giessman** (1988). Effects of intensive hunting on white-tailed deer movement. *Wildlife Society Bulletin (1973-2006)*, **16(2):** 145-151.

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

[5] **Caro, T.** (2005). *Antipredator defenses in birds and mammals*. University of Chicago Press.

Keywords: Hunting disturbance, spatial behaviour, *Cervus elaphus, Sus scrofa*

(oral)

Using stable isotope analyses to assess the impact of hunting on the breeding population of Common Snipe in Denmark

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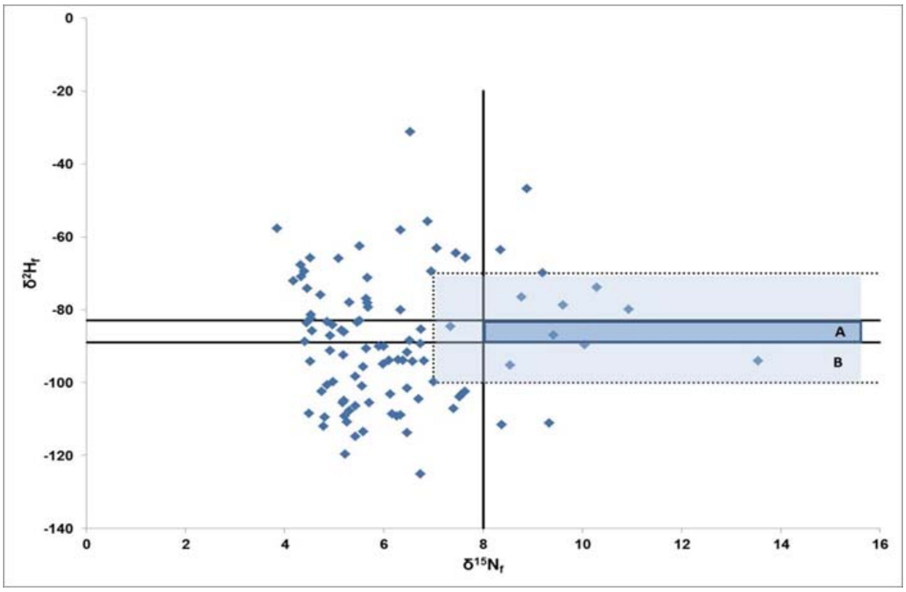
Denmark holds a breeding population that has declined markedly since the 1970s [1] and most recently was estimated to 1,300 pairs in 2011 [2]. This decline has led to a change in the national red-list status from ”least concern” to ”vulnerable” [3]. As an ongoing Atlas inventory (2014-2017) predicts a continuous decline, it has become relevant to assess the impact on hunting on the Danish population from a conservation and management perspective.

The annual hunting bag of Common Snipe *Gallinago gallinago* in Denmark on average comprises 11,000 birds (2010-2014 [4]) out of a rough estimate of 1.8 million birds that pass through Denmark during the autumn migration from northern Scandinavia and Northwest Russia, of which 1 million are assumed to stage for shorter or longer periods or undertake feather molt in Danish wetlands [5]. With hydrogen (δ2H) isotope ratios in snipe feathers reflecting a north-east/southwest precipitation continental gradient and nitrogen (δ15N) reflecting anthropogenic agricultural activity (fertilizers and livestock manure) [6,7], the origin of snipes bagged by hunters in Denmark was approximated from isotope ratios in juvenile feathers. The results showed that for the values of isotope ratios expected in Danish snipes (-83‰< δ2H<-89‰ and δ15N>8‰), only 1 (~1%) bird out of 97 showed an isotope signature complying with these criteria. Relaxing the isotope range (-70‰< δ2H<-100 ‰ and δ15N>7‰) resulted in 9 (9.3%) birds assigned as potential Danish birds (Fig. 1). Based on known age ratios in the hunting bag, these figures translate into 28 (1.1%) adults and 85 (3.0%) juvenile Danish snipes being bagged from a total autumn population of 2,600 adults and 2,860 juvenile birds, respectively. For the relaxed isotope criteria, the corresponding figures are 355 (9.8%) adults and 765 (26.8%) juvenile birds. The overall results show that the majority of snipes bagged in Denmark originate from areas north/northeast of Denmark and areas less affected by agricultural activities than seen in Denmark. That relatively few Danish breeding birds are affected by local hunting is further corroborated by the fact that the isotope ratios expected in Danish snipes would have similar values to snipes from southern Sweden, southern Norway and northern Germany. Hence, the present results are likely to overestimate the proportion of Danish breeding snipes in the overall hunting bag.

Figure 1: *Isotope values for hydrogen (δ^2H) and nitrogen ($\delta^{15}N$) in feathers from 97 juvenile Common Snipes shot by hunters in Denmark during the open season 2014/15. Area A) depicts isotope values expected to occur in Danish juvenile snipes, and area B) comprise a relaxed range (see text).*



References

[1] **Nyegaard, T., J.D. Larsen, N. Brandtberg & M.F. Jørgensen** (2015). Overvågning af de almindelige fuglearter i Danmark 1975-2014. Årsrapport for Punkttællingsprogrammet (in Danish with an English summary). Dansk Ornitologisk Forening.

[2] **Pihl, S. & J. Fredshavn** (2015). Størrelse og udvikling af fuglebestande i Danmark (in Danish). Artikel 12 rapportering til Fuglebeskyttelsesdirektivet. Aarhus Universitet, DCE – Nationalt Center for Miljø og Energi, 44 s. – Videnskabelig rapport fra DCE - Nationalt Center for Miljø og Energi nr. 176

[3] **Pihl, S. & K. Flensted** (2011). A Red List Index for breeding birds in Denmark in the period 1991-2009. *Dansk Ornitologisk Forenings Tidskrift,* **105:** 211-218.

[4] **Asferg, T.** (2015). Foreløbig vildtudbyttestatistik for jagtsæsonen 2014/15 (in Danish). – Notat fra DCE – Nationalt Center for Miljø og Energi, Aarhus Universitet. 9 s.

[5] **Meltofte, H.** (1993). Vadefugletrækket gennem Danmark (in Danish with English summary). *Dansk Ornitologisk Forenings Tidskrift,* **87:** 1-180.

[6] **Hobson, K.A.** (2005). Using stable isotopes to trace long-distance dispersal in birds and other taxa. *Diversity and Distribution,* **11:** 157-164.

[7] **Hobson, K.A., G.J. Bowen, L.I. Wassenaar, Y. Ferrand & H. Lormee** (2004). Using stable hydrogen and oxygen isotope measurements of feathers to infer geographical origins of migrating European birds. *Oecologia,* **141:** 477–488.

Keywords: Common Snipe, *Gallinago gallinago*, breeding provenance, stable isotope, hunting

(oral)

Northern pintails in agroecosystems: resolving trade-offs between competing conservation goals

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Widespread losses of wetland and native grassland habitats to agricultural intensification in the Prairie Pothole Region (PPR) of North America present significant challenges to conservation initiatives for birds and other biota in this region. The northern pintail (*Anas acuta*) population in North America experienced significant declines during the 1980s and, unlike most other dabbling duck species, it did not respond positively to near-record increases in PPR pond abundances during the period 2006-2016 and remains well below conservation goals. One hypothesis proposes that hunting mortality has limited population growth, but there is no evidence from survival or harvest data sets to support this conjecture. Other possibilities propose that deteriorating quality of winter and spring migration habitat has either reduced overwinter survival rates or lowered spring body condition of females with subsequent reductions in breeding propensity or reproductive success; support for these explanations is mixed or lacking. Recent model- and field-based evidence suggests that agricultural land management is a key driver of persistently low populations. The nearly universal adoption of conservation tillage practices across the Canadian PPR beginning in the early 1990s meant that croplands that had previously been repeatedly tilled and left idle (open soil) for one growing season as part of normal crop rotations were being cropped continuously by seeding directly into stubble of the crop sown one year earlier. These cropping operations produced significant environmental benefits via reductions in soil compaction, direct and indirect carbon emissions, and soil losses due to wind and water erosion. Yet, pintail and several other bird species use stubble fields in proportion to availability; given the vast cropland area within the PPR, large numbers of female pintails nest in stubble where most nests are either destroyed by predators or normal seeding operations. Furthermore, in years of abundant spring ponds, pintail pairs settle in highly cropped landscapes, creating potential for an ecological trap: pintails are attracted to wetland-rich agricultural landscapes where reproductive success is not sufficient to sustain populations. Conservation efforts in the PPR have concentrated on maintaining and restoring native grassland and wetland habitats wherever possible but these actions are difficult to implement, can only affect relatively small areas and are expensive. Producer-friendly programs like fall-seeded crops (winter wheat) enhance pintail nest success and have potential to affect large land areas. Duck nest success in winter wheat is comparable to that of grassland habitat and is roughly twice that of nests initiated in spring-seeded cropland. Despite concerns that benefits of higher nest success in winter wheat fields could be offset by costs in terms of lower survival of pintail ducklings raised in intensively farmed landscapes, this trade-off is weak and does not negate benefits of nesting in winter wheat. To conclude, in the PPR, a trade-off arises between environmental benefits of conservation tillage and negative impacts on reproductive success of pintail and other cropland-nesting species. However, this tension can be alleviated by planting fall-seeded crops like winter wheat because pintail nest success and duckling survival rates support population growth. The key challenge is to achieve the wide-spread uptake of fall-seeded crops like winter wheat, for instance, by substantiating market opportunities, demonstrating cost-effectiveness, and overcoming behavioural barriers among producers.

Keywords: conservation tillage, duckling survival, ecological trade-offs, nest success

(poster #9)

Drivers of duck population synchrony on two continents: is climate important?

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Global environmental variability has potential to affect population processes of widely-separated organisms sharing life-history and life-cycle traits, yet few studies have explored dynamics of species that may be affected by common environmental drivers such as climate in widely-separated regions or continents. We tested for evidence of population synchrony in dabbling and diving duck species from Western Europe and North America, 1974-2012. Annual changes in population sizes of nine ecologically or taxonomically equivalent species-pairs on each continent were evaluated; to measure synchrony, we fit Gompertz population models to each time series, and calculated the correlation between species analogues in the residuals, removing effects of density dependence and temporal trend. We also tested whether global climate indices explained annual variation in population estimates on each continent after controlling for density dependence. Overall, duck populations within continents tended to be positively correlated and synchronous from year to year. Between continents, population estimates from Western Europe and North America were positively correlated in four of nine species-pairs, but such patterns were not synchronous on an annual basis; there was no correlation between estimates in the five remaining species-pairs. Duck populations in Western Europe (five species-pairs; 4-15% residual variation explained [RVE]) and North America (four species-pairs; 3-6% RVE) were positively correlated with the Atlantic Multi-Decadal Oscillation (AMO) index one year before the population estimate, suggesting that AMO created favourable (i.e., warmer, wetter) environmental conditions for breeding (North America) or overwintering (Western European) ducks. Likewise, the warmer phase of the Atlantic Oscillation (NAO) index in the current or previous winter was positively correlated with population estimates in two additional species in each of Western Europe (2-11% RVE) and North America (4-5% RVE). Common climatic factors were associated with annual population estimates of five species-pairs on each continent, implying that climate-driven environmental conditions may contribute to synchronizing duck populations temporally over vast areas.

Keywords: climate variability, density dependence, population dynamics

(poster #10)

Dietary compositions and winter habitats of the woodpigeon in southwestern France

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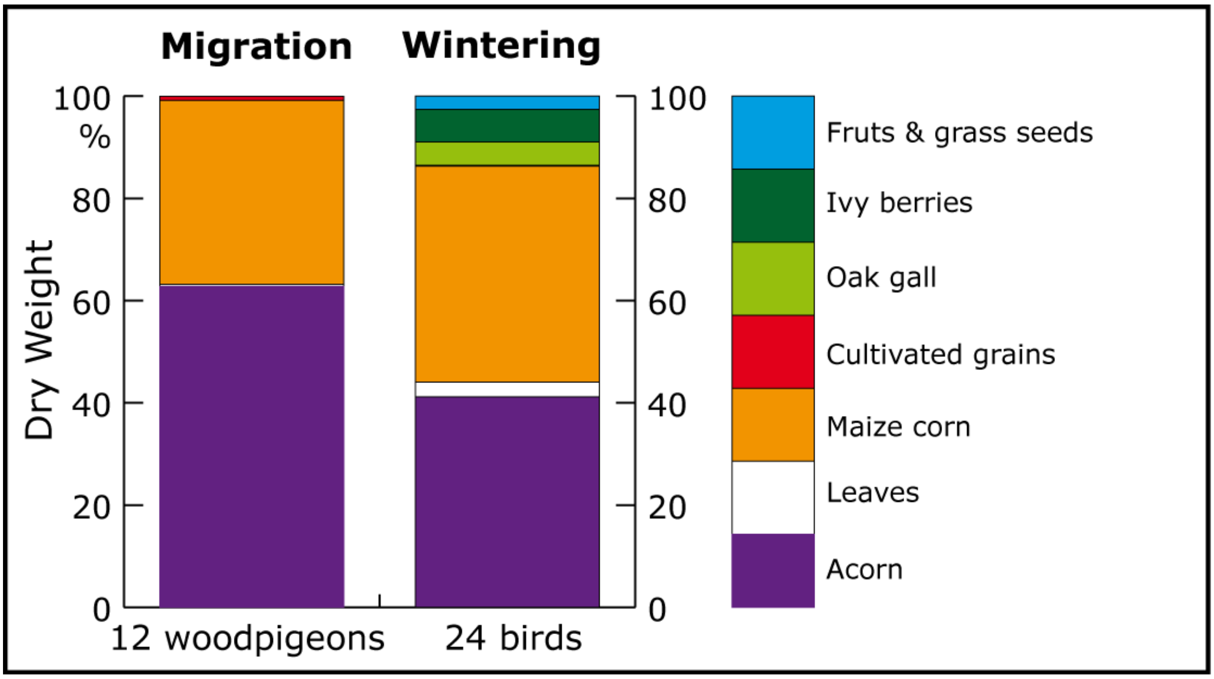
The woodpigeon *Columba palumbus* is a popular game bird throughout Western Europe. Since the 1950's, a growing number of birds that breed in northern and central Europe are coming to southwestern France to spend the winter instead of travelling to the Iberian Peninsula, where they historically go. Their presence during several months can cause severe damages in arable fields and the woodpigeon is locally considered as a serious pest of different crops.
The main management objective is to stabilize populations of woodpigeon to levels compatible with the demands of agricultural farmers and hunters. So, reliable annual population estimates, harvest estimates, and information on recruitment and distribution are crucial for effective woodpigeon management. The French GIFS (Groupe d'Investigation sur la Faune Sauvage) association and the French Office Natinal de la Chasse et de la Faune Sauvage (ONCFS) provide this kind of information each year. Unfortunately, crop damages are increasing year after year in many French localities. Another focus of research was developed recently by the GIFS association. The issues are linked to how the birds use the biotope. Indeed, determining the composition of a bird's diet and its seasonal evolution are fundamental for understanding the ecology and ecological functions of a species. In order to achieve this, we studied stomach contents of birds killed by hunters during the entire hunting season (September through February). Furthermore, to better understand year-round mouvements and habitat requirements of birds, we used data from woodpigeons tracked by satellite telemetry. In this paper, we present preliminary results on woodpigeon diet and habitat selection used by birds during wintertimes.

Figure 1. *Diet composition of woodpigeon in southwestern France.*



(keynote)

What are men to mountain mammals?

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"What are men to rocks and mountains?", asks one of the characters of Jane Austen's 'Pride and Prejudice', inquiring into the value of the natural world and underlining the importance of 'seeing' natural beauties in a less insupportable way than the "generality of travellers" do. Our knowledge of natural systems lies at the very heart of such a vision. Understanding the connection between the human and non-human components and thus the consequences of anthropogenic impacts, is the key towards a full appreciation of natural resources and their long-term conservation. Mountain areas occupy about 25% of continental surfaces, and a large proportion of the global population relies directly or indirectly on mountain-based resources [1]. Besides providing important sources of water, energy, forest and agricultural products and areas of recreation, mountainous landscapes host a great diversity of biotic and abiotic components [2]. Notwithstanding a general awareness of the negative consequences of the defilement of mountain biomes, we continue to negatively impact on these landscapes in many ways, either directly or indirectly [2].

Mountain mammals have a high value from both the scientific and the conservation standpoint. They inhabit a variety of ecosystems, where they developed a great diversity of morphological adaptations and of social organizations. Furthermore, they are important from the economic standpoint, for both consumptive (e.g. hunting) and non-consumptive (e.g. tourism) uses [3]. This, in turn, makes them particularly sensitive to anthropogenic impacts. But, what are men to mountain mammals? Paraphrasing Austen's quote, in this lecture I will provide an overview of our knowledge about mountain mammals and, specifically, about the consequences of human impacts on their life history traits, habitat use and, ultimately, conservation. I shall use a looser definition and include species that, despite not being strictly 'montane', inhabit mountainous areas and are subject to anthropic pressure, from rodents to ungulates to large carnivores, in different continents.

I will first focus on the negative effects of different forms of anthropogenic impact on mountain mammals: some effects may express themselves directly, such as the evolutionary consequences associated with trophy hunting of large ungulates in north America [4]. Other effects, however, may be indirect. Changes in life history traits or shifts in habitat use, for example, are being increasingly observed in *taxa* as diverse as rodents [5], ungulates [6] and carnivores [7] in different mountain regions of north America, Europe and central Asia, as a consequence of the global temperature increase. Further threats to the persistence of mountain mammals may derive from other forms of anthropic pressure, for example as a by-product of interspecific interference due to (re)introductions of different *taxa* [8] or to livestock overgrazing [9]. I will then discuss how human impacts can be beneficial to mountain mammals – specifically to ungulates and carnivores – through, for example, the restoration of suitable habitat conditions [10] or the realization of reintroduction plans [11,12] that took place in the European Alps over the last few decades. Finally, I will discuss how all these forms of anthropic intervention, to different extents, pose challenges to the coexistence between humans and mammals in mountain areas.

References

[1] **Beniston, M.** (2003). Climatic change in mountain regions: a review of possible impacts. *Climatic Change*, **59:** 5–31.

[2] **UN** (1992). Earth Summit: Agenda 21. The United Nations Programme of Action from Rio, The Final Text of Agreements Negotiated by Governments at the United Nations Conference on Environment and Development (UNCED), 3–14 June 1992, Rio de Janeiro, Brazil, 294 pp.

[3] **Shackleton, D.M.** (ed.) (1997). Wild Sheep and Goats and their Relatives. Status survey and Conservation Action Plan for Caprinae. IUCN, Gland, Switzerland and Cambridge, UK.

[4] **Festa-Bianchet, M.** (2017). When does selective hunting select, how can we tell, and what should we do about it? *Mammal Review*, **47:** 76-81.

[5] **Tafani, M., A. Cohas, C. Bonenfant, J.M. Gaillard & D. Allainé** (2013). Decreasing litter size of marmots over time: a life history response to climate change? *Ecology*, **94:** 580–586.

[6] **Pettorelli, N., F. Pelletier, A. von Hardenberg, M. Festa- Bianchet& S.D. Côté** (2007). Early onset of vegetation growth vs. rapid green-up: impacts on juvenile mountain ungulates. *Ecology*, **88:** 381–390.
[7] **Lovari, S., M. Ventimiglia & I. Minder** (2013). Food habits of two leopard species, competition, climate change and upper treeline: a way to the decrease of an endangered species? *Ethology Ecology & Evolution*, **25:** 305–318.
[8] **Ferretti, F., M. Corazza, I. Campana, V. Pietrocini, C. Brunetti, D. Scornavacca & S. Lovari** (2015). Competition between wild herbivores: reintroduced red deer and Apennine chamois. *Behavioral Ecology*, **26:** 550–559.
[9] **Chaikina, N.A. & K.E. Ruckstuhl** (2006). The Effect of Cattle Grazing on Native Ungulates: The Good, the Bad, and the Ugly. *Rangelands*, **28:** 8–14.
[10] **Marucco, F. & A.J.B. McIntire** (2010). Predicting spatio-temporal recolonization of large carnivore populations and livestock depredation risk: wolves in the Italian Alps. *Journal of Applied Ecology*, **47:** 789–798.
[11] **Mustoni, A., E. Carlini, B. Chiarenzi, S. Chiozzini, E. Lattuada, E. Dupré, P. Genovesi, L. Pedrotti, A. Martinoli, D. Preatoni, L.A. Wauters & G. Tosi** (2003). Planning the Brown Bear *Ursus arctos* reintroduction in the Adamello Brenta Natural Park. A tool to establish a metapopulation in the Central-Eastern Alps. *Hystrix*, **14:** 3–27.
[12] **Stüwe, M. & B. Nievergelt** (1991). Recovery of alpine ibex from near extinction: the result of effective protection, captive breeding, and reintroductions. *Applied Animal Behaviour Science*, **29:** 379–387.

Keywords: carnivores, climate change, mammals, mountain areas, selective hunting, ungulates

(oral)

Approaching a tipping point for transition to non-toxic ammunition?

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Background

Lead ammunition has good and well-understood ballistic properties having been used for centuries. Unfortunately lead is highly toxic and unlike most other anthropogenic uses of lead, release of lead in ammunition into the environment is largely unregulated. Once released, it can result in extensive poisoning of wildlife, sometimes impacting to such an extent as to threaten populations in particular for waterbirds, raptors and scavengers [1,2]. Recent research also highlights the risks posed by lead to frequent consumers of game meat shot with lead ammunition, in particular pregnant women and children due to neurological impacts of lead on the developing brain [3].

The development and field use of non-toxic alternatives for shot and most commonly used calibres of bullet now present the opportunity to reduce the risks to wildlife further and ensure healthier game meat. Scientific consensus statements from dozens of North American [4] and European [5] medics, veterinarians, wildlife biologists and academics support transition to non-toxic ammunition. There are some recognised practical challenges to overcome to progress transition to non-toxic ammunition, however these often represent the final stages of change and are preceded by more complex sociological steps.

The focus of the paper does not dwell on the natural science of lead poisoning but instead reviews the human dimensions of whether transition is desirable and asks whether we are near a tipping point for transition to use of non-toxic ammunition in at least some ammunition-using stakeholder groups.

Review and analysis

The paper will provide:

A review of policy developments at different scales: including responses to resolutions from multilateral environmental agreements such as the UNEP-Convention on Migratory Species and the African Eurasian Waterbird Agreement, initiatives such as a recent IUCN resolution, developments under the EU's Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) regulation (undertaken by the European Chemicals Agency) as well as national regulations.

An analysis of costs of transition: costs of change to non-toxic ammunition have been, and will be, borne by shooting stakeholders. This can be viewed as a transition of costs which are currently borne by the wildlife and humans impacted, conservation or welfare bodies dealing with affected wildlife, wider society via a loss of natural capital, and the scientific and regulatory community including governments and enforcement agencies. Some quantification of cost areas and cost owners will be provided.

A review of benefits and dis-benefits for ammunition users: technological and practical changes, and financial outlay are required for transition to non-toxic ammunition. In return there are arguably a range of benefits for ammunition users in the form of more sustainable hunting, less wastage of lead-affected game meat, secure markets for healthier game meat in the long-term, reduction of reputational risk and negative image of hunting – but can these benefits for both health and hunting be considered significant enough to warrant change and are they proportionate to the poisoning risk?

A review of stakeholders groups and their position on the road to non-toxic ammunition: ammunition users represent a diverse range of stakeholders with multiple reasons for ammunition usage, with different cultural and traditional ties to lead. An exercise to map these according to non-toxic ammunition usage status (with apparent motivations for transition or otherwise) will be presented, along with some case study initiatives from areas of high risks to wildlife. Commonalities will be drawn from those at different stages of transition.

A review of barriers to change to inform progress towards non-toxic ammunition usage: this will be drawn from the above and from previous experiences of questionnaire surveys of hunters, shooting media analysis [6], novel social science methodologies and expert opinion [7]. The IUGB audience will be asked to help inform this review.

Conclusion

The history of industrial lead use and its control in e.g. petrol, paint and pipes, shows that no wholescale change has been effected without regulatory frameworks. Whilst a top down approach is a likely key driver for change, transition to non-toxic ammunition also requires bottom up approaches understanding different motivations for usage of lead ammunition, values and beliefs and the complex socio-political landscapes in which these sit.

References

[1] **Green, R.E. & D.J. Pain** (2016). Possible effects of ingested lead gunshot on populations of ducks wintering in the UK. *Ibis*, DOI: 10.1111/ibi.12400.

[2] **Meyer, C.B., J.S. Meyer, A.B. Francisco, J. Holder & F. Verdonck** (2016). Can Ingestion of Lead Shot and Poisons Change Population Trends of Three European Birds: Grey Partridge, Common Buzzard, and Red Kite? *PLoS ONE,* **11:** e0147189.

[3] **Green, R.E. & D.J. Pain** (2015). Risks of health effects to humans in the UK from ammunition-derived lead. *In:* Delahay, R. J. & Spray, C. J. (eds.) *Proceedings of the Oxford Lead Symposium. Lead ammunition: understanding and minimising the risks to human and environmental health.* Edward Grey Institute, The University of Oxford, pp 27-43. http://www.oxfordleadsymposium.info/wp-content/uploads/OLS_proceedings/papers/OLS_proceedings_green_pain.pdf

[4] **Group of Scientists** (2013). Health risks from lead-based ammunition in the environment: a consensus statement of scientists. March 22, 2013 http://www.escholarship.org/uc/item/6dq3h64x

[5] **Group of Scientists** (2014). Wildlife and human health risks from lead-based ammunition in Europe: a consensus statement by scientists. http://www.zoo.cam.ac.uk/leadammunitionstatement/

[6] **Cromie, R.L., J.L. Newth, J.P. Reeves, M.F. O'brien, K.M. Beckmann & M.J. Brown** (2015). The sociological and political aspects of reducing lead poisoning from ammunition in the UK: why the transition to non-toxic ammunition is so difficult. *In:* DELAHAY, R. J. & SPRAY, C. J. (eds.) *Proceedings of the Oxford Lead Symposium. Lead ammunition: understanding and minimising the risks to human and environmental health.* Edward Grey Institute,The University of Oxford., pp 104-124. http://www.oxfordleadsymposium.info/wp-content/uploads/OLS_proceedings/papers/OLS_proceedings_cromie_newth_reeves_obrien_beckman_brown.pdf

[7] **Swift, J.A.** (2016). Lead Ammunition, Wildlife and Human Health: A report prepared for the Department for Environment, Food and Rural Affairs and the Food Standards Agency in the United Kingdom, p 90. http://www.leadammunitiongroup.org.uk/wp-content/uploads/2015/06/LAG-Report-June-2015-without-Appendices.pdf

Keywords: lead poisoning, non-toxic ammunition, game meat, policy, environmental economics

(oral)

Beyond Moose – the ecology and management of multispecies ungulate systems

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Several ungulate species have increased rapidly in numbers and distribution across Europe. Communities of 5-6 species are now increasingly common where a few decades ago only 1-2 species occurred. This represents challenges for sustainable management of these multi-species communities and their habitat and calls for actions that aim at moving from single- to multispecies management. In the Swedish context, we have to move "Beyond Moose". In the "Beyond Moose" research program we develop ecological understanding of the functioning of these multi-species communities in relation to game management and other land use practices (agriculture and forestry). We aim to understand trophic interactions in multi-species ungulate communities in relation to these land use practices and how these interactions influence their impact on the landscape. This understanding is crucial both for managing the ungulate community, but also for finding trade-offs between competing ecosystem services such as game meat and recreation from hunting vs. fiber from forests and food from crops. In an international perspective, the project provides a platform for a global discussion on how to manage diverse and increasing ungulate communities throughout Europe and North America.

(oral)

Integrative sustainable wildlife management
Principles, criteria and indicators for hunting, forestry, agriculture and recreation

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Wild animals (species, populations, individuals, genetic diversity) and their habitats are exposed to multiple impacts, such as hunting and various other, often overlapping and competing land use forms namely forestry, agriculture and recreation. In this multiple-use cultural landscapes the resulting interactions between habitat requirements of wild animals, hunting interests and other land use demands often lead to conflicts that can negatively affect sustainable conservation of native wild animal species and their habitats, the sustainability of involved forms of land use, and sustainable regional development at large. Stand-alone sectoral approaches to sustainable use are insufficient and often result in unintended adverse effects on both other land use sectors and the respective ecosystem. In contrast, sustainable integrative wildlife management requires that all land user groups in the wildlife habitat are aware of and consider the effects of their activities on both wildlife resources and other user groups. With this in mind, concepts and tools for integrated, i.e. cross-sectorally harmonized sustainability assessment of several land user groups have been developed in the Wienerwald Biosphere Reserve, Austria [1], based on former studies on sustainable hunting [2,3]. Application-oriented and participatory research methods (expert interviews, broad land user surveys, stakeholder participation panel) have been applied to identify, analyze and evaluate key interfaces and linkages (antagonistic and synergistic interactions) between wildlife, hunting, forestry, agriculture and recreational activities. The main project outputs were operational sets of principles, criteria and indicators of integrated sustainable wildlife management specific to the Wienerwald Biosphere Reserve. These assessment sets are harmonized across land use sectors and designed as self-evaluation tools which shall be applied by the major regional land user groups in order to evaluate their own respective influences on the sustainable conservation of wild animal species, their habitats and sustainable hunting. The assessment framework of each group also considers relevant sustainability requirements of other user groups. By focusing on the cross-cutting issue "wildlife management", the step from merely sector-specific towards cross-sectorally integrated assessment of sustainable use has been taken for the first time. Moreover, recommendations for integrated sustainable wildlife management and for respective monitoring have been elaborated. In a current project the whole assessment framework [1] was further adapted and tested at the Untersberg, Salzburg (2015 – 2017). As the Untersberg (mountain area up to 1973 m altitude, mainly protective forest, alpine tourism and alpine recreational activities, different wildlife species including chamois) differs in many features of the landscape to the Wienerwald (hilly Biosphere reserve next to the city Vienna, highest point 893 m, intensive multiple land use) the framework was improved to be used further for stakeholders of any wildlife management area.

Methodical access:

1) Adaption of the existing framework and indicators by the different research domains (institutes) involved in the project
2) Self-Evaluation of stakeholders (hunting, forestry, agriculture and recreational activities)
3) Survey of specific selected parameters by each participating institute in the field to evaluate the status for the wild animals and their habitat in the study area. These parameters are: influence of herbivores

on forest vegetation/damage, structure of the habitat, landscape of fear caused by hunting and recreational activities, health status of animals, wildlife population density

4) Evaluation of the assumed interdependency between the measured parameters and the assessed indicators as part of expert workshops using a system of 0 = no relationship up to 5 = strong relationship.
5) Comparison between the 2) self-evaluation, 3) field-parameters and the 4) interdependency evaluation which resulted in final conclusions for indicator adaptions and also introduction of new indicators for a further improvement of this assessment framework.

Project results shall contribute to the avoidance, mitigation and solution of wildlife-landuse conflicts and to the integration of wild animals and their management into a sustainable regional land-use system. The outcomes are practically applicable measures to minimize conflicts on all analyzed scales.

Acknowledgement:
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References

[1] **Reimoser, F., W. Lexer, Ch. Brandenburg, R. Zink, F. Heckl & A. Bartel** (2012). Integrative Sustainable Wildlife Management – Principles, Criteria and Indicators for Hunting, Forestry, Agriculture, Recreation. *Austrian Academy of Sciences Press, Vienna, ISBN 978-3-7001-7216-1, doi: 10.1553/ISWIMAN, 289 pp., http://epub.oeaw.ac.at/?arp=0x002b150e*
[2] **Casaer, J., R. Kenward, Y. Lecocq, F. Reimoser & R. Sharp** (2006). Guidelines on Sustainable Hunting in Europe. *IUCN-ESUSG European Sustainable Use Specialist Group, WG Wild Species Resources – WISPER.*
[3] **Forstner, M., F. Reimoser, W. Lexer, F. Heckl & J. Hackl** (2006). Sustainable hunting – principles, criteria and indicators. *Umweltbundesamt Vienna, REP-0115, ISBN 3-85457-913-6, 111 pp., http://www.umweltbundesamt.at/fileadmin/site/publikationen/REP0115.pdf*

Keywords: sustainable wildlife management, principles, criteria, indicators, multiple land use

(oral)

Predicting outcomes of management actions using individual-based modelling within adaptive management framework

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Modern-day adaptive wildlife management relies on accurate predictions of outcomes of chosen management actions in order to make informed decisions about which actions to implement. However, in social ecological systems there are interactions between different organisational levels (i.e. governance, human behaviour and the ecological system) and it is often desirable to test a wide range of realistic scenarios of management actions. The complexity of social ecological systems makes it impossible to do such tests experimentally, in contrast individual based models (IBMs) are well suited to this task. IBMs can be highly flexible, dynamic and can include interspecific competition, interactions between the environment and the focal species, and are usually spatially explicit. This makes it possible to make realistic tests of various management scenarios.

In the framework of the AEWA International Species Management Plan for the Svalbard breeding pink-footed goose (*Anser brachyrhynchus*), one of the objectives is to manage the population to reduce both conflicts with agriculture and possible damage to tundra vegetation [1]. An adaptive harvest management approach is used to achieve these objectives, but the current level of hunting is insufficient to reduce the growing population. Thus, the aim is to explore ways of increasing the harvest either by statutory hunting regulations or by improved local organisation of hunting which can increase harvest whilst minimising the displacement of geese due to hunting disturbance.

In order to provide accurate predictions about changes in harvest, as well as effects on the geese, a model needs to incorporate both hunters, geese and a realistic model of the agricultural landscape, as well as interactions and feedback mechanisms. Landscape interactions are very important since geese utilize fields heavily during their autumn/winter stay and are therefore strongly influenced by the current agricultural practices and the resulting resource provisioning. The types of crops grown and their spatial distribution determine the distribution of geese, which has impacts on the hunting bag via altered coincidence with hunters in time and space. Pink-footed geese in Denmark compete with other geese (mainly greylag *A. anser* and barnacle geese *Branta leucopsis*) through exploitative competition and therefore to create a realistic model of pink-footed geese, their main competitors need to be included too. To create a model with all these features we built goose and hunter models as extensions to the already existing ALMaSS system [2]. The ALMaSS system is an IBM system with a very detailed and dynamic agricultural model that models all farm management actions [3]. ALMaSS also includes a weather model which drives both growth of crops and has impacts on the animals being modelled (e.g. through temperature).

We present an overview of the goose management model and demonstrate its potential for use in adaptive management by predicting goose harvests under a range of realistic hunting scenarios, such as extending the hunting season, modifying hunting efficiency (hunters teaming up, hunters checking for game, increasing the number of hunters etc.). In addition, we used the model to evaluate potential future scenarios where the numbers of other competing goose species might change and impact the harvest of pink-footed goose. This combined socio-ecological IBM is a novel development that can be used by managers and stakeholders alike to assess the implications of management actions and the influence these have on the complex relationships between animals, humans and the landscape they share.

References

[1] **Madsen, J. *et al.*** (In press). Implementation of the first adaptive management plan for a European migratory waterbird population: The case of the Svalbard pink-footed goose Anser brachyrhynchus. *Ambio*

[2] **Topping, C.J. *et al.*** (2003). ALMaSS, an agent-based model for animals in temperate European landscapes. *Ecol. Modell.,* **167:** 65–82.

[3] **Topping, C.J., L. Dalby & F. Skov** (2016) Landscape structure and management alter the outcome of a pesticide ERA: Evaluating impacts of endocrine disruption using the ALMaSS European Brown Hare model. *Sci. Total Environ.,* **541:** 1477–1488.

Keywords: Agent-based modelling, pink-footed geese, human-wildlife conflict, adaptive management, socio-ecological systems

(poster #11)

Overview of national IWC schemes around the Mediterranean: a call for more pan-Mediterranean collaboration

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The International Waterbird Census (IWC), coordinated worldwide by Wetlands International, is a global monitoring program dedicated to wetland conservation. It is implemented through the AEWA (African-Eurasian Waterbird Agreement) and the Ramsar Convention. Ramsar sites are selected using IWC-based criteria (criteria 2, 5 and 6 of the Ramsar Convention) that enable the identification of Wetlands of International Importance. Governments are then committed to take the necessary steps to ensure that their ecological characteristics are maintained [1].

The IWC scheme provides one of the best indicator databases to evaluate the state of waterbird populations and/or the ecological condition of Ramsar sites. It also provides important support for the work of the Mediterranean Wetlands Observatory (MWO), an international initiative for monitoring and assessing the state of Mediterranean wetlands and advocating for their conservation. The MWO has defined sets of indicators such as the LPI (Living Planet Index), based on monitoring data collected in the field including IWC data.

We evaluated national IWC strategies around the Mediterranean basin. The hypothesis of this research was that monitoring effort invested in IWCs would be equally distributed among countries around the Mediterranean.

We analyzed 21 years of surveys (1991-2012) to examine the following questions:
a) are all IWC sites monitored in every country?
b) are key sites (fulfilling Ramsar criteria 5&6 whether Ramsar or not) better monitored that non-key sites?
c) are Ramsar sites better monitored than non-Ramsar sites?
d) could Ramsar site designation be improved thanks to waterbird monitoring data.

IWCs in the Mediterranean Region cover more than 7000 wetland sites but only a third of the sites have been regularly monitored in the last decade and half of the sites were only monitored six times over the thirteen year period. This situation is very disparate, depending on the country, with only six countries accomplishing regular monitoring (Figure 1). The monitoring effort deployed by countries is superior in Ramsar sites, where at least thirteen countries regularly monitor their sites since 2000. 18 countries have sites that would qualify as Ramsar sites following Criteria 5 and 6 but are not yet designated as such. Key sites for birds responding to both Ramsar and AEWA criteria, are not regularly monitored everywhere. According to these criteria, at least ten countries need to increase monitoring efforts, particularly in the North East of the Mediterranean (Figure 2).

Ramsar sites are considered to be an efficient tool to increase the abundance and the biodiversity of waterbirds [2,3]. This conservation tool should be promoted in Mediterranean countries, for the benefit of Mediterranean wetland biodiversity. International waterbird censuses are cost-effective tools for national decision-makers to identify key sites for waterbirds and to designate Ramsar sites. Based on this study, we advocate for an increased effort in the few key sites that are still not satisfactorily monitored and for the designation of a larger number of Ramsar sites in several Mediterranean countries. Conservation authorities are encouraged to increase their effort in IWC to ensure a better interpretation of wetland status and to respect their engagement to the Ramsar convention. Regional collaboration programmes can facilitate such data collection and coordinate data management with demonstrated results on the quality of their databases. The Medwaterbird network has coordinated this effort since 2012, with the aim of improving the quality of data collection and data management in North-African countries [3]. A Pan-Mediterranean programme gathering several organisations concerned by wetlands conservation in this Region could significantly improve waterbird monitoring schemes and wetland conservation.

Figure 1: *International Waterbird Census monitoring effort in Mediterranean countries for Ramsar and non-Ramsar sites between 2000 and 2012.*

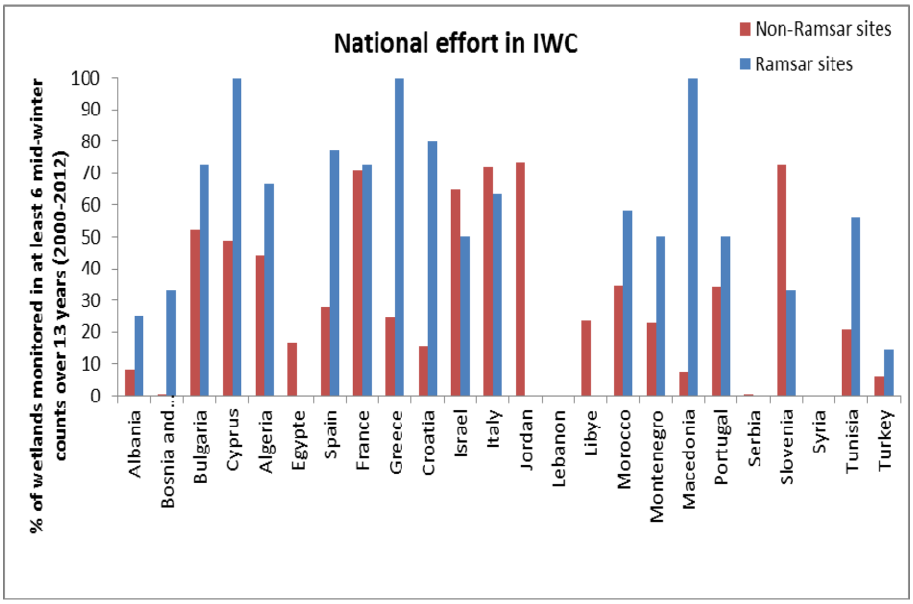
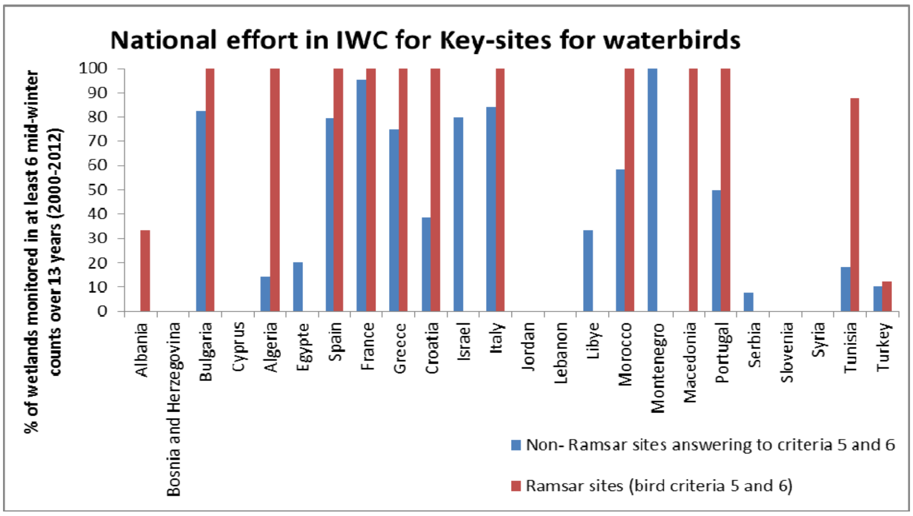


Figure 2: *International Waterbird Census monitoring effort in Mediterranean countries for important Key sites for waterbirds between 2000 and 2012.*



References

[1] **Ramsar Convention Secretariat** (2010). Designating Ramsar Sites: Strategic Framework and guidelines for the future development of the List of Wetlands of International Importance, Ramsar handbooks for the wise use of wetlands, 4th edition, vol. 17. Ramsar Convention Secretariat, Gland, Switzerland.Retrieved February 16, 2017, from http://www.ramsar.org/sites/default/files/documents/pdf/lib/hbk4-17.pdf

[2] **Kleijn, D., I. Cherkaoui, P.W. Goedhart, J. van der Hout & D. Lammertsma** (2014). Waterbirds increase more rapidly in Ramsar-designated wetlands than in unprotected wetlands. *J Appl Ecol,* **51:** 289–298. doi: 10.1111/1365-2664.12193

[3] **Sayoud, M.S., H. Salhi, B. Chalabi, A. Allali, M. Dakki, A. Qninba, M.A. El Agbani, H. Azafzaf, C. Feltrup-Azafzaf, H. Dlensi, N. Hamouda, W. Abdel Latif Ibrahim, H. Asran, A. Abu Elnoor, H. Ibrahim, K. Etayeb, E. Bouras, W. Bashaimam, A. Berbash, C. Deschamps, J.Y. Mondain-Monval, A.L. Brochet, S. Véran & P. Defos du Rau** (2017). The first coordinated trans-North African mid-winter waterbird census: The contribution of the International Waterbird Census to the conservation of waterbirds and wetlands at a biogeographical level. *Biological Conservation,* **206:** 11–20. doi: 10.1016/j.biocon.2016.12.005

Keywords: International Waterbird Census, Mediterranean Region, Ramsar sites, wetlands

(oral)

Activity pattern of partially migratory male and female deer: the forage maturation hypothesis meets sexual segregation theory

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Partial migration, where only a fraction of a population is migratory, is observed in a large variety of taxa in seasonally variable environments. It is important to understand the mechanisms underlying migration, as it affects fitness and is known to have consequences on population structure and dynamics [1]. Migratory herbivores benefit from delayed forage maturation and hence higher food quality at their higher elevation summer range, termed the forage maturation hypothesis (FMH) [1,2]. Due to the link between diet quality and rumination time, migrants eating a higher quality diet would then use less time for rumination that they can use to feed even more and hence grow more, the so-called multiplier effect [3]. However, this implicitly assumes that deer are energy maximizers [4,5], while studies have reported also time minimization strategies in deer under risk of predation. We here unify the FMH with the sexual segregation theory predicting sex-specific time allocation strategies. Male and female distribution is limited by different factors linked to both body-size differences and the reproductive tactic [6], but there is no study investigating differences in activity pattern according to the individual migratory strategy for male and female deer. We took advantage of a detailed long-term dataset on a population of red deer (*Cervus elaphus*) in west coast Norway where more than 300 deer were fitted with GPS collars to address this question. While migrants were more active during the migration process itself, we found no differences in activity pattern between migrant and resident red deer, neither in terms of proportion of daily time active nor in terms of daily time active, thus giving support toward the timing minimization hypothesis and rejecting the multiplier effect hypothesis. Overall, we found that females were more active than males during the main growing season even after controlling for body size differences, with a higher proportion of daily time spent active as well as a higher daily mean speed. These patterns are consistent with patterns predicted from sexual segregation theory linked to the reproductive tactic hypothesis, and suggest the higher reproductive demands of reproducing females forcing them to forage more. Our study highlights how the migration literature can be advanced by considering it in the context of sexual segregation.

References

[1] **Fryxell, J. & A. Sinclair** (1988). Causes and consequences of migration by large herbivores. *Trends in Ecology & Evolution*, **3:** 237–241.
[2] **Hebblewhite, M., E. Merrill & G. McDermid** (2008). A multi-scale test of the forage maturation hypothesis in a partially migratory ungulate population. *Ecological Monographs*, **78:** 141–166.
[3] **White, R.G** (1983). Foraging patterns and their multiplier effects on productivity of northern ungulates. *Oikos,* **40:** 377–384.
[4] **Hixon, M.A** (1982). Energy maximizers and time minimizers: Theory and reality. *The American Naturalist*, **119:** 596–599.
[5] **Schoener, T.W** (1971). Theory of feeding strategies. *Annual Review of Ecology and Systematics*, **2:** 369–404.
[6] **Ruckstuhl, K.E. & P. Neuhaus** (2002). Sexual segregation in ungulates: a comparative test of three hypotheses. *Biological Reviews of the Cambridge Philosophical Society,* **77:** 77–96.

Keywords: dual axis accelerometer, foraging strategy, GPS, migration, sexual segregation, ungulate

(oral)

Private landowners as a source of data for research and management evaluation: deer management assistance program

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The great majority of land in the eastern region of USA is in private ownership. State agencies tasked with managing resident wildlife populations must obtain biological information from private lands with limited governmental involvement and costs. An early cooperative project between Mississippi State University and Mississippi Department of Wildlife, Fisheries, and Parks was the development of a management model for white-tailed deer on private lands that would collect biological data from harvested deer, involve sportsmen in management decisions, reduce deer densities, and improve deer herd quality [1]. Expanding from this 4-year research project, the Deer Management Assistance Program (DMAP) became a statewide management program with about 500 cooperators impacting about 2 million acres annually in MS, USA. An important aspect of DMAP is the systematic collection of spatially-specific biological data; the current database of 309,978 male and 423,427 female deer is used by biologists to evaluate local management actions and by researchers to evaluate management models, which fulfills two basic tenets of the adaptive management model.

Cooperative research projects evaluating DMAP data have identified the need to alter management models. Research into antler characteristics associated with harvested deer [2,3] resulted in significant changes to how antler restrictions are incorporated into DMAP harvest recommendations and statewide harvest regulations.

Success with DMAP in Mississippi led other state agencies to adopt similar models for private lands deer management. Fifteen state agencies in the eastern USA have adopted programs similar to DMAP and have met similar success working with >7,000 cooperating properties [4].

References

[1] **Guynn, Jr., D.C., S.P. Mott, W.D. Cotton & H.A. Jacobson** (1983). Cooperative management of white-tailed deer on private lands in Mississippi. *Wildlife Society Bulletin,* **11:** 211-214.

[2] **Strickland, B.K., S. Demarais, L.E. Castle, J.W. Lipe, W.H. Lunceford, H.A. Jacobson, D. Frels & K.V. Miller** (2001). Effects of selective-harvest strategies on white-tailed deer antler size. *Wildlife Society Bulletin,* **29:** 509-520.

[3] **Demarais, S., B.K. Strickland & L.E. Castle** (2005). Antler Regulation Effects on White-tailed Deer on Mississippi Public Hunting Areas. *Proceedings, Southeastern Association of Fish and Wildlife Agencies,* **59:** 1-9.

[4] **Missouri Department of Conservation** (2017). Southeastern state deer harvest summaries for the 2015-2016 or most recent available season. *Southeast Deer Study Group Annual Meeting Proceedings*, **40:** St. Louis, Missouri, USA.

Keywords: white-tailed deer, adaptive management, harvest, private property

(oral)

Capercaillie: is it a meaningful indicator for French central Pyrenees forest biodiversity?

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Within the French National Strategy for Biodiversity program the preservation of biological diversity is a premium issue. Identifying "umbrella species" —whose needs are such that many other species benefit from their protection— is one of the tools towards this goal, provided this concept can be proven applicable to these umbrella species.
The main goal of our study was to settle the capercaillie, *Tetrao urogallus aquitanicus*, as a major umbrella species in the concerned areas, thus justifying the efforts put in its preservation hence in its whole ecosystem.
To this end we compared the potential for biodiversity of capercaillie vital sites ("leks") to other forest environments in its distribution area. We used an innovative method to evaluate forest stands biodiversity: the Potential Biodiversity Index ("PBI"). This standardized, fast and efficient method is based on scoring ten biological variables among two classes: seven characterize the forest management and three reflect the history of the forest stand.
Results demonstrate that leks offer a significantly higher potential biodiversity than control sites. This in turn means that these areas are potential home for a large number of taxa. Therefore, capercaillie protection measures not only benefit to this sensitive species but to a whole host of animal and vegetal species and to these Pyrenean ecosystems.

Keywords: biodiversity, capercaillie, Pyrenees, umbrella species

(oral)

Intensive management of native ungulates: conservation success inside a Pandora's box

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In the US, native wildlife is governed by the public trust doctrine, where wildlife is owned by the people, but managed in trust by state and federal entities. This long-standing principle was a key component of the restoration of wildlife populations during the 20th century. In reality, however, management of wildlife on private lands often contradicts the concept of public trust. The landowner controls access to the resource and is essentially the de facto owner, though s/he must abide by state game laws. Many state wildlife agencies have developed cooperative management programs to engage with landowners and incentivize sound management. The main focal species is often white-tailed deer because white-tails are the most popular and widely distributed species of large mammal in North America. Texas, USA, has a unique composition of landholdings and spirit that date from its history as an independent nation. More than 97% of the lands are in private ownership and the state agency permits flexibility in management that enable managers flexibility to harvest deer, to trap and translocate deer, to temporarily restrain deer for breeding purposes, and to propagate deer in captive conditions. Freedom for managers has encouraged broad participation in the incentive programs, benefitted other species of wildlife, and decreased competition between livestock and wildlife. Unfortunately, some interest groups seek greater freedom, to the point of challenging the public trust doctrine and pushing for privatization of native deer. Private lands management thus poses a series of unique challenges and opportunities for the public resource.

(poster #12)

Survival, breeding success and causes of mortality of wild hen pheasants *Phasianus colchicus* in Norfolk, England

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In Europe and North America, pheasant shooting often relies on released birds to ensure bags. In Britain, it is estimated that around 30-40 millions of birds are released each year [1]. Hence, the majority of pheasant shooting estates release pheasants, while only few areas have truly wild pheasants. This is the case in Norfolk (Eastern England), which offers a suitable habitat for wild pheasants in some areas and has a long history of gamekeeping.

Despite the high ecological and economic value of wild game (being more appreciated by hunters), not many studies have investigated the ecology of wild pheasants in Britain, and some factors limiting productivity remain understudied. Aiming to improve targeted management for wild pheasants, we studied the survival, breeding success and causes of mortality of hen pheasants on an estate at Norfolk with no history of releasing. The study was prompted by concern over higher than normal mortality in pheasants by the owners of the estate.

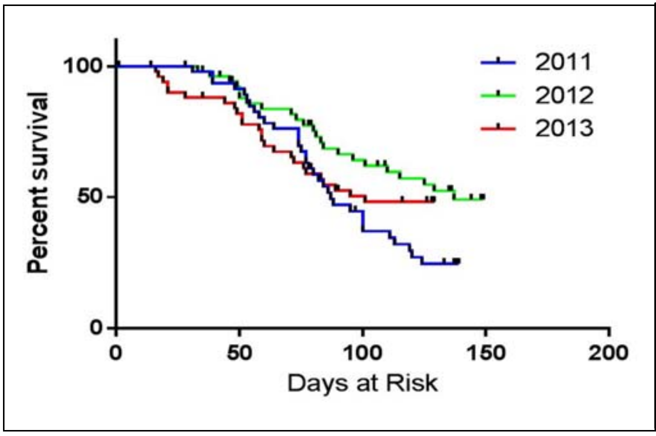
The estate comprised 1296 hectares of mainly arable crops (winter and spring barley, sugar beet, rape and potatoes), but also 90 hectares of woodland. As part of an agri-environment scheme, there were wild flower margins, wild bird cover and beetle banks, together with game cover, fallow and grass. A full-time gamekeeper was employed to conduct legal predator removal and provide supplementary feed. The estate had a high density of wild hen pheasants until 2005 (around 80hens/100hectares), but since then significant losses of breeding stock have been documented (in 2013 there were around 40hens/100 hectares).

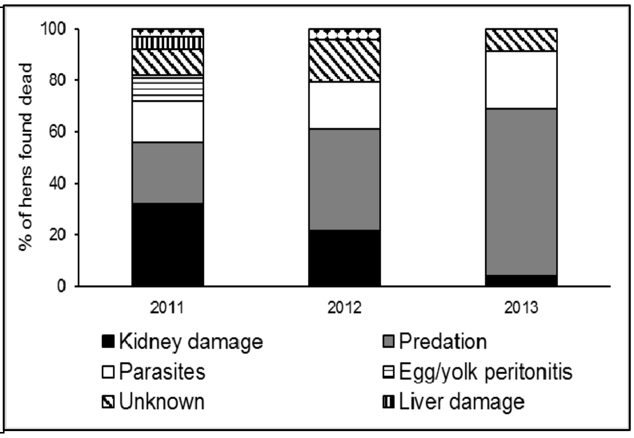
During late winter 2011 to 2013, 150 hen pheasants (50 per year) were caught using baited walk-in catchers in 15 locations across the estate. Age was determined observing primary feathers and biometrics were taken from the birds (including, weight, structural body size and condition), being examined for external parasites and any signs of abnormality. Each hen was fitted with a necklace radio-tag (approximate range of 1.5km, 12 months' battery life and mortality switch). Hens were radio-tracked twice weekly through March and at least three times a week between April and July. For all birds found dead, the most possible cause of death was determined and if the carcass was found intact it was sent to a Veterinary laboratory for post-mortem analysis.

No significant differences on survival were found between years (Mantel-Cox test, $\chi^2_2 = 5.35$, $P = 0.068$), and the median survival was 129 days when pooling all birds (Fig.1). Overall, the majority of birds survived from the beginning of March to mid April (100% survival in 2011 and 2012), though different patterns of survival were observed from April onwards for each year, and causes of mortality also varied.

In 2011, there were significant losses through May and June (plus a few more birds found dead in July and August). The major causes of death were kidney damage 32%, predation (mainly from fox *Vulpes vulpes*) 24%, and parasites (*Nematoda*) 16%. In 2012, there were also significant losses from May to June, though the survival was double of that recorded in the previous year, and several birds died owing to a combination of predation (36%), kidney damage (22%), and parasites (18%). In 2013, the survival pattern was quite similar to the one recorded in 2012, though in March and April more hen pheasants were predated by foxes (65%) than in the previous years, also recording birds dying from parasites (22%, especially gapeworms *Syngamus trachea*) and kidney damage (4%) (Fig. 2). A total of 57 birds were sent for detailed post mortem examination, and the most common post findings were kidney damage (51% of birds showing different degrees of damage), gape worm infections (28%) and *Capillaria sp.* infections (54%).

Figure 1: (left) survival of radio-tagged wild hen pheasants March-July 2011-2013 (day 1 = 1st March), and ***Figure 2:*** (right) causes of mortality from 2011-2013.





The survival values were similar to previous studies on wild hen pheasants and higher than the ones recorded in reared ones [2-4]. Predation rates during the nesting and rearing of the chicks period (May to June) were lower (with the exception of 2013) than other studies showing higher rates of predation in wild and reared hens (80-90%)[3,5]. This can be explained by the fact that pheasants were wild and predator removal was conducted at the study site during the breeding season, which may had increase nest survival [6].

Predation was the most frequent cause of death pooling all years (42%), but a combination of different causes of death was observed each year. The kidney damage (nephritis) was likely caused by a coronavirus (*Coronaviridae,* also known as infectious bronchitis virus *IBV* in poultry)[7], triggered by periods of nutritional and physiological stress for pheasants at the study site, such as the dry conditions recorded in 2011 and extremely wet weather in 2012. In the same way, the physiological stress may have increased negative effects of parasite burdens, which are known to negatively impact breeding success [8]. High parasite burdens may also increase susceptibility of birds to being predated or succumbing to other diseases. More research is required to address the extent and impact of parasites and disease on the ecology of wild pheasants.

References

[1] **PACEC** (2006). The Economic and Environmental Impact of Sporting Shooting.

[2] **Brittas, R., V. Marcstrom, R.E. Kenward & M. Karlbom** (1992). Survival and breeding success of reared and wild ring-necked pheasants in Sweden. *J. Wildl. Manage.,* **56:** 368–376.

[3] **Hill, D. & P.A. Robertson** (1998). Breeding success of wild and hand-reared ring-necked pheasants. *J. Wildl. Manage.,* **52:** 446–450.

[4] **Robertson, P.A.** (1988). Survival of released pheasants, *Phasianus colchicus*, in Ireland. *J. Zool. London,* **214:** 683–695.

[5] **Hoodless, A.N., R.A.H. Draycott, M.N. Ludiman & P.A. Robertson** (1999). Effects of supplementary feeding on territoriality, breeding success and survival of pheasants. *J. Appl. Ecol.,* **36:** 147–156.

[6] **Draycott, R.A.H., A.N. Hoodless, M.I.A. Woodburn & R.B. Sage** (2008) Nest predation of Common Pheasants *Phasianus colchicus*. *Ibis,* **150:** 37–44.

[7] **Cavanagh, D., K. Mawditt, D.D.B. Welchman, P. Britton & R.E. Gough** (2002) Coronaviruses from pheasants (*Phasianus colchicus*) are genetically closely related to coronaviruses of domestic fowl (infectious bronchitis virus) and turkeys. *Avian Pathol.,* **31:** 81–93.

[8] **Draycott, R.A.H., M.I.A. Woodburn, D.E. Ling & R.B. Sage** (2006) The effect of an indirect anthelmintic treatment on parasites and breeding success of free-living pheasants *Phasianus colchicus*. *J. Helminthol.,* **80:** 409–415.

Keywords: disease, *Phasianus colchicus*, predation, survival, wild

(oral)

Sex-specific estimation of red deer population size using non-invasive genetic sampling

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Non-invasive genetic approaches are increasingly implemented in wildlife monitoring for estimation of population size and density. In this context, they can not only be suitable for the monitoring of rare or endangered species, but can also serve as a tool for the survey of common ungulates like the red deer (*Cervus elaphus*). Besides the fact that genetic methods can yield quite precise population estimates, when sample sizes are sufficiently high, they also include information about the sex ratio and allow sex-specific data analyses. This can be an advantage particularly when the studied species shows sexual dimorphism with respect to behaviour and/ or space use.

Here we compare four non-invasive genetic estimation studies of red deer populations via faecal genotyping in three different study areas in western Germany (Table 1) with the aim to evaluate the practicability and relevance of sex specific population estimation. In all three areas, we sampled red deer faeces over areas of 10.000 – 12.000 hectares. The sex ratios calculated over all sampled individuals in each area ranged between 1 : 1,1 (male to female) and 1 : 1.8. Estimated total deer densities ranged from 3.3 (2.5 – 4.4) to 8.5 (6.4 – 11.3) individuals/ 100 hectares. The sample size and thus effective coverage of the sampled populations differed between areas/ years and between the sexes.

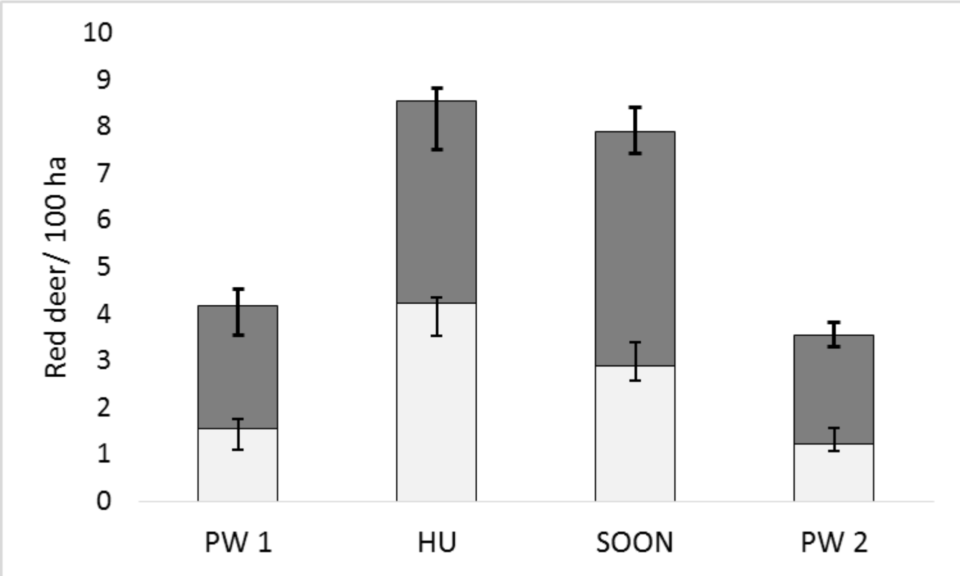
Red deer densities varied considerably between study areas, however in the study area Pfälzerwald, in which two studies were conducted (2010 and 2016), estimated densities did not change considerably over the six years. In the two study areas Hunsrück and Soonwald, the estimated red deer densities were similar, however the sex ratio strongly differed between both areas. A higher female proportion in the population implies a higher reproductive potential, thus knowledge about the sex ratio is important in addition to population density when planning management measures.

Further implications of the sex specific estimation approach, e.g. how sex differences in space use (in this case reflected by differences in the mean maximum distance between samples of the same indvidual) can affect density estimation, will be presented and discussed.

***Table 1:** Genotyping results of red deer faecal samples collected in three different study areas.*

Study area	Number of genotyped samples	Sampled individuals	Mean No. of samples/ ind.	Sex ratio male to female 1 :	Reference
Pfälzerwald 2010	398	247	1.57	1.3	Ebert 2011
Hunsrück 2012	823	504	1.63	1.1	Ebert et al. in prep.
Soonwald 2015	1234	600	2.06	1.8	Ebert et al. in prep.
Pfälzerwald 2016	704	327	2.16	1.6	Ebert et al. in prep.

Figure 1: *Sex specific red deer population densities estimated based on faecal genotyping. PW = Study area Pfälzerwald, HU = study area Hunrsück, SOON = study area Soonwald ; light grey = male density, dark grey = female density.*



References

[1] **Ebert, C** (2011). Non-invasive genetic approaches to estimate ungulate population sizes in the Palatinate Forest, south-west Germany. PhD-Thesis, Albert-Ludwigs-University of Freiburg.

[2] **Ebert, C., J. Sandrini, B. Thiele & U. Hohmann** (in prep). Comparing three different red deer populations using a non-invasive genetic approach.

Keywords: Red deer, faeces, genotyping, population density, sex ratio, non-invasive

(oral)

Global change and the Scandinavian wildlife community – answers provided by long-term hunting bag data

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Human population growth and resource use is causing global changes in climate, land use and land cover, altering the productivity of ecosystems. Global change also involves species extinctions. For example, large carnivores have experienced wide-spread declines and extirpations. Hence, both top-down and bottom-up ecosystem processes are changing. The effects on wildlife could be additive, synergistic or compensatory ("buffering"). Because anthropogenic global change has been substantial for more than 200 years, long-term data are needed to assess the effects [1, 2]. Here I present studies which include the use of long-term hunting bag statistics to explore consequences of changes in climate, land use and large carnivore status on the wildlife community in Scandinavia. In the nineteenth century, agricultural expansion was associated with large carnivore decline and mesopredator release of red foxes, suggesting that large carnivores suppressed red fox populations although the strength of the interaction depended on ecosystem productivity [3]. In contrast, large carnivores (wolf and Eurasian lynx) may have facilitated the existence of another carnivore, the wolverine [4]. Since the nineteenth century, climate warming and land-use change appear to have favoured species with a southern distribution in particular, causing increased abundances and northern range expansions in several southern species [5]. In the northern wildlife community, there has been periods of disrupted dynamics ("fading cycles") in small rodents and their predators [5, 6]. An assessment of potential changes in red fox abundance over 220 years suggested that fox abundance was favoured by several changes in the 1800s and early 1900s (a warmer climate, agricultural expansion and lynx decline) [5, 7]. At present, recolonizing lynx should suppress fox abundance. However, to "buffer" (compensate for) environmental enrichment, which has relaxed the bottom-up limitation of red fox, lynx abundance would have to increase above historical levels [7]. Knowledge about such long-term changes is needed in wildlife management.

References

[1] **Elmhagen, B., G. Destouni, A. Angerbjörn, S. Borgström, E. Boyd, S.A.O. Cousins, L. Dalén; J. Ehrlén, M. Ermold, P. Hambäck, J. Hedlund, K. Hylander, F. Jaramillo, V.K. Lagerholm, S.W. Lyon, H. Moor, B. Nykvist, M. Pasanen-Mortensen, J. Plue, C. Prieto, Y. van der Velde & R. Lindborg** (2015). Interacting effects of change in climate, human population, land use and water use on biodiversity and ecosystem service. *Ecology and Society*, **20(1):** 23.

[2] **Ripple, W.J., J.A. Estes, R.L. Beschta, C.C. Wilmers, E.G. Ritchie, M. Hebblewhite, J. Berger, B. Elmhagen, M. Letnic, M.P. Nelson, O.J. Schmitz, D.W. Smith, A.D. Wallach, A.J. Wirsing** (2014). Status and ecological effects of the world's largest carnivores. *Science*, **343:** 1241484.

[3] **Elmhagen, B. & S.P. Rushton** (2007). Trophic control of mesopredators in terrestrial ecosystems: top-down or bottom-up? *Ecology Letters*, **10:** 197-206.

[4] **Khalil, H., M. Pasanen-Mortensen & B. Elmhagen** (2014). The relationship between wolverine and larger predators, lynx and wolf, in a historical ecosystem context. *Oecologia*, **175:** 625-637.

[5] **Elmhagen, B., J. Kindberg, P. Hellström & A. Angerbjörn** (2015). A boreal invasion in response to climate change? Range shifts and community effects in the borderland between forest and tundra. *AMBIO*, **44 (Suppl. 1):** 39-50.

[6] **Elmhagen, B., P. Hellström, A. Angerbjörn & J. Kindberg** (2011). Changes in vole and lemming fluctuations in northern Sweden 1960-2008 revealed by fox dynamics. *Annales Zoologici Fennici*, **48:** 167-179.

[7] **Pasanen-Mortensen, M., B. Elmhagen, H. Linden, R. Bergström, M. Wallgren, Y. Velde van der & S. Cousins** (2017). The changing contribution of top-down and bottom-up limitation of mesopredators during 220 years of land use and climate change. *Journal of Animal Ecology*, In Press.

Keywords: hunting bags, species interactions, top-down, bottom-up, climate change, land-use change

(oral)

Extreme weather events create pinch points for northern bobwhite

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Broad scale patterns of conditions and resources can affect both the distributions of organisms and their population dynamics. However, discrete events such as extreme weather may also influence organisms individually and at the population level. Depending on the scale of investigation, these discrete events can often go undetected as they are averaged across seasons and years. Thermal stress in particular has been identified as a potential mechanism in determining space use and survival of organisms at fine temporal and spatial scales. To better understand the effect of discrete temperature events on a member of Galliformes (*Colinus virginianus*; northern bobwhite), we evaluated space use across an ambient temperature gradient (ranging from -20 °C to 38 °C) through a Maxent algorithm using telemetry locations from 895 northern bobwhite. Estimated useable space ranged from 18.6% to 57.1% of the landscape depending on ambient temperature. Specifically, we found that during both high and low temperatures (<-15 °C and >35 °C, respectively) much of the landscape was estimated to be unused (81.4% and 75.4% respectively), including areas of the landscape that were selected for during more moderate temperatures. We also found dissimilarity in northern bobwhite space use during times of thermal extremes compared to each other and to more moderate conditions (range overlap = 0.38), implying habitat under one set of environmental conditions may not be habitat under varying environmental conditions. Additionally, using Andersen-Gill proportional hazard models, we found northern bobwhite survival was most influenced by weekly minimum ambient temperatures. Therefore, both space use and survival of northern bobwhite were constrained during temperature extremes. These results demonstrate that ecological constraints can occur because of environmental pinch points at fine temporal scales. Failure to account for discrete environmental conditions and how they affect organisms can lead to an incomplete understanding of habitat requirements and how management may influence populations.

Keywords: climate change, *Colinus virginianus*, Maxent, temperature

(poster #13)

The contribution of climatic conditions to population changes in the declining European Turtle dove in France

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Besides habitat loss, there is overwhelming evidence that climate play a significant role in driving temporal variation in population dynamics of avian bird species [1]. Understanding the demographic mechanisms through which climate affects population dynamics is critical to highlight the root causes of population trends as well as for gauging future recovery prospects in a context of climate change [2]. To improve such an understanding, one step is to identify the keys stage of the species' life cycle at which climate-mediated mechanisms operate. This is particularly challenging for Afro-Palaearctic migrants for which limiting factors may operate across broad geographic ranges.

A large body of work clearly suggests that climatic conditions on winter quarters play a central role, notably through their influence on food availability [3]. Comparatively, the influence of climate during the breeding season has received less attention. Yet, some results show that climatic conditions on breeding grounds can be also significant determinants of population growth rates [4], through their impact on the annual production of offspring [1]. For most species however, the relative importance of breeding and wintering grounds climate in determining population growth remains poorly known [5] since studies generally focus on a single stage of the species' life cycle. Yet, this assessment is essential for understanding the complexity of mechanisms underlying population dynamics and guiding conservation policies.

We addressed such issue in the vulnerable European Turtle dove (*Streptopelia turtur*). We used time-series data to document population trends in France and assessed the influence of climatic variables on annual population growth rates. On the basis of about 900 sampling sites surveyed each year since 1996 using the point count method, we first calculated annual abundance index and population trends using generalized additive models (R-package poptrend, [6]). Then, the proportional change in the population index between successive breeding seasons (*t* to *t+1*) was modelled as a function of temporal variation in climatic conditions prevailing i) on breeding quarters in spring *t* and ii) on wintering quarters between years *t* and *t+1*. Weather variables, including temperature (min, max), precipitations and wet-day frequency, were extracted from gridded time-series dataset at a 0.5 x 0.5° spatial resolution (CRU TS 3.24.01, Climatic Research Unit,). To characterize climatic conditions during the breeding period, we first intersected the coordinates of sampling sites with monthly gridded climate data. For each sampling site, the resulting values were either averaged (temperatures) or summed (precipitation, wet-days) over the whole (May-August) or core (June-July) breeding period. Secondly, a mean value - calculated across sampling sites - was then used to characterize annual climatic conditions prevailing on breeding grounds. To characterize the climatic conditions experienced by wintering birds, we first delimited the winter quarters on the basis of an ongoing survey of European Turtle Doves originating from France and instrumented with Argos satellite transmitters. For each year and each 0.5 x 0.5° cell of the CRU dataset embedded in this region, monthly values for temperature were averaged over two periods: over the previous rainy season (May-October [7]) and in early winter (Nov-Dec). Rainfalls values (precipitations, wet days) were summed over the previous rainy season. Mean values calculated across grid cells were then used to characterize annual climatic conditions prevailing on wintering grounds.

Our results confirmed the population decline - about -38% since 1996 -, of the French breeding population, as reported elsewhere in Europe. To investigate whether trends varied regionally, the country was divided into 6 large clusters and the calculations were reiterated for each one. We found evidence for inter-regional difference in long-term population trends, with a more pronounced decline in the northern and eastern regions. Estimates for the long-term trends suggest that abundance indices would have halved in these regions during the last 20 years.

The proportional change in the population index between successive breeding seasons averaged -1.56%, with important year-to-year and regional variation in magnitude. For the whole France and 4 regions out of 6, climatic conditions prevailing during the preceding breeding season had the strongest and most consistent effects on population dynamics: growth rates decreased as previous breeding conditions were wetter. This was especially apparent when considering climatic conditions prevailing during the core breeding period (June-July). Climatic conditions prevailing on wintering quarters had weaker and inconsistent effects.

Overall, these results suggest that over the last 20 years, climate variability in breeding - not wintering - grounds played a major role in driving temporal variation in population dynamics of the European Turtle-dove in France. Presumably, this effect may reflect the influence of climate on populations' productivity. However, we stress that our results do not call into question the influence that negative rainfall anomalies in the Sahel may exert on population dynamics, especially by reducing survival rate. Indeed, our work corresponds to a period during which the rainfall regime in the Sahel was more favourable than during the drought in the 70s-90s.

References

[1] **Sæther, B.E. et al.** (2004). Climate influences on avian population dynamics. *Adv. Ecol Res.,* **35:** 185-209.
[2] **Altweeg, R. & M.D. Anderson** (2009). Rainfall in arid zones: possible effects of climate change on the population ecology of blue cranes. *Funct. Ecol.,* **23:** 1014–1021.
[3] **Zwart, L. et al.** (2009). Living on the edge: wetlands and birds in a changing Sahel. KNNV publishers, Utrecht, The Netherlands.
[4] **Pearce-Higgins, J.W. et al.** (2015). Drivers of climate change impacts on bird communities. *Journal of Animal Ecology,* **84:** 943-954.
[5] **Ockendon, N. et al.** (2013). Climatic effects on breeding grounds are more important drivers of breeding phenology in migrant birds than carry-over effects from wintering grounds. *Biol. Lett.,* **9:** 20130669.
[6] **Knape, J. et al.** (2016). Decomposing trends in Swedish bird populations using generalized additive mixed models. *J. Appl. Ecol.,* **53:** 1852–1861
[7] **Ockendon, N. et al.** (2014). Rainfall on wintering grounds affects population change in many species of Afro-Palaearctic migrants. *J. Ornithol.,* **155:** 905-917.

Keywords: European Turtle-dove, *Streptopelia turtur*, climate, population growth

(oral)

Conserving ecosystems through sustainable use: solutions from the internet

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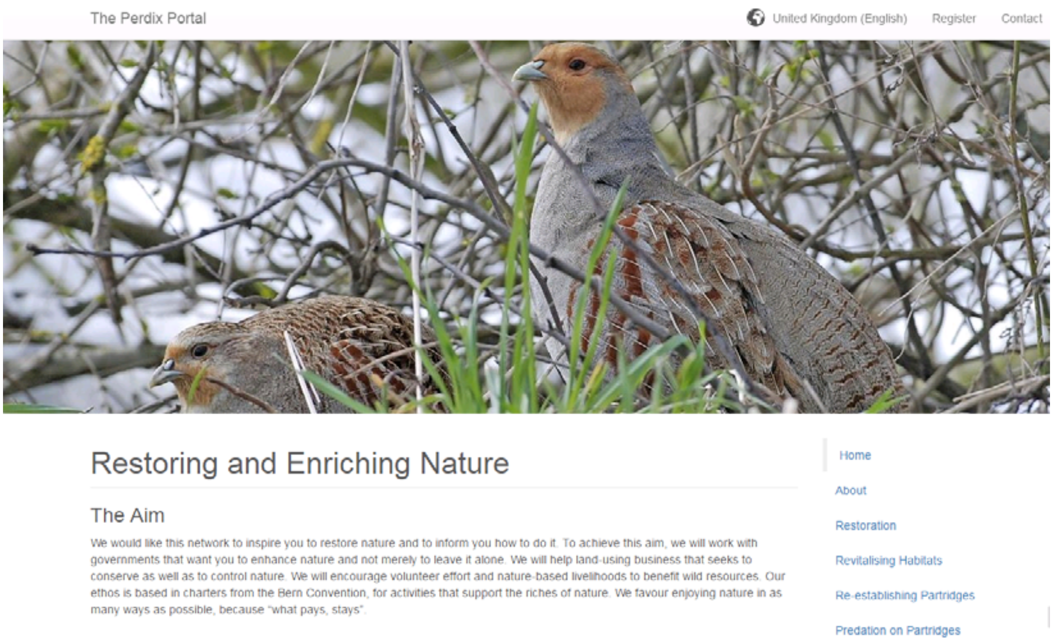
Recommendations from Multilateral Environmental Agreements (MEAs), under the Conventions on Biological Diversity (CBD), the Conservation of European Wildlife and Natural Habitats (Bern Convention), and the Conservation of Migratory Species (CMS; Bonn Convention) can provide a governance framework for conserving wild living resources through sustainable use[1]. Additionally, non-governmental actions are required to translate high-level efforts into effective conservation at local level[2] and MEAs underline need for local capacity and adaptive management in conservation. Research funded by European Commission showed that the financial value of private payments for ecosystem services is as high as state payments through the Common Agricultural Policy[3], and confirmed that conservation of biodiversity and sustainable use of ecosystem services associated most strongly with local knowledge capacity and adaptive management[4]. This work launched the first in a series of multilingual web-portals (www.naturalliance.eu) to encourage conservation through sustainable use. Another multilingual portal (www.sakernet.org) was designed for the Saker Falcon, following a Global Action Plan by CMS[5] that motivated falconers to help reverse a population decline. This project brought together several NGOs, including the International Union for Conservation of Nature (IUCN), the International Association for Falconry and Conservation of Birds of Prey (IAF) and Birdlife International. The successful outreach to practitioners through the previous portals has now encouraged IAF, IUCN and the Game and Wildlife Conservation Trust to start a network of multilingual project portals for research and restoration by communities and individual managers of land and species. The first of these, using the Grey Partridge and insect pollinators as flagships for conserving biodiversity in agricultural ecosystems (Fig. 1, www.perdixnet.org), is now signposted through local clubs and council administrations by a system for community liaison (http://sycl.net). Other projects, that should focus and advertise the actions of hunters and anglers, are being planned for beneficiaries of wild living resources worldwide.

Figure 1: *Perdixnet, an example of multilingual online restoration project hosting.*



References

[1] **Kenward, R., R. Sharp, B. Manos, S. Arampatzis, S. Brainerd, Y. Lecocq, K. Wollscheid & F. Reimoser** (2009). Conservation from use of biodiversity and ecosystem services. In Skrynnik, Y., Bendersky, E., Lecocq, Y., Melnikov, V., Petrikov, A., Sitsko, A., Fertikov, V. & Schramm, D. XXIX International Union of Game Biologists Congress. Ministry of Agriculture of the Russian Federation, Moscow, Russia. Pp. 68-83.

[2] **Brainerd, S.** (2007) European Charter on Hunting and Biodiversity. Bern Convention, Council of Europe, Strasbourg. www.coe.int/t/dg4/cultureheritage/conventions/Bern/ Recommendations/tpvs07erev_2007.pdf

[3] **Papathansiou, J. & R. Kenward** (2014). Design of a data-driven environmental decision support system and testing of stakeholder data-collection. *Environmental Modelling and Software,* **55:** 92-106.

[4] **Kenward, R.E., M.J. Whittingham, S. Arampatzis, B. Manos, T. Hahn, A. Terry, R. Simoncini, J. Alcorn, O. Bastian, M. Donlan, K. Elowe, F. Franzén, Z. Karacsyonyi, M. Larsson, D. Manou, I. Navodaru, O. Papadopoulou, J. Papathanasiou, A. von Raggamby, R. Sharp, T. Söderqvist, Å. Soutukorva, L. Vavrova, N.J. Aebischer, N. Leader-Williams & C. Rutz** (2011). Identifying governance strategies that support biodiversity, ecosystem services and resource sustainability. *Proceedings of the National Academy of Sciences,* **108:** 5308–5312.

[5] **Convention on the Conservation of Migratory Species, Raptors MoU.** (2014) Saker Falcon Falco cherrug Global Action Plan (SakerGAP), including a management and monitoring system, to conserve the species. CMS Technical Series No. 31.

Keywords: Sustainable use, adaptive management, falconry, citizen science, internet portal, grey partridge

(oral)

Shoot management for grey partridge recovery over 15 years and its effect on arable flora and cereal invertebrates

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Numbers of the grey partridge (*Perdix perdix*) have declined across much of Europe since the second half of the last century. For example, UK abundance in 2014 was 91% lower than in 1967 (1). The management required to turn around the fortunes of this gamebird is well established and there are numerous examples of landowners and gamebird ecologists working together to restore grey partridge numbers (2,3,4). Previously we reported on the successful restoration of a wild grey partridge shoot by one of the landowners on the GWCT's Sussex Study area, starting in 2003 (5,6). This wild grey partridge shoot continues to this day, this year marking the 15th year since restoration began and we report on the success of the project in terms of grey partridge abundance and shooting. We examined the effect of partridge management on arable flora and invertebrate abundance – particularly groups that contribute to food resources for grey partridges and other farmland birds. Arable flora responded positively to the conservation headland around each cereal field on the shoot area, with 26 of 34 taxa (76%) important in the diet of grey partridges and other farmland birds found significantly more often than on the remainder of the study area. Chick food index (7) was not found to differ significantly between the managed area and the unmanaged area whereas the chick survival rate of grey partridges averaged 46.4% on the managed area versus 33.9% on the remainder. This prompted us to investigate how the relationship between chick survival and invertebrate abundance has changed since the recovery project started, taking into consideration habitat management.

References

[1] **Robinson, R.A., D.I. Leech, D. Massimino, I. Woodward, M.J. Hammond, S.J. Harris, D.G. Noble, R.H. Walker, S.M. Eglington, J.H. Marchant, M.J.P. Sullivan & S.R. Baillie** (2016). BirdTrends 2016: trends in numbers, breeding success and survival for UK breeding birds. Research Report 691. BTO, Thetford. http://www.bto.org/birdtrend.

[2] **Buckley, K., P. Kelly, B. Kavanagh, E.C. O'Gorman, T. Carnus & B.J. McMahon** (2012). Every partridge counts, successful techniques used in the captive conservation breeding programme for wild grey partridge in Ireland. *Animal Biodiversity and Conservation*, **35:** 387–393.

[3] **Draycott, R.A.H.** (2012). Restoration of a sustainable wild grey partridge shoot in eastern England. *Animal Biodiversity and Conservation*, **35:** 381-386.

[4] **Koch, H.** (1999). Des territoires spécialement aménagés pour la perdrix grise. *Le Chasseur de Petit Gibier*, **5:** 18-22.

[5] **Ewald, J.A., G.R. Potts & N.J. Aebischer** (2012). Restoration of a wild grey partridge shoot: a major development in the Sussex study, UK. *Animal Biodiversity and Conservation,* **35:** 363-369.

[6] **Potts, G.R.** (2012). Partridges. Countryside Barometer. New Naturalist Library Book 121. Collins, London.

[7] **Potts, G.R. & N.J. Aebischer** (1991). Modelling the population dynamics of the Grey Partridge: conservation and management. In: Perrins, C.M., Lebreton, J.-D. & Hirons, G.J.M. (eds) Bird Population Studies: Their Relevance to Conservation and Management: 373-390. Oxford University Press, Oxford.

Keywords: *Perdix perdix*, grey partridge, chick food, farmland birds, cereal ecosystem, agri-environment measures

(poster #14)

Involving and retaining hunters in the management of migratory birds and their habitats: concertation and networking to "act local"

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The use of common natural resources has led European public policies to progressively evolve legislation and actions in the field of management and protection of nature. These measures have been characterized in particular by the implementation of directives ("Birds" and "Habitats") and the Natura 2000 network. However, this system has its limits when it's dealing with migratory birds species. Their life cycle is not limited to state or administrative divisions and they exploits environments of various countries of the Western Palearctic, many of which are located outside the European Union. From now on, the future of migratory bird management is increasingly being conceived in a concerted and shared way. The aim is to guarantee the sustainability of human actions.

Hunting is one of the main activities whose sustainability is regularly questioned, especially when it concerns migratory birds. To ensure this, an objective is dedicated to the knowledge and management of harvests. The notion of adaptive management becomes predominant, and a slogan summarizes the approach taken today: "think global, act local". The first part of the adage is increasingly integrated, in the manner of the North American management, born from the middle of the twentieth century. The rise of the African-Eurasian Waterbirds Agreement (AEWA) or the consultation of groups of scientists (especially the Waterbird Harvest Specialist Group) are characteristic signs that "think global" is taking place [6]. In order to sustainably manage a population, it is known, at least intuitively and theoretically, what information is needed: reproductive numbers, productivity of its numbers, natural mortality, mortality linked to harvest, etc.

Conversely, "act local" part requires a significant increase in the collection of information concerning both the hunted species (age-ratio, sex-ratio, weight...) but also their habitats according to their life cycle (quality and quantity of functional units, frequentation of stopover sites, density/productivity/survival of breeders...). Environmental professionals (from simple natural space managers to the most sophisticated scientists) have a key role to play, but moving from "think global" to "act local" cannot be done without acceptance and involvement of local actors, in the forefront of which the hunters.

The challenge becomes to convince, involve and then retain hunters, both in the return of their harvests, the management of the habitats of the species concerned but also in the provision of key information to the management of these species, the most often with sampling protocols (collection of wings, crops / gizzards ...) or observations (feeding of databases...). It's possible to envisage access to this information in a standard way through a simple request, but the approach from this angle sometimes does not give sufficient results in terms of number of participants.

Research has been conducted on rural and / or indigenous populations through the gateway to local ecological knowledge [3, 5]. The issue was access to old data, on large spaces (especially in the Arctic areas) in areas that are rarely frequented by humans, if not local populations. These latter provisions include long periods of observation and sometimes of traditional knowledge transmitted by their ancestors. Supplemented by their own empirical knowledge, these latest contributions to the co-construction of species and environmental management, like co-management or adaptive management [1]. Methods have been developed to gain access to reliable and sustainable knowledge [4]. Adapted to other populations, an approach at the crossroads of human sciences and natural sciences is possible.

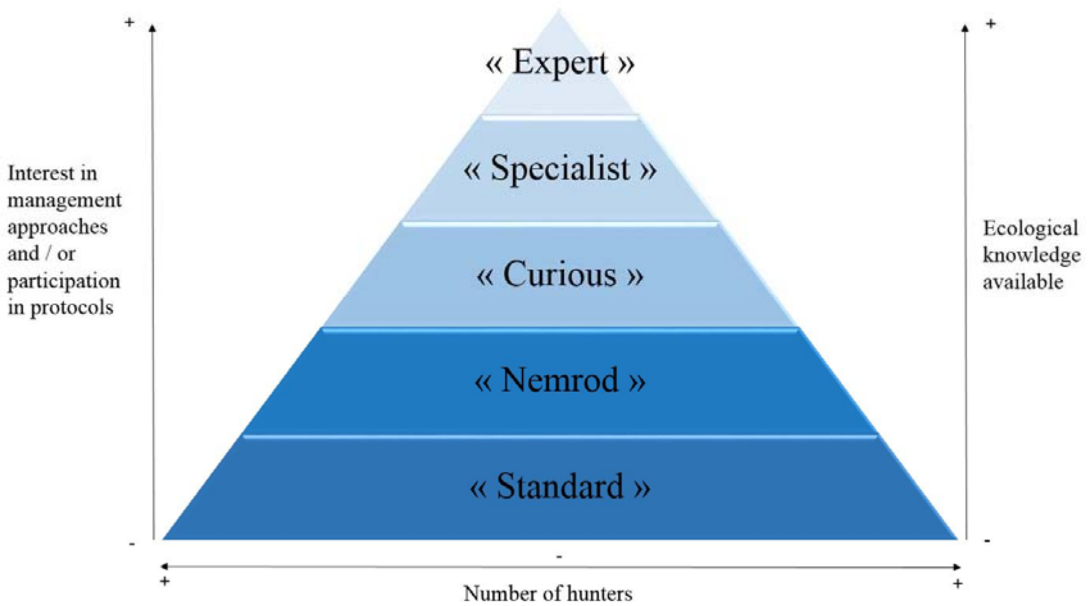
It is based on work carried out in Gironde (France) with waterfowl night hunters [2], and then reproduced in protocols for collecting samples (wings of anatidae, waders...) or management natural areas owned by private individuals. The basic principle that there is a typology of hunters (figure 1), some of which will at first be more receptive to participation in these scientific processes. These latter are few but their identification is generally facilitated by their involvement in specialized associations or more simply by their peer designation [6], giving them a certain legitimacy.

The strategy must be done in stages and then expanded to the greatest number:

1. Information through general oral procedures (Board of Directors, General Assembly ➔ Awareness of the most involved.
2. Individual returns of information on samples provided or actions implemented ➔ Information exchange (donation and counter-donation) and creation of the relationship of trust.
3. Returns to specialized meetings.

If the first year will mobilize rather than an audience of "experts" and "specialists", the following will allow to integrate other types of hunters, first "curious", scrutinizing the return of the first “testers” and the consequences of such participation. Then an iterative process will gradually take place from year to year, extending the mobilization to all categories, providers of less knowledge but much more numerous. This process, which takes longer and involves more time, nevertheless guarantees the involvement and the loyalty of the hunters. Ultimately, they will be more inclined to engage in protocols initially complex to implement, but especially more receptive to contemporary evolutions, such as adaptive management.

Figure 1: *typology of hunters based on their interest in management approaches and participation in ecological protocols and knowledge.*



References

[1] **Berkes F., J. Colding & C. Folke** (2000). Rediscovery of Traditional Ecological Knowledge as adaptive management. *Ecological applications,* **10(5):** 1251-1262.

[2] **Farau S.** (2016). Les savoirs écologiques des chasseurs de gibier d’eau girondin : étude de leur validité pour une gestion de l’avifaune des zones humides. Thèse de doctorat, Université de Pau et des Pays de l’Adour, Géographie spécialité Aménagement, 239 p + annexes.

[3] **Gilchrist G., M. Mallory & F. Merkel** (2005). Can local ecological knowledge contribute to wildlife management? Case studies of migratory birds. *Ecology and Society*, **10(1):** 20

[4] **Huntington H.P.** (2000). Using traditional ecological knowledge in science: methods and application. *Ecological application*, **10(5):** 1270-1274.

[5] **Huntington H. P.** (2011). Arctic science : the local perspective. *Nature*, **478:** 182-183.

[6] **Johannes, R.E.** (1981). Word of the Lagoon: Fishing and Marine Lore in the Palau District of Micronesia. Berkeley, University of California Press, 320 p.

[6] **Madsen J., M. Guillemain, S. Nagy, P. Defos du Rau, J.Y. Mondain-Monval, C. Griffin, J. H. Williams, N. Buffeneld, A. Czajkowski, R. Hearn, A. Grauer, M. Alhainen & A. Middleton** (2015). Towards sustainable management of huntable migratory waterbirds in Europe. *Wetlands International*, 47 p.

[7] **Olsson P., C. Folkes & F. Berkes** (2004). Adaptative comanagement for building resilience in social-ecological systems. *Environmental management*, **34(1):** 75-90.

Keywords: migratory birds, hunters, harvest, networking, consultation, adaptive management

(poster #15)

Operational experimentation of management methods on the Breton Marsh *(Marais breton,* Vendée, France) for breeding waterbirds: method and first results.

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The Breton Marsh (*Marais breton*, Vendée, France) is one of the most important Atlantic coastal wetlands (about 32 000 ha). It hosts an exceptional diversity of breeding waterbirds (especially waders and Anatidae) for the French metropolitan territory, with most of the national breeding stock for some species: nearly 1 600 pairs of northern shovelers *Anas clypeata* (80 % of national number), 2500 pairs of lapwing *Vanellus vanellus* (between 14 and 21 % of national number), and about 100 pairs of Black-tailed godwit *Limosa l. limosa* (about 65 % of national number) [5, 6]. This diversity can probably be explained by the surface of the wetlands [1, 4] and the mosaic of habitats that are there [3]. These habitats are probably the consequence of very specific human development (salt marshes, ponds…) and management methods [2] and development, leading to a heterogeneity both of vegetation heights and water levels. In order to better understand the links between breeding birds and these, a study is carried out over three years on the main breeding period of waterbirds, between March and July. The year 2015 took place of initial state to lead to experiments in 2016 and 2017.

Our work assumes a positive correlation between the diversity of breeding waterbirds and the heterogeneity of vegetation levels and water levels. These are probably obtained according to the variation of the management methods both in time and space: water conservation, grazing (cattle, equine...), mowing... To verify these hypotheses, twelve sites between 3 to 4 hectares were selected in the Breton Marsh. In the begin of Marsh 2015, each site was divided into four types of environments (grasslands, ponds, islets, ditches) and each environment, named subsite, was differentiated from the others (figure 1).

Follow-ups on the presence of water birds (staging or breeding) were carried out by fortnights between March and July, and each time an estimate of the vegetation heights (table 1) and of the water levels (table 2) by percentages of coverage could be made. An index of heterogeneity could thus be calculated for these two categories, by calculating the inverse of the sum of the deviations to the mean:

Heterogeneity vegetation/water index (IHV/IHW): $1/ \left| \sum m - x \right|$; [0,625 ; 50]
m = mean; x = value of percentage of coverage

Example: Class 1 = 0,3 (30 %) ; 2 = 0.5 ; 3 = 0,1 ; 4 = 0,1 ; 5 = 0.
IHV = $1/\left|0,3-0,2\right|+\ldots+\left|0-0,2\right| = 1,11$

Correspondence analyses were also carried out between breeding pairs and the different sites on which they were observed, as well as species and sub-sites (figure 2). The first results show that the sites frequented by high diversity of these waterbirds are those with the highest indices of heterogeneity. At the same time, the species then focus on finding more specific conditions in some sub-sites to breed.

Figure 1: Sktech of a study site. "B" = pond; "P" = grassland; "I" = islet; "F" = ditch.

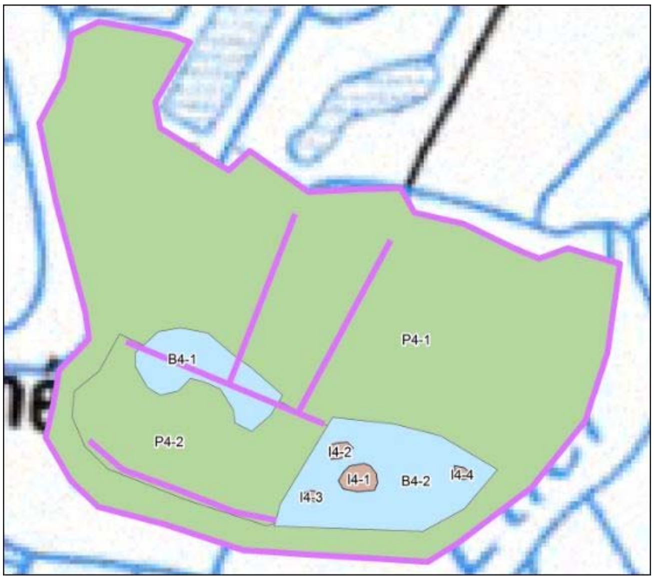

Figure 2: Correspondence analysis between environments and breeding species.

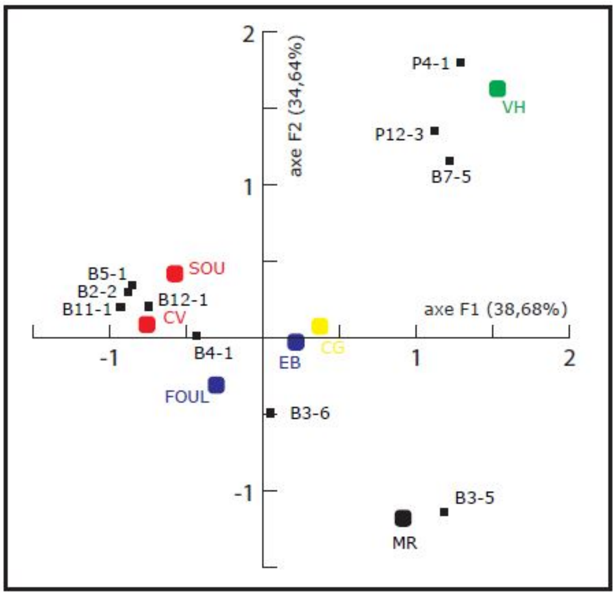

***Table 1:** Class of vegetation height.*

1	2	3	4	5
0 < x > 7 cm	7 < x > 15 cm	15 < x > 30 cm	30 < x > 50 cm	X > 50 cm

***Table 2:** Class of water levels.*

1	2	3	4	5
"wet ground"	0 < x > 5 cm	5 < x > 10 cm	10 < x > 15 cm	X > 15 cm

References

[1] **Celada, C. & G. Bogliani** (1993). Breeding bird communities in fragmented wetlands. *Boll. Zool.*, **60:** 73-80.
[2] **Kaminski R.M., A.G. Baldassarre & T.A. Pearse** (2006). Waterbird responses to hydrological management of Wetlands Reserve Program habitats in New York. *Wildlife Society Bulletin*, **34(4)**: 921-926.
[3] **Ma Z., Y. CAI, B. LI & J. CHEN** (2010). Managing wetland habitats for waterbirds: an international perspective. *Wetlands*, **30:** 15-27.
[4] **Paracuellos, M. & J.L. Telleria** (2004). Factors affecting the distribution of a waterbird community: the role of habitat configuration and bird abundance. *Waterbirds*, **27(4):** 446-453.
[5] **Trolliet B., O. Girard, F. Ibanez, A. Levesque, J.C. Delattre & A. Moreau** (2016). Les limicoles nicheurs du Marais breton. *Faune sauvage*, **312:** 4-10.
[6] **Trolliet B., O. Girard, F. Ibanez, A. Levesque & A. Moreau** (2016). Les anatidés nicheurs du Marais breton. *Faune sauvage*, **313:** 4 - 10.

Keywords: wetlands, breeding waterbirds, management methods, vegetation heights, water levels, *Marais Breton*

(poster #16)

Population Dynamic of Roe Deer (*Capreolus capreolus*, L. 1758) in the Ticino River Natural Park (Northern Italy): from the reintroduction to nowadays

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The Roe Deer (*Capreolus capreolus* L., 1758) is the most abundant and widespread deer in Europe, even though in Northern Italy was absent in the Po Plain since the last centuries. Between 1991 and 1994 a reintroduction project was carried out in the Ticino River Natural Park (province of Milan), with the release of 43 individuals in the first phase (capture and immediate release) and 47 individuals in the second phase (capture, acclimatization, and release) [1]. The aim of this study was to assess the reintroduction success after more than twenty years after the reintroduction by defining the habitat occupancy by the species and its population level and structure.
The study area extends 147.28 Km^2 and is placed in the south-western part of the Lombardy, in the Ticino Valley. The data were collected during the years 2015 and 2016 using two census techniques: camera-trapping and direct observations by car. Data collection was planned by a Tessellation Stratified Sampling design (*TSS*, [2]), within 56 sampling units represented by cells of a 2-km grid. Camera-traps were posed at 292 random points localized into the 56 cells, monitored twice a year, both in autumn-winter and spring-summer. The data about the age and sex structure of the population were analyzed by the Chi-square goodness-of-fit test and Likelihood Ratio (G test) for contingency tables. Furthermore a Population Viability Analysis (PVA) was run in order to define the probability of persistence (or on the contrary, of extinction) of the population within a specified future time interval (in this case thirty years) [3]. The PVA was conducted with the software *Vortex 10.0* [4] and the parameters used in the analysis derived from data collected during the census and literature. The PVA was performed running seven simulations, considering an initial population size of 30, 50, 200, 400, 600, 800 e 1000 individuals. Overall 94 Roe Deer were observed, distributed widespread in the Park, but for only 79 individuals it was possible to determine the sex and/or age. The global sex ratio (SR) was equal to 0.75, not significantly different from the expected sex ratio of 1:1 (Table 1). Moreover the sex ratio did not vary significantly between age classes (LR = 0.120; df = 1; P = 0.729). The reproduction success, calculated as the percentage of female which rear a fawn successfully, was equal to 33.0% (SD = 4.43). The PVA simulation showed that the population will increase over the next 30 years with a negligible extinction risk (Figure 1). Although the population is growing, the Roe Deer will not reach the carrying capacity (K) in the next 30 years, unless the initial population size was equal to 1000 individuals.

Figure 1: *Trend of the Roe Deer population in the Ticino River Natural Park in the next 30 years (K = 2495).*

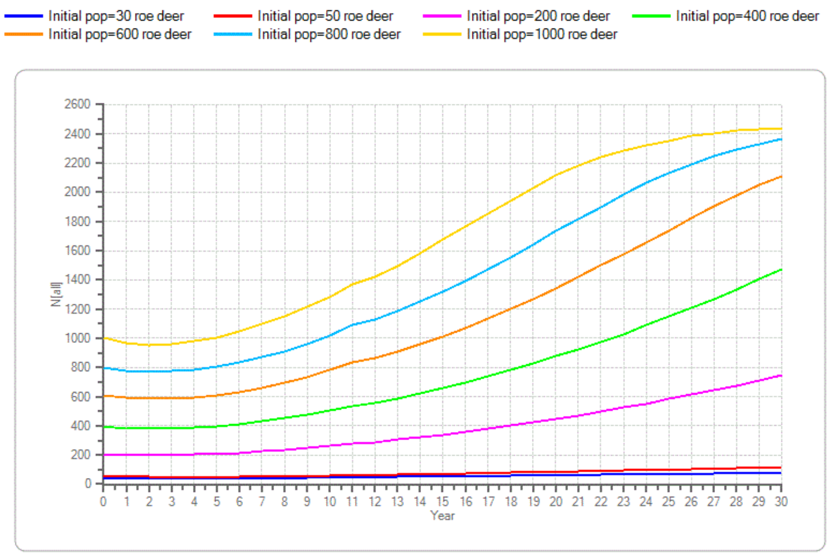

Table 1: *Roe Deer sex ratio (SR) in the Ticino River Natural Park.*

	Female	Male	SR (ff/mm)	Chi-square	df	P
Subadult	8	13	0.62	1.191	1	0.275
Adult	20	27	0.74	1.043	1	0.307
Total	30	40	0.75	1.439	1	0.232

References

[1] **Cravin, A. & D. Roveda** (2003). La reintroduzione del capriolo nel Parco del Ticino. *Consorzio Parco Lombardo della Valle del Ticino, Arti Grafiche Frattini*. Bernate Ticino (Italy).

[2] **Barabesi, L. & L. Fattorini** (2013). Random versus stratified location of transects or points in distance sampling: theoretical results and practical considerations. *Environ Ecol Stat*, **20:** 215-236.

[3] **Boyce, M.** (1992). Population viability analysis. *Annual Rev Ecol System*, **23:** 481-506.

[4] **Lacy, R.C. & J.P. Pollak** (2014). Vortex: a stochastic simulation of the extinction process. Version 10.0. *Chicago Zoological Society*, Brookfield (USA).

Keywords: Roe Deer, reintroduction, PVA, population dynamic, protected area

(oral)

MCR-system: combining passive marking and MR models to evaluate wild boars (*Sus scrofa*) abundances.

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An appreciated game species on the one hand, a species causing significant damages in agricultural lands on the other hand, the wild boar has contradictory, emotionally charged images amongst different stakeholders. The management of wild boar populations represents thus a challenge to managers, and this is made worse by the difficulty to assess the abundance of its populations. Most census technics are indeed considered as inappropriate for this species, and the few methods that might give representative results are too expensive to be used routinely. Wild boar populations are increasing and spreading in Switzerland, as in many parts of Europe, and more accurate census technics are needed to be able to establish adapted hunting quotas. In this context, we are developing a new census technic that should not be biased by climate, habitat, or hunting regime. It should also be easy to use, and cheap enough for managers to be used routinely. Aim of our method is to use MR-based models, similar to those used for species that are naturally, individually recognizable. A physical capture and marking is however too time demanding and expensive for managers to be used routinely. We thus propose a system that allows to passively Mark, Capture, and Recapture wild boars: a MCR-system. In this system, wild boars are marked at stations (baited or with natural attractiveness) regularly scattered within a given study area. The capture and recapture is achieved by camera-traps. First results show that this system allows to effectively mark wild boars of different sizes, in a passive way, and to identify them on the pictures, even after several days. The marking stations have however the potential to be improved. We are also still comparing different MR-models to determine the most appropriate one.

Keywords: Census technique, coloration, non-invasive marking, CMR-models

(poster #17)

Assessing the risk for an obligate scavenger to be dependent on routinely supplemented feeding sources

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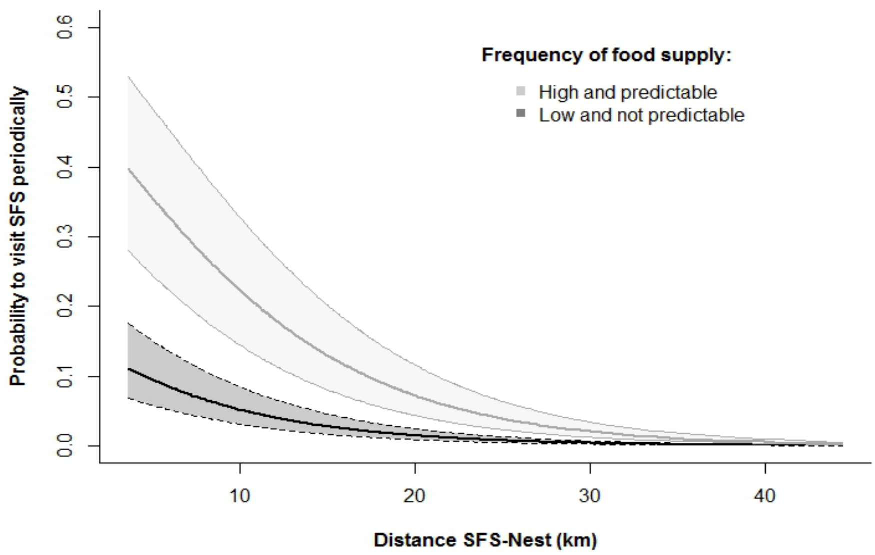
In a context of supplementary feeding, increasing artificially the predictability of resources may represent an ecological trap for obligate scavengers [1, 2]. For species that evolved to search for ephemeral and unpredictable resources like carrions [3], the display of foraging routines at supplementary feeding stations (SFS) where food is more likely to occur may hamper their natural behaviour [4], and hence population dynamics and viability. We used recent methodologies to investigate the possible existence of routine movement behaviour of the Eurasian Griffon vultures (*Gyps fulvus*), in southern France, where livestock carrions are provided at SFS [5]. We assessed whether the human-driven spatio-temporal distribution of resources would led vultures to display temporal and/or spatial routine foraging behaviours.
Overall, providing griffon vultures with supplementary food resources resulted in some regularity in their foraging patterns but at low levels. We show that only a low fraction (about 10%) of the SFS included within individuals' home ranges were periodically visited with a regular time-interval ranging from 1 to 6 days. The closer the SFS to their nest, and the higher the frequency of food supply, the more likely vultures tended to visit the site periodically (Fig 1). Vultures also tended to repeatedly visit series of SFS more often than expected if they would forage at random, but the average routine index remained nevertheless quite low. The observed spatial routine patterns consisted in few repeated short sequences of SFS.
Our results suggest that even when they are mainly human-fed, vultures rely only marginally on routine behaviour to find carcasses. They are most likely to be opportunistic and rely on public (social-based) information involving local enhancement. Diluting the availability of carcasses at a larger spatial scale, individual feeding stations (IFS) make food resources not predictable enough to disrupt the natural and social behaviour of griffon vultures. We thus encourage managers to establish IFS rather than collective feeding stations (CFS) as a conservation tool for avian scavengers, mimicking the availability and predictability of food resources close to natural conditions.

Figure 1: *GLMM predicted probabilities (with 95% confidence intervals) that an individual visits a supplementary feeding station (SFS) periodically as a logistic function of the distance between the SFS to its nest, and of the type of SFS (individual (IFS) versus collective (CFS) feeding. Grey and black lines and points indicate the type of SFS, i.e. IFS and CFS, respectively. The predicted probabilities that an individual visits a SFS periodically are represented with solid lines. The space between the dashed/thin curves shows the variation between the predicted values per individual (i.e. predicted probabilities ± 1.96 * SE).*



References

[1] **Duriez, O., S. Herman & F. Sarrazin** (2012). Intra-specific competition in foraging griffon vultures: 2. the influence of supplementary feeding management. *Bird Study*, **59:** 193–206.
[2] **García-Heras, M.-S., A. Cortés-Avizanda & J.A. Donázar** (2013). Who Are We Feeding? Asymmetric Individual Use of Surplus Food Resources in an Insular Population of the Endangered Egyptian Vulture Neophron percnopterus. *PLOS One*, **8:** e80523.
[3] **Ruxton, G.D. & D.C. Houston** (2004). Obligate vertebrate scavengers must be large soaring fliers. *Journal of Theoretical Biology*, **228:** 431–436.
[4] **Deygout, C., A. Gault, F. Sarrazin & C. Bessa-Gomes** (2009). Modeling the impact of feeding stations on vulture scavenging service efficiency. *Ecological Modelling*, **220:** 1826–1835.
[5] **Monsarrat, S., S. Benhamou, F. Sarrazin, C. Bessa-Gomes, W. Bouten & O. Duriez** (2013). How Predictability of Feeding Patches Affects Home Range and Foraging Habitat Selection in Avian Social Scavengers? *PLOS One*, **8:** e53077.

Keywords: Supplementary feeding, routine behaviour, foraging, ecological trap, vultures, *Gyps fulvus*

(oral)

Precocity as a major determinant of Common Pochard (*Aythya ferina*) nesting success

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Common pochard (*Aythya ferina*) is a harvested diving duck which has been experiencing a sharp decline in population size over the last decades in the Northwest European flyway. This decline has been hypothesized to result from reduced breeding success in former strongholds of central Europe. Assessing the factors underlying breeding success in this species is therefore a priority. To assess the determinants of nesting success, we modelled daily survival probabilities of nests monitored from 2008 to 2013 on Grand-Lieu Lake (Loire-Atlantique, France). Survival rates experienced large variations according to year and female age (5 to 74%). The effects of year and age were entirely absorbed by the precocity of laying computed separately by age, with higher survival rates observed in both adults and most precocious years. Clutch-size and body condition affected nest survival positively. Nest survival was affected negatively by numbers of neighbouring nests destroyed. Among the habitat components investigated, abundance of open-water, wet meadows, and sedge tussocks had a positive influence on nest survival. In contrast, that of willows had a negative influence. Spring temperatures on one hand and cumulated rainfall and water levels on the other, were positively and negatively correlated to precocity, respectively, although not retained in the best models for daily survival probabilities. Nest success therefore seemed to depend on the mother's quality attributes and to variables affecting predation risk. Envisaging simple habitat management procedures to improve nesting success seems therefore possible, as well as anticipating good versus poor years in terms nesting success.

Keywords: age, body condition, nest survival, duck, habitat features, predation

(oral)

Use of water troughs by the wild red-legged partridge, *Alectoris rufa*, in the south of France. Results of 2 years of camera-trapping.

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Lack of water may be a limiting factor in the dynamics of small game populations in Mediterranean ecosystems. We have studied the use of water troughs by the red-legged partridge in a Mediterranean area. Our study was carried out in the south of France in a private estate of 815 ha devoid of permanent water, and which 83% was occupied by natural vegetation, the rest being crops. We have monitored the use of 22 water troughs by wild red-legged partridges from June 2012 to November 2014 using camera-traps. The wild red-legged partridge population fluctuated during the study between 49 and 115 breeding pairs. We analyzed the annual and daily behaviour of use of drinking troughs in relation to meteorological (temperature, wind speed, rainfall, vegetation water content) and vegetation variables (shrub cover around water points as well as habitat types through Corine LAND COVER). The analyzes were carried out using generalized linear models (GLM) [1]. All tests were conducted using R 3.1.0 [2]. We observed 1374 uses by wild red-legged partridges during the study period. The distribution of the number of use of water troughs differed between months ($p < 0.001$) and also between years ($p < 0.001$). In August 2012 we recorded 396 uses of water troughs while in some months we recorded fewer than 10 uses (June 2012, April, May, November 2013 January, February, March, April, May, July 2014). Our results clearly show that the maximum daily temperature is the meteorological variable that most influences the use of water troughs, as shown by [3]. When the maximum daily temperature increases, the use of water troughs increases (figure 1). Our results do not show an effect of the vegetation water content on the use of water troughs, contrary to the hypothesis that we formulated. During summer, most of the use of water troughs is done in the morning, 66% taking place between 6 am and 10 am. Outside the summer the use of water troughs is low since we recorded on average less than one use per month per water trough and is much better distributed throughout the day ($p < 0.001$) (Figure 2). Our study showed that the most important environmental variable influencing the use of water troughs was the large habitat type in which the watering trough was located. Water troughs located in "natural lawn and pasture" environments are the most widely used, whereas those positioned in forest, shrub vegetation and scrub areas are the least used. Red-legged partridges are also sensitive to the vegetation structure within a radius of 2.5 m around the water troughs. When the percentage of shrub cover within 2.5 m of the water trough increases, the use of water troughs decreases. However, when trees are present in close proximity, use increases. These results confirm the importance of vegetation in the vicinity of game management to explain their use as shown by [4] and [5] in the Choukar partridge (*Alectoris chukar*), and by [6,7] in the red-legged partridge in relation to a feeling of security against predation. The fact that the water troughs are used when the maximum daily temperatures is high makes us advocate the installation of water troughs, mainly in summer. The importance of the type of environment in which the trough is located to explain its use by wild red-legged partridges tells us that managers must pay particular attention to the positioning, since they are not or very few used by red-legged partridges.

Figure 1: *Modelling of the relationship between the maximum daily temperature and the number of wild red partridges appearing on the photographs per day (95% IC).*

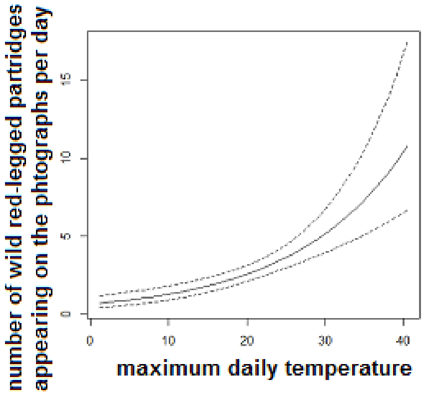
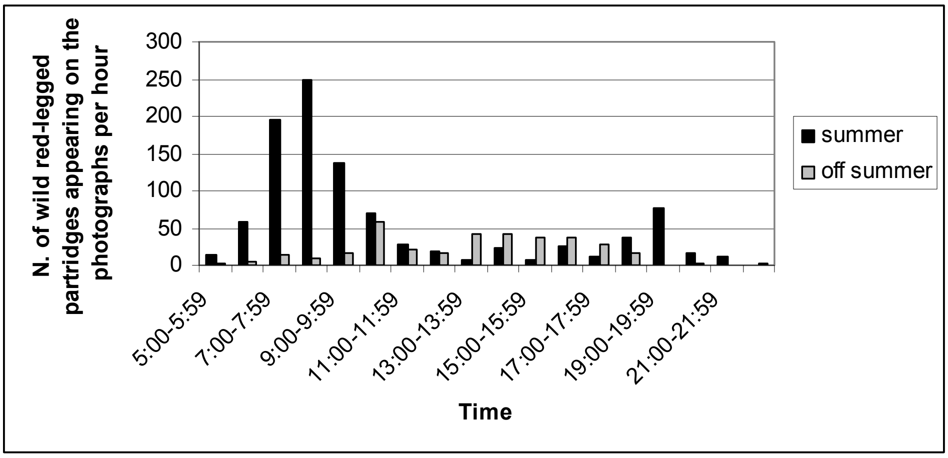


Figure 2: *Histogram of the number of individuals of wild red-legged partridge appearing by hour on the photographs according on time of day.*



References

[1] **Crawley, M.J.** (1993). "GLIM for Ecologists". *Blackwell Scientific Publications*. London United Kingdom.

[2] **R Development Core Team** (2014). R: A Language and Encironment for Statistical Computing (version 3.1.0). R fundation for Statistical Computing.

[3] **Gaudioso Lacasa, V.R., C. Sánchez Garcia-Abad, R. Prieto Martín, D.J. Bartolomé Rodriguez, J.A. Pérez Garrido & M.E. Alonso de la Varga** (2010). Small Game Water Troughs in a Spanish Agrarian Pseudo Steppe: Visits and Water Site Choice by Wild Fauna. *European Journal of Wildlife Research,* **56(4):** 591–599.

[4] **Larsen R.T., J.T. Flinders, D.L. Mitchell, E.R. Perkins & D.G. Whiting** (2007). Chukar Watering Patterns and Water Site Selection. *Rangeland Ecology & Management,* **60(6):** 559–565.

[5] **Wildlife Society** (1990). Nevada chapter, United States. Bureau of land management. Nevada state office, Nevada. Dept. of Wildlife. Wildlife Water Development: A Proceedings of the Wildlife Water Development 192p.

[6] **Sánchez-Garcia, C., J.A. Armenteros, M.E. Alonso, R.T. Larsen, J.M. Lomillos & V.R. Gaudioso** (2012). Water-Site Selection and Behaviour of Red-Legged Partridge *Alectoris Rufa* Evaluated Using Camera Trapping. *Applied Animal Behaviour Science,* **137(1-2):** 86–95.

[7] **Sánchez-Garcia, C., F.D. Buner & N.J. Aebischer** (2015). Supplementary Winter Food for Gamebirds through Feeders: Which Species Actually Benefit? Evaluation of Game Feeder Practices. *The Journal of Wildlife Management,* **79(5):** 832–845.

Keywords: *Alectoris rufa*; behaviour; water trough; camera-trapping; temperature; Mediterranean habitat

(oral)

Managing thermal landscapes for quail: an increasingly hot topic

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Habitat management by landowners and managers usually is directed at increasing food or hiding cover for wildlife, with thermal cover receiving only passing consideration. On the semiarid landscapes of southwestern Texas and adjacent northern Mexico, dealing with summer heat may be as big a challenge to animals as cold winters in northern latitudes. Our objective is to summarize recent research on the influence of heat on habitat use by northern bobwhite (*Colinus virginianus*) and scaled quail (*Callipepla squamata*). Based on continuous selection functions, northern bobwhites use sites with ground surface temperatures ranging from 23 to 39.5 °C and black globe temperatures ranging from 24.5 to 42.5 °C. Scaled quail use sites with ground surface temperatures ranging from 22 to 42 °C and black globe temperatures ranging from 27 to 37 °C. We sampled operative temperatures in an array of 48 black globes placed in grassland and woody plant communities. Mean daily operative temperatures during August 2014 were <39 °C in only 12.5% of these black globes, and maximum monthly temperatures <39 °C were recorded in only 6% of these black globes. Sites with woody vegetation structure that adequately reduces exposure of quail to high temperatures are rare. Climate models have projected average temperatures to increase by 4 to 6 degrees by 2080, making conservation of thermal cover of upmost importance. Traditional quail management often consists of soil disturbance to promote herbaceous plants and brush clearing. Instead, we recommend that landowners and managers seek ways to enhance the amount of thermal cover available.

(oral)

Reintroduction of large game species to Gilé National Reserve, Mozambique

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Like other protected areas having experienced armed conflicts, Gilé National Reserve, Mozambique, lost a large share of its wildlife during decades of unrest and post-war recovery. Several species of large mammals became extinct in the Reserve around the turn of the century.
The rehabilitation of the Gilé National Reserve was bolstered in 2007 by a partnership between the ANAC (*Administração Nacional das Áreas de Conservação*) and the IGF Foundation (*Fondation Internationale pour la Gestion de la Faune*) with the support of the FFEM (*Fonds Français pour l'Environnement Mondial*). This effort required to: (i) restore and protect the unfenced ecosystem of about 5000 km2, (ii) improve and develop the functioning of the Reserve and its Buffer Zone, and (iii) reintroduce extinct large mammals. In 2012 and 2013, three species of large mammals were reintroduced to the Reserve: (i) 67 Southern African buffalo (*Syncerus caffer caffer*), (ii) 20 Nyassaland wildebeest (*Connochaetes taurinus johnstoni*) and (iii) 15 Crawshay's zebra (*Equus quagga crawshayi*).
Founder individuals originated from Marromeu National Reserve, Gorongosa National Park (2012) and Niassa National Reserve (2013), the nearest possible wild free-ranging populations, in an effort to select the closest possible taxa to the extinct ones, with the least genetic manipulations, and the healthiest sanitary status. Monitoring of released animals included: (i) GPS and VHF tracking of 6 buffalo, 2 wildebeest and 1 zebra, (ii) opportunistic observations by anti-poaching patrols, and (iii) direct and indirect observations by experienced trackers.
After a successful release, the animals spent a few days moving away from the release site. Two groups of about 3 buffalo each, as well as one zebra, quickly left the Reserve and eventually disappeared. All other animals temporarily settled within the Reserve within 10-30 km from the release site. Over the following 2-3 months all three species alternated exploration and sedentary phases as they gradually established their respective home ranges. Re-sightings provided evidence that the threes species are successfully breeding with a marked increase for buffalo (82 individuals observed in 2016) and a possible slow increase for zebra (18 individuals observed in 2016) and wildebeest (20 individuals observed in 2015). The reintroduced populations are growing albeit at a lower rate than expected for an area with suitable habitat and extremely low large carnivore densities, suggesting that some individuals may have been killed by poachers or dispersed due to human disturbance especially illegal logging.
Recommendations for ensuring the success of the reintroduction operation include: (i) enhancing the surveillance of illegal activities in the Reserve, (ii) reinforcing the populations of zebra and wildebeest, and (iii) reintroducing other extinct species of large mammals.

Keywords: ecosystem restoration, reintroduction, animal movement, GPS, human disturbance, wildlife population monitoring

(keynote)

How do ungulates respond to environmental changes in temperate ecosystems?

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During the last half century, populations of large herbivores have increased tremendously over much of the temperate ecosystems, both in number and range, likely due to the regulation of hunting and to increased frequency of mild winters. However, it is unlikely that such irruptive dynamics is sustainable over the long term, particularly in view of the increasing rate of change in climatic conditions. There is clear evidence that in temperate ecosystems spring begins earlier in recent time, and how ungulates respond to this marked environmental change has become a key issue. We can envision three main types of responses to environmental changes: to resist, to adjust, or to move. I will first briefly review our current knowledge on ungulate responses that have been reported from intensively monitored populations, which will reveal a diversity of responses across ungulate species. I will then focus on the particular case of roe deer (*Capreolus capreolus*), the most widespread species of temperate ecosystems in Europe for which detailed data on reproductive phenology have been accumulated in several populations. In particular, I will compare patterns of birth timing across populations living at markedly different locations and will assess the potential influence of birth timing in a changing world on roe deer individual fitness and population dynamics.

(oral)

Trends in Teal bag in the Camargue: impact of weather and multi-scale abundance

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Assessing trends in migratory game species is a much debated and complex issue, not only for methodological reasons but also because of the international and sometimes controversial concerns involved. This is especially the case when the authorities have to decide whether or not a population of a given migratory species can be harvested. In Europe, several institutional tools have been developed to guide waterbird management, like the AEWA or the EU bird directive. Some species of geese are now harvested in Europe in a legal framework leaning toward adaptive management, but this is not yet the case for most of the other waterbird game species, despite current efforts. For many migratory bird populations, an adequate knowledge of the harvest levels and factors controlling them is indeed missing.

The Camargue (France) is one of the major river deltas in the Western Mediterranean. It is a wetland of international importance for several waterbird species and a major stronghold for wintering ducks at the European scale. It is also one of the most important areas in France for wildfowling. We conducted a long-term survey of hunting bags and activity in the Camargue since the 90's. A full inventory of the shooting estates was conducted in 1999 and is being updated regularly. Using GLMs/GAMs, time-trend in species-specific bag data were assessed for Common Teal (Anas crecca) on 119 private hunting estates amounting to 64% of the total area of private hunting in the Camargue.

The preliminary results of Mixed-GLM, revealed significant positive relationships between bag per unit effort (BPUE) and wind as well as the frequency of cold spells, while negative relationships were found between BPUE and cumulative local precipitation during the hunting period, winter NAO and distance to local day roost [1]. Wind is a factor which can influence hunter effectiveness [2], and all of these covariates can impact local abundance of game waterbirds [3]. This model was then improved when we added one of several population abundance indices (from the International Waterbird Census) for different spatial scales: European, national (France), regional (Mediterranean basin) and local (Camargue). All such indices showed positive relationships with BPUE and some were significant, including national and regional indices. Including national and regional indices significantly improved the model.

Local teal hunting bag in the Camargue hence appeared to be influenced by a combination of local and higher-scale factors and depended on the size of the population of common teal wintering in France and in the Mediterranean basin. This observation calls for the adoption of proper flyway-scale management of this population.

References

[1] **Guillemain, M., J.Y., Mondain-Monval, E. Weissenbacher, A.L. Brochet & A. Olivier** (2008). Hunting bag and distance from nearest day-roost in Camargue ducks. *Wildlife Biology,* **14(3):** 379–385.

[2] **Mondain-Monval, J.Y., P. Defos du Rau, M. Guillemain, & A. Olivier** (2015). Switch to non-toxic shot in the Camargue, France: effect on waterbird contamination and hunter effectiveness. *European Journal of Wildlife Research,* **61(2):** 271–283.

[3] **Almaraz, P., A.J. Green, E. Aguilera, M.A. Rendon & J. Bustamante** (2012). Estimating partial observability and nonlinear climate effects on stochastic community dynamics of migratory waterfowl. *Journal of Animal Ecology,* **81(5):** 1113-1125.

Keywords: *Anas crecca*, hunting, trend population, abundance index, GLM

(oral)

Reproductive allocation in pulsed-resource environments: a comparative study in two populations of wild boar

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Pulsed resources influence the demography and evolution of consumer populations and, by cascading effect, the dynamics of the entire community. Mast seeding provides a case study for exploring the evolution of life history traits of consumers in fluctuating environments. Wild boar (*Sus scrofa*) population dynamics is related to seed availability, (acorns/beechnuts). From a long-term monitoring of two populations subjected to markedly different environmental contexts (i.e., both low vs. high frequency of pulsed resources and low vs. high hunting pressure in Italy and in France, respectively), we assessed how pulsed resources shape the reproductive output of females. Using path analyses, we showed that in both populations, abundant seed availability increases body mass and both the absolute and the relative (to body mass) allocation to reproduction through higher fertility. In the Italian population, females equally relied on past and current resources for reproduction and ranked at an intermediate position along the capital-income continuum of breeding tactics. In contrast, in the French population, females relied on current more than past resources and ranked closer to the income end of the continuum. In the French population, one-year old females born in acorn-mast years were heavier and had larger litter size than females born in beechnut-mast years. In addition to the quantity, the type of resources (acorns/beechnuts) has to be accounted for to assess reliably how females allocate resources to reproduction. Our findings highlight a high plasticity in breeding tactics in wild boar females and provide new insight on allocation strategies in fluctuating environments.

Keywords: body mass, breeding tactics, fluctuating environments, masting, path analysis

(poster #90)

Researching recreational activities on different scales with GIS-based modelling – key findings of two case studies in Austria

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Wildlife populations are strongly influenced by landscape-related recreational activities and by other human activities such as agriculture, forestry and hunting. Land use thus influences the habitat use by wildlife in terms of time and space; the sum of all land-use types creates a "landscape of fear" [1], which might affect the animals' fitness negatively and furthermore lead to wildlife damage in forestry and agriculture. Especially land owners and persons responsible for wildlife management want and need information about recreational activities. However, as surveys are costly and e.g. video monitoring in nature is often not acceptable to society at large, modelling aspects of the "landscape of fear", as well as recreational use potentials and potentials for conflicts can be an alternative. Based on examples of two different study areas – with regard to their size and geomorphology as well as their catchment area and types of land use – the challenges of the investigation of the "landscape of fear for wildlife" with reliable data of recreational activities is discussed. Furthermore, the differing functionally interrelated areas and conclusions of this aspect are outlined.

Study areas

Two studies carried out in Austria are discussed: 1) "*IESP – Towards Integrated Ecological Spatial Planning for the Wienerwald Biosphere Reserve – Sustainable Wildlife Management and Leisure Activities*" [2] and 2) the ongoing project "*Integrative sustainable wildlife management in alpine ecosystems*" at the Untersberg, Salzburg.

1) The Wienerwald Biosphere Reserve includes 51 municipalities in Lower Austria and parts of Viennese districts; it covers an area of nearly 106,000 ha – in total, 815,000 persons live in the area. As the Biosphere Reserve is directly adjacent to the City of Vienna (app. 1,797,000 inhabitants in 2014 [3]) it is an attractive destination for recreationists. Activities are carried out in all seasons and at all times of the day and night – e.g. hiking, mountain biking, horse riding and ballooning [2].
2) The study area at the Untersberg is significantly smaller: it covers approximately 2,700 ha and contains parts of three municipalities (in total app. 9800 inhabitants in 2016 [4]); it is situated directly at the Austrian-German border. The study area is adjacent to the City of Salzburg (app. 151,000 inhabitants in 2016 [4]) and easily accessible by private and public transport; the top of the Untersberg can be reached by cableway. The area is regularly used for recreational activities such as hiking, skiing and paragliding (mountain biking is prohibited but also done) and visited by tourists.

Methods

Numerous studies have already been carried out worldwide and a vast amount of literature about lifestyle, characteristics and demands of recreationists already exists. As conducting surveys is costly, data from previous studies as well as volunteered geographic information (e.g. webshare services data) can provide important components to create GIS-based models of recreational use potentials and for spatial analysis of conflict potentials as analytical tools as well as for certain aspects of the "landscape of fear" for wildlife.

In both research projects, the methods used for investigating the recreational activities included expert interviews; in the Untersberg study area additional information was used and analysed from open geographic information (webshare services data). Furthermore, results from literature research, former studies and surveys of the various user groups were implemented. Based on this information, aspects of the "landscape of fear" as well as recreational use potentials and conflict potentials for various recreational activities have been modelled using ArcGIS.

But, however, especially to identify the recreational use potential, the focus not only has to be on the study area or the habitat of species itself – as is the case with land use types such as agriculture, forestry and hunting. Due to the increasing mobility of the human society and growing urban areas, the catchment areas of recreationists also have to be considered.
To identify and analyse the influence of recreational activities on ungulate habitat use, temporal and spatial land use of recreation activities have been analysed on the scale of

1) the catchment area of the recreationists (functionally interrelated areas),
2) the study area itself and
3) crucial wildlife habitats.

Results

Findings outline the importance of integrating functionally interrelated areas for the research of recreational activities and tourism as well as the necessity of combining different research methods.
The appliance of the various methods used in the project (1) IESP in the Wienerwald Biosphere Reserve proved to be effective and it produced reliable results, which were verified in close cooperation with experts and stakeholders. Another factor is that this area is already well studied in significant topics and substantial information is available. When applying those methods in the study area (2) at the Untersberg – and gathering additional information from volunteered geographic information (webshare services data) – it became clear that those methods are not suitable for such a small study area as land usage through recreational activities is strongly dependent on functionally interrelated areas. In contrast to the significantly smaller study area in Salzburg, the Wienerwald Biosphere Reserve represents an extensive study area and already contains extensive parts of the functionally interrelated areas.
So, however, the investigated area has to be extended to include the catchment area of the recreationists as well as – in the case of the Untersberg – the tourists to achieve reliable results. Furthermore, regional peculiarities (e.g. nearby state borders causing differing legislation, the existence of touristic hot spots) have to be taken into account as they can strongly influence recreational activities in an area.

Acknowledgements

The project “*IESP – Towards Integrated Ecological Spatial Planning for the Wienerwald Biosphere Reserve – Sustainable Wildlife Management and Leisure Activities*” was funded by the Man and Biosphere Program of the Austrian Academy of Science (ÖAW). The project “*Integrative sustainable wildlife management in alpine ecosystems*” at the Untersberg, Salzburg was carried out in cooperation with Mayr-Melnhof-Forstverwaltung Salzburg and with financial support by the Austrian Research Promotion Agency FFG (project number 846026).

References

[1] **Ciuti, S., J.M. Northrup, T.B. Muhly, S. Simi, M. Musiani, J.A. Pitt & M.S. Boyce** (2012). Effects of humans on behaviour of wildlife exceed those of natural predators in a landscape of fear. *PLoS ONE* **7(11)***: e50611. doi:10.1371/journal.pone.0050611.*

[2] **Reimoser, F., W. Lexer, Ch. Brandenburg, K. Ziener, B. Schreiber, A. Bartel, H. Tomek, F. Heckl, F. Hirnschall & A. Kasper** (2012). IESP - Towards Integrated Ecological Spatial Planning for the Wienerwald Biosphere Reserve – Sustainable Wildlife Management and Leisure Activities. *Österreichische Akademie der Wissenschaften, 477. Online available: http://dx.doi.org/10.1553/IESP-Wienerwald.*

[3] **MA 23 – Wirtschaft, Arbeit und Statistik** (2015). Wien in Zahlen 2015. *Online available: https://www.wien.gv.at/statistik/pdf/wieninzahlen.pdf.*

[4] **Statistik Austria** (2016). Ein Blick auf die Gemeinde online. *Online available: http://www.statistik.at/blickgem/index.jsp.*

Keywords: recreational activities, GIS-modelling, analysis of webshare data, catchment areas of recreationists, functionally interrelated areas

(poster #18)

Conservation and utilization of the white-tailed Mexican deer (*Odocoileus virginianus mexicanus*) as a detonator of social welfare in the Sierra de Huautla, Biosphere Reserve, Central Mexico

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To effectively implement conservation strategies it is prerequisite to alleviate social problems in human communities associated with biological richness sites. This is a common scenario in developing countries as Mexico.The biosphere reserve of the Sierra de Huautla (RBSH) in the State of Morelos, is the las bastion of biodiversity in the central region of Mexico. In RBSH occur relevant and emblematic wildlife species such the white-tailed Mexican deer (*Odocoileus virginianus mexicanus*), Mexican beaded lizard (*Heloderma horridum*) and five of the six species of felines that are distributed in Mexico, as well 180 bird species, including the endemic banded quail (*Philortyx fasciatus*). RBSH is a good representative sample of tropical deciduous forest, a highly vulnerable ecosystem.

Historically the inhabitants of the Sierra de Huautla have harvested and managed wildlife without good management practices in order to ensure the conservation of resources in a sustainable manner. For instance, transhumance ranching is a common practice and represents one of the few alternatives for survival in the region. Social marginalization and negative economic factors have led the mostly illegal migration of the native inhabitants to the United States of North America, with the aim of sending money for the subsistence of the members of the families who still inhabit the RBSH, which has generated family breakdown and social fractures.

Additionally, traditional agricultural activities have proved to be inefficient and insufficient to generate economic development and social welfare in the RBSH. Since 2010, The Mexican Alliance for Wildlife Conservation in conjunction with official state and federal agencies (e. g. DGVS-SEMARNAT, PROFEPA) has implemented new strategies to contribute to the development of the region. For example the research for generation of basic information on the biology and population status of the white-tailed mexican deer and on other hunting species such as the white-winged dove (*Zenaida asiatica*) and banded quail (*Philortyx fasciatus*) as a first step to propose its use and to develop conservation strategies under the scheme of management units for wildlife conservation (UMA); in order to capitalize on the faunistic and ecological value of the RBSH and help to translate it into economic and social benefits, through the offering of ecotourism and hunting to the country's largest potential market: Mexico City. Implementing community management of natural resources in order to generate human development and maintaining functional ecosystems.

References

[1] **Hernández, F., E.A. Lozano Cavazos, G. Chávez León, D. García Solórzano & L. A. Brennan** (2014). Codornices de México. *En: Ecología y manejo de fauna silvestre en México.* Raúl Valdez y J. Alfonso Ortega-S. Editores. Editorial del Colegio de Postgraduados.

[2] **Hernández Silva, D.A. , E. Cortés Díaz, J.L. Zaragoza Ramírez, P.A. Martínez Hernández, G. Tonatiuh González Bonilla, B. Rodríguez Castañeda & D.A. Hernández Sedas** (2011). Hábitat del venado cola blanca en la Sierra de Huautla, Morelos, México. *Acta Zoológica Mexicana,* **27(1):** 47-66.

[3] **CONANP** (2005). Programa de Conservación y Manejo de la Biosfera Sierra de Huautla. *Comisión Nacional de Áreas Naturales Protegidas.* Secretaria del Medio Ambiente y Recursos Naturales. México. D.F.

Keywords: Mexico, tropical deciduous forest, community, management

(poster #19)

Conservation without borders in jeopardy? The Mexico–United States cross wall border affair

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The idea of physically dividing the border between Mexico and United States of America has been latent in the regional geopolitical environment since past North American presidential administrations. Now this idea has become a controversial reality. Mexico and United States of North America experienced episodes of geopolitical tension from past centuries, as the transfer of Mexican territory that currently constitute as a whole the States of California, Nevada, and Utah, .and partially Arizona Colorado, New Mexico, Oklahoma and Kansas.

But the reality of the border wall going more beyond the geopolitical implications, because it suggests an important involvement of the gene flow of species as endangered as the Jaguar (*Panthera onca*) and masked bobwhite quail (*Colinus virginianus ridgwayii*). In addition, federal funds from the U.S. Fish and Wildlife Service that in the recent past have sponsored programs of priority species such as the Wildlife Without Borders program now are committed. Initiatives that promote strict immigration restrictions for students and Mexican and Latin American researchers who work or study in North American universities, today are seriously compromised. This situation offers a new opportunity to turn the gaze to seek new partnerships and collaborations with universities and conservation organizations in other latitudes.

Keywords: Conservation, borders, Mexico, United States, cross wall

(poster #20)

Monitoring of the endangered masked bobwhite quail population in Mexican desert shrubland

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Masked bobwhite (*Colinus virginianus ridgwayi*), distinct from all other 22 bobwhite subspecies currently registered, is the only one included at the Convention on International Trade in Endangered Species of Flora and Fauna in the Appendix I category [1]. Under Mexican legislation, it is considered as endangered ("en peligro de extinción") since 1994, by the "Norma Oficial Mexicana NOM-ECOL-059" which regulates the protection of flora and fauna native species for the Nation [2]. Present distribution is limited to a single wild population in Sonora estimated at 1000 to 2000 birds and a small number of individuals introduced in Arizona [3]. Historical distribution of masked ranged from South Arizona to central Sonora. In Mexico, within the municipality of Benjamin Hill, masked bobwhite was abundant in early 1990 at the iconic ranch "El Carrizo". By late August 2015 call detection was registered at "Rancho San Dario", were the latest registered sighting of the species occurred in 2008. This manuscript includes data obtained from intensive surveys of the species conducted at "San Dario Ranch", the description of a call recording, and valuable unpublished information from personal communications and local people interviews.

References

[1] **Convención sobre el Comercio Internacional de Especies Amenazadas de Fauna y Flora Silvestres. CITES** (2008). Apéndices I, II y III. <https://cites.org/esp/app/index.php.>. Accessed 15 June 2016. [In Spanish.]
[2] **Diario Oficial de la Federación**. 6/ Marzo/2002. Norma Oficial Mexicana NOM-059-ECOL-2001. México, D.F. [In Spanish.]
[3] **Hernandez, F., W.P. Kuvlesky, Jr., R.W. DeYoung, L.A. Brennan & S.A. Gall** (2006). Recovery of rare species: case study of the masked bobwhite. *Journal of Wildlife Management,* **70:** 617–631.

Keywords: Colinus virginianus ridgwayi, masked bobwhite, México

(oral)

Spatial and temporal variability of depredation on livestock by brown bear, *Ursus arctos*, in the Pyrenees, France

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One of the main factors limiting the acceptance of large carnivores worldwide is damages on livestock [1]. The brown bear, *Ursus arctos*, faces conservation issues in the Pyrenees with a minimum of 29 individuals recorded in 2015. Assessing the spatiotemporal dynamics of predation with respect to prey availability is a promising tool to minimize human-wildlife conflicts through identifying areas where mitigation efforts should be most effective. Yet, the spatial analysis of predation risk is currently overlooked in mitigation planning. As an example, a review of spatial predation risk modelling published in 2015 by Miller [2] found only 2 studies reporting a spatial analysis of predation on livestock by Ursids [3,4]. In order to fill the existing gap and to make use of the full potential of spatial analysis to address human-carnivore conflicts, we provide a spatial description of depredation by the Pyrenean brown bear on livestock in France at both the population and landscape scales.
We used a database of brown bear depredations in the Pyrenees from 2011 to 2015. All the damage claims were georeferenced and classified according to 3 categories: predation by brown bears, death not related to brown bear or undetermined causes of death.
From 2011 to 2015, 559 damage claims were related to brown bears. Among these, 539 targeted 951 domestic animals (96%) and 20 targeted beehives (3.6%). Among livestock attacks, 99% targeted sheep and 1.76 ± 0.07 animals were impacted per attack. There was no significant difference between years on the total number of attacks (χ^2= 8.97, d.f.=4, *P*=0.062) and on the distribution of the number of animals impacted per attack (χ^2=53.4, d.f.=44, *P*=0.16). The spatiotemporal pattern of depredation by brown bears was assessed from intra- and inter-annual maps of pastures-located attacks. Their locations and dynamics were analysed while accounting for the spatiotemporal distribution of domestic preys (i.e. availability), and depredation hotspots (i.e. areas of major predation conflicts) in the Pyrenees were identified.
This study is the first step of a workflow toward detailed spatiotemporal analysis of bear's predation in the Pyrenees. Ultimately, this project aims at addressing human-bear conflicts by answering strong social needs such as documenting the pastoral diagnosis or assessing pastures vulnerability analysis in order to focus mitigation efforts and minimize their costs.

Figure 1: *Distribution range of brown bears in the Pyrenees (France, Spain) from 2011 to 2015 (European grid: 10 x 10 km square).*

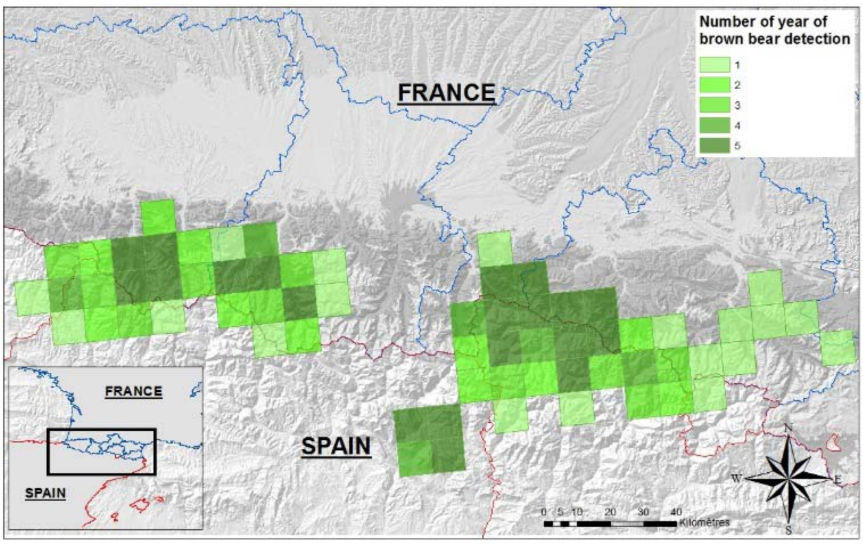
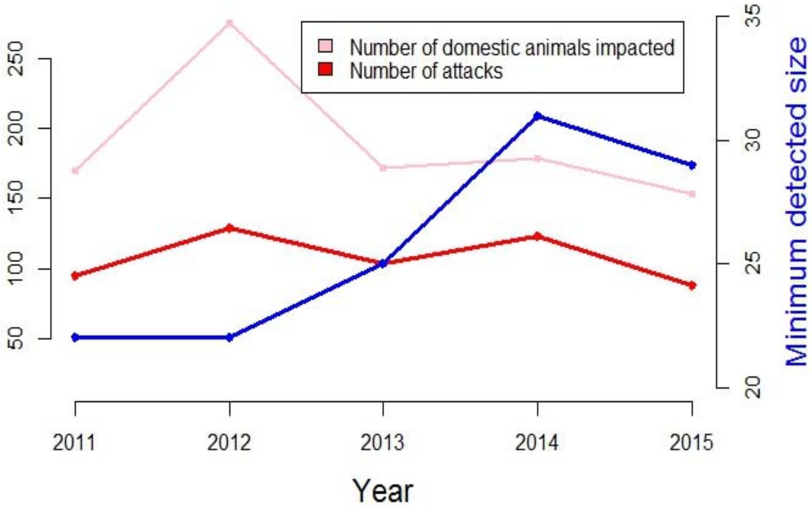


Figure 2: *Dynamics of brown bear attacks on domestic herds and of domestic animals killed or wounded (impacted) per year since 2011 in the Pyrenees (France). Dynamics of the minimum detected number of brown bears in the Pyrenees (blue line) since 2011.*



References

[1] **Treves, A. & J. Bruskotter** (2014). Tolerance for predatory wildlife. *Science,* **344:** 476-477.

[2] **Miller, J.R.B.** (2015). Mapping attack hotspots to mitigate human-carnivore conflict: approaches and applications of spatial predation risk modeling. *Biodiversity Conservation*, **24(12),** DOI10.1007/s10531-015-0993-6.

[3] **Baruch-Mordo, S., S.W. Breck, S.W. Wilson & D.M. Theobald** (2008). Spatiotemporal distribution of black bear-human conflicts in Colorado, USA. *Journal of Wildlife Management*, **72:** 1853-1862.

[4] **Wilson, S.M., M.J. Madel, D.J. Mattson, J.M. Graham, J.A. Burchfield & J.M. Belsky** (2005). Natural landscapes features, human-related attractants and conflict hotspots: a spatial analysis of human-grizzly bear conflicts. *Ursus,* **16(1):** 117-129.

Keywords: hotspot, depredation, brown bear, conservation, management, Pyrenees

(oral)

SNPs or Microsatellites? Assessing the reliability of different molecular markers to identify wild boar × domestic pig hybrids.

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Hybridization between wild and domestic species is a widespread phenomenon in vertebrates [1]. It is often considered as a threat for wild populations due to the great impact it can have on their fitness and their genetic integrity [2]. Indeed, it may lead to loss of locally adapted genes or introduction of artificially selected genes maladapted in the wild especially if hybridization is frequent [3,4]. Thus, understanding consequences of hybridization on wild populations is of prime interest in population genetic studies and for management of populations. However it may be difficult to detect hybrids especially when species are genetically very close, as it is the case for the wild boar (*Sus scrofa scrofa*) and the domestic pig (*S. s. domesticus*), despite the strong directional selection in the domestic subspecies. Indeed, domestic pig was and still is under strong directional selection to increase fertility rates. It has been recently suggested that introgression of domestic genes into wild boar genome could contribute to the demographic increase of wild boar populations observed over the past decades [5,6]. Therefore numerous studies have investigated if hybridization occurred in wild boar populations using different types of molecular markers [7–9]. Some markers have already been shown to be efficient at detecting some hybridization events but they never lead to hybrids identification beyond any doubt.
Here, we compared the efficiency of two sets of molecular markers to detect hybridization between wild boars and domestic pigs and to measure individual level of introgression. The first set with 20 SNPs (Single Nucleotide Polymorphism) was specifically designed to study hybridization while the second set of 12 microsatellites was previously used for population genetic studies. We sampled and genotyped a total of 270 individuals with wild boar phenotype from hunting bags collected in the population of Châteauvillain (France), 57 pigs from butchery meat and 139 individuals showing phenotypic evidence of hybridization, called thereafter phenotypic hybrids, from a national sampling campaign in France. Including individuals from probable hybrid origin allowed us to evaluate the ability of our sets of markers to detect hybridization.
We investigated above questions using the two Bayesian analyses based software STRUCTURE and NEWHYBRIDS on real genotypes. To statistically assess the efficiency of both type of markers to detect hybrids, we then produced simulated genotype datasets containing individuals of parental populations and of eight genotypic hybrid classes (first and second generation hybrids and several backcrosses) [10]. This allowed us to obtain decision rules to assign an individual to parental or hybrid groups.
Consistently with the design of each set of molecular markers, SNPs showed higher differentiation indexes than microsatellites, however, informativeness of ancestry indexes were the same. As already observed, less microsatellites are required than SNPs to get a given amount of information [11]. Our simulation results displayed equivalent ability of both sets of markers to distinguish simulated hybrids from individuals belonging to parental populations. Accuracies decreased when trying to discriminate hybrids groups one from another independently of the type of markers. Thus, hybrids are well identified but their introgression levels cannot be assessed, similarly to the study from Godinho et al. [12] on wolf-dog hybridization complex.
Decision rules established from simulation analysis allowed to diagnose as hybrid between 2 and 6% of wild boars sampled from hunting bags while these proportions were more than 7 times higher for phenotypic hybrids from sampling campaign. The high proportions of hybrids detected in the phenotypic hybrids group allowed us to validate identification realized by our analyses. Moreover hybridization rates in the wild boar population is in agreement with previous studies in Europe [7,13,14]. However, individuals detected as hybrids (wild boar from hunting bags or phenotypic hybrids from sampling campaign) varied with the set of markers and the software

leading us to consider some misidentification and/or differential selective pressures between markers. Despite different characteristics of both sets of markers, we concluded that they perform equally to detect hybridization. We hope our study may give new insights for the design of set of markers in genetic studies and call for a cost-efficiency analysis of the reliability of the type of markers used.

References

[1] **Rhymer, J.M. & D. Simberloff** (1996). Extinction by hybridization and introgression. *Annu. Rev. Ecol. Syst.,* **27:** 83–109

[2] **Allendorf, F.W., R.F. Leary, P. Spruell & J.K. Wenburg** (2001). The problems with hybrids : setting conservation guidelines. *Trends Ecol. Evol.,* **16:** 613–622

[3] **Bourret, V., P.T. O'Reilly, J.W. Carr, P.R. Berg & L. Bernatchez** (2011). Temporal change in genetic integrity suggests loss of local adaptation in a wild Atlantic salmon (*Salmo salar*) population following introgression by farmed escapees. *Heredity (Edinb).,* **106:** 500–510

[4] **Muhlfeld, C.C.** ***et al.*** (2009). Hybridization rapidly reduces fitness of a native trout in the wild. *Biol. Lett.,* **5:** 328–331

[5] **Fulgione, D.** ***et al.*** (2016). Unexpected but welcome. Artificially selected traits may increase fitness in wild boar. *Evol. Appl.,* **9:** 769–776

[6] **Massei, G.** ***et al.*** (2014). Wild boar populations up, numbers of hunters down? A review of trends and implications for Europe. *Pest Manag. Sci.,* **12:** 492–500

[7] **Scandura, M.** ***et al.*** (2008). Ancient vs. recent processes as factors shaping the genetic variation of the European wild boar: are the effects of the last glaciation still detectable? *Mol. Ecol.,* **17:** 1745–1762

[8] **Fang, M., F. Berg, A. Ducos & L. Andersson** (2006). Mitochondrial haplotypes of European wild boars with 2n = 36 are closely related to those of European domestic pigs with 2n = 38. *Anim. Genet.,* **37:** 459–464

[9] **Frantz, A.C., G. Massei & T. Burke** (2012). Genetic evidence for past hybridisation between domestic pigs and English wild boars. *Conserv. Genet.,* **13:** 1355–1364

[10] **Vähä, J.-P. & C.R. Primmer** (2006). Efficiency of model-based Bayesian methods for detecting hybrid individuals under different hybridization scenarios and with different numbers of loci. *Mol. Ecol.,* **15:** 63–72

[11] **Rosenberg, N.A., L.M. Li, R. Ward & J.K. Pritchard** (2003). Informativeness of genetic markers for inference of ancestry. *Am. J. Hum. Genet.,* **73:** 1402–1422

[12] **Godinho, R.** ***et al.*** (2011). Genetic evidence for multiple events of hybridization between wolves and domestic dogs in the Iberian Peninsula. *Mol. Ecol.,* **20:** 5154–5166

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

[14] **Frantz, A.C.** ***et al.*** (2013). Genetic evidence for introgression between domestic pigs and wild boars (*Sus scrofa*) in Belgium and Luxembourg : a comparative approach with multiple marker systems. *Biol. J. Linn. Soc.,* **110:** 104–115

Keywords: Introgression, hybridization detection, single nucleotide polymorphism, Bayesian analysis, *Sus scrofa*

(keynote)

Carnivores Among People: Urban Ecology of Carnivores with Insights From Coyotes in Chicago

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Wildlife species vary in their responses to urban areas, with some avoiding urbanization while others are synanthropic, in that they appear to thrive in urbanized landscapes. As a group, the Carnivora have been largely persecuted by humans, either for perceived or real conflicts, so it is not surprising that only 14% of terrestrial Carnivora species are associated with urban areas [1]. Indeed, more than other taxonomic groups, mammalian carnivores face additional pressures because of the risks they pose to people, especially larger carnivores [2]. However, as the global human population continues to grow and major cities expand, and as some carnivore species recover through conservation efforts, urban areas are now serving as points of intersection and increased contact between people and carnivores [3,4].

Cross-species comparisons reveal that body size and dietary breadth are two parameters that largely explain whether carnivore species are urban residents or urban transients [5]. Mesocarnivores (1-15 kg) with omnivorous diets tend to be residents, whereas larger carnivores tend to be 'transients', or occurring at the edges of the city. The average body size of resident Carnivora is 4.7 kg. However, even among urban resident species, there are substantial variations in response to urbanization, such that some urban species are synanthropes (e.g., raccoons [6], others are sinks (e.g., black bears [7]), and others are remnants (e.g. Eurasian badgers [8]).

Large carnivore species associated with urban areas tend to be transients, with the exception of ursids. However, recent trends suggest that the relationship between urbanization and some large carnivores may be shifting. In recent years, a variety of large cats, hyenas, and canids have been documented in or at the margins of urban areas across the globe (dingo [9]; leopard and striped hyena [10,11]; mountain lion [12]; spotted hyena [13,14]).

In North America, the coyote has become the most common 'large' carnivore occupying metropolitan areas. Although it was recorded in some western cities for decades, it is a recent immigrant to most cities across the continent. The coyote represents an interesting species because it occupies a transitional niche between mesocarnivore and 'large carnivore'. The coyote [15] and dingo [16] represent the smallest carnivores to lethally attack humans, thus they represent a risk to humans that is typically associated with larger carnivores [17]. In recent years, the coyote represented the most commonly reported species in attacks on people among large carnivores in developed countries [18]. Hence, developing an understanding as to how coyotes are, or are not, successful in urban areas, portends the likely extent to which larger, more carnivorous, species may be able to coexist with people and exploit urban systems.

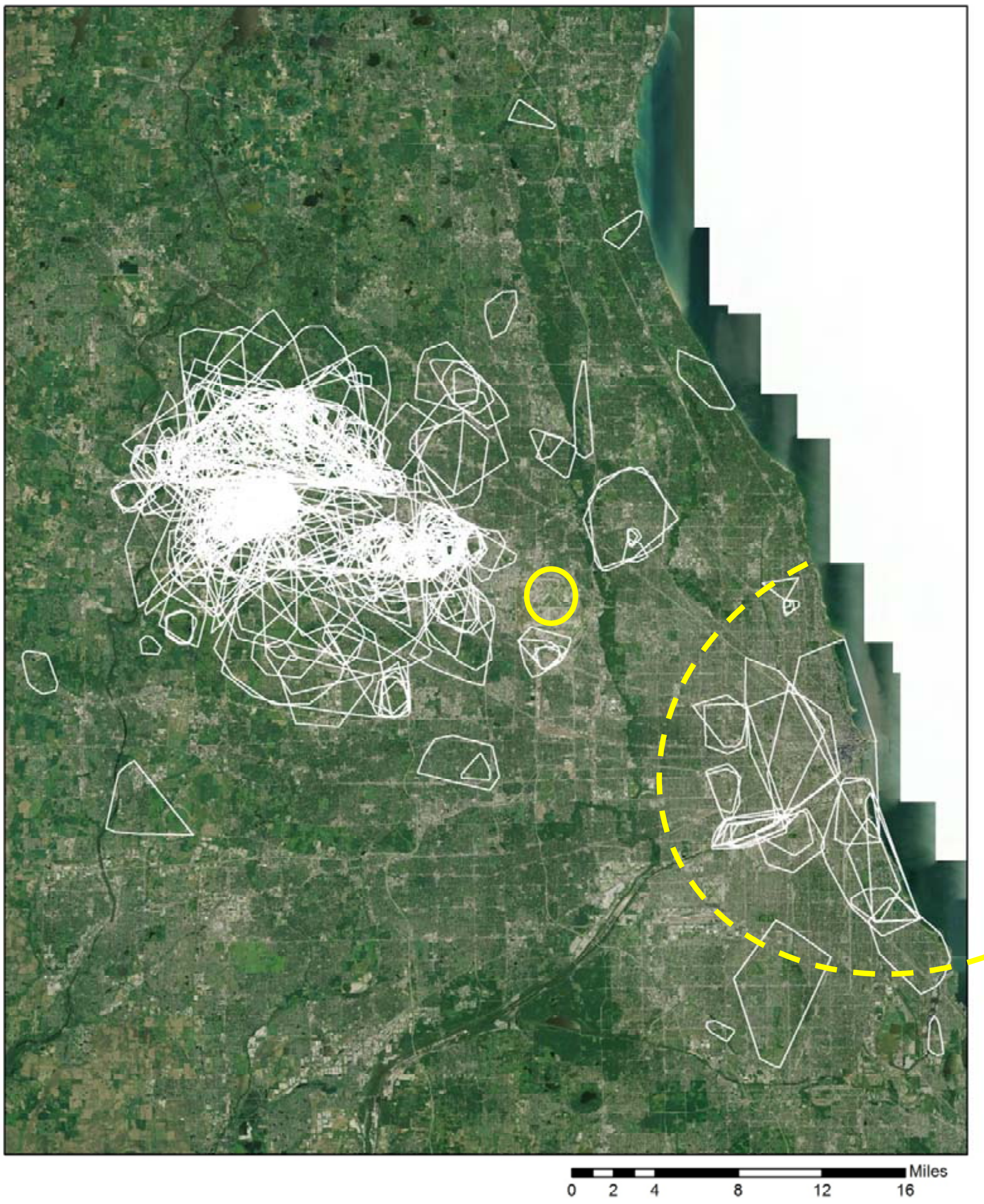
Since 2000, we have continuously monitored the coyote population in the Chicago, Illinois (USA) area, using standard livetrapping and radiotelemetry techniques [19]. The Chicago metropolitan area spans across 6 counties in northeastern Illinois and parts of Wisconsin and Indiana. Approximately 9 million people reside in the area. During 2000-2016, 1,073 coyotes were captured and marked using eartags and microchips. This sample was comprised of 438 free-ranging coyotes captured in traps and subsequently radiocollared, and 635 pups marked (but rarely collared) from natal dens. We recorded 99,798 VHF radiolocations, and >150,000 GPS locations. Coyotes were either residents that maintained discrete territories, transients that occupied large home ranges that overlapped multiple resident territories, or dispersers that permanently left the area[19,20]. Most of our monitoring was focused in the northwest suburbs (northwest of O'Hare International Airport), but in recent years we have attempted to capture and monitor coyotes using the urban core of Chicago. Figure 1 displays the annual territories (95% minimum convex polygons) of 288 resident coyotes monitored during 2008-2016. Although our sampling effort has been skewed toward the northwest suburbs, we were able to document coyote residency within the urban core, or the most intensively-developed portion of the landscape and highest human densities. For example, one of our female coyote territories encompassed an area that also included a human population of approximately 750,000 people. Territory sizes for urban core coyotes were three times the size of suburban territories, and activity patterns also differed between urban core and suburban coyotes. Physically, there was no difference in size or body condition among landscape types, and annjual survival did not change across the landscape. Stable isotope analysis revealed substantial individual variation in diet in all parts of the area, but surprisingly even in the urban core coyotes varied in their use of human foods, with some regularly using human foods while others still exploited natural foods [21]. We have not observed a change in frequency of conflicts across space or time.

Our results reveal the coyote is the largest North American carnivore to completely penetrate the urban landscape and maintain residency throughout the urban gradient, including the urban core of a major metropolitan city. This success has implications for larger carnivores in the following ways. First, we must note that when we began our study years ago, coyotes were not known to occur in the city but only in outlying areas. However, this changed over time, as their population grew and they exploited novel habitats. That some coyotes are able to do this without relying on subsidies is notable. Although it is unlikely that other carnivore species much larger than coyotes will be able to exploit the urban landscape as extensively as coyotes, we should not assume their past history is evidence that they cannot exist in or around urban areas to varying degrees.

Second, coyotes represent a species that poses a risk to humans, as they have attacked and, rarely, killed humans. For the first time, the Chicago population is confronted with the possibility of coexisting with a species that may attack them. The initial response to coyotes moving near them was negative, and early management programs attempted to remove coyotes from more developed areas. Over time this removal approach was unsuccessful, and management strategies evolved, as did human attitudes, to a higher degree of acceptance. This shift in acceptance suggests that tolerance toward predators can evolve even among the urban populace.

As we continue into the Anthropocene, it is increasingly important to understand how carnivores interact with urban systems, and the dynamic relationship between carnivores and people. It is likely that large, mammalian carnivores will vary in their abilities to exploit urban areas. More importantly, their ability to do so will be determined by the tolerance levels of the resident human populations [2].

Figure 1. *Annual 95% MCP home ranges (n = 570) for 288 resident coyotes during 2008-2016 in the Chicago, Illinois, metropolitan area. Urban core is denoted by the dashed line, and O'Hare International Airport by the circle in the middle of the map.*



References

[1] **Gehrt, S.D., S.P.D. Riley & B.L. Cypher** (2010). Urban Carnivores: Ecology, Conflict, and Conservation. The Johns Hopkins University Press, Baltimore, MD.

[2] **Treves, A. & K.U. Karanth** (2003). Human-carnivore conflict and perspectives on carnivore management worldwide. *Conservation Biology,* **17:** 1491–1499.

[3] **Bateman, P.W. & P.A. Fleming** (2012). Big city life: carnivores in urban environments. *Journal of Zoology,* **287:** 1-23.

[4] **Morell, V.** (2013). Predators in the 'Hood. *Science,* **341:** 1332-1335.

[5] **Iossa, G., C.D. Soulsbury, P.J. Baker & S. Harris** (2010). A taxonomic analysis of urban carnivore ecology. Pages 173-180. In: SD Gehrt, SPD Riley, BL Cypher (eds) Urban carnivores: ecology, conflict, and conservation. The Johns Hopkins University Press, Baltimore, 285 pp.

[6] **Prange, S., S.D. Gehrt & E.P. Wiggers** (2003). Demographic factors contributing to high raccoon densities in urban landscapes. *Journal of Wildlife Management,* **67:** 324-333.

[7] **Beckmann, J.P. & C.W. Lackey** (2008). Carnivores, urban landscapes, and longitudinal studies: a case history of black bears. *Human-Wildlife Conflicts,* **2:** 168-174.

[8] **Harris, S., P.J. Baker, C.D. Soulsbury & G. Iossa** (2010). Eurasian badgers (*Meles meles*). Pages 109-120. In: SD Gehrt, SPD Riley, BL Cypher (eds) Urban carnivores: ecology, conflict, and conservation. The Johns Hopkins University Press, Baltimore, 285 pp.

[9] **McNeill, A.T., L.K.P. Leung, M.S. Goullet, M.N. Gentle & B.L. Allen** (2016). Dingoes at the doorstep: Home range sizes and activity patterns of dingoes and other wild dogs around urban areas of North-eastern Australia. *Animals,* **6:** 48; doi:10.3390/ani6080048.

[10] **Athreya, V., M. Odden, J.D.C. Linnell, J. Krishnaswamy & U. Karanth** (2013). Big cats in our backyards: persistence of large carnivores in a human dominated landscape in India. *PLoS ONE,* **8(3):** e57872. doi:10.1371/journal.pone.0057872.

[11] **Odden, M., V. Athreya, S. Rattan & J.D.C. Linnell** (2014). Adaptable Neighbours: Movement Patterns of GPS-Collared Leopards in Human Dominated Landscapes in India. *PLoS ONE,* **9(11):** e112044. doi:10.1371/journal.pone.0112044.

[12] **Riley, S.P.D., L.E.K. Serieys, J.P. Pollinger, J.A. Sikich, L. Dalbeck, R.K. Wayne & H.B. Ernest** (2014). Individual behaviors dominate the dynamics of an urban mountain lion population isolated by roads. *Current Biology,* **24:** 1989–1994.

[13] **Yirga, G., W. Ersino, H.H. De Iongh, H. Leirs, K. Gebrehiwot, J. Deckers & H. Bauer** (2013) Spotted hyena (*Crocuta crocuta*) coexisting at high density with people in Wukro district northern Ethiopia. *Mammalian Biology,* **78:** 193-197.

[14] **Yirga, G., H. Leirs, H.H. De Iongh, T. Asmelash, K. Gebrehiwot, J. Deckers & H. Bauer** (2015). Spotted hyena (*Crocuta crocuta*) concentrate around urban waste dumps across Tigray, northern Ethiopia. *Wildlife Research,* **42:** 563-569.

[15] **Gehrt, S.D. & S.P.D. Riley** (2010). Coyotes (*Canis latrans*). Pages 79-96. In: SD Gehrt, SPD Riley, BL Cypher (eds) Urban carnivores: ecology, conflict, and conservation. The Johns Hopkins University Press, Baltimore, 285 pp.

[16] **Healy, S.** (2007). Deadly dingoes: 'Wild' or simply requiring 'due process'? *Social Studies of Science,* **37:** 443-447.

[17] **Löe, J. & E. Röskaft** (2004). Large carnivores and human safety: A review. *Ambio,* **33:** 283–288.

[18] **Penteriani, V. et al.** (2016). Human behaviour can trigger large carnivore attacks in developed countries. *Sci. Rep.,* **6:** 20552; doi: 10.1038/srep20552.

[19] **Gehrt, S.D., C. Anchor & L.A. White** (2009). Home range and landscape use of coyotes in a major metropolitan landscape: conflict or coexistence? *Journal of Mammalogy,* **90:** 1045–1057.

[20] **Gese, E.M., P.S. Morey & S.D. Gehrt** (2012). Influence of the urban matrix on space use of coyotes in the Chicago Metropolitan Area. *Journal of Ethology,* **30:** 413-425.

[21] **Newsome, S.D., H.M. Garbe, E.C. Wilson & S.D. Gehrt** (2015). Individual Variation in Anthropogenic Resource Use in an Urban Carnivore. *Oecologia,* **178:** 115-128.

Keywords: Activity, Carnivora, Coyote, Diet, Home Range, Urban Systems

(poster #21)

The "Programme Lynx Massif des Vosges": improving the conservation status of the boreal Lynx in the French Vosges Mountains through a concerted and shared approach with local stakeholders

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The boreal Lynx was reintroduced in the French Vosges Mountains between 1983 and 1993. A total of 21 lynx were released but only 4 females and 6 males survived and so, contributed to the population establishment [1]. Despite this reintroduction program, the future of the Lynx remains uncertain in this part of its French range area. Indeed, after the reintroduction period, the regular presence area of the Lynx in the Vosges massif progressed reaching in 2004 a maximum of around 2.000 km^2. Then, this regular presence area began to decrease continuously until today [2-6]. This diagnostic is based on the monitoring made by volunteers of the lynx-monitoring network ("Réseau Loup Lynx") coordinated by the French National Game and Wildlife Agency (ONCFS) since 1988 [7]. This opportunistic monitoring has been supplemented since 2011 by different field protocols with camera traps to clarify the conservation status of the Lynx in the Vosges Mountains [see 8-13]. In 2016, the last biennial synthesis published by the lynx-monitoring network reported a regular presence area of less than 400 km^2 in this massif [6].

Considering the very low size of its regular presence area, the current conservation status of the Lynx in the French Vosges Mountains appears critical. Besides, the feline is classified as a protected species threatened with extinction in France. It is also listed on international and European directives and conventions justifying the need for protection or conservation measures throughout its range area. Thus, the priorities to improve the conservation status of the Lynx in this massif have to be identified urgently. This is a challenge for the species not only at the scale of the Vosges Mountains but also at the western European one. Indeed, this massif is located between the Jura Mountains, which hosts the main core of the French lynx population and is linked to the Swiss lynx population [3], and the Palatinat in Germany where a reintroduction program is under way [14-17]. The lynx natural colonization in the Vosges Mountains is thus possible both by the north and the south of the massif [18-23]. Therefore, promoting favourable ecological and social actions for Lynx presence in the Vosges Mountains would necessarily contribute to the exchange of individuals between massifs and to the viability of a lynx metapopulation [24].

The "Programme Lynx Massif des Vosges" (PLMV) was born in this context at the end of 2016. A program specific to the French Vosges Mountains massif has been proposed because the Lynx is not concerned in France by a National Action Plan. In the continuity of Breitenmoser *et al.*'s action plan for Lynx conservation in Europe [25], the PLMV aims to define and develop concrete actions to improve the conservation status of the Lynx in the massif. This work will be carried out through a concerted and shared approach implying local stakeholders of the massif whose activities are concerned by the Lynx presence.

Our poster presentation will focus on the presentation of the first phase of the PLMV: identifying the priorities and constructing the actions. After a rapid review of the PLMV context, methodology and validation process will be explained. First lines of actions will be presented according to the progress of the concertation meetings with the stakeholders involved in the program.

References

[1] **Vandel, J.M., P. Stahl, V. Herrenschmidt & Marboutin** (2006). Reintroduction of the lynx into the Vosges mountain massif: From animal survival and movements to population development. *Biological conservation*, **131:** 370-385.

[2] **Laurent, A., F. Léger, P.E. Briaudet, Y. Léonard, A. Bataille & G. Goujon G.** (2012). Evolution récente (2008-2010) de la population de Lynx en France. *Faune Sauvage*, **294:** 38-39.

[3] **Marboutin, E., C. Duchamp, P. Moris, P.E. Briaudet, F. Léger, A. Laurent, Y. Léonard & M. Catusse** (2011). Le suivi du statut de conservation de la population de lynx en France : bilan pour la période triennale 2008-2010. *Bulletin Lynx du Réseau*, **17:** 24-29.
[4] **Marboutin, E** (2013). Note sur le statut du Lynx dans les Vosges. *Bulletin Lynx du Réseau*, **18:** 14-17.
[5] **L'équipe animatrice du Réseau** (2014). Bilan national d'évolution de l'aire de présence détectée du Lynx. Les données du Réseau. *Bulletin Lynx du Réseau*, **19:** 26-27.
[6] **L'équipe animatrice du Réseau** (2016). Bilan national d'évolution de l'aire de présence détectée du Lynx en 2014-2015. Les données du Réseau. *Bulletin Lynx du Réseau*, **20:** 26-27.
[7] **Herrenschmidt, V. & J.M. Vandel** (1989). Dossier Lynx, commission d'observations, Commissions d'expertise, Formation. Office National de la Chasse, CNERA Petite Faune Sédentaire de Plaine, Section prédation, 69p.
[8] **CROC** (2014). Bilan des programmes scientifiques et des activités pédagogiques conduits par le CROC du 1er janvier au 31 décembre 2013. Rédaction : Germain E. et Pichenot P., Mai 2014, 114p.
[9] **CROC** (2015). Bilan des programmes scientifiques et des activités pédagogiques conduits par le CROC du 1er janvier au 31 décembre 2014. Rédaction : Germain E., Pichenot P., Papin M. et Clasquin M., Mai 2015, 152p.
[10] **CROC** (2016). Bilan des programmes scientifiques et des activités pédagogiques conduits par le CROC du 1er janvier au 31 décembre 2015. Rédaction : Germain E., Papin M. et Charbonnel A., Mai 2016, 122p.
[11] **Germain, E.** (2014). Suivi par piégeage photographique du Lynx dans le massif Vosgien : session intensive 2014. *Bulletin Lynx du Réseau*, **19:** 22-25.
[12] **Germain, E., A. Laurent & E. Marboutin** (2013). Rapport technique. Test de détectabilité du Lynx dans le massif des Vosges. Première session de piégeage intensif dans le sud du massif (Hautes Vosges), Décembre 2012-Janvier 2013, 10p.
[13] **Germain, E., M. Clasquin & M.L. Schwoerer** (2016). Suivi par piégeage photographique du lynx dans le massif des Vosges / Session intensive 2015 dans les Vosges du Nord. Technique et Recherche. *Bulletin Lynx du Réseau*, **20:** 19-22.
[14] **Kurtz, C.** (2015). Le projet de réintroduction du lynx dans le Palatinat allemand. *La Gazette des grands prédateurs*, **55:** 26-28.
[15] **Schwoerer, M.L. & C. Scheid** (2016). Le projet « Life Lynx » de réintroduction du félin sur le palatinat Allemand entre dans sa phase opérationnelle. *Bulletin Lynx du Réseau*, **20:** 2.
[16] **Stiftung Natur und Umwelt Rheinland-Pfalz** (2015). Wiederansiedlung von Luchses (*Lynx lynx carpathicus*) im Biosphärenreservat Pfälzerwald. EU LIFE+ Natur-Projekt der Stiftung Natur und Umwelt Rheinland-Pfalz, 4p.
[17] **Stiftung Natur und Umwelt Rheinland-Pfalz** (2016). Höfken: Die ersten Luchse sind frei! Heute wurden die ersten 3 von insgesamt Heute wurden die ersten 3 von insgesamt 20 Luchsen im Pfälzerwald freigelassen. Presse mitteilung, 3p.
[18] **Zimmermann, F. & U. Breitenmoser** (2007). Potential distribution and population size of the Eurasian lynx *Lynx lynx* in the Jura Mountains and possible corridors to adjacent ranges. *Wildlife Biology*, **13:** 406-416.
[19] **Assmann, C.** (2011). Etude de la connectivité des massifs des Vosges et du Jura au niveau de la trame forestière. Master FAGE. Biologie et Ecologie pour la Forêt, l'Agronomie et l'Environnement. Université de Nancy, 51p.
[20] **Blanc, L.** (2015). Dynamique des populations d'espèces rares et élusives : Le Lynx Boréal en Europe. Thèse en Biologie des populations et Ecologie, Université de Montpellier 2, UMR CNRS 5175 (Laboratoire d'Ecologie Fonctionnelle et Evolutive), 268p.
[21] **Morand, A.** (2016). Le Lynx : risques routiers et mesures correctrices – état des lieux et recommandations. Cerema Direction Territoriale Est, 93p.
[22] **Chenesseau, D. & P.E. Briaudet** (2016). Destin de lynx, trombinoscope insolite de lynx identifiés par piégeage photographique : Bingo ! Du massif jurassien aux Vosges, il n'y a qu'un pas… de lynx. Actualité. *Bulletin Lynx du Réseau*, **20:** 9-10.
[23] **Hurstel A. & Laurent A.** (2016) Rapport de monitoring 2015. Observatoire des Carnivores Sauvages. 32p.
[24] **Marc, M.** (2015). Le Lynx dans le massif des Vosges : propositions d'actions en faveur de l'habitat, des connectivités écologique et sociologique. Rapport de fin d'études, CROC, Centre de Recherche et d'Observation sur les Carnivores, Lucy, France, 39p.
[25] **Breitenmoser, U., C. Breitenmoser-Würsten, H. Okarma, T. Kaphegyi, U. Kaphegyi-Wallmann & U. Müller** (2003). Plan d'action pour la conservation du Lynx eurasien en Europe (*Lynx lynx*). Convention relative à la conservation de la vie sauvage et du milieu naturel de l'Europe. Sauvegarde de la Nature n°112, Editions du Conseil de l'Europe, 80p.

Keywords: *Lynx lynx*, French Vosges Mountains, conservation, coexistence

(poster #22)

Captive breeding as a valuable tool to achieve the recovery of the endangered huemul deer (*Hippocamelus bisulcus*)

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The population size of huemul (*Hippocamelus bisulcus)*, an endangered deer species from Patagonia, is presently estimated at about 350-500 in Argentina and 1.000 in Chile and occurring in over 100 small fragmented family groups. The reduction of its past population size has been estimated at over 99%. Despite the species' protection by law, a lack of effective captive breeding prevents an active recovery approach animal reproduction and their subsequent reintroduction to suitable natural environments.
Taking into account examples of other important species recovery, e.g. us European bison (*Bison bonasus*), European beaver (*Castor fiber*) and Pere David's deer (*Elaphurus davidianus*), captive breeding can be a useful and successful method to improve the status of endangered animals. Besides animal reproduction, such a center should provide for a wide range of scientific investigations based on human imprinted animals, reared on bottles. Newborn raised on cattle milk do not shows any fear towards humans, and therefore, it is possible to obtain reliable scientific results without influence of stress. A good model of a captive breeding facility for huemul would be the experimental deer facility of the Polish Academy of Sciences in Popielno, where a variety of important investigations on physiology of red deer of both sexes have been conducted. Methods were also developed there for semen collection from red deer stags using artificial vagina. Applying these techniques to huemul would provide an opportunity to establish a live semen bank protected in LN2 as a reserve of genes of this endangered species. By adopting an adaptive management approach to accompany the reintroduction phase, various additional important questions will be possible to investigate.

References

[1] **Flueck, W. & J.A. Smith-Flueck** (2006). Predicaments of endangered huemul deer, *Hippocamelus bisulcus*, in Argentina: a review. *Europ. J. of Wild. Res.,* **52(1):** 69-80.
[2] **Gizejewski, Z.** (2004). Effect of season on characteristics of red deer /*Cervus elaphus* L./ semen collected using modified artificial vagina. *Reproductive Biology,* **4(1):** 51-66.
[3] **Jiménez, J., G. Guineo, P. Corti, J.A. Smith, W. Flueck, A. Vila, Z. Gizejewski, R. Gill, B. McShea & V. Geist** (2008). *Hippocamelus bisulcus*. In: IUCN 2009. IUCN Red List of Threatened Species. Version 2009.1. <www.iucnredlist.org>.

Keywords: Huemul (*Hippocamelus bisulcus*), captive breeding, semen collection

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(oral)

Reducing nest predation in partridges by adaption of landscape elements

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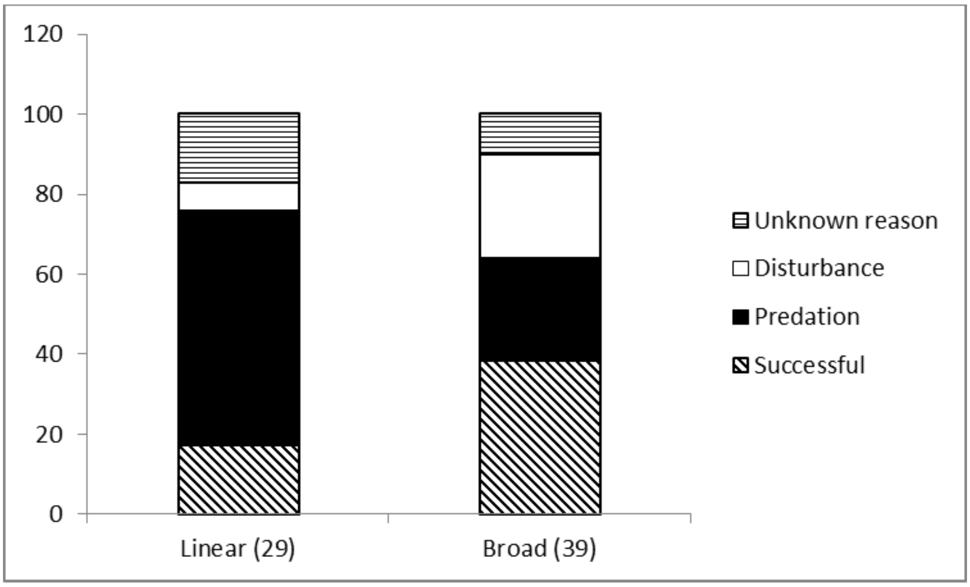
We investigated 169 partridges by radiotracking during the years 2009 – 2016 (mortality, breeding success, nest losses, habitat use, and mobility) in central Germany in an agricultural landscape, intensively used by farming and with high abundances of predators. We managed the landscape by introducing breeding and chick rearing habitat (partridge friendly flower strips). Predation rate is highest for hens during breeding. Hens do not breed in crop fields but only in landscape elements with unsprayed, perennial vegetation. We found a significant difference in predation risk when comparing hens nesting in linear landscape elements (< 10 m) with partridge nests in spacious landscape elements (> 10m). Predation rate in linear structures was about 60%, in spacious landscape elements 26%. The difference is highly significant (p<0,001, Chi²Test). We recommend introducing breeding habitat with low predation risk to the landscape in order to avoid predation.

Figure 1. *Differences in the fate of nests of partridges in linear structures (n = 29) and broad structures (n = 39). Predation rate is more than twice as high in linear structures (59% vs 26%).*



Reference

[1] **Gottschalk, E. & W. Beeke** (2014). Wie ist der drastische Rückgang des Rebhuhns (*Perdix perdix*) aufzuhalten? Erfahrungen aus zehn Jahren mit dem Rebhuhnschutzprojekt im Landkreis Göttingen. *Berichte zum Vogelschutz,* **51:** 95-115.

Keywords : *Perdix perdix*, predation rate, nesting success, impact of landscape

(poster #92)

Assessment of the red and roe deer population density using thermal imaging and Distance Sampling in Lower Saxony, Germany**

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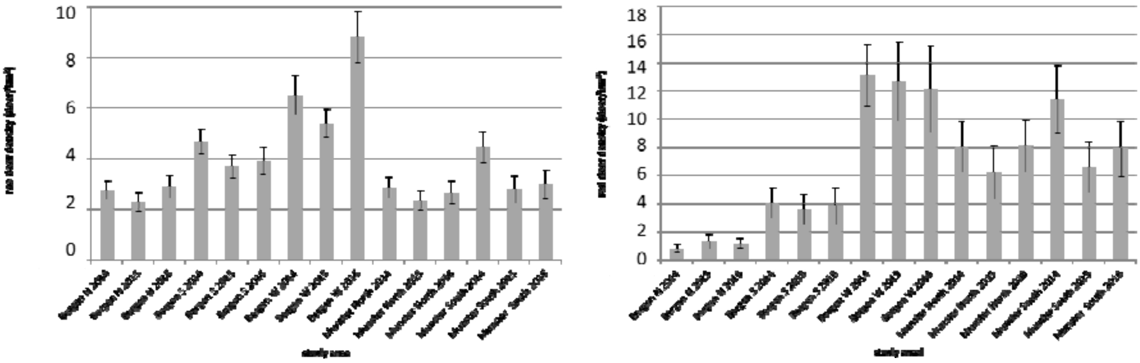
Estimating the population density of deer is an essential task for public agencies for management decisions. Managing public lands within suburban or exurban settings in many regions of Germany usually involves population control measures in response to high densities of roe and red deer (*Capreoulus capreolus, Cervus elaphus*), alteration of forest succession [1,2], and human–deer conflicts [3,4]. On public lands management is often demand driven if deer densities, or indirect damage metrics, exceed a predetermined level [5,6]. Although most population estimates of wildlife are based on harvest data or mark–recapture principles [7,8,9,10], population estimates can be obtained for animals where individuals are neither captured nor individually identified [11,12]. Distance sampling is a robust method for estimating animal populations when they are visible but not readily captured or identifiable as individuals, and allows managers to confidently estimate deer densities as long as sampling assumptions are met. Distance sampling calculates a detection function, taking into account distance from the survey route, animals detected and transect length. Assuming a representative survey route density within an effective strip width based on the empirical data can be extrapolated to the entire study area [11,12]. Distance sampling has become increasingly popular in recent years for collecting density information on multiple wildlife species [13,14,15,16].
Unlike in a classic, design-based application, there is the constraint that sampling of ungulates in military training sites is restricted to the route network. Therefore, transects were not systematically distributed, but along the paths bringing limitations of unknown magnitude. The aim of this study was to determine the population densities of red and roe deer using recognized scientific methods. And at the same time evaluate the methods for assessing management effectiveness.
Our study was conducted at the two military training sites Bergen and Munster. Deer densities were estimated for each military training site during spring 2014, 2015 and 2016. The distance from the observer to the deer or to the center of a deer group was measured. Population density, the detection function and the average cluster size of deer groups were estimated. We pooled the distance data over both sites and the three years to produce the detection function model and hence the probability of detecting deer [11]. Multiple covariate distance sampling (MCDS) was used to examine the effect of habitat type on the detectability of animals. For the density surface modelling (DSM) the real estate data was made available for the evaluations of the DSM (density surface modelling). In addition, the Corine Landcover 2006 dataset, digital terrain model (DEM) and soil types were taken into account. The analyses were stratified by year and region. Data were grouped a posteriori into different distance intervals to improve model fit [14] and account for responsive movement/ avoidance of tracks. The selection of the best model was based on Akaike's Information Criterion (AIC). In the case of the MCDS, the detection probability is not only dependent on the distance, but also other factors which influence the detectability of the objects can be taken into account [16,17]). For most wildlife species forested areas reduce the detection probabilities, in particular dense stands of Norway spruce and Douglas fir.
If transects are not randomly, or systematically distributed in the area, design-based calculations can be unreliable. On the basis of spatial information in the study area the estimation of the density is carried out in the model of the DSM. With this method the representative and random distribution of transects is somewhat less important, but the efficient sampling of environmental gradients is more important. In DSM habitat variables are used to predict wildlife densities. The theoretical framework is a combination of generalized additive models (GAM) [18] and the estimated density of segments is used as response variable.
Over the three years the results for roe and red deer population density (MCDS) (Figure 1) fluctuated somewhat, but except Munster South for red deer, there is a constant density in the three years on the military training places. In Munster were the management attempted to reduce the population size, there may have been some success from 2014-2015.
Results of the DSM will be presented. The most important gradients were found to be aspect and land use types
The method showed consistent results, even though the reliability of absolute numbers is questionable due to methodological limitations. Nonetheless, they were close to the expectations of the responsible foresters or higher. In these relatively homogenous study sites the method thus seems robust despite the opportunistic

study design. Regardless the non-systematic design, comparisons between years should be unaffected. Thus, for the assessment of management effectivity distance sampling is a good option even if only tracks are available.

Figure 1: *red deer (left) and roe deer (right) density (MCDS)*



References

[1] **Frost, H.C., G.L. Storm, M.J. Batcheller & M.J. Lovallo** *(*1997). White-tailed deer management at Gettysburg National Military Park and Eisenhower National Historic Park. *Wild. Soc. Bulletin,* **25:** 462–469.

[2] **Healy, W.M.** (1997) Influence of deer on the structure and composition of oak forests in Central Massachusetts. Pages 249–266 *inW. J. McShea, H. B. Underwood, and J. H. Rappole, editors. The science of overabundance: deer ecology and population management. Smithsonian Institution Press, Washington, D.C., USA.*

[3] **Stewart, C.M., W.J. McShea & B.P. Piccolo** *(*2007). The impact of white-tailed deer on agricultural landscapes in 3 National Historical Parks in Maryland. *Journal of Wildlife Management,* **71*:*** 1525–1530.

[4] **McShea, W.J., C.M. Stewart, L.J. Kearns, S. Liccioli & D. Kocka** (2008). Factors affecting autumn deer/vehicle collisions in a rural Virginia county. *Human–Wildlife Conflicts,* **2:** 110–121.

[5] **Minnis, D.L. & R.B. Peyton** *(*1995). Cultural carrying capacity: modeling a notion. *Pages 19–34 inJ. B. McAninch, editor. Urban deer: a manageable resource? Proceedings of the 1993 Symposium of the North Central Section. The Wildlife Society, St. Louis, Missouri, USA.*

[6] **Swihart, R.K. & A.J. DeNicola** (1997). Public involvement, science, management, and the overabundance of deer: can we avoid a hostage crisis? *Wildlife Society Bulletin,* **25:** 382–387.

[7] **White, G.C., D.R. Anderson, K.P. Burnham & D.L. Otis** *(*1982). Capture–recapture and removal methods for sampling closed populations. *Los Alamos National Laboratory, New Mexico, USA.*

[8] **Pollock, K.H., J.D. Nichols, C. Brownie & J.E. Hines** *(*1990). Statistical inference for capture–recapture experiments. *Wildlife Monographs,* **107.**

[9] **Roseberry, J.L. & A. Woolf** (1991). A comparative evaluation of techniques for analyzing white-tailed deer harvest data. *Wildlife Monographs,* **117.**

[10] **Roseberry, J.L. & A. Woolf** (1998). Habitat–population density relationships for white-tailed deer in Illinois. *Wildlife Society Bulletin,* **26:** 252–258.

[11] **Buckland, S.T., D.R. Anderson, K.P. Burnham, J.L. Laake, D.L. Borchers & L. Thomas** (2001). Introduction to distance sampling estimating abundance of biological populations. *Oxford University Press, Great Britain, United Kingdom.*

[12] **Thomas, L., S.T. Buckland, E.A. Rexstad, J.L. Laake, S. Strindberg, S.L. Hedley, J.R.B. Bishop, T.A. Marques & K.P. Burnham** (2010). Distance software: design and analysis of distance sampling surveys for estimating population size. *Journal of Applied Ecology,* **47:** 5–14.

[13] **Koenen, K.K.G., S. DeStefano & P.R. Krausman** (2002). Using distance sampling to estimate seasonal densities of desert mule deer in a semi-desert grassland. *Wildlife Society Bulletin,* **30:** 53–63.

[14] **Ruette, S., P. Stahl & M. Albaret** *(*2003). Applying distance sampling methods to spotlight counts of red foxes. *Journal of Applied Ecology,* **40:** 32–43.

[15] **Stapp, P. & D.A. Guttilla** (2006). Population density and habitat use of mule deer (*Odocoileus hemionus*) on Santa Catalina Island, California. *The Southwestern Naturalist,* **51:** 572–578.

[16] **Marques, T.A., L. Thomas, S.G. Fancy & S.T. Buckland** *(*2007). Improving estimates of bird density using multiple-covariate distance sampling. *The Auk,* **124:** 1229–1243.

[17] **Marques, F.F.C. & S.T. Buckland** (2004). Covariate models for the detection function. In Advanced Distance Sampling - Estimating abundance of biological populations (pp. 31–47). *New York: Oxford University Press Inc.*

[18] **Wood, S.** (2006). Generalized additive models: an introduction with R. *CRC press.*

Keywords: cervus elaphus, capreolus capreolus, distance sampling, management, ungulates

(oral)

Working across boundaries to conserve upland gamebirds in Southern Texas: a case study

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Southern Texas is one of the largest remaining parcels of quail habitat (approximately 133,000 sq. km) in the United States and contains 3 of the 6 species of North American quail: northern bobwhite (*Colinus virginianus*), scaled quail (*Calipepla squamata*), and Montezuma quail (*Cyrtonyx montezumae*). Despite this distinction, the region has experienced widespread developmental pressure from energy production enterprises, intensive agriculture, and urbanization, all of which reduce habitat for quail. To further complicate issues associated with these pressures, some wildlife and land managers with honorable intentions inadvertently degrade quail habitat because of widely available but fallacious information. In this region, habitat loss most often occurs through landowner misinformation rather than deliberate, negative practices. This issue—application of misinformation by landowners—represents a boundary between wildlife scientists and people making decisions on landscapes, or misunderstandings between conservationists and personnel between backgrounds and trades. In order to combat further loss of quail habitat and to provide science-based information to landowners and personnel in other industries, the “Quail Outreach Program” was conceived. The “Quail Outreach Program” began in August 2013 as a cooperative effort between non-profit quail conservation organizations, private landowners, and the Caesar Kleberg Wildlife Research Institute. Since its conception, the program has provided science-based 1) land management advice on over 120 ranches representing nearly 4,000 sq. km of the land area in Southern Texas, and 2) information to quail enthusiasts and landowners through more than 70 seminars. The program also has resulted in an expansion of management-based quail research in Southern Texas. Challenges and breakthroughs when working across interdisciplinary boundaries for conservation and current management-based research on New World quails will be presented.

(oral)

Adaptive harvest and habitat management of Northern Bobwhites: balancing population recovery and cultural heritage

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Northern Bobwhite populations have been in decline for decades yet remain an important game species in the Southeastern US. Managers often consider habitat management to restore bobwhite populations, but bag limits remain high. To sustain bobwhite populations while allowing harvest, it is important to identify an appropriate strategy that considers the uncertainties with immediate and long-term responses of populations to habitat management, harvest, and their interaction. We developed an adaptive harvest and habitat management framework for bobwhite using data collected from 17 Wildlife Management Areas (WMA) in the Southeastern US to optimize trade-offs among competing and conflicting management objectives, including population persistence, harvest, hunter satisfaction, and cost. We developed a population simulation model using estimates of density and population growth rates from previous research and vital rate estimates from the literature to predict the response of bobwhite populations to various harvest rates and timings, habitat management, and predator control. We then used a policy iteration algorithm to identify the optimal decision strategies under a range of objective weights. Optimal strategies varied widely based on objective weights. Habitat management was recommended in most cases because of its strong positive effect on population growth, and recommended harvest rates generally increased with bobwhite density. Our approach can be adapted for other sites and species. Additional information on harvest rates and management effects on bobwhite populations can be collected and used to reduce uncertainty in the decision process to inform future decisions.

Keywords: adaptive management, decision analysis, game birds, harvest management, hunting, optimization

(poster #23)

Wintering habitat used by Wood Warbler (*Phylloscopus sibilatrix*) influenced by habitat characteristics and wintering period in centre region of Cameroon

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Populations of many Afropalearctic birds have declined, with those wintering in sub-Saharan Africa, such as Wood Warbler *Phylloscopus sibilatrix*, being particularly affected. Causes of these declines are not well known but there is some evidence to suggest that events occurring on the wintering grounds are to blame. However, Wood Warbler wintering habitat use is poorly understood, making it difficult to identify potential drivers and hindering conservation efforts. In particular, no studies to date have quantified habitat use throughout the entire wintering period, which could change in response to resource availability and environmental cues.In this study we investigated the effect of habitat characteristics and wintering period on Wood Warbler presence/absence in Centre Region of Cameroon. From November 2015 to April 2016, a total of six transects were established in three habitats types (forest, forest savannah transitional zone and savannah). Call playback surveys were conducted monthly to determine Wood Warbler presence / absence. Detailed habitat measurements and information on potential anthropogenic threats were also recorded in each transect. Wood Warbler presence increased significantly with the number of trees between 3 - 7 m in height, and decreased significantly with the number of shrubs between 0.5 - 3 m in height. We found no seasonal change in habitat preferences, and anthropogenic disturbance such as agriculture cycle and burning was not found to have an effect on Wood Warblers presence/absence. We conclude that Wood Warblers preferred forested habitats with a relatively low canopy and an open understory, which probably favors the species foraging strategy. Land-use change and forest clearance in sub-Saharan Africa could therefore be contributing to declines, and this study will allow future conservation research to focus on investigating changes in the appropriate habitat.

Keywords: Wood Warbler, forest, forest savannah transitional zone, savannah, anthropogenic activities

(poster #24)

A new analytical technique for statistical delineation of migratory bird flyways

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Accurate flyway delineation is a prerequisite for appropriate determination of the most important sites, population size and population trends in migratory birds, hence for effective conservation and management of these populations. Genetic or stable isotope analyses have recently allowed important steps forward in this domain, yet they still rely on relatively few individuals and remain costly procedures. To this day, the existing large-scale ring-recovery datasets therefore remain a major source of information to infer population boundaries with a relatively high degree of precision and robustness. We developed a new statistical method to infer population boundaries from the analysis of such ring recoveries, using a Bayesian framework. The approach allowed delineating the migration corridors of Eurasian Teal *Anas crecca* ringed in Camargue, southern France, and Abberton Reservoir, Essex, eastern England. The results confirm the long-suspected existence of two Teal flyways in Western Europe, with boundaries broadly matching those previously defined, including a significant zone of overlap. Furthermore, 2.4 to 2.6% of the birds appear to switch flyways (i.e. abmigrate) between ringing and recovery, such rates being greater for birds ringed as juveniles than as adults. Abmigrants ended up at sites within the other flyway where the density of native birds was lower than expected by chance. This suggests abmigration resulted from exploratory or aberrant behaviour rather than birds following conspecifics from another flyway they simply happened to meet. The method developed here is not specific to Teal or waterfowl, and could be applied to infer flyway boundaries of any bird (or even non-bird) species with an adequate mark-recapture dataset, which could greatly help the conservation of species of greater concern than most ducks.

Keywords: Abmigration, conservation status, flyway delineation, ring recoveries, spline functions

(poster #25)

Protection status of critical duck sites in Europe: are we ready for climate change?

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Many migratory bird populations are shifting their annual ranges in response to climate change. Under such circumstances birds may first rely on protected areas, where they could preferentially settle when expanding their geographic distribution. Model projections suggest Western Palearctic ducks (mostly *Anas* and *Aythya* species) are likely to shift their distribution towards the north and to the east under warming climate. Sites in these areas that are mostly used as migration stopovers currently could become future wintering grounds, such as what have happened in southern Sweden already. Using the Critical Site Network Tool, it was therefore checked whether the mean protection level of the most critical sites for ducks in the Western Palearctic shows any latitudinal or longitudinal trend. The good news is that more northern sites actually had a greater protection level on average, especially within countries of the European Union. Within a given range of longitudes, critical sites in EU countries were also more protected than in non-EU countries on average, suggesting EU directives and international agreements have been successful at protecting the most important wetlands to ducks. Conversely, a concerning negative longitudinal gradient was also recorded, with a much poorer protection of critical duck sites in Eastern Europe, the Middle East and Central Asia compared to Western Europe or Africa. Unfortunately, such eastern areas are also where duck populations are already the largest, and among the areas where duck populations are expected to increase in the future following climate change. International conservation efforts should therefore be targeted towards such sites east of the Mediterranean.
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Keywords: climate change, geographic distribution, geographic shift, protected areas, ducks

(poster #26)

How rice cultivation can benefit wintering waterfowl… and vice-versa

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Cultivated systems dominate the Earth and represent both a threat and an opportunity for the conservation of biodiversity. Some agricultural practices can simultaneously allow abundant food production and some protection of the environment. Winter flooding of rice fields has been identified as a habitat management with potential advantages for both wintering ducks and farmers in Asia and North America. Through a set of empirical and experimental studies, we tested if similar benefits could be expected in Europe. Applying a variety of agricultural practices to 50 harvested rice fields in Camargue (France), we demonstrate the existence of vast amounts of duck food resources (ca. 500 kg/ha of rice and weed seeds remaining on the ground after harvest). Seed availability greatly decreases across the winter (-89% for rice seed mass and -69% for weeds), seed depletion being accentuated by ploughing. Winter flooding is the main determinant of nocturnal use of the fields by wintering ducks (on average 24 and. 0.3 ducks/ha in flooded and unflooded fields, respectively). In return, experiments show that waterfowl foraging in flooded rice fields enhance straw stalks reduction, but do not significantly reduce the weed seed bank, albeit flooding by itself increases decomposition of some weed seeds. A cost-benefit analysis was eventually carried out to evaluate whether winter flooding in France would be economically realistic considering agronomic and environmental constraints and advantages. Harvesting rice in flooded fields is four times more profitable to farmers and more than eight times more profitable for the Camargue society than the traditional burning-ploughing, that is not economically acceptable either for the farmer or for society (benefits-to-costs ratios for farmers: 4.30 vs. 0.93; for society: 6.81 vs. 0.73). Promoting winter flooding of rice fields in Europe would benefit both farmers and wintering ducks. In Camargue, in addition to be economically realistic for farmers, this practice is strongly desirable from an environmental conservation point of view, and should therefore be promoted.

Keywords: Habitat management, ecosystem services, wintering ducks, food availability, rice fields, conservation

(poster #27)

Habitat shift in European hare (*Lepus europaeus*) resting sites selection during spring and summer in France

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Arable areas provide a very changing environment, in particular due to vegetation growth and crops harvesting. In such a context, European hares (*Lepus europaeus*) are expected to change their habitat use over seasons in order to match their needs in terms of food and cover [1]. The impact of crop harvest and grassland mowing on hare population dynamics highly depends on where animals rest during the day. Highlighting an habitat shift in diurnal resting sites selection as a function of habitat changes in spring and summer would allow to assess the mortality risk associated to a particular plot in relation to its vegetation characteristics and to those of surrounding plots. More broadly, understanding the habitat requirements of hares provide insight into the consequences of agricultural intensification and into the benefit of habitat management policies.

In a three-year study (2012, 2013 and 2014) conducted in western France, 37 hares were radiocollared and their resting sites were located 4 to 5 times a week from April to September. The habitat types in the whole study area were mapped and the vegetation height was recorded in a sample of agricultural plots, in different types of crops, and was then inferred to other fields of the same type. The available habitat for each hare was defined as its minimum convex polygon over the whole period [2]. Since the vegetation height changes over time, comparisons of used and available habitat types were performed for each period of two weeks between April and September and each animal, which represented 188 hare-periods.

A co-inertia analysis [3] revealed a subtle selection of habitat type and vegetation height: Grain fields are selected at medium height (50-60 cm) but as the wheat grows it becomes less attractive; at the same time, the vegetation height in the cornfields increases, and are correlatively more and more selected. This result suggests an habitat shift over time, which is confirmed by two compositional analyses [4] performed for two periods: (i) from mid-April to mid-June and (ii) from mid-July to mid-September. During the first period, grain fields were preferred to other habitats while corn and alfalfa fields were avoided. Conversely, during the last one, cornfields were the most selected crops, and rapeseed and peas fields were the least ones.

This study demonstrates an habitat shift in diurnal resting site selection in the European hare in an arable landscape. Hares do not select the same fields and the same habitat type over time. During the day, they look for cover but the vegetation height is not a sufficient predictor since they shift from grain fields to cornfields while the wheat is still growing. Vegetation density and heterogeneity may play a crucial role in habitat preference [5]. Those results stress the importance of a diversity of habitat types and vegetation structures over the seasons to provide adapted cover to hares. Since the relative attractiveness of fields change over time, they also show that the mortality risk associated to harvest or mowing depends on the season and on the vegetation type and structure of surrounding fields. Some strips of corn plants near alfalfa fields for example may reduce the impact of mowing since hares may prefer this type of cover.

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References

[1] **Smith, R.K., N.V. Jennings, F. Tataruch, K. Hackländer & S. Harris** (2005). Vegetation quality and habitat selection by European hares *Lepus europaeus* in a pastural landscape. *Acta theriologica*, **50(3):** 391-404.
[2] **Johnson, D.H.** (1980). The comparison of usage and availability measurements for evaluating resource preference. *Ecology*, **61(1):** 65-71.
[3] **Dolédec, S. & D. Chessel** (1994). Co‐inertia analysis: an alternative method for studying species–environment relationships. *Freshwater biology*, **31(3):** 277-294.
[4] **Aebischer, N.J., P.A. Robertson & R.E. Kenward** (1993). Compositional analysis of habitat use from animal radio‐tracking data. *Ecology*, **74(5):** 1313-1325.
[5] **Smith, R.K., N.V. Jennings, A. Robinson & S. Harris** (2004). Conservation of European hares *Lepus europaeus* in Britain: is increasing habitat heterogeneity in farmland the answer?. *Journal of Applied Ecology*, **41(6):** 1092-1102.

Keywords: Habitat selection, agriculture, radio-tracking

(poster #28)

New technologies for monitoring abundance and harvest of game species: App "Becada"

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To develop sustainable management models of natural resources it is necessary to understand abundance changes, an appropriate knowledge of the social and economic context, and to design tools for monitoring populations [1]. Instead, it is relatively common to base management decisions on tradition or economic reasons rather than in studies over animal ecology or population dynamics [2,3]. In the case of the Eurasian Woodcock *Scolopax rusticola* in Spain, there are as many different management plans as political territories and in no case these differences are based in ecological differences [4].
Despite this, there are currently new opportunities of collaboration between those using the resources and those designing and assessing management. An example is citizen science, a collaboration between citizens and scientists in which the former participate in data collection and the latter lead and organise the scientific work [5]. An example of how a group of resource users can organise itself and make citizen science is the "Club de Cazadores de Becada" (CCB), the main woodcock hunters´ association in Spain. They have been collecting hunting bags and woodcock abundance data over the last 15 years and making them available for scientific research [4,6,7].
With the aim of expanding and facilitating this approach, since October 2016 the app "Becada" is available for Spanish woodcock hunters. It is a free smart-phone application developed to gather information about the abundance and hunting bag variations of woodcock between years and territories. The app has several screens where collaborators can introduce hunting data, the number of woodcock observed and hunted, and other relevant information (e.g. location or the time of hunting); collaborations can see global results obtained from all collaborators in several graphs as well (Figure 1).
We present in this poster the first results of the app "Becada" as a hunting species monitoring tool. There have been participants from 33 provinces in Spain (Figure 2). In addition, we analyse the differences of results obtained from the app and CCB data, and provide estimates of the Spanish woodcock hunting bag based on available data.

Figure 1: *App screens: A, Home, B, formulary to introduce hunting data; B, graphs to consult hunting data by month and province.*

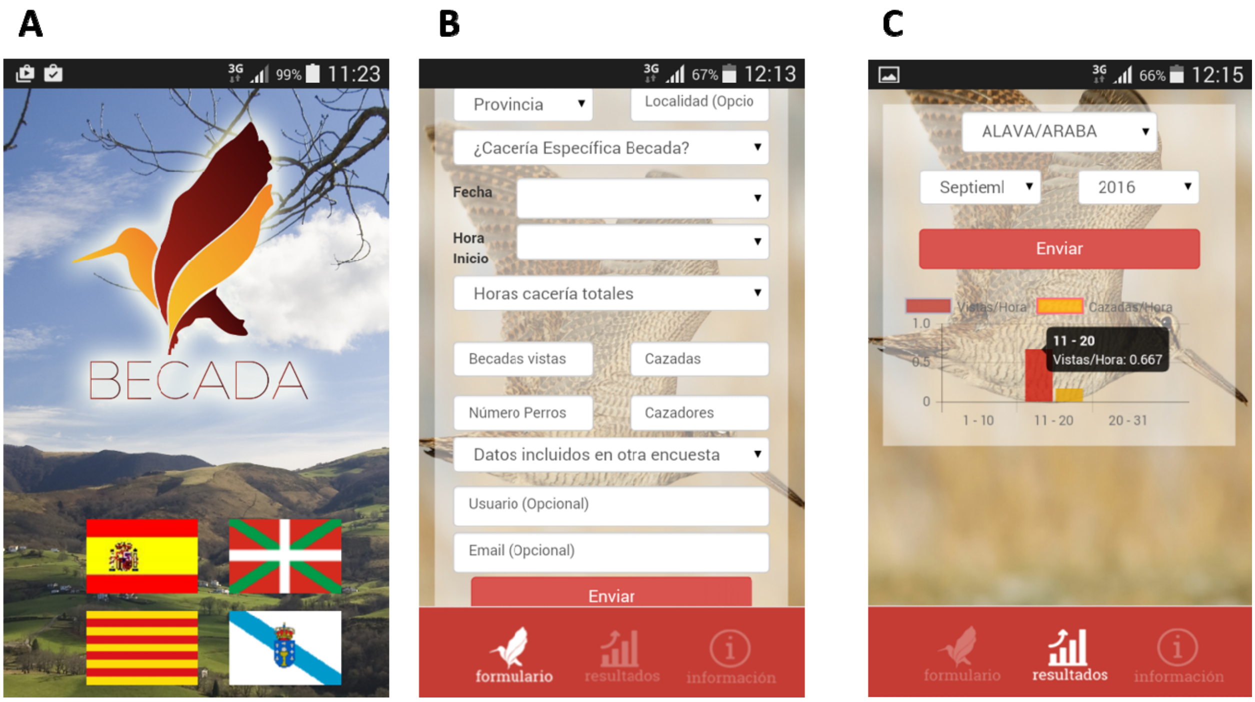

Figure 2: Provinces (in yellow) where hunters have provided information about woodcock hunting through the App Becada in the 2016-2017 hunting season.

References

[1] **Milner-Gulland, E.J. & R. Mace** (1998). Conservation of biological resources. Blackwell Science, Oxford, 404 pp.

[2] **Martínez, J, J. Vinuela & R. Villafuerte** (2002). Socioeconomic and cultural aspects of gamebird hunting. - Final report of the Workpackage 2 of the project Reconciling Gamebird Hunting and Biodiversity (REGHAB). Instituto de Investigación en Recursos Cinegéticos, 50 pp.

[3] **Díaz, S.** (2012). Relationships between red-legged partridge hunting management, red-legged partridge populations, and human populations. PhD Thesis, Instituto de Investigación en Recursos Cinegéticos (IREC), Ciudad Real, Spain

[4] **Guzmán, J.L.** (2013). Factores que modulan la abundancia poblacional de la becada (*Scolopax rusticola*): implicaciones para su gestión y conservación. PhD Thesis, Universidad de Castilla La Mancha.

[5] **Silvertown, J.** (2009). A new dawn for citizen science. *Trends in ecology & evolution*, **24(9):** 467-471.

[6] **Arizaga, J., A. Crespo, I. Telletxea, R. Ibáñez, F. Díez, J. Tobar et al.** (2015). Solar/Argos PTTs contradict ring-recovery analyses: Woodcocks wintering in Spain are found to breed further east than previously stated. *Journal of Ornithology,* **156(2):** 515-523.

[7] **Crespo, A., M. Rodrigues, I. Telletxea, R. Ibáñez, F. Díez, J.F. Tobar & J. Arizaga** (2016). No Habitat Selection during Spring Migration at a Meso-Scale Range across Mosaic Landscapes: A Case Study with the Woodcock (*Scolopax rusticola*). *PloS one,* **11(3):** e0149790.

Keywords: App, hunting bag, management, *Scolopax rusticola*, Spain

(oral)

Red-legged partridge *Alectoris rufa* productivity in relation to weather and land use

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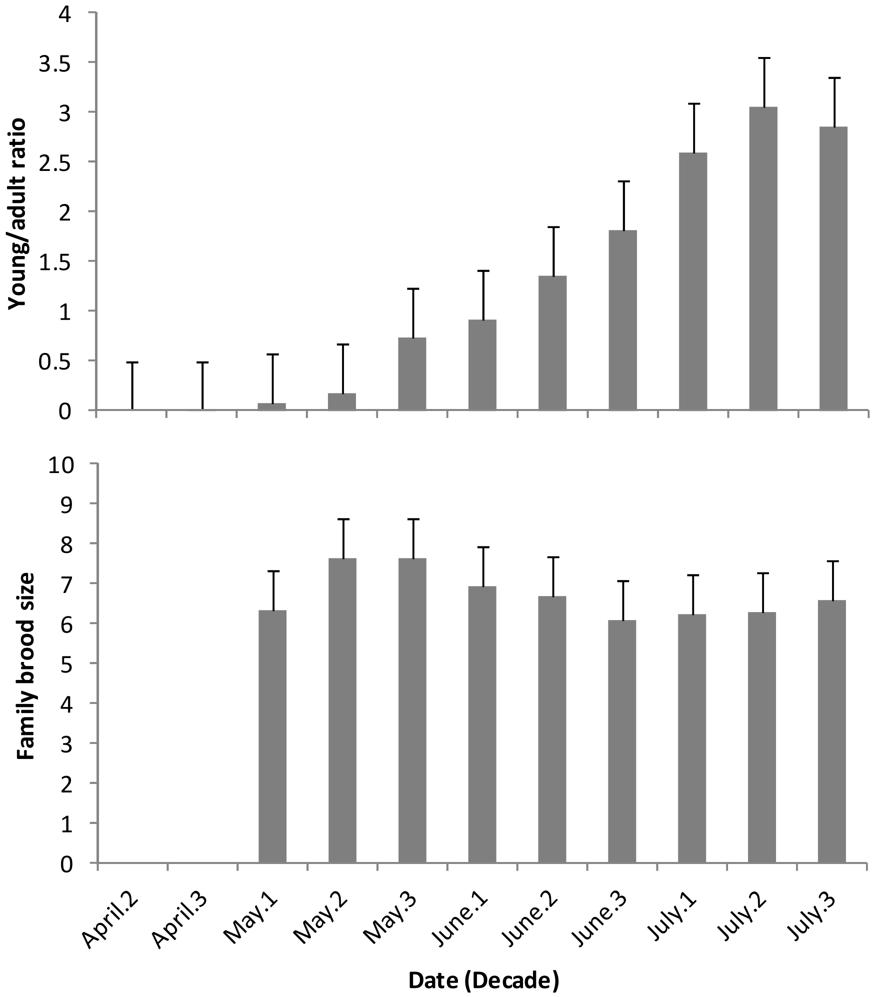
Productivity is usually a critical demographic parameter affecting population dynamics in many species [1]. In most species, spatial and temporal variations in breeding success are usually associated to variations in environmental conditions, primarily food abundance [2]. Breeding habitat is usually a good surrogate of environmental conditions, as habitat quality may be the factor guiding spatial variations in food abundance or predation risk, and thus breeding success and productivity [3]. Weather is also an important parameter explaining among and within-year variations in breeding success in many species [4]. The determination of the importance of these different factors in explaining productivity is relevant in the context of conservation management, as some of these factors may be modified by man (like habitat quality), but others may not (like weather).

We evaluated the reproductive success of the Red-legged partridge and factors associated with it, based on the analysis of 10519 observations of red-legged partridge adults and chicks. Data was obtained from April to July, in 2010, 2011 and 2012, along 300 car transects in the in the regions of Andalucía and Castilla-La Mancha (Figure 1). We used Generalized Mixed Models with “transect” nested within “year” as a random factor; number of chicks per observation, and the ratio of young to adult as dependent variables; age class, observation date, hatching date, climatic variables (rain and temperature), and land use (vegetation, crop diversity and plot size) as independent variables.

Average observed brood size for chicks hatched just a few days prior to observation was 6.6 ± 3.5, whereas the observed clutch size in this species in the study area averages between 10 and 14 eggs. This suggests important mortality just after hatching. Young-to-adult ratio increased with observation date, as number of hatched broods increased (Figure 2); values observed at the end of summer were relatively low compared with those observed in other studies. Furthermore, we found a negative relation of family group size (number of chicks) with hatching date, and eldest age classes; and both dependent variables presented relationships with year, climatic and land use variables. Finally, we discuss these results in relation to agriculture intensification link to habitat changes, and weather links to food availability and energy demands.

Figure 1. *Location of transects in the regions of Andalucia and Castilla-La Mancha, Spain (n=333).*

Figure 2. *Average (± SE) young-to-adult ratio (above) and family brood size (below) of red-legged partridges observed during censuses according to observation period.*



References

[1] **Begon, M., J.L. Harper & C.R. Townsend** (1990).Ecology: Individuals, Populations and Communities. Blackwell Scientific Publications, Cambridge, UK.

[2] **Martin, T.E.** (1987). Food as a limit on breeding birds: a life history perspective. *Annual Review of Ecology and Systematics,* **18:** 453-487.

[3] **Martin, T.E.** (1995). Avian life history evolution in relation to nest sites, nest predation and food. *Ecol Monogr.,* **65:** 101-127.

[4] **White, T.C.R.** (2008). The role of food, weather and climate in limiting the abundance of animals. *Biological Reviews,* **83:** 227-248.

Keywords: *Alectoris rufa*, climatic variations, land use, mixed models, reproductive success

(poster #29)

Habitat use by migrating and wintering geese in the Hortobágy (Hungary)

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The wetlands and fishponds of the Carpathian basin have a great importance in the migration and wintering of several Eurasian goose species. The Hortobágy region is a traditional stopover site along the flyway of many migrating birds and several goose species population have increased in the last years. The White-fronted Goose (*Anser albifrons*) is the most numerous in migration but two globally endangered species the Lesser White-fronted Goose (*Anser erythropus*) and the Red-breasted Goose (*Branta ruficollis*) are regularly observed each year. The breeding population of Greylag Goose (*Anser anser*) also has increased, this is the only breeding goose species in the wetlands of the Hortobágy. In the Hortobágy National Park the geese can find safe resting places and hunting pressure is relatively low in the protected areas. This increase is presumably caused by shifting migration routes or favourable climatic condition changes in migrating and wintering seasons. The management of the wetlands and the feeding habitats in the national park can have a positive impact on the population growth of these rare goose species.

The migrating wild geese flocks have different feeding habitats in each season. The feeding places differed according to the season of the year, in spring, geese preferred fresh grass, so they mostly grazed on wet grasslands. In autumn and winter, goose flocks feeding in arable lands stubble fields of maize where they eating the remaining corns and winter wheat fields where they could graze young shoots of emerging plants. During our investigation we do not observed any significant crop damage, on some sample plots of wheat fields, the goose population density was extremely high (rate of defoliation up to 100%), while on the others, e.g. on edges of the field, geese did not graze at all. The number of goose droppings also changeable, but sometimes extremely high density on the grazing fields (0-35 pieces m-2). In the end of March when the bigger geese flock moved away from the Hortobágy and the crop fields can recover from the grazing pressure.

The main feeding sites the croplands are lying outside the border of the national park, in this sites the geese are exposed to hunting and more disturbance. In the future we should create some goose feeding fields near the main resting places inside the Hortobágy National Park, where the geese can feed without disturbance.

References

[1] **Mooij,J.H.** (1991). Hunting - a questionable method of regulating goose damage. *Ardea,* **79(2):** 219-223.

[2] **Patterson, I.J.** (1991). Conflict betwen geese and agriculture: Does grazing cause damage to crops? *Ardea,* **79:** 179-186.

[3] **Summers, R.W.** (1990). The effect on winter wheat of grazing by brent geese Branta bernicla. *Journal of Applied Ecology,* **27(3):** 821-833.

Keywords: goose, migration, Hortobágy, agriculture, crop damage

(oral)

Non-Invasive monitoring of glucocorticoid metabolite response in *Capreolus capreolus* impact of a drive hunt

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Roe deer (*Capreolus capreolus*) is the most prevalent hunted hoofed game in Germany. Each year, some hundred thousand Roe deer are taken by drive hunts. Typical for this kind of hunting is that beaters and dogs flush out the game. This puts physical and psychological discomfort on these game animals. The endocrine nervous system is activated and reacts with the production of cortisol.
Our aim is to measure the glucocorticoid metabolite (GCM) concentration in feces to detect the stress levels of Roe deer in response to a drive hunt.
The network of observation points for feces samples, which are distributed over the hunting area, are cleared on the day before hunting started. After the hunt and during the following five days, feces in the sample areas were collected. In total, we gathered 386 fecal samples in four different Bavarian drive hunt habitats.
An unpublished research paper by a PhD student measuring the stress levels throughout the years 2011 to 2014 will be compared to the results of this research. Furthermore, 95 samples of a preliminary study conducted by a previous student are included in the evaluation.
The results of our study indicate an increase in GCM concentration with a peak during the first day after the drive hunt. On the third day, the concentration gradient approaches the baseline. We didn't find highest GCM levels as reaction on drive hunts but as reaction on social behavior of roe deer in spring and summertime.

Figure 1: *GCM-values of all roe deer according to the season*

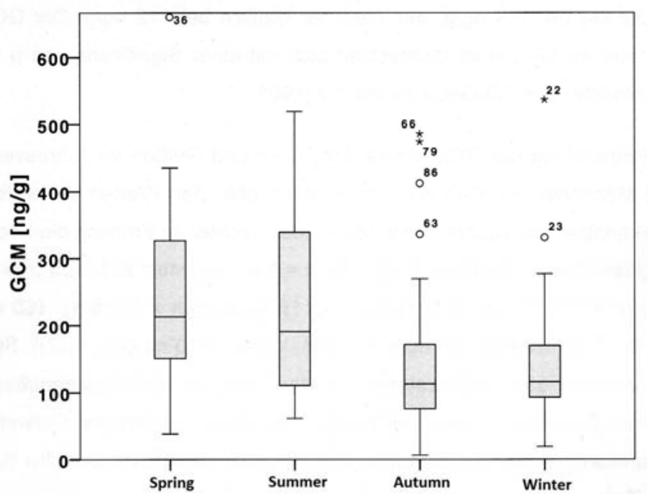
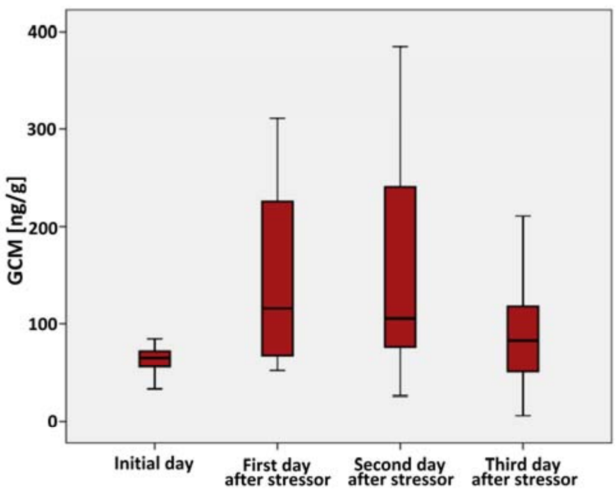


Figure 2: *GCM-values of all roe deer before and after a drive hunt*



References

[1] **Christofoletti, M., R. Pereira & J. Duarte** (2010). Influence of husbandry systems on physiological stress reactions of captive brocket and marsh deer-noninvasive analysis of fecal cortisol metabolites. *European Journal of wildlife research*, **56:** 561-568.

[2] **Corlatti, L., R. Palme, F. Frey-Roos & K. Hackländer** (2011). Climatic cues and glucocorticoids in a free-ranging riparian population of red deer. *Folia Zoologica*, **60:** 176-180.
[3] **Dehnhard, M., M. Clauss, M. Lechner-Doll, M. Meyer & R. Palme** (2001). Noninvasive Monitoring of Adrenocortical Activity in Roe Deer by Measurement of Fecal Cortisol Metabolites. *General and Comparative Endocrinology*, **123:** 111-120.
[4] **Keay, J., B. Singh, M. Gaunt & T. Kaur** (2006). Fecal glucocorticoids and their metabolites as indicators of stress in various mammalian species: a literature review. *Journal of Zoo and Wildlife Medicine*, **37:** 234-244.
[5] **König, A., U. Hohmann, C. Ebert & J. Mitschke** (2016). Wildbiologische Forschungsberichte. *Schriftenreihe der Vereinigung der Wildbiologen und Jagdwissenschaftler Deutschlands*, **2:** 74-82.
[6] **König, A., M. Scheingraber & J. Mitschke** (2016). Energiegehalt und Qualität der Nahrung von Rehen (*Capreolus capreolus*) im Jahresverlauf in unterschiedlich geprägten Habitaten. *Forstliche Forschungsberichte*, **215:** 130-133.
[7] **Moberg, G. & J. Mench** (2000). The biology of animal stress: basic principles and implications for animal welfare. *CABI Publishung Series*.
[8] **Möstl, E., J. Maggs, G. Schrötter, U. Besenfelder & R. Palme** (2002). Measurement of Cortisol Metabolites in Faeces of Ruminants. *Veterinary Research Communications*, **26:** 127-139.
[9] **Möstl, E. & R. Palme** (2002). Hormones as indicators of stress. *Domestic Animal Endocinology*, **23:** 67-74.
[10] **Möstl, E. & R. Palme** (2014). Measuring faecal steroid metablites with enzyme immunoassays (EIA) on microtitre plates using biotinylated steroids as labels. *V. U. Wien*.
[11] **Sheriff, M.J., B. Dantzer, B. Delehanty, R. Palme & R. Boonstra** (2011). Measuring stress in wildlife: techniques for quantifying glucocorticoids.
[12] **Weilnböck, G.** (2013). Zur Stressbelastung des Rehwilds (*Capreolus capreolus*) beim Fang mit der Kastenfalle. *Technische Universität München.*
[13] **Zwijacz-Kozica T., N. Selva, I. Barja, G. Silvan, L. Martines-Fernandez, J.C. Illera & M. Jodlowski** (2012). Concentration of fecal cortisol metabolites in chamois in relation to tourist pressure in Tatra National Park.

Keywords: *Capreolus capreolus*, roe deer, stress, glucocorticoid, feces, drive hunt

(oral)

Coat colour change pattern in Alpine mountain hares (*Lepus timidus varronis*) along an altitudinal gradient in Grisons, Switzerland: implications for game management

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Alpine mountain hares are a glacial relict species in the Alps and can be found between 700 and 3800 m a.s.l. [1]. They show a coat colour change from brownish in summer to white in winter [2]. The white fur provides camouflage and a better insulation (hairs are filled with air instead of melanin), likely increasing winter survival. We hypothesise that the seasonal phenological timing of the coat colour pattern is under high selection pressure as observed in the related snowshoe hares [3] and that the pattern is adapted to the environmental differences along an altitudinal gradient characterized with increasing snow cover duration. To test our hypothesis, we used data from regular hunting in the canton Grisons, where about 1000 mountain hares are harvested every year. Hunters were asked to report the day and altitude of their hunting bag and to provide a photo of the shot individual. Photos were used to estimate coat colour (in % white). We collected datasets of 235 shot hares between 2012 and 2016 during the hunting season in autumn (October-November). The altitudinal range was between 1250 and 2960 m a.s.l. Coat colour was analysed in relation to calendar week, altitudinal class and bio-geographical region using generalized linear models. Our results reveal strong relationship of coat colour moult pattern and altitude, with earlier change into white fur at higher altitudes.
The results are discussed in the light of global warming with shorter snow cover duration, genetic diversity and adaptability in highly fragmented populations [4] and additional threats by European hares (*L. europaeus*) moving to higher elevations [2] and heavy winter tourism in the Swiss Alps [5].

References

[1] **Rehnus, M., V. Braunisch, K. Hackländer, L. Jost & K. Bollmann** (2016). The seasonal trade-off between food and cover in Alpine mountain hare (Lepus timidus). *Eur J Wildl Res*, **62:** 11-21.

[2] **Schai-Braun, S. & K. Hackländer** (2016). Mountain hare *Lepus timidus*. In: Wilson DE, Lacher TE, Mittermeier RA (eds.) *Handbook of the Mammals of the World, Vol. 6. Lagomorphs and Rodents I*, Lynx Edicions, Barcelona: 145-147.

[3] **Zimova, M., L.S. Mills & J.J. Nowak** (2016). High fitness costs of climate change-induced camouflage mismatch. *Ecol. Letters,* **19:** 299-307.

[4] **Zachos, F., H. Ben Slimen, K. Hackländer, M. Giacometti & F. Suchentrunk** (2010). Regional genetic in situ differentiation despite phylogenetic heterogeneity in Alpine mountain hares. *J. Zool.*, **282:** 47-53.

[5] **Rehnus, M., M. Wehrle & R. Palme** (2014). Mountain hares *Lepus timidus* and tourism: stress events and reactions. *J. Appl. Ecol.,* **51:** 6–12.

Keywords: Lepus timidus, Mountain hare, coat colour, global warming

(poster #30)

Resolutions of the 6th World Congress on Mountain Ungulates and the 5th International Symposium on Mouflon and their effect on Mouflon taxonomy

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The Ministry of Interior of the Republic of Cyprus, with the cooperation of Frederick University (Nature Conservation Unit) and the Caprinae Specialist Group of the Species Survival Commission of IUCN, from the 29th of August 2016 to the 1st of September 2016, organized the 6th World Congress on Mountain Ungulates and the 5th International Symposium on Mouflon (WCMU), in Nicosia, Cyprus. Sixty seven scientific papers were presented, from about 228 participants from 27 countries [1,2]. Before the WCMU, the classification of mouflons, urials and their hybrids were under taxonomic confusion and spelling inconsistencies [3-5]. The International Commission on Zoological Nomenclature (ICZN) in 2003 accepted the Asian mouflon (*Ovis gmelini*) as *Ovis orientalis* and relegated the European/Mediterranean mouflon with domestic sheep *Ovis aries* [6,7]. Recent genetic and biochemical studies revealed that the Cypriot mouflon mitochondrial lineage had an early split from other domestic sheep about 170 thousand years ago (KYA), and fall within a cluster closely related to *Ovis gmelini* [8,9]. The rise of the current domestic sheep haplogroups, have occurred around 5-35 KYA, suggesting that domestication of wild sheep initiated about 25 KY before than previously assumed, perhaps originated partly from the Cyprian mouflon, but the Cyprian mouflon did not originated from domestic sheep [8, 9]. The gathering at the WCMU of experts on wild sheep and ungulates from all over the world, provided the opportunity, in the light of the new scientific studies and new molecular evidence, to discuss and to come into unanimous conclusions on the taxonomy of the above taxa. The participants concluded that *Ovis orientalis* seems to refer to the hybrid Alborz red sheep, a reason for which the name is unusable and may enter into homonymy [10,11]. Based on recent complete sequence of Cyprian mouflon mtDNA and phylogenetic analyses using a large dataset of whole *Ovis* mitogenomes, as well as D-loop analysis comprising samples from the main Mediterranean islands [8,9], as well as other phenotypic and forensic studies, the participants agreed that the Cyprus mouflon must be considered as a subspecies of *Ovis gmelini*, i.e. *O. g. ophion* [11]. The participants of the 6th WCMU, in their resolutions which were accepted unanimously at the end of the congress, among other decisions, recommended that: To uniformly update the taxonomy of the Cyprus mouflon to *Ovis gmelini ophion* within all the relevant legal and scientific frameworks such as the Cypriot law, EU Habitats Directive, CITES, IUCN Red List of Threatened Species, and the Genetic Database repositories [11]. This is the first time in the taxonomic history of wild sheep, that such unanimous decision took place on the taxonomy of mouflon by so many experts from all over the world, something which clarifies a taxonomic matter which bewildered scientists for decades.

References

[1] **Hadjisterkotis, E.** ed. (2016). Abstracts of the 6th World Congress on Mountain Ungulates and 5th International Symposium on Mouflon. Ministry of the Interior, Nicosia, Cyprus.

[2] **Hadjisterkotis, E.** ed. (2016). Abstracts of the 6th World Congress on Mountain Ungulates and 5th International Symposium on Mouflon, 3rd Edition. Ministry of the Interior, Nicosia, Cyprus.

[3] **Damm Gerhard, R. & F. Nicolás** (2014) The CIC Caprinae Atlas of the World – CIC International Council for Game and Wildlife Conservation, Budakeszi, Hungary in cooperation with Rowland Ward Publications RSA (Pty) Ltd. Johannesburg, South Africa.

[4] **Hadjisterkotis, E., P. Mereu & B. Masala** (2016) A review of the nomenclatural spelling variation of the scientific name of the Armenian mouflon (*Ovis gmelini gmelinii*). Pp38-39, In: E. Hadjisterkotis (ed.) Abstracts of the of the 6th World Congress on Mountain Ungulates and 5th International Symposium on Mouflon. Ministry of the Interior, Nicosia, Cyprus.

[5] **Hadjisterkotis, E., P. Mereu & B. Masala** (2016). A review of the nomenclatural spelling variation of the scientific name of the Armenian mouflon (*Ovis gmelini gmelinii*) and the Cyprian mouflon (*Ovis gmelini ophion*). Pp 48-50, In: E. Hadjisterkotis (ed.) Book of Abstracts of the of the 6th World Congress on Mountain Ungulates and 5th International Symposium on Mouflon, 3rd Edition. Ministry of the Interior, Nicosia, Cyprus.

[6] **ICZN, Opinion 2027** (2003). Case 3010: usage of 17 specific name was based o wild species which are pre-dated by or contemporary with those based on domestic animals (*Lepidoptera, Osteichthyes, Mammalia*); conserved. *Bulletin of Zoological Nomenclature* **60:** 81-84.
[7] **Gentry, A., J. Clutton-Brock & C.P. Groves** (1996). Case 3010: Proposed conservation of usage of 15 mammal specific names based on wild species which are antedated by or contemporary with those based on domestic animals. *Bull. Zool. Nomenclature* **53:** 28-37.
[8] **Sanna, D., M. Barbato, E. Hadjisterkotis, P. Cossu, L. Decandia, S. Trova, M. Pirastru, G.G. Leoni, S. Naitana, P. Francalacci, B. Masala, L. Manca & P. Mereu** (2015). The First Mitogenome of the Cyprus Mouflon (*Ovis gmelini ophion*): New Insights into the Phylogeny of the Genus Ovis. *PLoS One* **10(12):** e0144257.
[9] **Mereu, P., M. Pirastru, M. Barbato, E. Hadjisterkotis, G.G.Leoni, S. Naitana, B. Masala & L. Manca** (2016). The entire mtDNA sequence of the Cyprian mouflon (**Ovis gmelini ophion**): a new method for the study of mouflon and domestic sheep evolution. Pp 59-60, In: E. Hadjisterkotis (ed.) Book of Abstracts of the of the 6th World Congress on Mountain Ungulates and 5th International Symposium on Mouflon, 3rd Edition. Ministry of the Interior, Nicosia, Cyprus.
[10] **Groves, C. & P. Grubb** (2011). Ungulate taxonomy. The Johns Hopkins University Press.
[11] **Hadjisterkotis, E. & S. Lovari** (2016). Results and Resolutions of the 6th World Congress on Mountain Ungulates and 5th International Symposium on Mouflon. Pp 20-23 In: E. Hadjisterkotis (ed) Book of Abstracts of the 6th World Congress on Mountain Ungulates and 5th International Symposium on Mouflon, 3rd Edition. Ministry of the Interior, Nicosia, Cyprus.

Keywords: mouflon, *Ovis gmelini ophion*, sheep haplogroups

(oral)

Multi-scale occupancy models provides insights to landscape conservation needs of Lesser Prairie-Chicken

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The Lesser Prairie-Chicken (*Tympanuchus pallidicinctus;* hereafter prairie-chicken) is a species of conservation concern in the United States [1]. The primary threats to prairie-chickens are habitat loss and fragmentation that result from land uses incompatible with the species' biology. However, landscape scale initiatives are underway and designed to yield population level responses to conservation practices [1,2]. Further complicating species' conservation is 90% of its habitat is privately owned. Monitoring biological responses to these conservation actions are paramount to maintain prairie-chicken populations into the future. Since 2012, abundance has been estimated annually across 4 eco-regions that encompass the prairie-chicken distribution [3]. Briefly, the method entails double-observer counts along two aerial (i.e., helicopter) transects, that are nested within a 15-km × 15-km grid cell. The approach enables robust estimation of abundance of prairie-chickens and their leks using distance sampling methods. Here, we present an occupancy approach to determine the status and habitat responses for the range-wide distribution of the prairie-chicken population. We partitioned the detection/non-detection data collected under the monitoring program into 7.5-km × 7.5-km quadrants, and estimated prairie-chicken occupancy at large- and small-scales [3, 4]. This type of model can predict multi-scale covariate relationships to inform habitat management at multiple spatial extents at which species may respond differently. Our objectives were to 1) estimate prairie-chicken occupancy at multiple spatial scales from the range-wide monitoring program, 2) conduct an exploratory evaluation of the multi-scale occupancy model's potential to predict the effects of habitat and conservation practices on prairie-chicken occupancy. We discuss the results of our single year (2015) exploratory analysis [5] in the context of our (forthcoming) findings from applying these models to the multi-year (2012-2016) dataset.

Methods

The monitoring program for the prairie-chicken [3] spanned the entire occupied range (8 million ha) of the species including parts of Colorado, Kansas, New Mexico, Oklahoma and Texas. Four strata were delineated based on ecoregional designations [3].

The Raven II (R-44) helicopter was the survey platform used. This helicopter accommodated two observers in the rear left and right seats, and a third observer in the front left seat. Transects were flown north to south or south to north at nominal values of 60 km per hour and 25 m above ground. During the lekking period (15 Mar to 15 May 2015), surveys were conducted from sunrise until approximately 2.5 hours after sunrise.

The multi-scale model can be thought of as a within-season robust design, where quadrants within grid cells were primary occasions for estimating θ, and temporal replicates or multiple observers were secondary occasions for estimating p [4]. The modeling approach allows the estimation of occupancy at the scale of grid cells and quadrants. We fit the multi-scale occupancy models using the RMark interface (Version 2.1.13; R Development Core Team 2015) for program MARK (Version 8).

Results

The best approximating model for prairie-chicken detection (p) included the effects of observer and stratum. The evidence ratio indicated the top model containing the effects of observer and stratum was ~2 times more plausible than the second best model containing only the observer effect. The probabilities of detection in the top model were greater for back seat observer than the front seat observer (β = 1.30; 90% CI = 0.68, 1.92), and varied among strata.

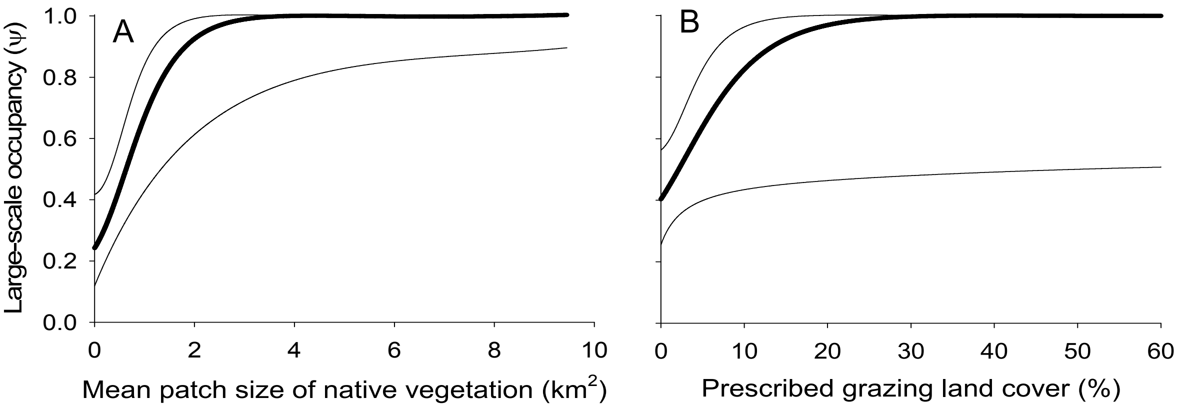
The best model for the small-scale occupancy (θ) of the prairie-chicken included the effects of stratum. The evidence ratio indicated the top model containing the effect of stratum was ~5 times more plausible than the fourth best model with a constant probability of small-scale occupancy. Small-scale occupancy in the top model was lower in the sandsage prairie (β = –0.96; CI = –1.86, –0.06) and shinnery oak prairie (β = –2.03; CI = –3.01, –1.05) strata than in the shortgrass stratum.

The best approximating model for the large-scale occupancy (ψ) of the prairie-chicken included a constant probability of occupancy across the strata. The best model for the large-scale occupancy of the prairie-chicken as a function of habitat contained the effects of patch size of native landcover and prescribed grazing (Fig 1). The best approximating model for small-scale occupancy (θ) included the effects of CRP and stratum (ecoregion). For example, θ of the prairie-chicken was > 0.5 when CRP land cover exceeded 20% of a quadrant in the shortgrass stratum of northwest Kansas.

Discussion

Our work provides initial insights to effectiveness of utilizing established aerial surveys for estimating prairie-chicken occupancy at multiple scales. Our primary findings are two-fold: 1) with minor adjustments to how the data are recorded and by subdividing the grid, occupancy could be estimated at multiple scales with reasonable levels of precision and 2) an exploratory set of a priori hypotheses were modeled and covariates were identified that helped explain large (ψ) and small scale occupancy (θ). These findings support the conservation concept that broad landscapes and management practices may be effective in maintaining or improving the condition of the landscape [5]. There were measurable and positive effect sizes between mean patch size of native vegetation and probability of occupancy by prairie-chickens in the large scale grid cells. Ecologically, we recognize prairie-chickens are a landscape scale species [5]. Our findings suggested that landscapes with a mean value of CRP (10%) and prescribed grazing (3%), and as mean patch size exceeds 1.5 km^2, the proportion of occupied grid cells was > 0.83. While minimum patch size requirements for populatoin persistence still elude us, our findings provide an indication of what minimum patch sizes in the landscape may be for a site to at least be occupied. The strong positive relationship between percent prescribed grazing and probability of occupancy in our modeling is also encouraging, but unexpected at the large-scale. This relationship indicates that current conservation investments may be targeted correctly, and that occupancy is positively related to ongoing conservation practices.

***Figure 1**. The large-scale occupancy (ψ: 95%CI) of the lesser prairie-chicken in 15-km × 15-km grid cells by the A) mean patch size of native landcover (patchsize) and B) prescribed grazing landcover (holding the other covariate values at their mean values) in the exploratory analysis.*



References

[1] **Van Pelt, W.E., S. Kyle, J. Pitman, D. Klute, G. Beauprez, D. Schoeling, A. Janus & J.B. Haufler** (2013). The Lesser Prairie-Chicken Range-Wide Conservation Plan. Western Association of Fish and Wildlife Agencies, Cheyenne, Wyoming, USA.

[2] **US Department of Agriculture** (2014). Natural Resources Conservation Service: Conservation beyond boundaries LPCI 2014 Progress Report. http://www.nrcs.usda.gov/wps/portal/nrcs/detail

[3] **McDonald, L.L., G. Beauprez, G. Gardner, J. Griswold, C. Hagen, F. Hornsby, D. Klute, S. Kyle, J. Pitman, T. Rintz, D. Schoeling & B. Van Pelt** (2014). Range-wide population size of the lesser prairie-chicken: 2012 and 2013. *Wildlife Society Bulletin,* **38:** 536–546.

[4] **Pavlacky, D.C., Jr., J.A. Blakesley, G.C. White, D.J. Hanni & P.M. Lukacs** (2012). Hierarchical Multi-Scale Occupancy Estimation for Monitoring Wildlife Populations. *Journal of Wildlife Management,* **76:** 154–162.

[5] **Hagen, C.A., D.C. Pavlacky, K. Adachi, F.E. Hornsby, T.J. Rintz & L.L. McDonald** (2016). Multiscale occupancy modeling provides insights into range-wide conservation needs of lesser prairie-chicken (*Tympanuchus palldicinctus*). *Condor,* **118:** 597-612.

Keywords: abundance, conservation practices, landscape ecology, monitoring, occupancy

(oral)

Success and failure of a stakeholder based approach mitigating human-wild boar conflicts in rural areas in Bavaria (South East Germany)

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The wild boar population in Bavaria (South East Germany) has increased dramatically. Hunting bags indicate the population growth which goes along with a massive range expansion south to the Alpine region. The reduction of the wild boar population was postulated unanimously by landowners, hunters and competent authorities since several years. Nevertheless, hunting efforts have obviously no lasting effect to reverse the trend of wild boar population growth and range expansion. This is astonishing as landowners are complaining about serious damages, traffic accidents with wild boar are daily occurrence and the high risk for transmission and outbreaks of diseases like Classical swine fever, African swine fever or pseudorabies is more topical than ever.

In 2002 the Bavarian State Ministry for Food, Agriculture and Forestry (StMELF) together with the Bavarian Farmers Association (BBV), the Bavarian Forest Owners Association (WBV) and the Bavarian Hunting Association (BJV) agreed upon "common recommendations for reducing the excessive wild boar population". An evaluation by the Bavarian State Institute of Forestry (LWF) in 2007 showed, that the recommendations are not implemented adequately and the reduction efforts by the hunters are not sufficient.

Based on this a new approach was tested by the project "Focus on wild boar - project to develop innovative regional concepts". The project focused on stakeholder participation and the development of local solutions to solve existing and expected negative impacts caused by the boar population in rural areas. The project operated in five pilot areas representing different initial situations. Following a stringent bottom-up process various ideas and constructive suggestions were made on workshops by the different stakeholders involved (hunters, landowners, farmers, foresters, veterinarians, competent authorities and politicians). The implementation of management measures was realized by so called “coordination teams” which are equally represented by the stakeholders involved. In the whole process moderation and mediation techniques were used to generate different results for an improved regional wild boar management. As result a lot of management instruments, like improved driven hunts with hounds, improved baiting systems, the use of night vision devices, a web-based monitoring and communication system, several training modules for hunters and landowners and many other tools have been developed and used by the local stakeholders.

The strength and weakness of a stakeholder-based approach to mitigate wild boar problems is assessed using examples of the project areas. Failures and the requirements for successful continuation of the implemented measures are analysed. Based on the experiences suggestions for the transferability of the used approach are given. To beat future conflicts caused by high wild boar population levels it is essential to understand human dimension aspects. The presented bottom-up process on regional level shows that recreational hunting is insufficient to limit wild boar population growth permanently and that it will only partly be promising to resolve the existing human-wild boar conflicts.

References

[1] **Hahn, N.** (2014). Brennpunkt Schwarzwild. Projekt zur Entwicklung innovativer regionaler Konzepte. Erstellt im Auftrag der Bayerischen Landesanstalt für Wald und Forstwirtschaft (LWF). Final report *(in German)*. 240 Seiten*. Download: http://www.lwf.bayern.de/service/publikationen/sonstiges/082825/index.php*

Keywords: human dimension, human-wild boar conflicts, bottom-up process, management measures, population, hunting

(oral)

Recovering grey partridges: A genuine intersection of sustainable farming, wildlife conservation and management

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According to the records of the Hungarian Game Management Database [1], grey partridges *(Perdix perdix)* in Hungary suffered a 98% decline during the past 50 years, with local extinctions becoming ever more frequent. Estimations of hunters indicate that where partridges persist, their numbers are probably below the recovery threshold of 2 pairs per square kilometres [2]. It is therefore essential to demonstrate how this trend can be reversed locally by implementing a complex management package that invollves the restoration of partridge habitats, a reduction in predation pressure, an intorduction of supplemetary feeding and the reinforcenment of existing populations following the grey partridge recovery guidelines of Buner & Aebischer [2].

The LAJTA Project (3065 hectares) started in 1992 and is the longest ongoing farmland eco-system and wildlife monitoring programme in Central-Europe. Actions to conserve grey partridges focused on habitat development and predator control [3-5], however concerning the latter activity, due to changes in the legislation, some of the originally applied methods were altered during the project period.

In 2014, along with the employment of a new gamekeeper on 2545 hectares, predation management based on legal restraining and killing trapping methods was intensified to reduce fox *(Vulpes vulpes)*, badger *(Meles meles),* stone marten *(Martes foina)*, weasel *(Mustela nivalis)*, brown rat *(Rattus norvegicus)* and corvid *(Corvus cornix, Pica pica)* numbers prior to and during the breeding period of partridges. Additionally, a network of hopper feeders and drinkers was introduced along field margins, while new "in field" game cover strips were established within a 370 hectare core area of the project. Altogether 42 chicks of four bantam reared broods were fostered to four barren pairs in 2014 and 2015, and a family group consisting of two adults and 11 juveniles was released in 2015. Since then, no birds were released, due to the density of partridge pairs reaching the recovery threshold in 2016.

As a result of the management package applied, grey partridge pairs increased from 12 to 59 between 2014 and 2017. During the same period, brown hare *(Lepus Europaeus)* and pheasant *(Phasianus colchicus)* densities rose, allowing for increased harvests, thus contributing to the maintainance of management activites primarily targeting grey partridge recovery. Apart from game, many other species benefit from the revitalised grey partridge conservation programme. Prior to 2014, the last great bustard lek *(Otis tarda)* was observed in 2007 by Faragó & Spakovszky [6]. In 2016 two males and four females, while in 2017 two males and seven hens were observed at an old lekking site, following the overwintering of 32 males and 13 females. The LAJTA Project is also home to other species of remarkable biodiversity, such as the imperial eagle *(Aquila heliaca)*, the white tailed eagle *(Haliaeetus albicilla)*, or the red footed falcon *(Falco vespertinus)*. Recent censuses of birds of prey [7] indicate no change in the large nesting population of marsh harriers *(Circus aeruginosus),* and common buzzards *(Buteo buteo)*, while the sighting frequency of overwintering hen harriers *(Cricus cyaneus)* and rough-legged buzzards *(Buteo lagopus)* is four to eight times higher than the national average [8].

Unfortunately, the majority of the farms within the project area that were involved in previous agri-environmental contracts were not renewed in 2015, due to the high competition of eligible applicants thoughout the country. Therefore, the major factor for the recent increase of grey partridges at the LAJTA Project was almost certainly predation control. The ability to increase densities of farmland game and other ground nesting bird species alongside the high abundance of raptors further highlights the relevance of efficient and legal management of generalist predators. In order to boost the effect of agri-environmental schemes targeting the recovery of species, it is recommended to supplement the creation and restoration of habitats with gamekeeping.

Maintanence and development of the innovative combination of trapping methods applied at the LAJTA Project is essential to improve success of farmland wildlife conservation and management throughout Central-Europe.

With regard to the already expired implementation time table laid out in the Agreement on International Humane Trapping Standards (AITHTS), which is binding to all EU Member States, the challenge is how the obligations may be rapidly fulfilled by competent authorities. Without efficient certified and approved methods at hand, wildlife professionals may lose an important tool of management. Establishment of a trans-boundary cooperation to implement AIHTS in a way that benefits wildlife conservation, is an urgent challenge which has to be met by stakeholders.

References

[1] **Csányi, S. et al.** (eds.) (2016) Vadgazdálkodási Adattár 2015/16. vadászati év. Gödöllő: Országos Vadgazdálkodási Adattár (Hugarian Game Management Database).

[2] **Buner, F. & N.J. Aebischer** (2008) Guidelines for re-establishing grey partridges through releasing. Fordingbridge: Game & Wildlife Conservation Trust.

[3] **Faragó, S.** (1997) The Hungarian Partridge Conservation Program. Conservation, Research and Managemement. *Magyar Apróvad Közlemények (Hungarian Small Game Bulletin)*, **1:** 31-44.

[4] **Faragó, S.** (1998) Habitat improvement of Hungarian partridge population (*Perdix perdix*): The Hungarian Partridge Conservation Program (HPCP). *Gibier Faune Sauvage – Game and Wildlife*, **15(1)**: 145-156.

[5] **Faragó, S., G. Dittrich, K. Horváth-Hangya & D. Winkler** (2012) Twenty years of the grey partridge population in the LAJTA Project (Western Hungary). *Animal Biodiversity and Conservation*, **35.2:** 311-319.

[6] **Faragó, S. & P. Spakovkszky** (2012) A túzok a LAJTA Projectben (Great Bustard in the LAJTA Project). In: Faragó, S. (ed.) LAJTA Project * 20 év * (LAJTA Project * 20 years *. Sopron: Nyugat-magyarországi Egyetem Kiadó 364-400.

[7] **Kovács, G., T.M. Németh, D. Winkler & S. Faragó** (2015) Ragadozómadarak élőhelyhasználata a Lajta Project területén *(Habitat use of raptors at the Lajta Project)*. In: A. Bidló & F. Facskó, (eds.) V. Kari Tudományos Konferencia. Sopron: Nyugat-magyarországi Egyetem Erdőmérnöki Kar, V: 15.

[8] **Szép, T., K. Nagy, Z. Nagy & G. Halmos** (2012) Population trends of common breeding and wintering birds in Hungary, decline of long-distance migrant and farmland birds during 1999-2012. *Ornis Hungarica*, **20(2):** 13-63.

Keywords: grey partridge recovery, predation control, supplementary feeding, sustainable farming, habitat improvement, AIHTS

(oral)

Seral Stage Manipulation Increases Nutritional Carrying Capacity for Cervids

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Closed-canopy forests dominate the landscape across much of the eastern United States and often lack a well-developed understory, which limits cover and nutrition for cervids. Early successional plant communities provide high-quality summer nutrition and cover for cervids, but are rarely managed in the region. We evaluated the influence of timber harvest combined with prescribed fire and/or herbicide treatment in young mixed-hardwood forests on summer forage availability, nutritional carrying capacity (NCC), and vegetation composition for elk (*Cervus elaphus*) and white-tailed deer (*Odocoileus virginianus*) at the North Cumberland Wildlife Management Area (WMA), Tennessee, USA, July-August, 2013-15. We compared forage availability, NCC (animal days/ha) using a 14% crude protein (CP) nutritional constraint, and vegetation composition in untreated mature forest stands (MATFOR), reclaimed surface mines (MINE), and 6 harvest treatments (timber harvest only (HARV), with early growing-season fire (EBURN), with late growing-season fire (LBURN), with herbicide (HERB), with herbicide and early growing-season fire (EBHERB), and with herbicide and late growing-season fire (LBHERB)). We measured forage by collecting leaf material of herbaceous and woody plant species that were determined selected by elk and white-tailed deer through bite count surveys. Forage availability in MATFOR (147 kg/ha) and MINE (363 kg/ha) was less than all timber harvest treatments. More forage was available in HARV (1,116 kg/ha), EBURN (1,183 kg/ha), LBURN (1,356 kg/ha), and HERB (1,220 kg/ha) than EB_HERB (947 kg/ha) and LB_HERB (954 kg/ha) ($P<0.0001$). NCC estimates at the 14% CP constraint were less in MATFOR than all treatments and MINE, which were not different ($P=0.0013$). Lower quanitities of forage in EBHERB, LBHERB, and MINE were compensated by increased forage quality, and NCC estimates were similar to other timber harvest treatments resulting from the transition to an herbaceous-dominated early successional plant community. We used the point-intercept transect method to quantify vegetation composition (Figure 1) and species diversity across treatments. Herbaceous species coverage in LB_HERB (72%) and EB_HERB (57%) was greater ($P<0.0001$) than HARV (7%), EBURN (23%), LBURN (28%), HERB (24%), and MATFOR (15%). Woody species coverage in LB_HERB (7%) and EB_HERB (12%), was less ($P<0.0001$) than HARV (54%), EBURN (22%), LBURN (24%), HERB (32%), and MATFOR (38%). A notable portion of MATFOR understory composition was "none" (38%), which represented a lack of living groundcover. Species diversity was greater in LB_HERB (12.5 (index value)) and EB_HERB (10.3) in comparison to HARV (6.5), HERB (7.5), EBURN (4.6), LBURN (5.7), and MATFOR (5.9). Our data indicate using periodic prescribed fire and herbicide applications following timber harvest are effective techniques to transition young mixed-hardwood forests to herbaceous-dominated early successional communities and maintain increased summer forage availability and NCC for cervids. Summer nutrition has a tremendous influence on body growth, antler growth, and reproductive success of cervids and is one of the most manageable components of habitat for elk and white-tailed deer. However, nutritionally limiting portions of properties often are not identified. The availability and distribution of summer forage is an important consideration for game managers working to maximize productivity of their property or management area for cervids. Providing an opportunity to visualize the distribution of forage resources from an aerial perspective could enable managers to easily identify and strategically address nutritional limitations for cervids on their property or management area. We used the previously described 3 years of site-specific summer forage availability and NCC data along with land cover data and site-specific forest and field management data to develop a spatially-explicit model to estimate summer NCC and evaluate the distribution of summer forage for white-tailed deer and elk across the North Cumberland WMA using the ordinary kriging interpolation method in ArcMap 10.4 (Figure 2). Our model output displayed the distribution of summer forage across the WMA and indicated overall NCC was being negatively impacted by widespread coverage of closed-canopy forest on specific portions of the property. Our model proved to be a valuable decision-making tool to aid future habitat management decisions on the WMA and can be modified easily to assist managers wanting to improve NCC for cervids.

Figure 1: *Percentage coverage of vegetation classes by treatment at North Cumberland WMA, Tennessee, USA, July-August 2013-15.*

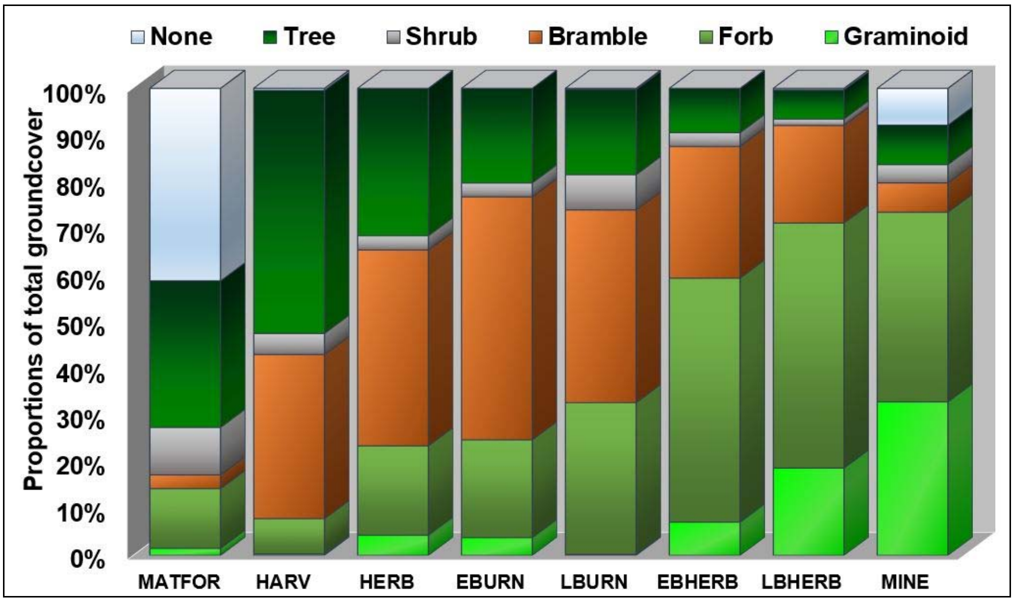
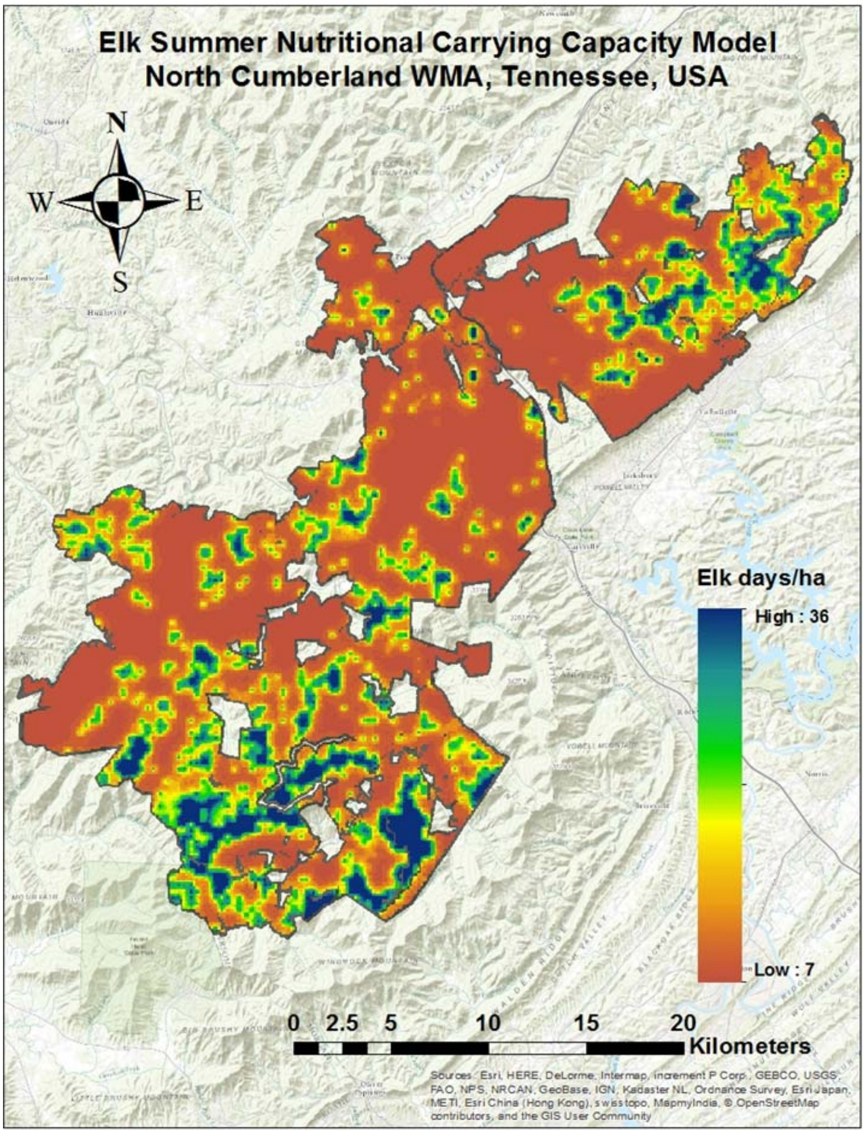


Figure 2: *Output raster of the nutritional carrying capacity model for elk at North Cumberland WMA, Tennessee, USA.*



Keywords: cervid, forage availability, herbicide, nutritional carrying capacity, prescribed fire, timber harvest

(oral)

Value in the eye of the beholder: landowner-driven restoration of pronghorn

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Texas boasts a diversity of flora and fauna that is unparalleled. Ecoregions in Texas range from Gulf of Mexico to the Great Plains and from bottomland hardwoods to desert mountains. Wildlife diversity follows suit. Landownership in Texas is predominantly private (95%) with varying land use. Fragmentation rates are highest in east and central Texas compared to south and west Texas. Landowners have varied backgrounds, ethnicity, management philosophies, and conservation ethics, making conservation strategies difficult to implement. Successful conservation efforts in Texas must embody public-private partnerships. We describe a recent example of collaborative conservation focused on pronghorn (*Antilocapra americana*) that was developed, initiated, and sustained by landowners in Texas.

In Texas pronghorn numbers reached 1 million and once ranged over 2/3rd of the state, but are presently restricted to a fraction of their historic range in far west Texas. Beginning as early as the 1980s, pronghorn populations began a precipitous decline which was accentuated in the 2000s when only 5,000 remained. Landowners in the Trans-Pecos documented a die-off of 2,500 pronghorn in 2007 and began a grassroots effort to address the decline. Partnering with state wildlife agency, veterinarians, hunting guides, and university researchers, landowners coordinated outreach events, broad community support, and fundraisers to support the investigation. Those efforts evolved into a defined recovery plan and sustained funding from private and public sources. Through collaborative conservation and adaptive resource management, Texas landowners have successfully restored >500 pronghorn helping reverse the decline of pronghorn.

(poster #31)

Golden jackal (*Canis aureus*) occurrence in Austria: from first records to recent findings

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The golden jackal (*Canis aureus moreoticus*, I. Geoffroy Saint-Hilaire, 1835) is expanding its range from the source countries in the Balkans. A first wave of expansion took place in the 1950s and a second one in the 1980s [1]. In two of Austria's neighbouring countries, Slovakia and Slovenia, first golden jackal records date back to 1947 [2] and to 1952 [3]. In Hungary a different development was observed; jackals were already confirmed to be part of the Pannonian Basin fauna in the 19th century [4] and after a near extinction in the 1940s, reproduction was again affirmed in the 1990s in southern parts of the country [5,6].
Austria was not affected by the first wave. Sightings in the reed area around Lake Neusiedl in the province of Burgenland stayed without any hard facts [4]. The first substantial golden jackal proof originated in 1987 in Styria. Afterwards some vagrants were reported and twenty years later, in 2007, the first reproduction was confirmed near lake Neusiedl [7]. Since then, additional observations of single individuals scattered throughout Austria indicated golden jackal presence.
In the beginning of 2016 the first actively sought out record confirmed one territorial golden jackal group by means of bioacoustic monitoring [8]. On the basis of reported evidence and information from hunters, we performed additional surveys in several dozens of pre-selected and presumed suitable areas close to the Austrian-Hungarian border. As a result of these surveys new territorial golden jackal groups could be verified in presumed areas.
Both, previously shot specimen in adjacent regions on Hungarian side and observations from local hunters suggest that recorded groups have already occupied their territories in the past years and did not settle there recently. Only a few territorial jackal groups were confirmed in surveyed areas; future studies will complement presented preliminary results. Further surveys are needed in order to determine whether confirmed jackal groups will keep their territories in the coming years. Selected regions will be monitored in detail to detect future dispersal.

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References

[1] **Trouwborst, A., M. Krofel & J.D.C. Linell** (2015). Legal implications of range expansions in a terrestrial carnivore: the case of the golden jackal (*Canis aureus*) in Europe. *Biodiversity and Conservation,* **24:** 2593–2610.
[2] **Ferianc, O.** (1955). Príspevok k stavovcom Žitného ostrova I. *Biológia Bratislava,* **10:** 308-324.
[3] **Brelih, S.** (1955). Šakali (*Canis aureus* L.) na ozemlju Slovenije. *Biol. Vest.,* **4:** 56–58.
[4] **Bauer, K.** (1960). Die Säugetiere des Neusiedlersee-Gebietes. *Bonner Zoologische Beiträge,* **11:** 141–344.
[5] **Tóth, T., L. Krecsák, E. Szücs, M. Heltai & G. Huszár** (2009). Records of the golden jackal (Canis aureus Linnaeus, 1758) in Hungary from 1800th until 2007, based on a literature survey. *North-Western Journal of Zoology*, **5(2):** 386–405.
[6] **Szabó L., M. Heltai & J. Lanszki** (2009). The growth of the distribution area and the population of the golden jackal in Hungary in the last decade. *Journal of Veterinary Behaviour,* **4(2):** 64–65.
[7] **Herzig-Straschil, B.** (2008). Short note: First breeding record of the golden jackal (*Canis aureus* L, 1758, Canidae) in Austria. *Annalen des NHM Wien,* **109 B:** 73–76.
[8] **Hatlauf, J. & K. Hackländer** (2016). Current status of a spreading meso-carnivore in Austria, the golden jackal (*Canis aureus*). *Mammalian Biology,* **81 Supplement:** 3–18.

Keywords: *Canis aureus*, distribution, bioacoustic monitoring, Austria

(poster #32)

Helping French wildlife researchers to comply with new animal welfare regulations

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The EU directive 2010/63/EU on the protection of animals used for scientific purposes has been translated into French legislation in February 2013, extending the existing framework for lab animals to wildlife species studied *in natura*. In particular, researchers and technicians now have to complete a mandatory training to ensure they have the proper competences and expertise to design and implement ethically-approved research projects. However, until recently no adequate training was offered to scientists working specifically on free-ranging, wild animals. Therefore the French National Museum of Natural History (MNHN), the French National Agency of Hunting and Wildlife (ONCFS) and the French National Center of Scientific Research (CNRS) have joined forces to organize the first officially approved training course on ethical use of wild animals for scientific purposes specifically aimed at wildlife researchers and technicians. Combining theoretical and field approaches, the first session will be held in the first semester of 2017 on a large variety of animal models (mammals, birds, amphibians and reptiles). This is an important step to help this community adjust to the new regulatory framework but other topics are still pending, such as methods of killing or management of veterinary pharmaceuticals.

Keywords: ethics, animal welfare, training course, directive 2010/63/EU

(oral)

Welcome and introduction: wildlife management in the shadow of the human footprint

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The human footprint on wildlife and its habitats has been persistent and effective in the last century. More than 97% of the land in Texas is private property, and south Texas, one of the largest tracks of contiguous habitat for wildlife (approximately 133,000 sq. km) in the United States has been affected by developmental pressure including urbanization, intensive agriculture, and energy production enterprises. The Caesar Kleberg Wildlife Research Institute at Texas A&M University-Kingsville was established in 1981 by a grant from the Caesar Kleberg Foundation for Wildlife Conservation, the Institute operates as a nonprofit organization and depends financially upon private contributions and faculty grantsmanship. Our mission is to provide science-based information for enhancing the conservation and management of wildlife in South Texas and related environment. The Institute includes 25 outstanding research scientists, covering a wide range of specialties. The diverse faculty facilitate the often complex wildlife-related research studies and keep the Institute on the cutting edge in advancing conservation and management of wildlife. Modern high-tech facilities, specially designed wildlife study pens, and rangeland tracts provide an ideal environment for conducting quality research by Institute faculty. Most of the field research is conducted on private ranches in south Texas where ranchers and landowners are committed to conservation and throughout proper management of our natural resources. The symposium presenters will outline challenges and success stories in private lands management, and give their views on the present and future of management on private lands.

(oral)

The performance of satellite telemetry in wildlife research: what does the evidence show?

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For species of management or conservation concern, detailed information about habitat use and movement patterns is often required to design appropriate management strategies. However, for practical reasons, detailed observational studies are not always feasible. Satellite tags have been used successfully in wildlife research for these and other purposes, and the scope of applications is still increasing [1]. Nonetheless, the application in the terrestrial realm faces a number of challenges. Tag orientation, species behaviour, canopy cover/basal area of the habitat, terrain ruggedness in the area, and satellite visibility can cause high variation in the amount and quality of fixes stored on the unit [2,3], and the method of data transfer from the unit to the user can strongly influence the amount of data eventually obtained. In addition, unit failure as well as animal mortality are not uncommon [4] and can shorten a unit's operational life, hence causing a loss in the expected data volume. And lastly, the acquisition of terrestrial satellite telemetry units generally involves a considerable financial investment. We evaluated the success rate of satellite telemetry units in obtaining fixes and transferring fixes to the user, and evaluated technical failure rates. To avoid the suspected literature bias towards successful applications of satellite telemetry, we used questionnaires to collect data from over 3000 units, deployed on 63 species in 143 study areas worldwide, regardless of the projects' eventual academic result. We used boosted beta-regression [5] to model the units' performance as a function of a set of variables representing species and environment characteristics, deployment settings, and unit specifications.
We found that species characteristics and unit specifications were more important than qualitative or quantitative measures of environmental characteristics in determining the fix success rate of units, while the method of data transfer from the unit to the user considerably impacted the final amount of data obtained. On average, close to half of the unit deployments ended prematurely, and about 25% suffered a technical failure.
Our study shows that some challenges faced by satellite telemetry are influenced at least as much by parameters inherent to study species and unit specifications than by environmental factors. Data transfer over satellite systems shows room for improvement, and in general, satellite telemetry wildlife research would benefit from a more transparent and standardised content and structure of data transferred from the unit to the user.
Despite the challenges involved in satellite telemetry, the detail, amount, and quality of the resulting data often still exceeds that of data gathered using traditional VHF telemetry or camera trap grids. Nevertheless, researchers and conservationists should thoroughly consider the need for satellite telemetry to answer their specific research or management questions, given the sizeable investments usually needed for scientifically sound and statistically robust results [6,7].

References

[1] **Kays, R., M.C. Crofoot, W. Jetz & M. Wikelski** (2015). Terrestrial animal tracking as an eye on life and planet. *Science,* **348:** aaa2478.
[2] **Frair, J.L., S.E. Nielsen, E.H. Merrill, S.R. Lele, M.S. Boyce, R.H.M. Munro, G.B. Stenhouse & H.L. Beyer** (2004). Removing GPS collar bias in habitat selection studies. *J Applied Ecology,* **41:** 201–212.
[3] **DeCesare, A.J., J.R. Squires & J. a Kolbe** (2005). Effect of forest canopy on GPS-based movement data. *Wildlife Society Bulletin,* **33:** 935–941.
[4] **Matthews, A. et al** (2013). The success of GPS collar deployments on mammals in Australia. *Australian Mammalogy,* **35:** 65–83.
[5] **Schmid, M., F. Wickler, K.O. Maloney, R. Mitchell, N. Fenske & A. Mayr** (2013). Boosted Beta Regression. *PLoS ONE* **8**.
[6] **Johnson, C.J., D.C. Heard & K.L. Parker** (2002). Expectations and realities of GPS animal location collars: results of three years in the field. *Wildlife Biology,* **8:** 153–159.
[7] **Hebblewhite, M. & D.T. Haydon** (2010). Distinguishing technology from biology: a critical review of the use of GPS telemetry data in ecology *Phil. Trans. R. Soc. B,* **365**

Keywords: fix success rate, GPS collar, canopy cover, animal movement, boosted beta regression

(oral)

Status of the Danish action plan to reduce wounding of game by shotgun hunting

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Hunting by shotgun inevitably causes non-lethal wounding of game that are hit by pellets but not retrieved by the hunter. Danish X-ray investigations in the 1990s detected shotgun pellets among 36% adult (i.e. older than first winter) pink-footed geese, 34% adult eiders and 25% red foxes. For this reason, a national action plan to reduce wounding was implemented in 1997, granting hunters an initial trial period during which to reduce the number of wounded animals on a voluntary basis. The objective of this study is to follow up on the action plan by investigating the number of animals with shotgun pellets during 2013-2015.

Red fox and eiders were collected by shotgun using rifle or #BB shotgun pellets (4.6 mm) during January-February. In addition, nesting female eiders were collected in May. Pink-footed geese were caught alive using cannon-nets in March 2014 in Denmark and 2015 in Norway. All individuals were aged, sexed and X-rayed. #BB pellets were easily distinguished from ordinary shotgun pellets in X-ray images.

9.4% of red foxes carried shotgun pellets in 2013-2015. This percentage has been stable since 2003 and is a significant decrease from the 25% in the 1990s. The percentages of wounded eiders during 2013-2015 were 11.5% and 7.1% for males and females, respectively, a significant and continuous decline since the 1990s.

The percentages of adult pink-footed geese carrying shotgun pellets in 2014-2015 were 19.2%, a decrease from the 36% during the 1990s, but an increase since 2005, where only 18% were inflicted. The percentages are difficult to analyse, because of differences in hunting pressure and population size during the period. We therefore introduce “crippling ratio” as a novel approach to evaluate hunter performance in a way accounting for differences in both population size and hunting pressure.

Knowing the population size, harvest rate and wounding rate, we show that the number of geese crippled for each goose bagged has dropped from 1.00 in 1992 to 0.11 in 2016. This corresponds to an 89 % reduction of wounding.

Minimizing crippling is a major focus of current waterfowl management, and the ability to accurately estimate the effect of mitigation measures to alleviate this problem is an important instrument to future management decisions and policy making in the discipline of natural resource management.

In general, the results are taken to indicate that the Danish action plan have had a positive impact on reducing wounding of red fox, eider and pink-footed geese.

Keywords: red fox, common eider, pink-footed goose, crippling ratio, x-ray infliction rate

(oral)

Reintroduction of grey partridges: lessons from the Swiss recovery project in Geneva

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As in many other European countries, the grey partridge *Perdix perdix* alarmingly declined in Switzerland in the last decades of the 20th century. The Swiss recovery project was launched 1991 in two regions with a focus on habitat improvements to conserve grey partridge and other farmland bird species. From 1998 onwards, reintroduction projects were launched in both areas. In the canton of Geneva we released more than 2000 captive-reared grey partridges between 2008 and 2012, with the aim (1) to re-establish a viable population, (2) to analyse if strain origin and unpredictable food supply during rearing could influence survival and (3) to increase hatching success by habitat improvements and nest protection.

First, we experimentally tested the effects of postnatal unpredictable food supply on post-release survival of two captive strains (two or >30 generations in captivity). We also investigated whether survival was affected by radio-tags. In total, 1385 birds were individually colour-ringed, 922 of them radio-tagged (tags of 8 or 11 g), released in autumn in coveys and followed by radio tracking and visual observations. Post-release survival rates were low. We found no substantial effects of strain on survival, but survival rate was higher in birds having encountered postnatal unpredictable food supply. We also found strong negative effects of radio-tags on survival. The use of radio-tags detrimentally affected individual survival and the success of our reintroduction project.

In parallel to our study on survival, we aimed at increasing hatching success. In the two study areas in Geneva and Schaffhausen, about 5 % of the area was covered with pluri-annual field margins, implemented as set-asides to promote biodiversity. Out of 121 localised grey partridge nests in both regions, we fenced 30 nests using electric wire fences to enhance hatching success. We analysed grey partridge nesting habitat preference and factors affecting hatching success. Grey partridges showed a clear preference for nesting sites in field margins, and nest fencing significantly increased hatching success. Hatching success of unprotected nests was on average 43 %, compared to 77 % of protected nests. Additionally, increasing proportions of field margins and, more importantly, of cover vegetation around the nest (mainly bushes and blackberry) were positively correlated with increasing hatching success. In fact, high amounts of covering structures around the nest of grey partridges can even compensate for nest fencing and appear to successfully prevent nest depredation.

Keywords: captive breeding, habitat enhancement, nest protection, *Perdix perdix*, reintroduction, survival

(oral)

Lepus: introducing an all-in-one software for camera trap data treatment (from data input to analysis)

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Camera trapping is a recent tool used for biological conservation, and more widely for ecological studies. The field of applications is wide, ranging from studies of cryptic species to density estimation. The method is furthermore non-invasive, and it allows to standardize the sampling protocols. This exponentially increasing technology – as reflected by the number of citations and publications in literature [Figure 1] – seems thus to be limitless, exploding since around 2007 In fact, the low cost of data collection hides multiple problematics in post-hoc analysis and data treatment works. To start, we briefly review what main problems we can encounter in camera trap studies.

Figure 1. *Literature citations for terms "camera trap" in categories: "biological conservation" (left) and "ecology" (right), from Web of Science™ [1]*

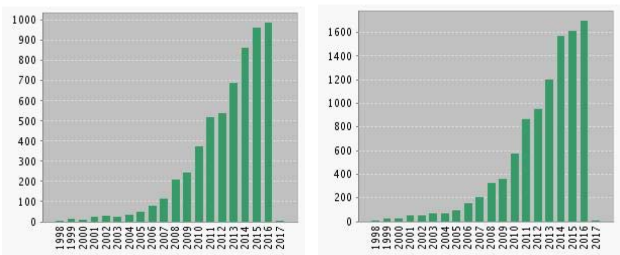
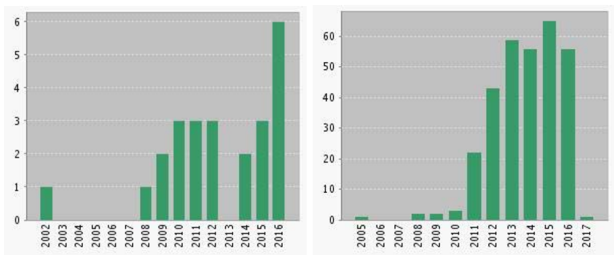


Figure 2. *Literature publications (left) and citations (right) for terms "camera trap software" in category "ecology" from Web of Science™ [1]*



Studies can be conducted by different people, working on the same data, but these people have different skills in data treatment, organization and storage. A **lack of standardization** certainly leads to a skewing of the data or even to an impossibility of interpretation. This can be linked to bad uses of analysis tools: using a **non-adapted software** to store the analytic data of a camera trap study is unsafe (e.g. spreadsheets). Studies need a structure to organize data and more importantly to be able to retrieve, query and treat it as efficiently as possible. There is now few software for camera trap analysis (non-exhaustive list: CamtrapR [2], Aardwolf [3], Camera Trap Manager [4]). They have all their own advantages and drawbacks. Sometimes programming skills (using R) are needed, sometimes it's not cross-platform compatible (PC, Mac, etc.), and more importantly it never encompasses **all the steps** from data input to interpretation. But above all these problems, the more important one is a so-called "**big data**" issue. It means that the data collection exceeds processing capacities. This leads to researchers spending very long times in analysis from an overloaded dataset. This spent time is generating important costs, slowing scientific knowledge acquisition and conservation efficiency.

If camera traps are a recent technology, this is even more the case for the corresponding analysis software. The publications in this field (considering that it reflects new software releases) timidly started around 2010, but the peak of last year 2016 shows how actual the thematic is [Figure 2].

To address all the previous problematics, we present *Lepus*, an all-in-one software for camera trapping data interpretation. "All-in-one", because it encompasses **all steps of camera trap studies**, including:

1. images importation, based on EXIF;
2. (semi-)automatic events detection;
3. species data input, on events basis;
4. multiple post-hoc statistics and graphical analyses.

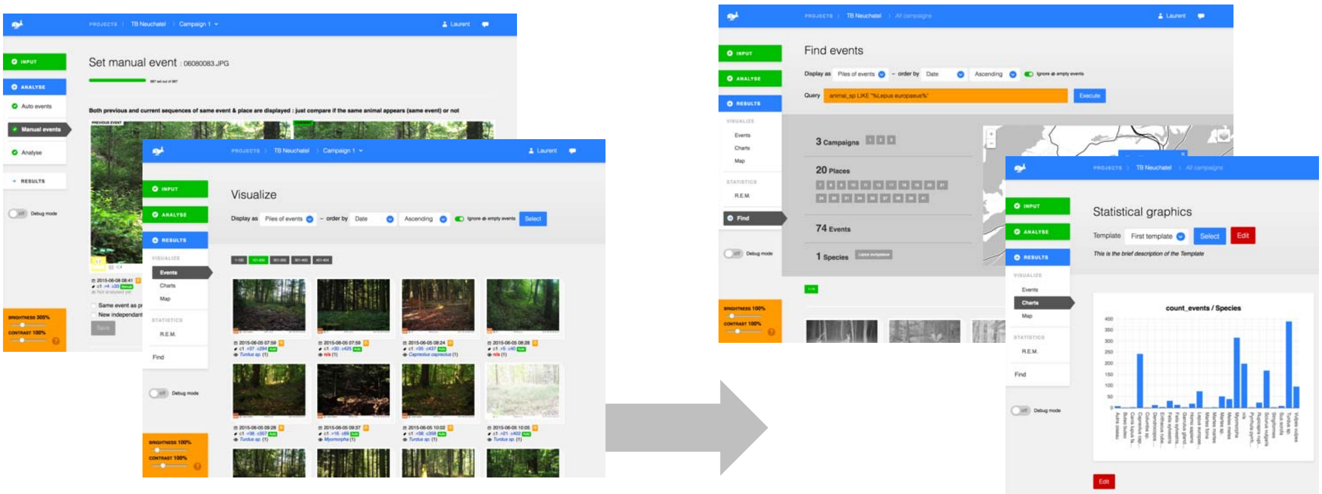
Lepus differentiates itself from the other software at different levels. It offers an **intuitive and productive user interface** [

Figure *3*], designed by and for ecologists and environmental engineers; **a full accessibility** from the cloud platform with multiple languages; **great scientific features** we will describe, statistics based on a powerfull MySQL database. The whole process is designed to standardize and permit the use of different persons to work on the same dataset, with **no "observer bias"** or skewing impact on the results. Finally, it **decreases drastically the analysis workload** (theoreticaly by around 85%), because the software's automatizations takes care of the big data, and let the scientists focus on essential points.

We tested it in 2015 (first version) on a real scale case: a study on the importance of forest habitat for *Lepus europaeus*, the European brown hare, in the canton of Neuchâtel (CH) [5]. We analysed 15'021 images grouped in 2'128 events: the process of species determination and input was **divided by seven**. Based on that, *Lepus* permit to reduce the corresponding work load and linked costs by around 85%. Furthermore, no maintenance work is necessary. Directly from the software, we got an estimated density generated from the integrated Random Encounter Model [6].

During our presentation, we would like to present *Lepus* – with demonstrations on real datasets –, and show why we are convinced that this is a little revolution, favoring ecological studies, scientific knowledge acquisition and conservation efficiency.

Figure 3. *Lepus (alpha) screenshots, from analysis to queries and graphics*



References

[1] **Thomson Reuters** (2017). “Web of Science (TM),” Web of Science. [Online]. Available: http://apps.webofknowledge.com/. [Accessed: 08-Feb-2017].

[2] **Niedballa, J., R. Sollmann, A. Courtiol & A. Wilting** (2016). camtrapR: an R package for efficient camera trap data management, *Methods Ecol. Evol.*, **7(12):** 1457–1462.

[3] **Krishnappa, Y.S. & W.C. Turner** (2014). Software for minimalistic data management in large camera trap studies, *Ecol. Inform.*, **24:** 11–16.

[4] **Zaragozí, B., A. Belda, P. Giménez, J.T. Navarro & A. Bonet** (2015) Advances in camera trap data management tools: Towards collaborative development and integration with GIS, *Ecol. Inform.*, **30:** 6–11.

[5] **Huber, L.** (2015). Détermination de l’importance de l’utilisation des milieux forestiers par les lièvres, dans le canton de Neuchâtel. Genève.

[6] **Rowcliffe, J.M., J. Field, S.T. Turvey & C. Carbone** (2008). Estimating animal density using camera traps without the need for individual recognition. *J. Appl. Ecol.*, **45(4):** 1228–1236.

Keywords: camera trap, software, analysis, database, ecology, conservation

(oral)

Partial meso-mammal predator removal positively affects Northern Bobwhite reproduction

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Perceived changes in predator-prey dynamics along with documented declines of northern bobwhite (*Colinus virginianus*) have created a renewed interest from biologists and managers about the role meso-mammals play in shaping bobwhite population trajectories. As part of a larger effort to understand this predator-prey relationship, we evaluated the efficacy of meso-mammal trap and removal (MMTR) at reducing meso-mammal activity and increasing bobwhite reproductive success. During 1999-2006, we monitored bobwhite reproduction via radio-telemetry on 11 sites in 3 states across the Southeastern United States (Florida, Georgia, and Alabama). Meso-mammal trap and removal occurred every year during the study on 5 sites and 6 sites had some or all years when meso-mammal trap and removal did not take place. Combined, there were 37 site-year combinations monitored when MMTR occurred and 20 combinations when it did not occur. We conducted 57 meso-mammal activity surveys using scent stations and calculated an index of meso-mammal activity (i.e., Predator Index), for each site, as the average number of station visits per night by raccoons (*Procyon lotor*), nine-banded armadillos (*Dasypus novemcinctus*), Virginia opossums (*Didelphis virginiana*), bobcats (*Lynx rufus*) and foxes (*Vulpes vulpes*, *Urocyon cinereoargenteus*). The average Predator Index for all sites combined was 0.13 (range = 0.03-0.38, SD = 0.08). We collected bobwhite reproductive information from a total of 3,935 radio-tagged bobwhites ($\bar{x}$ = 69 site^{-1}, SD = 31.37) resulting in 2,499 nests ($\bar{x}$ = 44 site^{-1}, SD = 24.11). Nest success on the sites ranged from 0.29 to 0.72 and averaged 0.52 (SD = 0.11). The number of nests per hen ranged from 0.22 to 1.92 and averaged 0.71 (SD = 0.32). Broods per hen averaged 0.37 (SD = 0.21) with a range of 0.06 to 1.02 and the number of chicks per hen averaged 4.09 (SD = 2.42) and ranged from 0.42 to 11.52. We used generalized linear mixed models to evaluate the relationships between MMTR and predator activity and MMTR and bobwhite reproduction metrics. The predicted mean Predator Index for non-trapped sites was 0.21 (95% CLs: 0.18, 0.24) compared to 0.10 (95% CL: 0.07, 0.13) for trapped sites. Bobwhite nests were 1.33 times (Odds ratio, 95% CL: 1.09, 1.62) more likely to be successful on trapped sites than non-trapped sites. MMTR had a positive effect on nests per hen (β = 0.25 ± 0.06; 95% CL: 0.13, 0.37), broods per hen (β = 0.37 ± 0.08; 95% CL: 0.21, 0.53), and chicks per hen (β = 1.09 ± 0.52; 95% CL: 0.07, 2.11). Our results suggest that MMTR reduces meso-mammal activity and positively affects bobwhite reproduction, thus, predator management may be warranted at times on some sites to maximize bobwhite productivity. Future research and modeling efforts should explore the impacts of MMTR on population growth rates and stability, especially in varying spatial contexts.

Keywords: *Colinus virginianus*, meso-mammal, northern bobwhite, predation management, predator-prey, radio-telemetry

(oral)

'Chicken-eating' foxes: isotopic evidence of individual specialisation in a rural population of red fox (*Vulpes vulpes*)

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Abundance and distribution of food resources directly influence adaptative strategies in foraging [1,2]. Indeed, for many predator species, specialisation toward one particular food resource is commonly observed, both at individual and population levels [3]. When specialisation occurs for food products derived from humans [4] or agriculture [5], human-wildlife conflicts raise and call for a better understanding of predator diet to manage efficiently problematic species. The increasing use of stable isotope in food-web ecology allowed considerable advances in the understanding of individual food specialisation both in evolutionary ecology and wildlife management. The study of individual specialisation requires repeated measurements of the diet on the same individual over time and over a relatively long period to assess intra-individual variation. An isotopic approach can be used to deal with this difficulty, for example, using temporal variations of isotopic signatures along whiskers [6-8].

The purpose of this study was to describe the diet and to investigate dietary specialisation in red foxes (*Vulpes vulpes*) using stable isotopes. The studied population was located in Bresse, a rural region in Eastern France. The Bresse region is a free-ranging poultry area with predominantly crops and pastures. Predation on chicken has increased during the last 15 years, causing financial losses for poultry farmers [9]. Therefore, red fox is considered as a pest-species and can be legally trapped and hunted in the study area. To measure the inter- and intra-individual variability of fox diet, whiskers of 68 foxes were cut into fragments (n=13 ± 5 SD), and for each fragment, isotopic compositions of carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) were measured. Whiskers growth rate was estimated to date each vibrissae fragment by using an allometric relationship between whiskers growth rate and body weight on a panel of mammals, allowing us to reconstruct the diet of foxes over, on average, 133.9 ± 41.8 days. We also sampled likely food resources for red foxes in the study area including chickens, which have a particular isotopic signature relative to wild food items due to their feeding on maize (C4 plant). We determined isotopic compositions of all food items and grouped potential food sources into five main categories: chickens, rodents, birds, invertebrates and berries.

The analyses of isotopic data were performed using Bayesian isotope mixing models, with the SIAR R package [10]. We used the ratio WIC/TNW [11] as a metric of population specialisation and ε [12] as a metric of individual specialisation. $\delta^{13}C$ and $\delta^{15}N$ were modelled according to sex and season using linear mixed models.

Overall, the preferential consumption of rodents and chickens represented more than 60% of the global population diet. The contributions to diet of food sources 'berries', 'invertebrates', and 'birds' were negligible. The fox population presented individuals with varied isotopic compositions, hence varied diets, as evidenced by the range of variation of $\delta^{13}C$ and $\delta^{15}N$ values ($\delta^{13}C$ = -20.55 ± 1.57‰ [-24.19 – -16.82] and $\delta^{15}N$ = 9.24 ± 0.85 ‰ [7.00 – 11.02]). The WIC/TNW ratio was low (0.28 for $\delta^{13}C$ and 0.31 for $\delta^{15}N$) highly suggesting the presence of individual specialisation in the red fox population. This indicated that some foxes preferentially consumed wild (i.e. 'natural') food sources with low $\delta^{13}C$ isotopic signatures while others consumed preys with a high $\delta^{13}C$ isotopic signature such as Bresse chickens, i.e. 'chicken-eating' foxes. This was also evidenced by the range of variation of ε (from 0.114 to 0.716) with 10.3% of individual values above 0.4 demonstrating individual specialisation. Intra-individual heterogeneity of diet was also shown in some individuals with diet shifting from natural food resources to chicken over time (i.e. variability of isotopic signatures between the different fragments of a single whisker). Modelling the pattern of variation in $\delta^{13}C$ and $\delta^{15}N$ values showed that $\delta^{13}C$ and $\delta^{15}N$ were higher for females than for males suggesting a higher predation on chickens by females. It is also noteworthy that significant differences in $\delta^{13}C$ occurred between seasons for females, with $\delta^{13}C$ values being higher in summer and lower in winter. Thus chicken predation by females mostly occurred in summer when females reared youngs.

Individual food specialisation for free-ranging chickens was demonstrated in this red fox population. The high availability of a readily usable food resource (i.e. Bresse chickens) could explain the fact that some red foxes used this ecological opportunity in the definition of their diet. From a management point of view, this result calls for targeted trapping of specialised, i.e. problematic, individuals in the close vicinity of poultry farms.

References

[1] **Gittleman, J.L.** (1986). Carnivore life history patterns: allometric, phylogenetic, and ecological associations. *American Naturalist*, **127:** 744–771.

[2] **Luniak, M.** (2004). Synurbization–adaptation of animal wildlife to urban development. In *Proc. 4th Int. Symposium Urban Wildl. Conserv. Tucson*, 50–55.

[3] **Araújo M.S., D.I. Bolnick & C.A. Layman** (2011). The ecological causes of individual specialisation. *Ecology Letters*, **14:** 948–958.

[4] **Murray, M., A. Cembrowski, A.D.M. Latham, V.M. Lukasik, S. Pruss & C.C. St Clair** (2015). Greater consumption of protein-poor anthropogenic food by urban relative to rural coyotes increases diet breadth and potential for human-widlife conflict. *Ecography*, **38:** 1235–1242.

[5] **Walter, W.D.** (2014). Use of stable isotopes to identify dietary differences across subpopulations and sex for a free-ranging generalist herbivore. *Isotopes in environmental and health studies,* **50:** 399–413.

[6] **Cherel, Y., L. Kernaléguen, P. Richard & C. Guinet** (2009). Whisker isotopic signature depicts migration patterns and multi-year intra-and inter-individual foraging strategies in fur seals. *Biology Letters*, **5:** 830–832.

[7] **Kernaléguen, L., B. Cazelles, J.P. Arnould, P. Richard, C. Guinet & Y. Cherel** (2012). Long-term species, sexual and individual variations in foraging strategies of fur seals revealed by stable isotopes in whiskers. *PLoS One*, **7:** e32916.

[8] **Robertson, A., R.A. McDonald, R.J. Delahay, S.D. Kelly & S. Bearhop** (2013). Whisker growth in wild Eurasian badgers *Meles meles*: implications for stable isotope and bait marking studies. *European Journal of Wildlife Research*, **59:** 341–350.

[9] **Stahl, P., S. Ruette & L. Gros** (2002). Predation on free-ranging poultry by mammalian and avian predators: field loss estimates in a French rural area. *Mammal review*, **32:** 227–234.

[10] **Parnell, A.C., R. Inger, S. Bearhop & A.L. Jackson** (2010). Source partitioning using stable isotopes: coping with too much variation. *PloS one*, **5:** e9672.

[11] **Bolnick, D.I., L.H. Yang, J.A. Fordyce, J.M. Davis & R. Svanbäck** (2002). Measuring individual-level resource specialization. *Ecology*, **83:** 2936–2941.

[12] **Newsome, S.D., J.D. Yeakel, P.V. Wheatley & M.T. Tinker** (2012). Tools for quantifying isotopic niche space and dietary variation at the individual and population level. *Journal of Mammalogy*, **93:** 329–341.

Keywords: Stable isotopes, whiskers, *Vulpes vulpes*, predation, individual specialisation

(poster #33)

Practical innovations in construction and method of installing the water flow devices regulating the water surface in areas flooded by beavers

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Population of European beaver (*Castor fiber*) in Poland has increased in recent years, and in 2015 was estimated at over 101 000 individuals [1]. Despite the relatively large and constantly increasing number of animals in Poland the species still has the status of partially protected. The new rules of beaver management introduced in 2016 allowed a more intense reduction of beavers by hunters' shooting, but as practice shows, this kind of reduction is effective at only about 2-5% of the management plan.

Damming the water culverts, beaver causes huge losses in agriculture and forestry which in 2015 were estimated for about 7 000 000 €. One of the most effective ways to reduce the flooded areas is to install the special pipes devices across the dams which allow the water to flow down from newly created ponds. Installing overflowing devices in beaver dams has been known for many years [3]. Previous researches, carried out by the author [2], proved that this kind of method is much more effective to compare that of destroying and removing entire dams because in these cases the animals are able to rebuild them relatively soon.

However, the methods that have been used up till now are burdened with many deficiencies. The most significant are:

- necessity of dismantling the upper parts of a dam till to the place where the pipe could be laid, however it makes the whole construction weaker, it could even destroy its water tightness what often leads to collapsing of a dam. In this case, having wanted to avoid a disaster, beaver are often being stimulated to increase their effort in repairing the entire construction, making it sometimes even higher and stronger,
- stiff fixation of a steel mesh item to protect the inlet of the overflowing device at the bottom of a culvert has limited range of adjusting the depth of an overflowed area,
- huge amount of effort, labour intensity as well as it makes this undertaking costly.

During many-year author's practical works, concerning with protection the areas flooded by beavers, a few special devices were improved to eliminate some inconveniences of the previous method mentioned above.

To eliminate the necessity of manual dismantling the top layer of a dam for placing a pipe, a special equipment has been constructed which is able to get through a beaver dam smoothly. The front is tapered and attached to a hook when it's rear part is specially adopted to the diameter of installed pipe and fitted with a special protective collar. The special construction of the wedge connected by a rope with a cable winch allows for relatively easy getting through, and installing a pipe inside a beaver dam, regardless of its thickness – and what is particularly significant – without damaging the dam's structure.

Steel mesh item – that protects the inlet of a pipe against possibility of being blocked by beavers as well as by any incoming plant material – is designed in the shape of a wedge which additionally reduces the risk of getting some leaves, twigs, sprouts and others into the pipe. What is more important, the steel mesh item is fixed by screws to three separate steel rods placed in the bottom of a culvert. This kind of attachment enables to adjust the device up or down, according to necessary level. Consequently, this kind of steel mesh item construction allows for easy control of the water level in beaver ponds. Using this method, more than 70 devices were installed during the period of 2014-2015 in Poland.

Summing up, one can enumerate following selective and highly positive effects of the innovated method:

- there is no necessity to dismantle a beaver dam at all,
- one can place the device anywhere in a dam,
- there is ability of changing the position of the pipe's inlet what gets the possibility to adjust the surface and depth of a beaver pond,
- simple in design and relatively low price to build,
- low labour-intensiveness, one needs only about 1-1,5 hrs to install it,
- high durability,
- high efficiency of the method – estimated at about 80%,

According to the achieved results, the author is currently preceding the reserved rights of implementing the whole project.

References

[1] **Central Statistical Office** (2016). Forestry. Warsaw.
[2] **Janiszewski P**., A. **Woźniak & L. Janiszewska (**2005). Wpływ tam bobrowych na zmiany w przegrodzonym cieku wodnym. *Zeszyty Problemowe Postępów Nauk Rolniczych*, **506:** 197-204.
[3] **Taylor J.D. & R.D. Singleton** (2014). The Evolution of Flow Devices Used to Reduce Flooding by Beavers: A Review. *Wildlife Society Bulletin*, **38(1)**: 127-133.

Keywords: beaver damages prevention, water flow devices, *Castor fiber*

(poster #34)

The influence of moon phases on activity of herbivores and carnivores in the vicinity of railway tracks

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The influence of moon phases on animals is well known [1-5]. During the lunar cycle the moonlight (the amount of sunlight reflecting by the Moon's surface to Earth) changes, and this also influences the activity of wild carnivores and herbivores [3]. Carnivores (predators) are more active during brighter nights, when the visibility on Earth increases. On the other hand, herbivores (prey species) are more active during darker nights, when they are less visible for predators [4]. As ungulates can be preyed upon only by large carnivores, they don't change their activity during the lunar cycle [5]. The aim of the study was to determine how the behaviour of animals living in the vicinity of railway tracks changed during the lunar cycle and if it was dependent on the intensity of moonlight. We analysed the behaviour of ungulate, smaller herbivorous' and carnivorous species.

The research was conducted in central Poland along the E65 railway between Warszawa Wschodnia and Legionowo. Digital cameras were used to register animal activity 24h a day between July 2010 to March 2011. The species observed most often were roe deer (*Capreolus capreolus*), red fox (*Vulpes vulpes*) and brown hare (*Lepus europaeus*) and they were chosen for further analyses as the representatives of (accordingly) ungulates, carnivores and herbivores. We focused only on observations collected during nights. We distinguished four basic moon phases – new moon, first quarter, full moon and third quarter. At new moon, nights on Earth are dark (no sunlight is reflected by Moon to Earth). In contrast, at full moon, nights on Earth are bright (the maximum of sunlight is reflected by Moon to Earth) [1,3]. During first and third quarter of moon the visibility on Earth changes [3]. Therefore we divided nights during the course of first or third quarter into bright and dark nights. In situations when no train passed three types of behaviour of animals observed at the railway tracks were described: (1) foraging, (2) walking along the tracks, (3) crossing the tracks. In situations when a train passed another three types of animal reaction to an approaching train were described: (1) escape, (2) getting alarmed, (3) no reaction.

We collected 537 night observations of roe deer, 304 night observations of red fox and 193 night observations of brown hare. The activity of carnivorous species changed with the lunar phases (χ^2=10.31, p<0.05). Red foxes were observed most often during first quarter (37%) and less often during new moon (19%). The activity of ungulates as well as smaller herbivores also changed in the moon phases (roe deer: χ^2=11.11, p<0.05, brown hare: χ^2=20.38, p<0.001). Roe deer were observed most often at new moon (32%) and less often at full moon (19%). Brown hares were observed most often at first quarter (45%) and less often at third quarter (14%) (Figure 1). Changes in the intensity of moonlight influenced roe deer (χ^2=6.24, p<0.05), which were observed most often at dark nights (58%). The activity of brown hares during dark and bright nights was the same as roe deer (Figure 2). Nevertheless, this difference was not statistically significant due to a small sample size.

***Figure 1:** The percent of animals' observations in the vicinity of railway tracks in the four moon phases.*

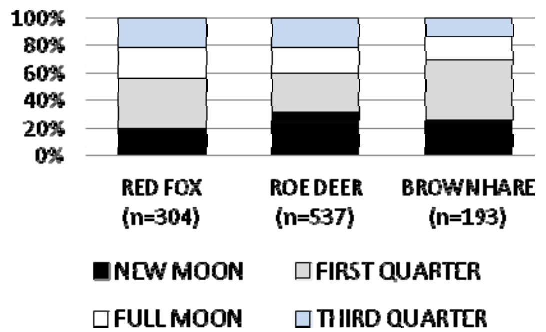
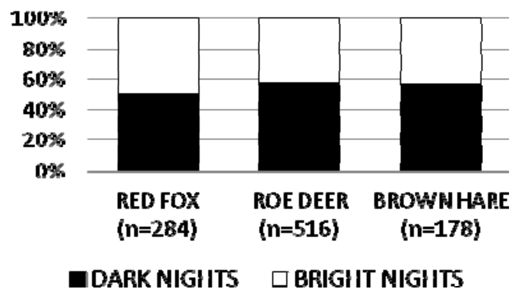
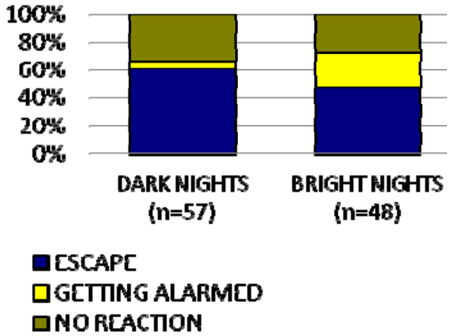


***Figure 2:** The percent of animals' observations in the vicinity of railway tracks at dark and bright nights.*



Carnivores and ungulates changed their behaviour at the railway tracks during lunar cycle (red fox: χ^2=20.87, p<0.05, roe deer: χ^2=15.66, p<0.05; situations when no train passed). However there were no changes in these species' behaviour between dark and bright nights (p>0.05). Nevertheless, when an empirical frequency of each kind of behaviour was tested against an expected (equal frequency) value it turned out that roe deer foraged in the vicinity of railway tracks more often at dark than bright nights (χ^2=13.07, p<0.001). The behaviour of brown hares at the railway tracks didn't change during lunar cycle and between dark and bright nights (p>0.05, situations when no train passed).
The moon phases influenced ungulates' reactions to an approaching train (χ^2=14,12, p<0,05), with no difference for the remaining species. None of the species reacted differently to an approaching train at dark and bright nights (p>0.05). Nevertheless, when an empirical frequency of each kind of behaviour was tested against an expected (equal frequency) value we found out that brown hares became more alarmed during bright nights (χ^2=4.28, p<0.05) (Figure 3).

Figure 3: *The percent of brown hare's observations near the railway tracks in situations when train was approaching.*



Ungulates, as well as smaller herbivores and carnivores, living in the vicinity of railway tracks reacted to the changes in lunar cycle by changing their behaviour. Roe deer and brown hares, being prey species, reacted to the moonlight in the same way. They avoided open space (i.e. side of the railway track) when they might be more visible for predators (i.e. during bright nights). On the other hand, they were able to see and categorise a possible danger (i.e. an approaching train) earlier when the visibility was higher. Our findings show that the moon phase is an additional factor that may influence risk of wildlife-train collision and its temporal distribution.

References

[1] **Prough, L.R. & C.D. Golden** (2014). Does moonlight increase predation risk? Meta-analysis reveals divergent responses of nocturnal mammals to lunar cycles. *Journal of Animal Ecology*, **83:** 504-514.
[2] **Jetz, W., J. Steffen & K.E. Linsenmair** (2003). Effects of light and prey availability on nocturnal, lunar and seasonal activity of tropical nightjars. *Oikos*, **103:** 627-639.
[3] **Jasińska, K. & P. Kowal** (2016). The relationship between behavioural activity of herbivorous and predatory mammals and moonlight. *Badania i Rozwój Młodych Naukowców w Polsce. Nauki przyrodnicze. Część III. Poznań*: 46 – 53. [in polish]
[4] **Sábato, M.A.L., L.F. de Melo, E.M.V. Magini & R.J. Young** (2006). A note on the effect of the full moon on the activity of wild maned wolves, Chrysocyon brachyurus. *Behavioural Processes*, **73:** 228-230.
[5] **Webb, S.L., K.L. Gee, B.K. Strickland, S. Demarais & R.W. DeYoung** (2010). Measuring Fine-Scale White-Tailed Deer Movements and Environmental Influences Using GPS Collars. *International Journal of Ecology*, **2010:** 459610.

Keywords: railway, moonlight, lunar phobia, lunar philia, predator-prey interactions

(oral)

Increase of over-wintering individuals in Spain of a transaharian migratory game bird: the Common Quail (*Coturnix coturnix*)

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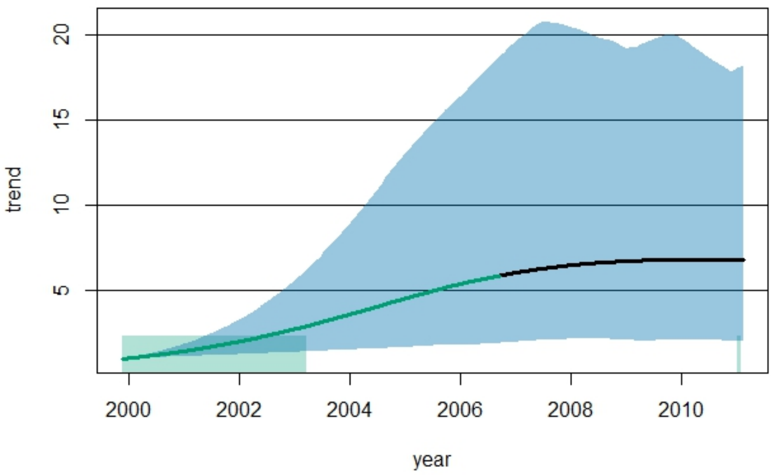
Migratory behaviour has evolved as an adaptation to seasonal changes in environmental conditions and trophic resources. Of avian species, 26% are migratory and, within them, populations may vary in their migratory strategy, being some migratory and some resident, usually in relation to the latitude where they inhabit. This dichotomy (migratory-resident) can exist as well within a population. This phenomenon, known as partial migration [1], is widely spread and may be genetically or environmentally determined [2, 3].
Environmental change due to global warming may drive long distance migratory bird species to change their migratory strategy in response to the changes in habitat and the cues that trigger migration. Thus, birds may advance their arrival time [4], to adapt to the advancement of spring [5]. The most plausible way to advance arrival time is by reducing migratory distance [6], so that climate change may be favoring a resident strategy and partial migration [2].
The Common Quail (*Coturnix coturnix*) is a migratory galliform widely distributed in the Palearctic, that winters in the Sahel and breeds in northern Africa and Europe, mainly in cereal crops. France, the Iberian Peninsula and Morocco hold the majority of the Atlantic population. While mainly migratory, it is a partial migratory bird: some birds have the potential to migrate but would do it under severe environmental circumstances [7]. In Spain, a minor fraction of the breeding population overwinters in the country, where is subject to hunting [8]. Over-wintering of migratory birds has conservation implications, what fosters the need of studying this process in detail. Under the global warming reality, Common Quail populations may have also started to respond to milder winters.
Here we investigate how the proportion of over-wintering individuals of Common Quail breeding in Spain has evolved in the last decade. Due to the difficulties of monitoring this species during winter and given its hunting status, ring recoveries by hunting appear to be an opportunity to assess any possible trend of the population during winter. We used the bird ringing recaptures data banks for Common Quail of the Spanish Society of Ornithology and EURING [9]. We selected the interval from 2000 to 2011, since the number of quails ringed in previous years was very low and, hence, the possibility of recapture.
The Common Quail standard phenology comprises a breeding period from March to July and a migratory passage to winter quarters in south Sahara that extends from August to middle of October [10]. Hunting season in Spain is divided in two periods: a) one from 12th August to 15th September (dates may vary depending on the Regional Government), that consists of a half ban warrant (hereafter “summer period”), where hunting is allowed just on some few species and during the migratory period; b) a second period from 12th October to 28th February, where hunting is allowed for small species during the non-breeding period (hereafter “winter period”). We selected those quails ringed in Spain during the breeding season (from April 1st to August 14th), and recovered also in Spain the hunting season after ringing, either during summer or winter periods. Ringing effort and hunting during the summer period are associated ($r = 0.61$, $p = 0.03$, $n = 12$). Accepting that yearly proportion of hunting effort between the two hunting periods remains relatively constant, the number of rings recovered during summer can be used as an offset term in the analysis, allowing controlling for the inter-annual variation of both hunting effort and ringing effort.
We modeled the frequency of rings retrieved during hunting in winter (response variable) with a generalized additive model (GAM), with «year» as independent variable and taking as an offset the frequency of ring retrieved in summer. We used the quasipoisson family and a logarithmic link function. We used the functions gam ( ) and ptrend ( ) of the mgcv and poptrend R packages.

A total of 28042 quails were ringed in the breeding season (mean=2336.8, s.d.=919.1); 664 rings were recovered in the summer period (mean = 55.3, s.d. = 26.8) and 17 rings were recovered in the winter period (mean=1.41, s.d.=1.16). This conveys the low proportion of over-wintering individuals in general and the low reporting of rings, despite the huge amount of birds ringed. GAM model (penalized regression spline, k=3), shows a significant increase over the years in the proportion of quails hunted in winter with respect to quails hunted in summer (F=5.61, edf=1.74, p-value=0.03, deviance explained= 61.3%).

From 2000 to 2011, hunting data strongly suggest a wintering increase of around six times, concentrated from 2000 to 2007 (Fig.1). Despite this, the over-wintering fraction of the population keeps being very low. Further monitoring of the population is needed to evaluate a change in the migratory strategy of the species, together with further studies to link this change to environmental factors such as climate change.

Figure 1: *Estimated trends for the proportion of rings retrieved by hunting during winter period from 12th October to 28th February) with respect to rings retrieved by hunting in summer period (from 12th August to 15th September) over the years studied. The graph shows a significant increase at the 5% level (trend line coloured) from 2000 to 2007 of six times the starting proportion, while from 2007 to 2011 the proportion remains stable. Confidence Intervals (blue area) are computed from the 2.5% and 97.5% quantiles of the bootstrap distributions.*



References

[1] **Terrill, S.B. & K.P. Able** (1988). Bird Migration Terminology. *Auk*, **105:** 205–206.

[2] **Berthold, P.** (2001). Vogelzug: eine neue Theorie zur Evolution, Steuerung und Anpassungsfähigkeit des Zugverhaltens. *Journal of Ornithology*, **142(S1):** 148–159.

[3] **Lundberg, P.** (1988). The evolution of partial migration in Birds. *Trends in Ecology and Evolution*, **3(7):** 172–175.

[4] **Knudsen, E., A. Lindén, C. Both, N. Jonzén, F. Pulido, N. Saino, W.J. Sutherland, L.A. Bach, T. Coppack, E. Torbjorn, P. Gienapp, J.A. Gill, O. Gordo, A. Hedenström, E. Lehikoinen, P.P. Marra, A.P. Moller, A.L.K. Nilsson, G. Péron, E. Ranta, D. Rubolini, T.H. Sparks, F. Spina, C. Studds, S.A. Saether, P. Tryjanowski & N.C. Stenseth** (2011). Challenging claims in the study of migratory birds and climate change. *Biological Reviews of the Cambridge Philosophical Society*, **86(4):** 928–46.

[5] **Parmesan, C.** (2006). Ecological and evolutionary responses to recent climate change. *Annual Review of Ecology, Evolution and Systematics*, **37:** 637-69.

[6] **Pulido, F.** (2007). The Genetics and Evolution of Avian Migration. *Bio Science*, **57(2):** 165–174.

[7] **Guyomarc'h, J.-C., & M. Belhamra** (1998). Les effets de la sélection sur l'expression des tendances sexuelles et migratoires chez la caille des blés (*Coturnix c. coturnix*, L.). *Cahiers d'Ethologie*, **18(1):** 1–16.

[8] **Juan M.** (2012). Codorniz. In SEO/BirdLife: *Atlas de las aves en invierno en España 2007-2010*, pp. 116-117. Ministerio de Agricultura, Alimentación y Medio Ambiente-SEO/BirdLife. Madrid.

[9] **du Feu, C.R., A.C. Joys, J.A. Clark, W. Fiedler, I.S. Downie, A.J. van Noordwijk, F. Spina, R. Wassenaar & S.R. Baillie** (2009). EURING Data Bank geographical index 2009.

[10] **Rodriguez-Teijeiro, J.D., F. Sardà-Palomera & M. Puigcerver** (2012). Post–breeding movements and migration patterns of western populations of common quail (*Coturnix coturnix*): from knowledge to hunting management. *Animal Biodiversity and Conservation*, **35(2):** 333-342.

Keywords: migration, climate change, hunting, over-wintering, birds

(oral)

Harvest Management of Taiga Bean Geese in the Face of Demographic Uncertainty

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The abundance of many goose species in Europe has increased in recent decades, likely as a combination of factors including reductions in hunting pressure, favorable changes in land use, and climate change [1]. The taiga bean goose (*Anser fabalis fabalis*) is an exception, however, declining from about 100 thousand birds in the mid-1990's to 63 thousand in 2009 [2]. Signatories of the African-Eurasion Waterbird Agreement recently upgraded the conservation status of the taiga bean goose, requiring that any harvest must be conducted within the framework of an international species action plan, through which parties endeavour to implement the principles of adaptive harvest management. We describe harvest levels appropriate for first rebuilding the population of the Central Management Unit (principally Russia, Finland, Sweden, and Denmark), and then maintaining it near the goal specified in the AEWA International Single Species Action Plan (ISSAP). We also provide estimates of the length of time it would take under ideal conditions (no density dependence and no harvest) to rebuild depleted populations in the Western and Eastern Management Units. We emphasize that our estimates are a first approximation because detailed demographic information is lacking for taiga bean geese. Using allometric relationships, we estimated parameters of a theta-logistic matrix population model. The mean intrinsic rate of growth was estimated as $r = 0.150$ (90% credible interval: 0.120 – 0.182). We estimated the mean form of density dependence as $\theta = 2.361$ (90% credible interval: 0.473 – 11.778), suggesting the strongest density dependence occurs when the population is near its carrying capacity. Based on expert opinion, carrying capacity (i.e., population size expected in the absence of hunting) for the Central Management Unit in mid-winter was estimated as $K = 93{,}700$ (90% credible interval: 82,000 – 94,100). The ISSAP specifies a population goal for the Central Management Unit of 60,000 – 80,000 individuals in winter; thus, we specified a preliminary objective function as one which would minimize the difference between this goal and population size. Using the concept of stochastic dominance to explicitly account for demographic uncertainty, we determined that optimal harvest rates for 5, 10, 15, and 20-year time horizons were $h = 0.00$, 0.02, 0.05, and 0.06, respectively (Figs. 1 and 2). These optima represent a tradeoff between the harvest rate and the time required to achieve and maintain a population size within desired bounds. We recognize, however, that regulation of absolute harvest rather than harvest rate is more practical, but our matrix model does not allow calculation of an exact harvest associated with a specific harvest rate. Approximate harvests, however, for current population size in the Central Management Unit are 0, 1,200, 2,300, and 3,500 for the 5, 10, 15, and 20-year time horizons, respectively. Populations of taiga bean geese in the Western and Eastern Units would require at least 10 and 13 years, respectively, to reach their minimum goals under the most optimistic of scenarios. The presence of harvest, density dependence, or environmental variation could extend these time frames considerably. Finally, we stress that development and implementation of internationally coordinated monitoring programs at the flyway level will be essential to further develop and implement an adaptive harvest management program.

Figure 1: *Simulated mean utility over time horizons of 5, 10, 15, and 20 years (black, red, blue, and green, respectively) for a range of harvest rates of taiga bean geese in the Central Management Unit. Population sizes at the median goal of 70,000 geese have unit utility. Vertical dotted lines are the optimal harvest rates for the different time horizons.*

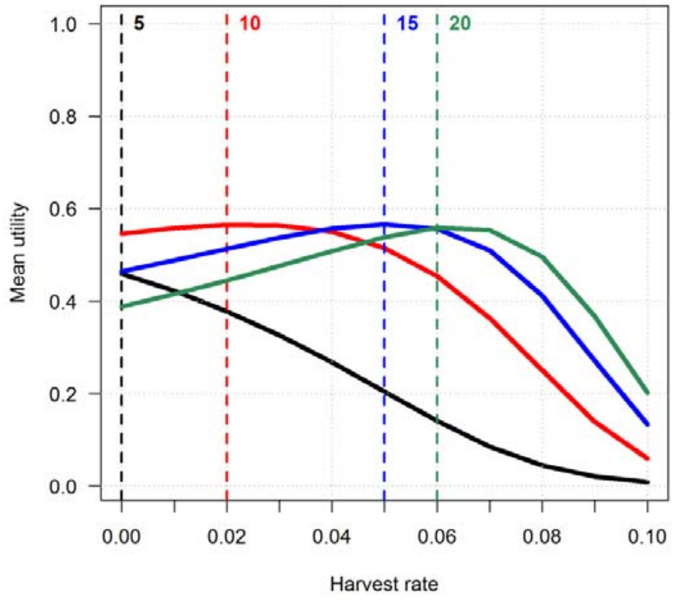
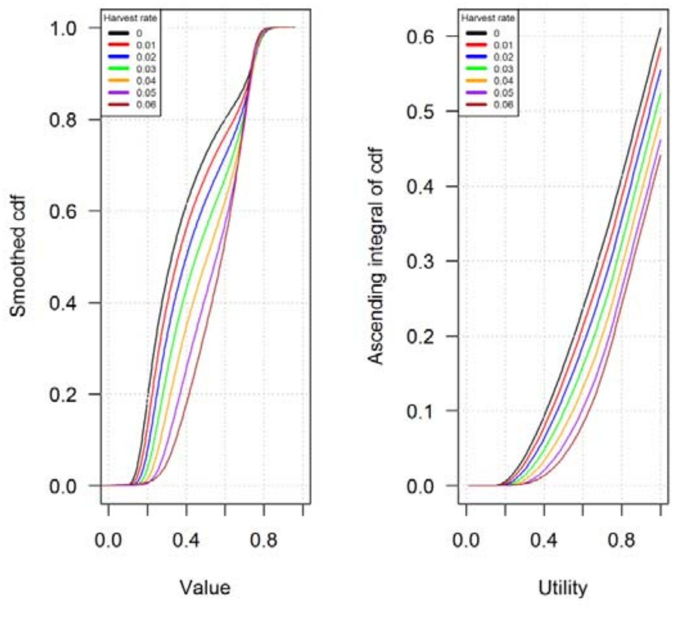


Figure 2: *Cumulative distribution function (cdf) (left panel) and the ascending integral of the cdf (right panel) of population utility based on simulation of a range of harvest rates of taiga bean geese in the Central Management Unit for a 20-year time horizon. The cumulative distribution functions in the left panel cross, meaning that the choice for a risk-neutral decision maker is ambiguous. However, a risk-averse manager can examine the right panel to determine that the ascending integral for h = 0.06 dominates all of the remaining integrals, suggesting it is the optimal harvest rate for a 20-year time horizon.*



References

[1] **Madsen J., G. Cracknell & A.D. Fox**, editors (1999). Goose Populations of the Western Palearctic: A Review of Status and Distribution. Wetlands International Publication No. 48. National Environmental Research Insitute, Ronde, Denmark.

[2] **Fox, A.D., B.S. Ebbinge, C. Mitchell, T. Heinicke, T. Aarvak, K. Colhoun, P. Clasen, S. Dereliev, S. Farago, K. Koffijberg, H. Kruckenberg, M. Loonen, J. Madsen, J. Moijj, P. Musil, L. Nilsson, S. Pihl & H. van der Jeugd** (2010). Current estimates of goose population sizes in western Europe, a gap analysis and an assessment of trends. *Ornis Svecica* **20:**115-127.

(poster #35)

Sexual dimorphism in two Alpine chamois (*Rupicapra rupicapra*) subspecies based on craniometric characters

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Alpine chamois (*Rupicapra rupicapra*) populations inhabit mountain ranges of central and southeastern Europe and western Asia and are classified into seven subspecies: *cartusiana*, *rupicapra*, *tatrica*, *carpatica*, *balcanica*, *asiatica* and *caucasica*. Sexual dimorphism in Alpine chamois is often problematic because males and females can be distinguished mainly by the shape and curvature of the horns. The degree of sexual dimorphism based on craniometric characters is not easily noticable and it varies among different subspecies of Alpine chamois, usually because of different habitat use, foraging behavior and social interactions.

We investigated the degree of sexual dimorphism in two Alpine chamois subspecies - Balkan chamois (*Rupicapra rupicapra balcanica* Bolkay, 1925) and Carpathian chamois (*Rupicapra rupicapra carpatica* Couturier, 1938) based on craniometric characters in a sample of 174 adult individuals (53 males and 39 females of Balkan chamois and 49 males and 33 females of Carpathian chamois). The analyses were performed using 25 craniometric characters and seven craniometric indices. The skulls were measured during 2013-2016 in five Balkan chamois populations (in Serbia, Montenegro, Bosnia and Herzegovina and Albania) and two Carpathian chamois populations (in Romania). The craniometric characters and indices were analyzed using ANOVA, principal component and discriminant analysis.

Our study showed that males of both subspecies had larger skulls compared to females, while females had more pronounced facial region than males. Balkan chamois showed greater level of sexual dimorphism if compared to Carpathian chamois, with males having larger skulls and less developed orbital region than females. In Carpathian chamois, males had larger nasal bones and less pronounced palatal and facial region of the skull than females. In both sexes, Carpathian chamois had larger skulls with less developed facial region compared to Balkan chamois. Besides observed differences in both subspecies, we found no craniometric character that can be used for the precise sex determination, as these characters in males and females showed considerable overlap between the ranges of variation.

The observed differences between males and females are presumably related to the differences in perception, diet, foraging behaviour, offspring protection and social communication. On the other hand, the differences in the degree of sexual dimorphism between analyzed Alpine chamois subspecies are caused by the habitat differences. Balkan chamois inhabits wide range of isolated habitats throughout the Balkan Penninsula, so observed higher level of sexual dimorphism can be related to the variation among populations inhabiting different habitat types.

The results obtained in the study contribute to the understanding of craniometric variability in both Balkan and Carpathian chamois. The Alpine chamois populations have been declining accross Europe, so clarification of the differences between subspecies and between sexes are of great importance for the appropriate game management and conservation of this species.

Keywords: Alpine chamois, Balkan chamois, Carpathian chamois, sexual dimorphism, craniometric variability, conservation

(poster #36)

Great Cormorant (*Phalacrocorax carbo*) monitoring in the fishponds of Hortobágy

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The Hortobágy is the first national park in Hungary established in 1973. The landscape is dominated by grasslands and marshes in the deeper areas. The Hortobágy has a great importance in breeding, migrating and wintering of about 350 bird species. After the regulation works of the Tisza river the area was dried out in the 19th century. Severeal artificial fishpond were created in the middle of the 20th century, the fishponds are giving a similar wetland for birds. There are several endangered and rare bird species breeding in the fishponds, for example Spoonbill (*Platalea leucorodia*), Great White Egret (Egretta alba), Glossy Ibis (*Plegadis falcinellus*), Pygmy Cormorant (*Phalacrocorax pygmaeus*), Whiskered Tern (*Chlidonias hybrius*). The migrating species including the Lesser White-fronted Goose (*Anser erythropus*), Redbreasted Goose (*Branta ruficollis*) and the fishponds are the main resting place for the Eurasian Cranes (*Grus grus*) in autumn migration. The extensive ecological fish management by the Hortobágy Fish Farm Co. in cooperation with the Hortobágy National Park provides a favourable breeding condition for the breeding and migraing bird species.

The population of the Great Cormorant (*Phalacrocorax carbo*) was very low in Hungary before the 1980s. After this period the breeding and migrating number increased significantly in the wetlands of Hungary but also in most European countries. The size of the Great Cormorant breeding population in the Hortobágy is relatively stable, but the migrating and wintering number has increased. Due to considerable fish consumption of cormorants, in order to ensure adequate protection it is essential to know which pond units and what categories of ponds (rearing, growing and fattening) are preferred by the birds. Our data was examined according to 15 years of continuous monitoring. The results show that the population on each unit of pond and in different periods of the year seem to vary extremely. The nature of exploitation of the fishponds varies as well, according to monitoring. The examinations were analyzed by chi2 independence audit. We found out that the population of the cormorant depends on the feeding possibilities and the fish size composition of the ponds.

References

[1] **Wernham, C.V., M. Armitage, B. Hughes, R. Hughes, S.J. Holloway,M. Kershaw, J.R. Madden, J.H. Marchant, W.J. Peach & M.M. Rehfisch** (1997). Population, distribution, movements and survival of fish-eating birds in Britain. Report to the Department of the Environment and the Environment Agency.

[2] **Steffens, W.** (2010). Great cormorant – substantial danger to fish populations and fishery in Europe. *Bulg. J. Agric. Sci.,* **16:** 322-331

Keywords: great cormorant, population, fishpond, Hortobágy, fish

(poster #37)

Population dynamics of Eurasian Collared Dove populations in two Eastern Hungarian County seats

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The Eurasian Collared Dove is an invasively spreading bird species, the survey of its expansion and ecology can be tracked back to the early 20th century. It appeared nearly 70 years ago in Hungary then colonised Europe. In Algeria the Eurasian Collared Dove was mainly spread through urban habitats within a few years, and expanded to agricultural lands in 2006. This process is still going on nowadays [1]. The nesting population of the Eurasian Collared Dove was estimated a number of 100.000-300.000 individuals at the end of the 20th century [2]. This species typically follows human related habitats, and land covers, while some populations are directly linked to human settlements. However, it also appears as nesting species in farmlands. Rural woods and gallery forests can also be function as roost sites, but in the last few years the Eurasian Collared Dove left those habitats and compressed in villages. In winter, numerous individuals are seeking shelter in parks and gathering in big groups at night, while they leave the city to seek food sources [3].

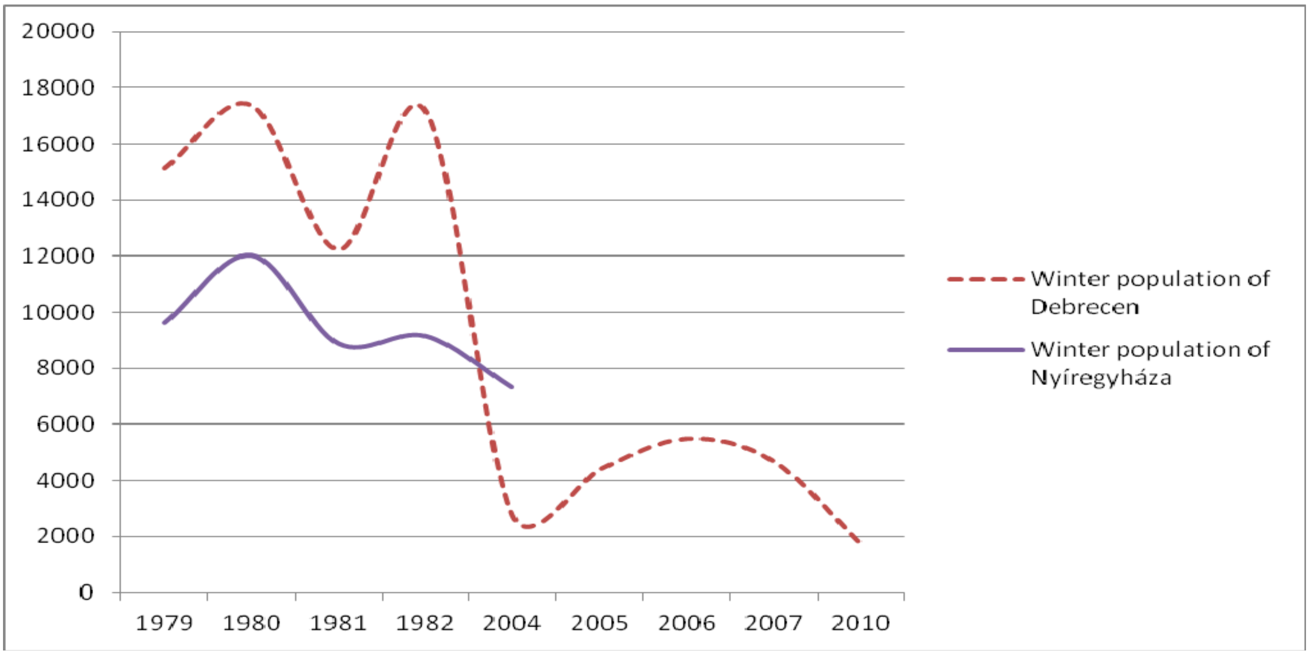
However, according to the national observations and monitoring, in national scales the population of the Eurasian Collared Dove is slightly increasing, locally there are areas, where the populations have a decreasing tendency. The reason of this phenomenon has not known completely, as it not tested with statistical methods, respectively.

The aim of this research was to collect and summarize data of wintering Collared Dove populations in two Eastern-Hungarian cities. This study showed that wintering population of the Collared Dove was stable in the late 1970's in Debrecen and in Nyíregyháza as well [4,5], but started to decrease until the millennium, especially in Debrecen while in Nyíregyháza the population remained more stable at a lower level. The main reason is the degradation of urban habitats which can inflict the loss of wintering roosts. After the analysis we stated, that the national trends in population levels are significantly not relevant in Debrecen and Nyíregyháza.

The main reason is the disappearing of roosts, but we think there might be other impacts. According to one of the previous publications [6-8] we suggest that the decrease of the Eurasian Collared Dove's population can be tracked to the high pressure on hunting, strengthened by the modern agriculture and storing methods, and last, but not least the increasing amount of predators, e.g. Hooded Crows (*Corvus cornix* L.), and Magpies (*Pica pica* L.). In our opinion the greatest source of danger is the increased number of Hooded Crows is presented in Debrecen [9]. The ecological effect and the competition between the two species can fill the former knowledge and experiences about urban ecosystem. The two cities' city structures are nearly the same; they can be compared easily because of their short geographical distance (50 km).

We think that the rapid increase in Hooded Crows can be responsible for the inverted trends in Collared Dove populations. Thus, further field work should be needed to explore more information about impacts of Hooded Crows, and their effect on Collared doves. The four decades long research pointed out that the influential factors in connection with the population dynamics of the Eurasian Collared Dove are lack of information, and need further research. A new research about the interaction between Hooded Crows and Eurasian Collared Doves is carried out with the support of the New National Excellence Program of the Ministry of Human Capacities.

***Figure 1:** population dynamics of Eurasian Collared Dove in Debrecen and Nyíregyháza*



References

[1] **Bendjoudi, D., J.F. Voisin, S. Doumandji, A. Merabet, N. Benyounes & H. Chenchouni** (2015). Rapid increase in numbers and change of land use in two expanding Columbidae species (*Columba palumbus* and *Streptopelia decaocto*), *Algeria Avian Research,* **6:** 18.

[2] **Magyar, G., T. Hadarics, Z. Waliczky, A. Schmidt & A. Bankovics** (1998). Nomenclator Avium Hungariae. MME– Winter Fair. Budapest-Szeged, **202.**

[3] **Eraud, C., A. Jacquet & P. Legagneux** (2011). Post-Fledging Movements, Home Range, and Survival of Juvenile Eurasian Collared-Doves in Western France. *The Condor*, **113(1):** 150-158.

[4] **Bozsko, Sz. & L. Juhász** (1981). Population dynamics of the Collared dove's (*Streptopelia decaocto* Friv.) population in Debrecen. *Aquila,* **88:** 91-115.

[5] **Bozsko, Sz. & L. Juhász** (1984). Comparative survey of the Collared Dove (*Streptopelia decaocto* Friv.) population at five county seats in Hungary. *Aquila,* **91:** 140-150.

[6] **Juhász, L.** (1991). Population dynamics of the Collared Dove (*Streptopelia decaocto Friv.*) in Hungary between 1980-1990, *XXth Congress of the IUGB, Gödöllő, Hungary, Transactions*: 284-289.

[7] **Juhász, L.** (1995). Possible cause of changes in the dynamics in the Collared Dove (*Streptopelia decaocto Friv.*) populations in Hungary*, XXII Congress of IUGB Sofia, Bulgaria, Proceedings*: 66-69.

[8] **Juhász, L.** (2007). The population dynamics of the Collared Dove (*Streptopelia decaocto Friv.*) in Eastern Hungary, *XXVIII Congress on IUGB Uppsala Sweden, Book of Abstracts:* 257.

[9] **Kövér L., P. Gyüre, P. Balogh, F. Huettmann, Sz. Lengyel & L. Juhász** (2015). Recent colonization and nest site selection of the Hooded Crow (*Corvus corone cornix* L.) in an urban environment. *Landscape and Urban Planning,* **133:** 78–86.

Keywords: Eurasian Collared Dove, *Streptopelia decaocto*, population dynamics, wintering groups, habitat degradation, urban ecosystem

(oral)

Who took the eggs? – An experimental wildlife camera trap survey

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In Europe the populations of many ground nesting farmland birds have declined in the recent decades. Changes in agricultural landscapes, such as the loss of suitable habitats, have mainly been held responsible for this phenomenon. Increase in predator populations and nest predation, may however play an important role in the decline of the bird populations along with the habitat loss. The role of certain predators in nest predation has remained unclear, and the real predator of a nest has been almost impossible to identify. In this study we used wildlife cameras that reveal the exact date of the nest predation, and the duration of the survival of each nest as well. In addition, thanks to the cameras, we gained knowledge of how many times and in which order the predators have visited the depredated nests.

The aim of our study was to monitor the nest survival rate and to identify nest predators of ground nesting birds and to assess if specific aspects in the choice of nesting site increase the risk of predation. In our study we used artificial pheasant nests (N=104), with real pheasant eggs, which we observed with wildlife cameras for 8-10 days. Overall predation rate was 40% (N=42). Of the predators 40% were mammals and 50% birds, 10% remained unknown. The mammal group consisted of raccoon dogs (*Nyctereutes procyonoides*) (N=12), badgers (*Meles meles)* (N=1) and roe deer (*Capreolus capreolus*) (N=4). Avian predators were hooded crows (*Corvus cornix*) (N=10), magpies (*Pica pica*) (N=10) and jackdaws (*Corvus monedula*) (N=1). We tested the effect of three different habitat-related distances to the level of nest predation: distance to forest edge, distance to nearest water system and distance to nearest tree (observation tree for predatory birds) as well as the effect of nest visibility to predation. According to GLMM analysis, avian predators showed preference in preying further away from the forest edge in open fields. In addition, nest visibility increased the risk of predation. Mammal predation was more typical when the distance to water increased. Interestingly, we found out that most of the predated nests were visited by more than one predator, especially raccoon dogs could be seen visiting the nest several times after the depredation.

Our study shows the efficiency of using wildlife cameras in wildlife management studies compared to older techniques, i.e. exact predation dates are revealed and the predator species and their nest visiting frequencies can be recognized. The ongoing expansion of various (alien) predators all over Europe may indeed have a greater impact on the ground nesting bird populations than previously considered. At least in our study the impact of one invasive alien species, the raccoon dog, seemed to be considerable.

Keywords: Nest predation, farmland birds, *Phasianus colchicus*, *Nyctereutes procyonoides*, wildlife camera traps

(poster #38)

Predation pressure of the Red fox on the Brown hare in the South and North West of Switzerland

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Availability of resources, diseases, destruction of habitats and/or climate are all factors likely to influence an animal population's cycle. In addition, predation is also often pointed as being an important driver of population dynamics [1] [2]. The latter is often considered to be one of the main factors affecting Brown hare (*Lepus europaeus)* populations that experienced a strong decrease throughout Europe during the last decades [3] [4] [5]. In this case, it is the opportunistic Red fox (*Vulpes vulpes*) that is considered to be the most important predator [6] [7] [8], hunting skills that are likely overestimated.

Our study aims at estimating the predation pressure that the Brown hare is subjected to considering the Red fox and other potential predators. Contrary to what is generally considered, our hypothesis is that the Brown hare is not a regular prey to the Red fox in Geneva. This should have an effect on the behavior of each species during encounters in the field. We assume that the Brown hare should be less often in alert or in flight when in contact with predators that are not perceived as dangerous, in comparison to predators that are perceived as real danger. We also assume that the most frequent behavior of the Red fox towards the Brown hare is indifference. Furthermore, the behavior succession observed during these interspecific encounters is analyzed in order to point out a recurrent pattern of behavioral responses for both species.

Since September 2016 direct observations are carried out at night in two agricultural landscapes of Switzerland (Geneva and Neuchâtel). Both these regions differ in altitude, Brown hare density, and in hunting pressure. Direct prey-predator interactions are observed with a far-infrared thermal imaging sensor.

So far, 178 hours of field work has allowed to observe a total of 119 interactions between hares and potential predators: 110 with foxes, 2 with badgers and 7 with dogs (accompanied by humans).

Statistical analyses have not been conducted yet, however some indicative numbers may be already revealed:

100% of the encounters with dogs (with humans) ended by the hare fleeing, whatever the initial distance to the dog and its interest.

100% of the encounters with badgers were marked by a reciprocal indifference.

Regarding interactions between hare and fox: in 60% of the cases, foxes manifested a total indifference, going on with their initial activity. They stopped to look at the hare before passing their way in 37% of cases. In the remaining 3%, foxes tried a fast but quickly aborted approach. Regarding hares, in 40% of the cases hares reacted with the Signalling behavior, were on alert in 34% of cases and displayed a total indifference towards foxes in the remaining 26%.

To make this study as relevant as possible, data will be collected until spring 2018.

References

[1] **McNamara, J.M. & A.I. Houston** (1987). Starvation and predation as factors limiting population size. *Ecology*, **68(5):** 1515-1519**.**

[2] **Hik, D.S.** (1995). Does risk of predation influence population dynamics? Evidence from the cyclic decline of Snowshoe Hares. *Wildlife Research*, **22:** 115-129.

[3] **Smith, R.K., Jennings, N.V. & Harris, S.** (2005). A quantitative analysis of the abundance and demography of European hares *Lepus europaeus* in relation to habitat type, intensity of agriculture and climate. *Mammal Review,* **35(1):** 1-24.

[4] **Schmidt, N.M., T. Asferg & M.C. Forchhammer** (2004). Long-term patterns in European brown hare population dynamics in Denmark: effects of agriculture, predation and climate. *BMC Ecology*, **4:** 15.

[5] **Edwards, P.J., M.R. Fletcher & P. Berny** (2000). Review of the factors affecting the decline of the European brown hare, *Lepus europaeus* (Pallas, 1778) and the use of wildlife incident data to evaluate the significance of paraquat. *Agriculture, Ecosystems and Environment,* **79:** 95-103.
[6] **Panek, M.** (2013). Landscape structure, predation of red foxes on grey partridges, and their spatial relations. *Central European Journal of Biology*, **8(11):** 1119-1126.
[7] **Knauer, F., H. Küchenhoff & S. Pilz** (2010). A statistical analysis of the relationship between red fox *Vulpes vulpes* and its prey species (grey partridge *Perdix perdix*, brown hare *Lepus europaeus* and rabbit *Oryctolagus cuniculus*) in Western Germany from 1958 to 1998. *Wildlife Biology,* **16:** 56-65.
[8] **Lindstrom, E.R., H. Andren, P. Angelstam, G. Cederlund, B. Hornfeldt, L. Jaderberg, P.A. Lemnell, B. Martinsson, K. Skold & J.E. Swenson** (1994). Disease reveals the predator: sarcoptic mange, red fox predation, and prey populations. *Ecology*, **75(4):** 1042-1049.

Keywords: prey-predator interaction, Brown hare, Red fox, predation impact, animal behavior

(oral)

Scabies in Bavarian Chamois (*Rupicapra rupicapra*) Population: or why haven't Chamois in Bavaria Scabies?

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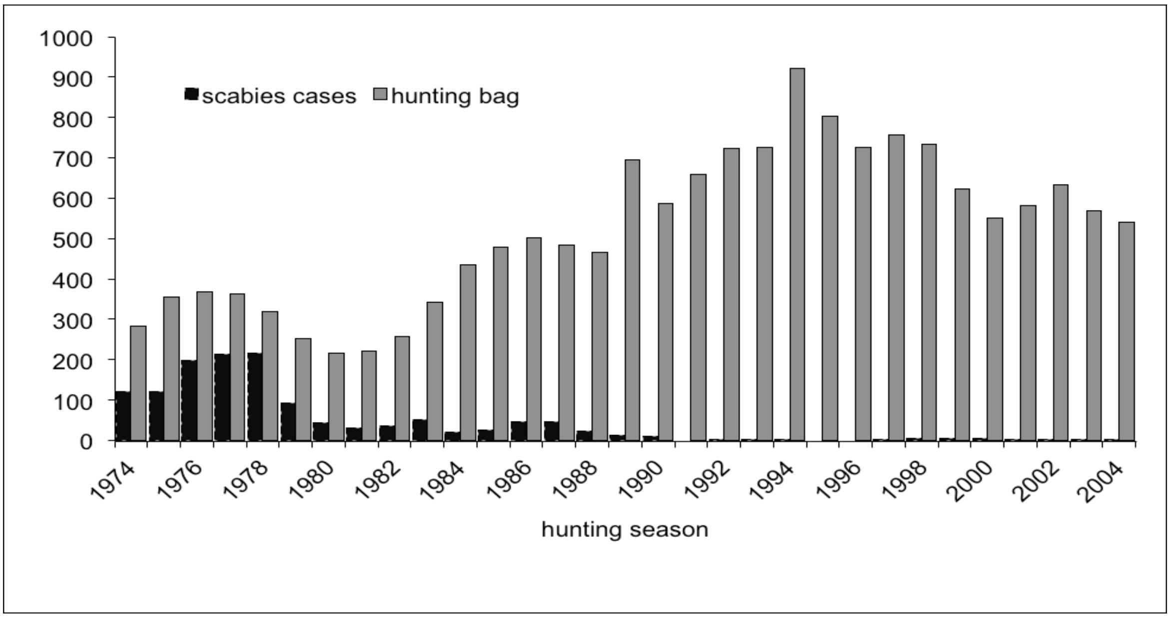
Scabies (*Sarcoptes scabiei var. rupricaprae*) is the disease most likely to have the greatest impact on the development of the chamois population and is spreading throughout large areas of the Alps [1,2]. In severe epidemics, up to 80 % of affected population can be lost due to the outbreak of scabies [3-7]. Once affected by scabies chamois population do not get rid of this pest. One exception of this rule is the chamois population in Bavaria.

There, scabies was registered for the first time in the year 1824 among the chamois population of the Berchtesgaden region, and disappeared 6 years later [3,8,9]. For the next 119 years, the chamois populations in the Bavarian Alps seemed not to be infected by scabies. But in 1949 scabies occurred again in the Bavarian chamois populations east of the River Inn, with origin in the Berchtesgaden region. Scabies has been recorded repeatedly since then. Whereas between 1949 and the early 1990s scabies had a great impact on the development of the chamois populations in the Bavarian Alps east of the river Inn, the disease has had little significance since 1995.

As it is assumed that there is a link between high population density [1,2,3]. and the occurrence of scabies among chamois, hunting bags (as indicators of population density) were compared with the recorded scabies cases (shot or deceased game) among chamois populations in the Bavarian state forests east of the river Inn [10]. Data collected from the Berchtesgaden Forest Office were further analysed according to age and sex parameters.

There is a highly significant, inverse, non-parametric correlation between recorded incidences of scabies and hunting bags in the whole study area and in the area of Berchtesgaden Forest Office. The results of the analysis show that bucks were slightly more likely to be registered with scabies than does (p=0.018). Young animals (yearlings and juveniles) played only a secondary role in terms of scabies prevalence. Both the historical background of scabies in the Alps and the present study support the above-mentioned hypothesis that the incidence of scabies in chamois is related to high chamois population densities and related low condition oft he single animals. The spread of scabies and its importance to chamois populations can therefore be slowed down or prevented by increasing game bags over a large area.

Figure 1: *Annual scabies cases and hunting bags in the Bavarian state forests east of the river Inn, hunting seasons 1974/75 to 2004/05.*



References

[1] **Menzano, A., L. Rambozzi & L. Rossi** (2004). Outbreak of scabies in human beings, acquired from chamois (Rupicapra rupicapra). *Vet. Rec.,* **155(18):** 568-568.
[2] **Schaschl, E.** (2003). Gamsräude. Östereichischer Jagd- und Fischreiverlag, Wien
[3] **Boch, J. & H. Schneidawind** (1988). Krankheiten des jagdbaren Wildes. Paul Parey, Hamburg, Berlin.
[4] **Deutz, A. & G. Greßmann** (2001). Gams- & Steinwild. Leopold Stocker Verlag, Graz.
[5] **Fuchs, K, A. Deutz & G. Gressmann** (2000) Detection of space-time clusters and epidemiological examinations of scabies in chamois. *Veterinary Parasitology,* **92:** 63-73.
[6] **Rossi, L., P.G. Meneguz, P. De Martin & M. Rodolfi** (1995). The epizootiology of Sarcoptic Manage in Chamois, *Rupicapra Rupicapra*, from the Italian Estern Alps. *Parasitologia,* **37:** 233-240.
[7] **Rossi, L., C. Fraquelli, U. Vesco, R. Permunian, G.M. Simmavilla, G. Carmignola, R. Da Pozzo & P.G. Meneguz** (2007). Descriptive epidemiology of a scabies epidemic in chamois in the Dolomite Alps, Italy. *European Journal of Wildlife Research,* **53(1),S.:** 131 - 141.
[8] **Kobell von, F.** (1858). Wildanger. Jagd- und Kulturverlag Reprint 2004.
[9] **Hauber, G.** (1924). Das Gamswild. Verlag von Piloty&Loehlein, München
[10] **Grauer, A. & A. König** (2009) Management of Chamois in Bavaria (Germany): The Importance of Game Activities in Scabies ControlWildl. *Biol. Pract.,* **December 5(2):** 115-127

Keywords: Mountain ungulate, wildlife disease, *Rupicapra rupicapra*; *Sarcoptes scabiei* var. *rupricaprae*; population density; game management

(oral)

Plasticity of roe deer on annual changes of energy and quality in their diet

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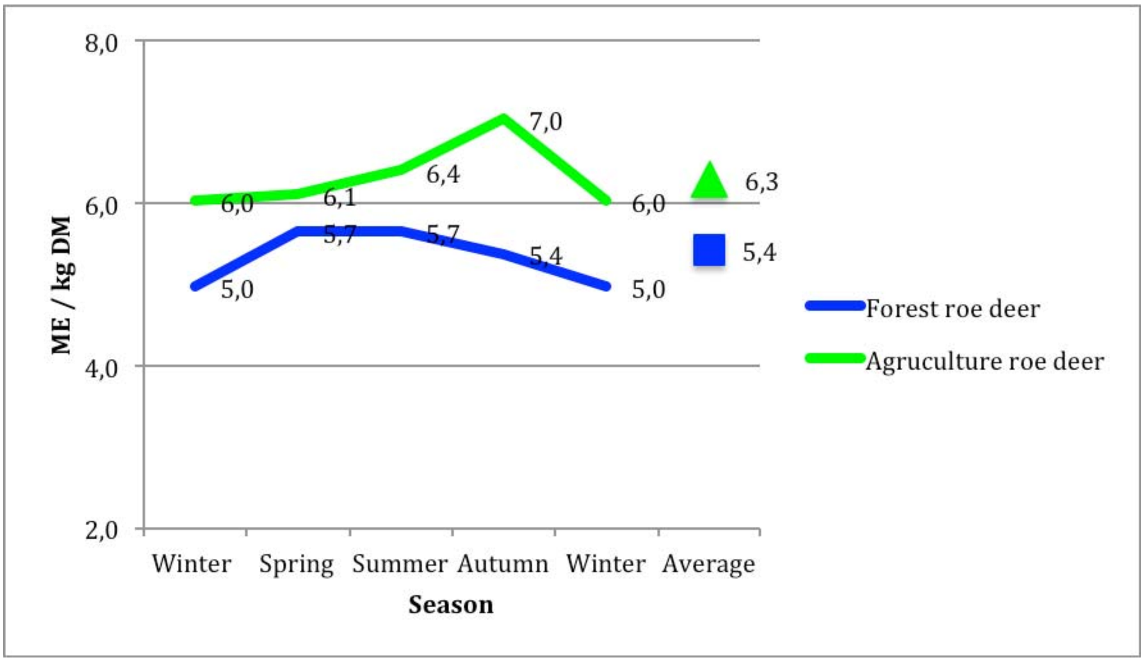
European roe deer (*Capreolus capreolus*) are forest dweller [1,2] and are classified as a typical "Browser" or "Concentrate Selector" [3-5]. This means, that roe deer depend on diet with low fibre and high crude protein proportion in their diet [4-11]. That's why some hypothesis that roe deer are unable to digest on agricultural plants, as they have high fibre proportion [12-16].
From 2011 to 2014 rumens and conditions parameters of 220 roe deer were collected from legal hunts in a forest habitat as well as in an agricultural habitat [17]. In order to observe seasonal influences we gathered samples over 12 month each year. Therefor we got a permit of the local hunting authorities to bag roe deer outside of the regular hunting seasons. Our aim was to measure the quality and energy content of natural roe deer diet, which we got out of the rumens. As method we used the standards for diet analysis [18, 19]. In order to get an overview about the total energy budget of the roe deer, we analyzed according to a wildlife system approach condition and physiological adaption of roe deer to local and seasonal changes in diet. Additional availability and quality of the local vegetation and stress of the deer were measured as degree of human disturbance. Fodder of roe deer in the agricultural habitat had an mean energy content of 6,29 MJ/ kg DM. Which was significant more digestible energy as roe deer in the forest habitat with a mean of 5,43 MJ/kg DM (Fig. 1). To increase the energy food intake per rumen the rumen intake was in the middle 300g higher in roe deer from the forest habitat. However, in both habitats fibre proportion wasn't less than 23 % TM and in winter, roe deer were able to gather more energy out of fibrous diet than the grazer "sheep". The german term "Concentrate selector" should be removed by "Selector" or "Browser" to avoid misinterpretations. During our study period we didn't observe any energy gap in both populations. Related to diet energy roe deer in our agricultural habitat didn't recognize, that it was winter.

. ***Figure 1:*** *Mean energy in roe deer diet in two different habitats*



References

[1] **Reimoser, F.** (2005). Rehwild in der Kulturlandschaft - Biologie, Lebensraum, Hege, Bejagung. 11. Österreichische Jägertagung, 15-16 Februar 2005.

[2] **Stubbe, C.** (1997). Das Rehwild. Parey Buchverlag, Berlin.
[3] **Drescher-Kaden, U.** (1976). Untersuchungen am Verdauungstrakt von Reh, Damhirsch und Mufflon. Mitteilung 1: Gewichtserhebungen und Kapazitätsmessungen am Verdauungstrakt, insbesondere am Pansen-Haubenraum von Reh, Damhirsch und Mufflon. *Z. Jagdwiss.,* **22:** 184-190.
[4] **Drescher-Kaden, U.** (1984). Stellung des Rehs im System der Wiederkäuer. Rehwild-biologie. Arbeitstagung am 10.-12. März 1984 im Nationalpark Bayerischer Wald, 29-35.
[5] **Hofmann, R.R.** (1989). Evolutionary steps of ecophysiological adaption and diversification of ruments: a comparative view of their digestive system. *Oecologia,* **78:** 443-457.
[6] **Cornelis, J., J. Casaer & M. Hermy** (1999). Impact of season, habitat and research techniques on diet composition of roe deer (*Capreolus capreolus*): a review. *J. Zool. London,* **248:** 195-297.
[7] **Dissen, J. & W. Hartfiel** (1985). Beobachtungen zum Äsungsverhalten sowie Untersuchungen zur Nährstoffverdaulichkeit von Rehwild. *Z. Jagdwiss.,* **31:** 83-91.
[8] **Drescher-Kaden, U. & E.A. Seifelnasr** (1976). Untersuchungen am Verdauungstrakt von Reh, Damhirsch und Mufflon. Mitteilungen 2: Rohnährstoffe im Panseninhalt von Reh, Damhirsch und Mufflon. *Z. Jagdwiss.,* **23:** 6-11.
[9] **Duncan, P., H. Tixier, R.R. Hofmann & M. Lechner-Doll** (1999). Feeding strategies and the physiology of digestion in roe deer. In: Anders, R, Duncan, P. & Linnell, J.D.C (Eds.) The European Roe Deer: The Biology of Success. Scandinavian University Press, Oslo.
[10] **Djordjevic, N., Z. Popovic & G. Grubic** (2006). Chemical composition of the rumen contents in roe deer as potential quality indicator of their feeding. *Journal of Agricultural Sciences,* **51(2):** 133-140.
[11] **Popovic, Z., N. Dordevic, M. Dordevic, G. Grubic & B. Stojanovic** (2009). Estimation of the Quality of the Natution of Roe Deer based on Chemical Composition of the Rumen Content. *Acta Veterinaria (Beograd),* **59(5-6):** 653-663.
[12] **Bauer, J.** (2007). Rehwildfütterung und Waldschutz. In: Reddemann, J. (Hrsg.): Tierschutz in der Jagd. Schriftenreihe des Landesjagdverbandes Bayern e.V. Bd. 16, 67-71.
[13] **Onderscheka, K.** (1999). Das Rehwild – seine Ernährung und Fütterung. In. Reddemann, J. (Hrsg.) Rehwild in der Kulturlandschaft. *Schriftenreihe des Landesjagdverbandes Bayern. e.V.,* **7:** 37-61.
[14] **Helm, G.** (2015). Ernteschock und Verbiss. Volle Silos, leere Mägen. *Jagd in Bayern,* **10:** 16-17.
[15] **Hofmann, R.R. & A. Herzog** (1980). Jahreszeitliche Ernährungssituation beim Reh und Rotwild. *Jagd in Tirol,* **9:** 7-13
[16] **Hofmann, R.R. & N. Kirsten** (1982). Die Herbstmast-Simulation. Untersuchungs-ergebnisse und kritische Analyse eines praxisorientierten AKWJ-Projektes zur Problematik der Schalenwildfütterung. Schriften des Arbeitskreises für Wildbiologie und Jagdwissenschaft an der Justus-Liebig-Universität Gießen, H. 9, Ferdinand Enke Verlag, Stuttgart.
[17] **König, A., M. Scheingraber & J. Mitschke** (2016). Energiegehalt und Qualität der Nahrung von Rehen (*Capreolus capreolus*) im Jahresverlauf in zwei unterschiedlich geprägten Habitaten (Analysis of annual changes of energy and quality in roe deer diet in two different habitats)
[18] **Kirchgessner, M., F.X. Roth, F.J. Schwarz & G.I. Stangl** (2008). Tierernährung. DLG Verlag, Frankfurt a. Main.
[19] **Steingaß, H., & K.H. Menke** (1986). Schätzungen des energetischen Futterwertes aus der in vitro mit Pansensaft bestimmten Gasbildung und der chemischen Analyse. 1. Mitteilungen: Untersuchungen zur Methode. *Übers. Tierern.,* **14:** 251-270.

Keywords: ungulate, *Capreolus capreolus*, diet energy, diet quality, phenotypic plasticity, stress, rumen microbiome, Bavaria

(poster #39)

Dynamics of structure of mountain ungulate herds supporting the population homeostasis

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The aim of this work was to study the patterns of changes in the structure of mountain ungulate herds, aimed at maintaining the population homeostasis in response to changes in habitat conditions.

Most of the environmental parameters have been obtained in the study of populations of Turkmen mountain sheep (*Ovis vignei cycloceros*) and bezoar goat (*Capra aegagrus*) in the mountains of Central Kopet-Dag (Turkmenistan). In the observation period from 1979 to 1985 there were 432 meetings of 6045 mountain sheep and 236 meetings of 3757 bezoar goats. During the recovery of natural populations of the Arabian tahr (*Arabitragus jayakari*) from 2005 to present time, the dynamics of this process has been studied in the United Arab Emirates mountains (176 meet ups). In addition, in all these years we have carried out numerous trips to the mountains and reserves in Turkmenistan, Slovakia, Kyrgyzstan and the United Arab Emirates for the study of natural populations and organization of nurseries (in addition to listed above species) to Bukhara (*O. v. Bochariensis*) and Marco Polo (*O. ammon polii*) mountain sheep, Siberian goat (*C. sibirica*) and Markhor (*C. falconeri heptneri*). Our methods of data collection and questionnaires on the observations of ungulates in nature and nurseries were published earlier [1].

In the study of natural populations of animals not only the quantity and its dynamics were assessed, but mainly the features of biotope distribution and density, features of dynamic processes of intraspecific structure, trophic relations when the habitat conditions change being caused by various factors. This has allowed a better understanding of the mechanism of adaptation to the specific conditions of the habitat in order to maintain the population homeostasis.

The dynamics of sex-age composition of the groups of mountain ungulates for all members of the tribe Caprini was very close, despite the diversity of its species and geographical forms, body dimensions and weight. It all depends on the situation in specific habitat conditions, changes in the structure of offspring sex pattern, patterned change of the parents' age, as well as on the density of the animals in process of change of their quantity.

There are three main levels of conditional reproductive strategy to ensure the survival of the population and maintaining the optimal number in a changing habitat:

1. In the most favorable conditions of habitat the herd size in rut reaches the maximum of 20-30 (up to 100 individuals), which has several adult males and females and clearly identified leaders-guide and leaders-dominant, strict hierarchy and communication between individuals. Sex ratio is 1:2-3. Females breed 1.6-1.8 yeanlings. Reproductive strategy in most cases corresponds to promiscuity, as it requires the greatest possible genetic diversity of the species composing the population for exploring new habitat resources.
2. In the statistically average habitat conditions it is needed to preserve the genetic diversity and reproductive potential in case of rapid change of habitat conditions (drought, the transformation of the landscape, etc.). A reproductive strategy is polygyny. In the herd there is a dominant male and several females. The core of the fittest individuals adapted to living in the limited resources conditions manifests. Sometimes in the herd there are 1-2 subdominant males. The size of herd is of 3 to 10 individuals with a sex ratio of 1: 3-7. Females breed 1.2-1.4 yeanlings.
3. When the catastrophic changes in the conditions of the habitat occur, as well as in the cases of long-term negative factors, only the most adapted individuals survive, the ones which have managed to survive in the negative for their species conditions. Isolated and scattered areal animals do not gather in groups even during the rutting period. Sex ratio is: 1-0.85. Females breed 0.6-0.8 yeanlings.

A key mechanism for the transition to the different levels of the reproductive population strategy are regular seasonal changes in the structure of the herd. Based on the analysis of meet ups with animals and the observations we have identified 4 major periods in the life of mountain ungulates: winter-spring, yeanling birth, watering (preparatory) and rutting. Each of these periods has a different structure of the herd, and radical internal restructuring.

Winter-spring period in the life of mountain ungulates occurs after the end of the rut and is characterized by the highest indicator of gregariousness. Association of the animals in large groups is the result of establishing the adverse weather conditions, reduction of the areas and the deterioration of the quality of winter pastures in connection with the termination of vegetation. Snow cover makes the animals gather in relatively small, snow-free areas. In such areas the animals gathering (but the gathering, not the herd) reaches 300 or more individuals.

Yeanling birth period timing is connected to the spring vegetation season and is characterized by significant changes in the life of animals. As the time is getting on for birth the females leave the mixed herds to find hiding places for yeanling birth. Mature males also leave the herd. There is a separation within a herd into groups according to sex and age. Remaining mixed herds are presented by young and immature males and juvenile and spinster. Stable groups of mature males appear.

Watering or preparation period begins with increasing daytime temperatures and dry air to the maximum value. With the birth of the yeanlings the density of the population of mountain ungulates increases, and the growing generation, with the transition to self-dependent feed increases the load on the pasture vegetation. The general need for accessible water sources and the increasing concentration of animals on pastures to promote association of females with their young with spinsters, with females which lost their young, and the young males in the group. Exactly during this period the reproductive cycle program and the reproductive strategy is selected for the next breeding season and which are dependent on the combination of the existing natural and anthropogenic factors.

Rutting period begins with the transition of young to adult life, usually when they turn 6 months. During this period, the sexually mature males and females come together to form a mature rut herd with all relevant structures, corresponding to the reproductive strategy. Immature and defective males are expelled from the mixed groups met in the watering period, and they form a group merging with young. But this group is of a completely another quality.

Knowledge of these patterns is necessary to control the population and the organization of activities for protection of species of mountain ungulates in nature, as well as in the practice of management of the animals in special nurseries. Evaluation of the sex and age structure and quantitative characteristics of the groups of mountain ungulates obtained in the monitoring process can be an indicator of the state of populations in a specific habitat.

Reference

[1] **Korshunov V.M.** (2005). Types of protocols (questionnaires, forms) to monitoring ungulates in nature and in breeding centres.// Ungulates in Zoos and Breeding Centres: Inter-department scientific and methodic articles. Moscow zoo, p. 120-133 (in Russian)

Keywords: mountain ungulates, herd, dynamic, population, homeostasis

(poster #40)

The morphometric data of Arabian tahr (*Arabitragus jayakari*). Comparison of some morphometric data of different types of mountain ungulates occurred in the UAE

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The studies were carried out in the MNC of UAE Wildlife Sanctuary during 3 years (December to January, July to August); the measurements were taken at the time of vaccination. We chose 6 species of mountain ungulates adapted to living in the mountainous landscape in similar environmental conditions: markhor (Capra aegagrus) (21 species) Transcaspian urial (Ovis vignei) (59), Arabian tahr (Arabitragus jayakari) (112), Nubian goat (Capra nubiana) (23), Bukhara sheep (Ovis ammon) (10), Isfahan mouflon (Ovis musimon) (55).
The measurements of the animals were taken following generally recognized scheme (Danilkin, 1999) [1] using a measuring tape accurately to within 0.1 mm and weight accurately to within 0.1 kg.
We collected the results of 11 body measurements, such as body length, withers height, trunk girth, oblique body length, foot length, ear length, tail length, neck length, head length, horn length, left and right, and live weight. The average data were calculated, as well as the withers height/ foot length ratio and withers height /body length ratio. The measurements data collected for the parameters of greatest practical interest are presented in tabular form (Table 1).
Height, length and foot length continue to grow as animals mature, but they grow at different rates, which affect the body proportions (Table 2). Of particular interest to mountain ungulates is the length of the foot, which, along with the shape of the hooves differs in goats and sheep. V.I. Tsalkin (1951) [2] pointed to the peculiar elongation bones of the foot in wild sheep, while the bones are shortened in the goats. P.P. Gambarian (1972) [3] showed that the main component of the success of adaptation to some methods of run is the ratio of the front limb length and the foot length of which the length and height of the jump depends. The shorter is the forelimb, the faster the animal can move its body forward, respectively, the speed of run will be faster. For lope type of run, which is typical for goats, the load to the ankle significantly increases and this contributes to the reducing of the foot length. The role of the vertebral column (body length) is always less important for locomotion.1
In our opinion the degree of adaptation to life in the mountainous landscape is mainly contributed to the ratio of withers height to foot length. In the above table (Table 2) are included: sand gazelle, as a representative of the fast running technique per P.P. Gasparian's classification of form of locomotion (1972) [4], and mountain ungulate species for which the sufficient data is collected allowing to make certain conclusions. According to our calculations, the withers height to foot length ratio increases gradually in a number of species from mountain sheep to mountain goats such as: Bukhara sheep - 2.16; Transcaspian urial - 2.20; Isfahan mouflon - 2.32; Bezoar goat - 2.64; Arabian tahr - 2.78; Markhor - 2.88, which generally corresponds to their natural status, classification by method of locomotion and their systematics. The place that Arabian tahr took in the above row indicates that by its morphometric features it is closest to representatives of genus Capra, although genetic scientists (Ropiquet, Hassanin, 2005) [5] refer it to genus Ammotragus. The absence of any system in the proportions of withers height to body length of mountain ungulates indicates a minor role of body length as a parameter in such studies. This result shows the importance of measurements of morphometric parameters, as in the practice the technologies and methods of management the mountain ungulates in captive depend primarily on the morphometric features and ecological characteristics.
Since the body weight gain, growth of body circumference and horns length in males continue almost to the end of life, it is legitimately to assume the correlation between these parameters. The correlation coefficient between the horns size and the age for males Transcaspian urial is 0.92 ± 0.05, Arabian tahr - 0.75 ± 0.08, markhoor - 0.91 ± 0.09, Nubian goat - 0.87 ± 0 11 (Table 3). However, the horns size of male Arabian tahr can serve as a criterion of age only up to the age of three years, i.e. reaching reproductive age, when the correlation coefficient between the horns size and age reaches 0.87 ± 0.07. The highest correlation coefficient recorded was the correlation coefficient between the trunk girth and weight (0.95), age and body weight of the animal, age and trunk girth, body weight and horns length of studied species of mountain ungulates males (Table 3). Upon reaching the reproductive age the correlation between body weight and age is not observed in all species. This indicates that the groups of Arabian tahr of reproductive age are extremely heterogeneous by the morphometric data. We associate it with a specific population structure (Arabian tahr is solitary and does not live in groups), and with the peculiarities of its breeding strategy, when a male, by selecting a most favorable breeding territory, mark it when in rut and aggressively protects from other bucks. Does, mostly

solitary, easily enter the protected breeding territory, where they are mated by a dominant male. Males not having their breeding territories are in a worse situation that affects their morphometric data.

The results of our work allow concluding as follows:

1. Basic morphometric data for 6 species of mountain ungulates have been collected.
2. Morphometric data and their dynamics in mountain ungulates are similar and reflect their degree of adaptation to the environment and can be used to monitor their populations in habitats, as well as separate groups of species in captive.
3. The ratio of withers height to foot length characterizes the method of running and the degree of adaptation of mountain ungulates species to the irregularity of the terrain.
4. The horns length and trunk girth is highly correlated with the body weight of the mountain ungulates and can serve as a criterion for its evaluation.
5. When the reproductive age is reached males are stratified by their weight parameters, which determine their subsequent social status.

Table 1: *Morphometric data of a number of species of mountain ungulates*

Ungulates type	Body weight (kg)	Withers height (cm)	Circumference of the trunk (cm)	Body Length (cm)	Foot length (cm)
Ovis vignei arcal	62,01 ± 1,67	82,01± 1,90	96,00 ±1,54	68,46 ± 1,26	37,33 ± 0,42
O. v. Bochariensis	44,28 ± 0,74	75,60 ± 1,50	87,12 ± 1,16	65,72 ± 1,10	34,92 ± 0,32
O. orientalis isphahanica	35,67 ± 1,87	74,53 ± 1,91	82,76 ± 0,52	61,28 ± 1,10	32,08 ± 0,46
Capra falconeri heptneri	70,77 ± 3,14	94,1	-	77,69 ± 2,56	32,71 ± 0,27
Capra nubiana	49, 25 ± 1,44	-	-	71,86 ± 1,18	30,11 ± 0,29
Arabitragus jayakari	32,77 ± 2,92	68,25 ± 1,59	78,46 ± 2,82	59,93 ± 2,27	25,29 ± 0,19

Table 2: *Symmetry of morphometric data upon measurements of ungulates*

Ungulates type	Withers height / foot length	Ungulates type	Withers height / foot length
Gazella sugutturosa marica	2,07	Gazella sugutturosa marica	1,28
Ovis vignei bochariensis	2,16	Capra aegagrus	1,28
Ovis vignei arcal	2,20	Capra falconeri heptneri	1,28
Ovis orientalis isphahanica	2,32	Ovis orientalis isphahanica	1,23
Ammotragus lervia	2,48	Ovis vignei arcal	1,20
Capra cylindricornis	2,58	Ammotragus lervia	1,18
Capra aegagrus	2,64	Arabitragus jayakari	1,15
Arabitragus jayakari	2,78	Ovis vignei bochariensis	1,12
Capra falconeri heptneri	2,88	Capra cylindricornis	0,68

Table 3: *Correlation between individual parameters of a number of species of mountain ungulates*

Parameter/species	a · w	w · h	t · w	a · f	a · h	a · t
Arabitragus jayakari	0.83±0.07	0.95±0.04	0.96±0.04	0.54±0.10	0.75±0.08	0.78±0.08
Ovis vignei arcal	0.78±0.09	0.89±0.10	0.95±0.07	0.38±0.19	0.92±0.05	0.86±0.10
Capra falconeri heptneri	0.81±0.13	0.87±0.11	-	0.65±0.17	0.91±0.09	-
Capra nubiana	0.73±0.15	0.90±0.10	-	0.17±0.22	0.87±0.11	-

Parameters: a - age; w - weight; h - the maximum horns length; t - trunk girth; f - foot length.

References

[1] **Danilkin, A.A.** (1999). Deer (Cervidae). M .: GEOS, 1999. 552 p.
[2] **Tsalkin, V.I.** (1951). Mountain sheep of Europe and Asia. Moscow. 344 p.
[3] **Gambarian, P.P.** (1972). Locomotion of mammals. Adaptive features of locomotion organs. Publishing house "Nauka", Leningrad. Dep SH 1 -. 334.
[4] **Gasparyan, K.M.** (1969). Ecology of Bezoar goat and morpho-functional features of locomotion organs of some Bovidae species. Synopsis of a thesis in candidacy for a degree of candidate of biological sciences. Yerevan.
[5] **Ropiquet, A. & A. Hassanin** (2005). Molecular evidence for the polyphyly of the genus Hemitragus (Mammalia, Bovidae). *Molecular Phylogenetics and Evolution,* **36:** 154-168.

Keywords: arabian tahr, morphometry, ungulates in UAE

(poster #41)

Control possibility of corvids in urban environment – a trapping experiment

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Hooded Crows (*Corvus corone cornix* L.) have colonised and spread in many European cities in recent decades. They are often considered a pest due to their noise, spilling litter, aggression to humans and domestic animals, and predation on birds of urban environments. Consequently, the control and/or management of crow populations may become necessary in the future in many cities. The aim of this study was to compare the effectiveness of different trap types in catching crows and other corvids in an urban environment. We experimentally tested four types of traps (Larsen: side and upper door versions, Swedish trap and ladder entrance trap) at the campus of the University of Debrecen (Hungary) during the winter season. As bait, we used bread and live decoy birds. During more than 100 trap-days we caught almost 30 Hooded Crows, 250 Rooks (*Corvus frugilegus*), two Jackdaws (*Corvus monedula*) and two Magpies (*Pica pica*). The results showed that the ladder entrance trap and the side-opening Larsen trap were the most effective. We caught only juvenile Hooded Crows, and both juvenile and adult Rooks, likely related to the wariness of adult crows. We had many recaptures and some trap-happiness crows were experienced. Our study suggests that trapping may be an effective way to catch crows and that some trap types may be more efficient than others. We present detailed guidelines for the construction and operation of these traps, which experience will be important in urban environmental management, and in nature conservation and wildlife management.

Keywords: control, trapping, Corvids, Hooded Crow, Corvus cornix, Rook, Corvus frugilegus, urban environment

(poster #42)

Development of the population of the red fox in Warsaw

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Rapid development of urbanized areas, their expansion and inclusion of green areas into city borders brings consequences for wild-living mammals. Some of the species retreat from highly urbanized areas, the others remain in the city. Urban mammals mostly inhabit relatively natural green areas (i.e. forest complexes located in the outskirts) but some of the species adapted to habitats of higher transformation. Among most common urban carnivores is red fox *Vulpes vulpes*. In the XIX century it started to colonize cities of Great Britain where, as a result, extremely abundant populations were established. On contrary, in Poland, colonisation of urban areas by red foxes took place much later, being the result of a general increase in the species number, mostly due to anty-rabies vaccination implemented in the area of the whole country. Data from the 1970s show that foxes were present only in the outskirts and in bigger forest complexes. Now they may be encountered even in the strict city centre.

The aim of the study was to asses how advance is the process of colonisation of Warsaw, the biggest city and the capital of Poland and what is the current density of the red fox population. To do this three types of data were used: (a) Records of red foxes encountered by city citizens and reported to the City Forests of Warsaw from the years 1998-2015; (b) records of red foxes from the years 2011-2012 (direct and indirect observations) in the whole city divided into 1 km x 1 km grid net. Each grid was systematically searched for any signs of the red fox presence (i.e. tracks, dens, direct observations). We assumed that red foxes would be present mainly in grids located in the outskirts and close to the Vistula River (which can serve as an ecological corridor for the species as it runs through the whole city); (c) results of snow-tracking carried out in 2016. The snow tracking was done on transect routes distributed in various city habitats (i.e. forests, open rural areas, city parks and cementers, residential areas, industrial areas). Total transect route was 190 km, snow-tracking was done in January 2016. Density of red fox was calculated according to Priklonski (1965) method.

According to data from City Forests of Warsaw, the number of red fox records increased from the late 1990s, when only a few cases were reported each year to 86 records in 2015. Points were foxes were seen were distributed across the whole city and its districts. In the subsequent years foxes were recorded in the same distance from the strict city centre. Also, the mean distance from green areas >20 ha and from the Vistula River did not change. Foxes were most often recorded in green areas or in their close neighbourhood.

On contrary to our expectations, presence of red foxes was confirmed in all the grids across the city.

According to snow-tracking current mean density of the species was 1.2 ind./km^2. Nevertheless, it differed among habitats, being the biggest in open areas (mainly rural) and in forests (1.7 and 1.2 ind./km^2, respectively), while markedly lower in more transformed green areas as well as build-up areas.

Our results show that the whole city of Warsaw was already colonized by the species. Nevertheless, density of red fox in Warsaw is still rather low (as compared to other known urban populations) and animals inhabit mostly habitats typical for rural populations of the species. It can be assumed that further process of population development will involve increase in the density and colonization of suboptimal habitats.

Keywords: *Vulpes vulpes*, snow tracking, direct and indirect observations, urban carnivore, density increase

(oral)

"Do nothing" as a disease management strategy for pestivirus infection in Pyrenean Chamois?

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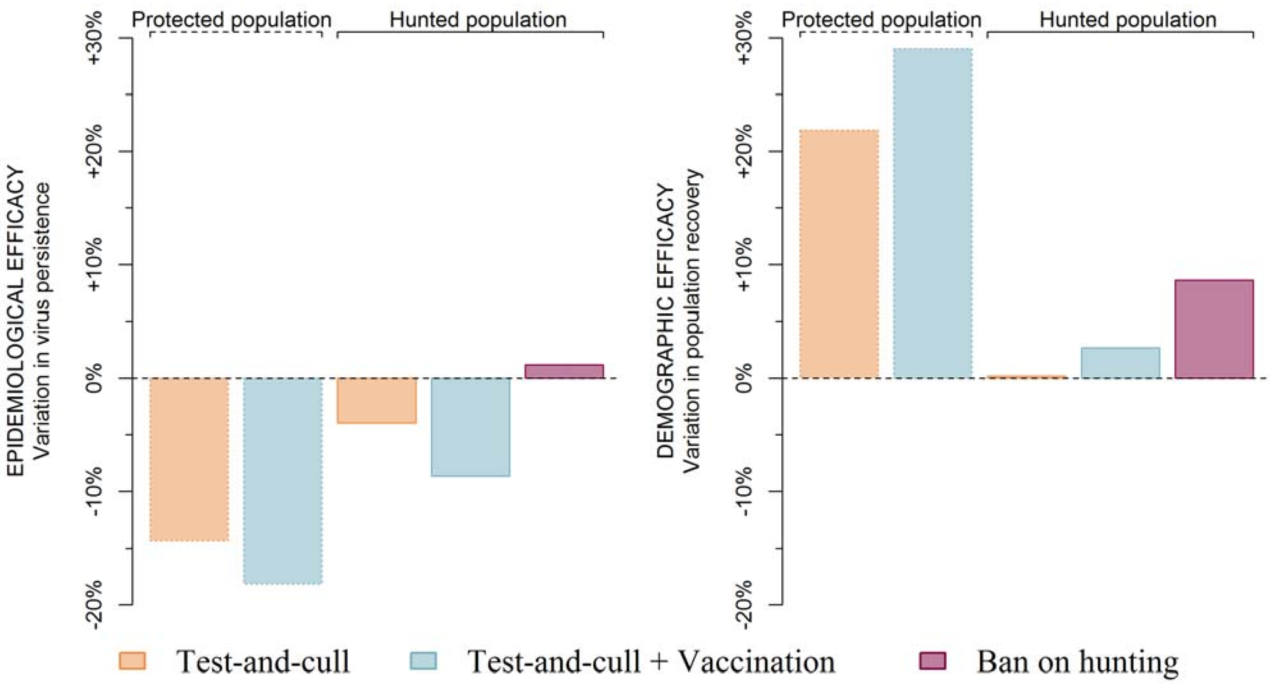
Disease management in wildlife depends on many factors such as the biological and ecological characteristics of the pathogen and host population, which if not accounted for can mitigate the success of management strategies. For instance, the density-dependent response of vital rates to hunting can promote pathogen transmission and therefore interfere with the efficacy of disease management [1]. For this and other reasons like practicality, disease management strategies used in controlled systems (e.g. domestic animals) cannot be directly applied in wildlife. In addition, comparing management strategies under experimental conditions is most often impractical in wildlife populations. Hence, mathematical modelling is a relevant tool to analyse the impact of potential management strategies in wildlife.

Here, we used the case of an emerging disease, pestivirus infection in Pyrenean chamois *Rupicapra pyrenaica pyrenaica*, to determine the influence of biological/ecological characteristics of the host population on the efficacy of management strategies classically used in wildlife. Outbreaks of this virus (Border Disease Virus-4) occurred in the last two decades in several Spanish, Andorran and French populations. These epidemics led to various consequences on host population dynamics: while no impact was detected in some populations, severe population collapses were observed in others, with decreases up to 80% [2]. In this context, wildlife managers are searching for disease management strategies preventing or limiting the impact of the virus on populations.

We developed a stochastic compartmental model adapted from the deterministic model described in [3]. Parameters were calibrated using data from the National Game and Wildlife Reserve of Orlu in the eastern French Pyrenees. We used a realistic framework in terms of population management by contrasting protected populations with no hunting and hunted populations with a harvest rate of 10% of the estimated population size. Three disease management strategies were implemented: selective culling (test-and-cull of infected animals by trapping 30% of the population), selective culling and vaccination, and ban on hunting. The model integrated the main biological and ecological characteristics of Pyrenean chamois populations: density-dependent processes on vital rates, seasonality of the life cycle (mating and birth periods), and time-varying contact structure among age-sex classes due to behavioural changes during mating.

We first demonstrated that the efficacy of selective culling, with or without vaccination, depends on whether the population was hunted or not (Figure 1). The efficacy on both virus persistence and population recovery was much lower in hunted than in protected populations. This is probably related to population size at virus introduction (higher in the protected than in the hunted population) and to the release of density-dependent processes in protected population after the outbreak.

Figure 1: *Epidemiological and demographic efficacy of management strategies compared to the reference scenario without management strategies for two cases: protected vs hunted population. The epidemiological efficacy is evaluated as the time to reach viral extinction in 80% of simulations (compared to the reference scenario); the demographic efficacy is the population size 10 years after virus introduction minus the population size at virus introduction (compared to the reference scenario).*



In a protected population, the most effective strategy was selective culling combined with vaccination, while ban on hunting was the most relevant in terms of population recovery in a hunted population. However, in both cases, the efficacy of these management strategies was quantitatively limited, supporting the idea that the best disease management strategy could be to do nothing. This is an example in which management strategies used in domestic animals, such as test-and-cull, are not as efficient in wildlife because of interactions between biological and ecological characteristics and logistic difficulties in implementing strategies on the field. In the future, the monitoring of infected populations will allow refining our predictions and challenging the prediction that virus dynamics differs between hunted and protected populations.

These results underline the influence of density-dependent processes and management context (protected vs hunted) on the efficacy of disease management strategies. A modelling approach used to predict the effect of management strategies may be of interest for many other emerging or endemic diseases in wild-living species. Indeed, a better knowledge of the interaction between populations and disease dynamics constitute an essential prerequisite to mitigate sanitary and economic consequences of diseases in public health (zoonosis), veterinary health (diseases shared between wildlife and domestic species) and wildlife management / conservation.

References

[1] **Choisy, M. & P. Rohani** (2006). Harvesting can increase severity of wildlife disease epidemics. *Proceedings of the Royal Society B: Biological Sciences*, **273(1597):** 2025-2034.

[2] **Marco, I. *et al.*,** (2015). The two sides of border disease in Pyrenean chamois (*Rupicapra pyrenaica*): silent persistence and population collapse. *Animal Health Research Reviews*, **16(1):** 70-77.

[3] **Beaunée, G. *et al.*,** (2015). A novel epidemiological model to better understand and predict the observed seasonal spread of Pestivirus in Pyrenean chamois populations. *Veterinary Research*, **46:** 86.

Keywords: stochastic epidemiological modelling, Pyrenean chamois, pestivirus, management of infectious diseases, wildlife disease

(oral)

Population Demographics of West Virginia Bobcats using Age-at-Harvest Data

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The Convention on International Trade in Endangered Species: Appendix II requires state agencies affirm stability of bobcat (*Lynx rufus*) populations before granting exportation authority to international markets. The West Virginia Division of Natural Resources (WVDNR) needs current survival and reproductive rates to guide bobcat management decisions. With current harvest rates bordering 2,000 cats per season, access to updated demographic data on the population is critical. Our objectives were to estimate age distribution, recruitment, sex ratios, and survival of West Virginia bobcats. Results will be used by WVDNR to modify their change in population model used to determine harvest limits. Following public outreach, hunters and trappers across West Virginia donated 300 and 224 bobcat carcasses over the 2014–2015 and 2015–2016 harvest seasons, respectively. Lower canines (n_T=524) and female reproductive organs (n_f=260) were collected during necropsy to estimate age at mortality and reproductive success. Ages were estimated by counting cementum annuli of canines, and implantation rates were estimated by placental scar counts. The sex ratios of males to females from both seasons is approximately 1:1 (n_m=264; n_f=260). Young (juvenile [<1 year; 30%] and yearlings [1 year; 27%]) bobcats averaged 47% of the total bobcats collected over the study, with subadults (2–5 years) representing 40% and mature adults (6+ years) representing 12% of the total population. Implantation rates were estimated at 2.74 kittens per mature adult female (n=38), 2.01 kittens per subadult female (n=235), and 0.51 kittens per yearling female (n=144) averaged over both seasons. Survival for the population was estimated using a modified catch-curve model that accounts for biases in the data when using age-at-mortality data. Juvenile bobcat survival rate was estimated to be 0.83 ($\pm$ 0.19), while yearling survival was 0.77 ($\pm$ 0.19) and 2+ year olds had a survival rate of 0.68 ($\pm$ 0.06). Population growth rate was assumed to remain constant between age classes in the model, while capture probability for juveniles to yearlings was set at 50% - the rate of release as reported by trappers in WV in a survey provided by WVDNR. Accurate demographic statistics, along with density estimates, will provide WVDNR with the necessary data to ensure sustainable harvest of bobcats in West Virginia.

Keywords: bobcat, *Lynx rufus*, survival, population demography, reproduction, harvest management

(plenary)

To be or not to be a sustainable game: a demographer's point-of- view

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Hunting regulation strongly vary among game species and populations. Some of these regulations stem from the concerned country's history and traditions, some other ones are more directly related to the species traits. I review here how demographic traits are a major determinant of the sustainability of hunting of any game. In fact, the harvest of a population by hunting, as well as through incidental human-induced mortality, can be viewed as a tax on a capital, the population submitted to harvest. The primary factor for sustainability is thus the maximum (or intrinsic) population growth rate, i.e. the interest rate of the capital. The intrinsic growth rate is in a narrow inverse relationship with generation time. As the latter is much easier to estimate than the former, generation time appears the most straightforward and relevant demographic trait to be taken into account in determining the sustainability of any hunting regime. A number of secondary factors play a role: amount of incidental mortality, species-habitat relationships and dependence on specific habitats. Another determinant of hunting sustainability is the possibility of compensation. Heterogeneity in reproductive values of the various segments in the population – defined as their relative contributions to the growth rate- are the major determinant of compensation, contrary to the common belief that density-dependence is the prevailing compensatory mechanism. The various demographic concepts presented are illustrated through examples. In conclusion, several general principles deduced from demography that should back hunting regulations are drawn.

(oral)

Adaptive Harvest Management (AHM) of waterbirds in the context of the EU Birds Directive

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The Birds Directive establishes a general system of protection for all wild birds in the EU. By way of exception, species listed in annex II of the directive may be hunted. However, this hunting must not jeopardize conservation efforts for those species and must comply with the principle of "wise use" and ecologically balanced control (art. 7). To help the Member States fulfilling those EU legal obligations, the European Commission (EC) has launched in 2001 a "*sustainable hunting initiative*" leading to an "*agreement on sustainable hunting*" in 2004 between FACE and Birdlife International, and it published an "*EC guide to sustainable hunting under the Birds directive*" in 2008.
Amongst the species which can be hunted, certain species, according to the national reporting under art. 12 of the Birds Directive, are showing population declines. Furthermore, the last reporting exercise has shown that, amongst the species that are huntable, the share of species that has declining populations is increasing. On the other hand, certain species, huntable or not, are causing conflicts with human activities, linked to their increasing populations (e.g.: Cormorants, certain Geese, etc).
In that context, the *EC guide on sustainable hunting under the Birds directive* intends to clarify the possibilities offered by the EU legal framework to address those dynamics, both for declining species (ensuring a sustainable hunting under art. 7) or for increasing species (using the derogation regime under art. 9).
For declining species, the *EU guide on sustainable hunting under the Birds directive* invites the Member States to consider a temporary ban of hunting (e.g. moratorium) or to take actions which ensure securing their status, e.g. through implementing *EU Management plans for huntable bird species considered to be in unfavorable status*, such as the ones elaborated by the EC for the 13 huntable species.
For species with increasing populations that are causing conflicts, the *EU guide on sustainable hunting under the Birds directive* clarifies the conditions under which Member States can use the flexibility offered by the derogation regime under art. 9 of the Birds Directive.
However, neither the Birds Directive itself nor the *EC guide on sustainable hunting under the Birds directive*, provides a mechanism for coordinated, science-based harvesting management to address the legal requirements of sustainable management and wise use of populations of waterbirds. In that context, AHM can be a tool helping EU Member States to fulfill their obligation of sustainable hunting, in particular when it comes to implement concretely the aforementioned management plans.
Considering that the status and trends of EU birds species also depends on harvest and management outside the EU, the European Commission sees the AHM approach as an opportunity to ensure a consistent approach due to its work at flyway level, taking the entire populations into account. AHM should help ensuring that the conservation efforts taken in the EU are not jeopardized by counterproductive actions taken outside the EU.
AHM can also be an opportunity to ensure a sustainable management of certain sub-species or sub-populations of huntable species which show declining populations (e.g. the Taïga Bean goose).
Finally, the fact that the AHM approach requires data and monitoring, often on an annual basis, fosters a better knowledge and reliable data in the EU for those species. This also helps understanding the effects of harvest on those species which then allows taking the appropriate actions accordingly, in order to take those impacts into account, in an iterative manner.
As long as all the EU legal requirements are fulfilled, the European Commission therefore considers the approach of AHM as an iterative tool helping maintaining the populations at a satisfactory level while ensuring a sustainable hunting across the EU. The fact that this work is carried out at flyway level and based on scientific data, ensures that entire populations and their dynamics are properly taken into account. This is crucial to meet EU obligations in the EU Member States, while ensuring optimal cooperation and coordination with the other Range States.
The European Commission supports the current work and developments at international level such as the *European Goose management platform* (EGMP) coordinated by AEWA. The European Commission also provides funds to the AEWA Secretariat for this work and participates in related meetings. In order to help the AEWA Secretariat and partners to gather reliable data, the next national reporting exercise under art. 12 of the Birds Directive will require hunting bags statistics, which is crucial to ensure a sustainable harvest of waterbirds.

To conclude, the European Commission believes that AHM can be a tool to assist EU Member States in meeting their obligations under the EU Birds Directive and an interesting approach to face dynamics of waterbirds.

(oral)

Joint modelling of data from multiples sources: an application to abundance indexes of woodcock wintering in France

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Assessing changes in population size and distribution is of main concern for evaluating species status. To do so, several monitoring programs are often involved at the same time and over the same study area by different institutions, e.g. research teams and non-governmental organizations. Such multiple sources of data are becoming more and more frequent with the development of citizen sciences.

In spite of the fact that the objectives pursued by the institutions can be the same, each dataset is usually analysed on their own. Actually, it is the easiest way to account for the fact that datasets have been collected with different protocols. However, a statistical modelling approach can be use to account for the differences in the kind of data collected. Combining a couple of datasets into one will increase much the sample size and thus the statistical power.

In France, two different surveys on wintering woodcock abundance are involved at the same time and over the entire country. The first one consists in counts of woodcock seen at night during ringing sessions (NAI: night abundance index - *Réseau Bécasse ONCFS/FNC/FDC*) while the second one consists in counts of woodcock seen the day during hunting sessions (HAI: hunting abundance index – *Club National des Bécassiers*). The aim of this study is to combine both datasets in the same analysis accounting for the differences in the type of data collected as well as their distribution in space and time. It leads to the estimation of a new abundance index reflecting the information available in both datasets at the country scale, the wintering woodcock abundance index.

We show how much merging different sources of data can improve the accuracy of the estimates by compensating the weakness of each survey. We also point out the importance to account for the distribution of the data collected in space and time to provide reliable abundance indexes. This study provides the methodological basis for further work that will be conducted on population trends and changes in the wintering range of woodcock since 10 years in France.

Keywords: Citizen sciences, spatio-temporal modelling, species distribution, woodcock relative abundance

(oral)

Impact of an outbreak of RHDV2 on a semi-natural population of European rabbits in France

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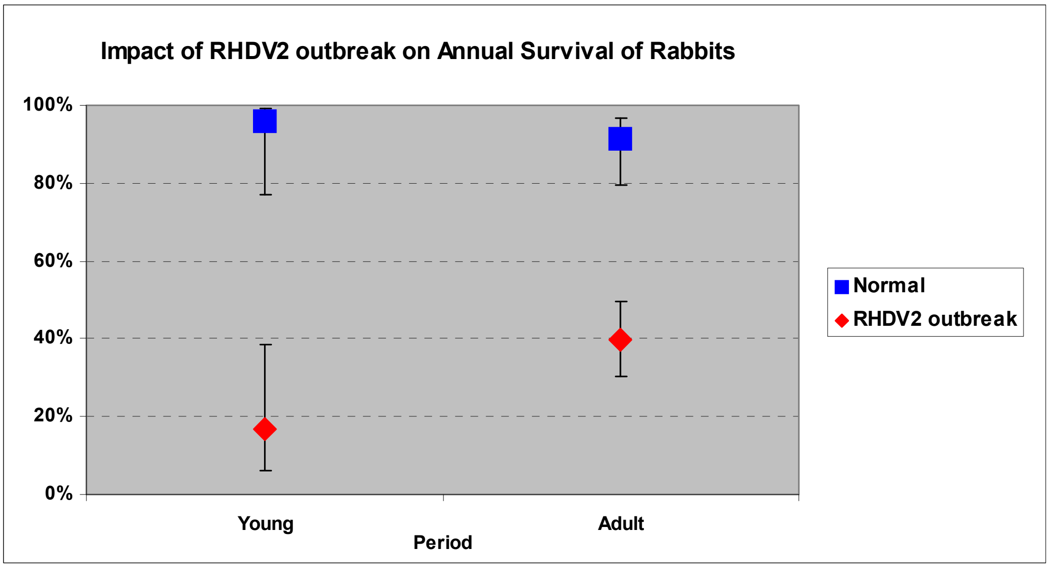
Rabbit hemorrhagic disease (RHD) is one of the several possible causes of decline of wild rabbit (*Oryctolagus cuniculus*) populations in Europe. A new genotype of the RHD virus (RHDV), called RHDV2, has emerged in 2010 and is a new threat to previously weakened populations as this virus can infect individuals immunized against classical strains of RHDV. We assessed the demographic impact of a RHDV2 outbreak that occurred in a semi-natural wild rabbit population in a 0.2 ha enclosure. Rabbits were marked with RFID microchip and monitored by automatic detections of individuals. We assessed survival rates of individuals by multi-event capture-recapture modelling. Although rabbits were regularly vaccinated against RHDV, at least two cases of mortality due to RHDV2 were recorded in spring 2011 (an adult and a 1-month-old young). Whereas, all age classes taken together, the seasonal survival (3 month period) usually fluctuated above 80%, it dropped from autumn 2011 and fluctuated, with a temporary increase, between 50% and 90% until early 2013. This prolonged drop in rabbit survival was attributed to a RHDV2 outbreak which apparently lasted nearly 2 years. When analysing the annual survival, the model selection revealed that survival depended on year and age class, with an additive effect of sex (females surviving slightly better than males). The best period model distinguished 2011 and 2012, with a lower survival attributable to the outbreak, from the other years. During the outbreak, annual survival fell around 17% in 2-4 month old juveniles and 40% in adults (figure 1). Model selection also discarded both a permanent effect of primary vaccination and a temporary effect of recent vaccination. Thus, RHDV2 seems to escape vaccination against classical strains of RHDV and to equally affect vaccinated individuals. A new vaccine, effective against RHDV2, has now been developed. Finally, around 15% of the 70 adults known alive before the RHDV2 outbreak were still alive after its end. Overall, the mortality due to a prolonged outbreak of RHDV2 seems equivalent to the mortality caused by previous classical RHDV strains.

Figure 1: *Estimated annual survival rates of wild rabbits according to age (adult or 2-4 month old juveniles) and period (normal or RHDV2 outbreak).*



Keywords: epidemiology, survival, European rabbit, rabbit hemorrhagic disease, outbreak, vaccination

(oral)

Exploring predator-prey relationship through experimental reduction of red fox and its effect on brown hare population dynamics

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Predation may be a significant limiting factor for game population dynamics. In particular, red fox predation is often suspected to have a significant impact on brown hare demography.

We have assessed this impact by performing an experimental reduction of red fox abundance following a crossed control impact design on two adjacent and similar areas in eastern France, Sarce (213 km²) and Barrois (235 km²), during 6 years. From 2006 to 2008, intense red fox culling was applied in Barrois and basal culling in Sarce, and conversely from 2009 to 2011. Each spring, we assessed red fox and brown hare population densities by distance sampling, and red fox culling rate and brown hare recruitment rate from hunting bag data. Intense culling revealed three-fold higher than basal culling. And, from similar initial red fox densities in Barrois (0.7 fox/km²) and Sarce (0.8 fox/km²), intense culling during 3 consecutive years induced a decrease in red fox density of around 50% in both areas [1]. This resulted in significant changes in predator-prey breeding densities ratio in both areas (figure 1). As a whole, in the course of the study, red fox density fluctuated between 0.24 and 1.01 fox/km², whereas on average brown hare density remained always lower in Barrois (between 6.5 and 9.6 hares/km²) than in Sarce (between 13.3 and 24.7 hares/km²).

We investigated brown hare demography via both the percentage of young in hunting bag data (as a proxy for recruitment) and the annual realized growth rate of brown hare. We performed general linear modeling to assess the effect on brown hare demography of (i) red fox culling and (ii) red fox demography, respectively.

Culling of red fox positively affected the recruitment rate of brown hare likely through a better survival of young hares, but it was also modulated by basal density of brown hare, suggesting intrinsic mechanism occurring inside brown hare population. Indeed, the proportion of young hares in the hunting bag, that was known to be usually higher in Sarce than in Barrois, became higher in Barrois during the period of fox reduction. And this trend was reversed later when fox reduction was applied in Sarce (figure 2).

When investigating the effect of red fox demography on the growth rate of brown hare, we found a negative effect of both density of red fox and predator-prey ratio (consistent with the predator-prey relationship). But, there was also a positive interaction between density of brown hare and predator-prey ratio indicating that the negative effect of the predator-prey ratio was stronger when the density of brown hare was lower.

Finally, our study reveals the existence of intricate interactions between demographic parameters of brown hare and red fox that play on brown hare population dynamics.

__Figure 1:__ Evolution over time of the breeding densities ratio between red fox and brown hare (number of fox per hare) in Barrois and Sarce in relation to the period of red fox culling (from 2006 to 2008 in Barrois, and from 2009 to 2011 in Sarce).

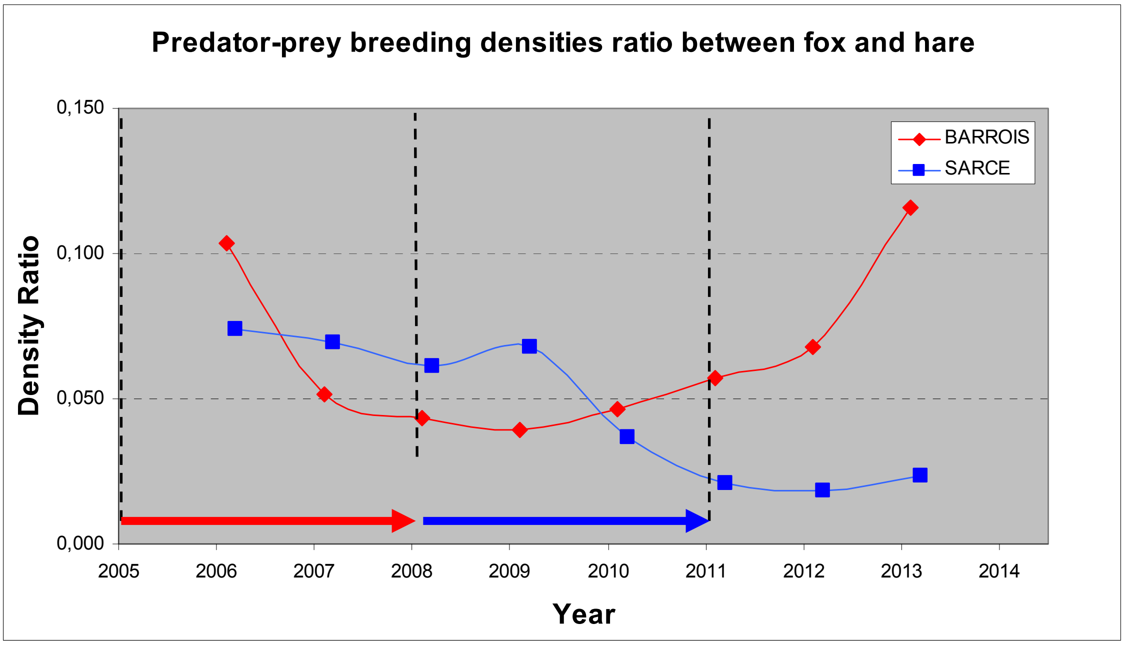
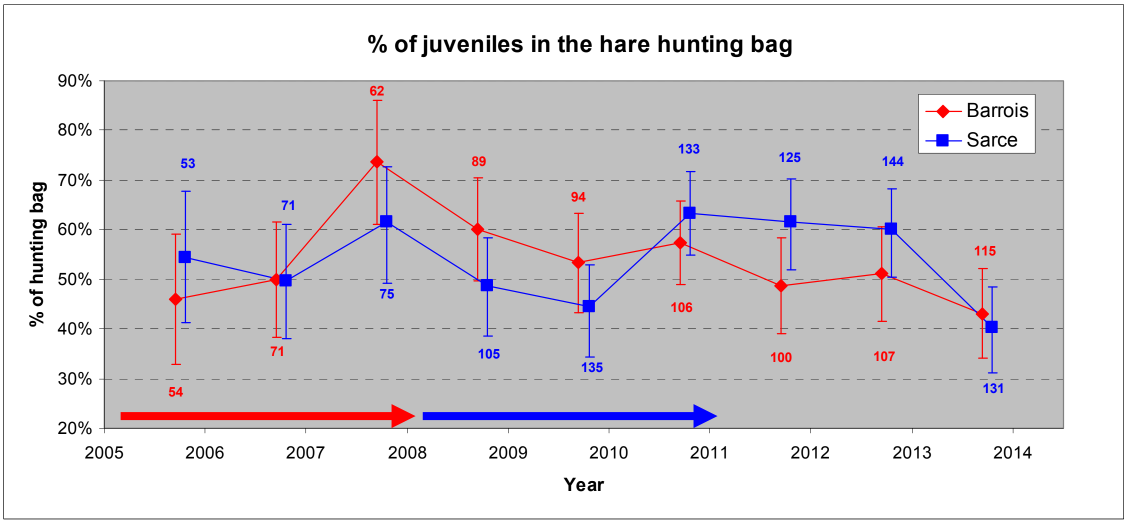


__Figure 2:__ Evolution over time of the percentage of young in the brown hare hunting bag in Barrois and Sarce (confidence interval and sample size are indicated in the figure) in relation to the period of red fox culling (from 2006 to 2008 in Barrois, and from 2009 to 2011 in Sarce).



References

[1] **Lieury, N., S. Ruette, S. Devillard, M. Albaret, F. Drouyer, B. Baudoux & A. Millon** (2015). Compensatory immigration challenges predator control: an experimental evidence-based approach improves management. *The Journal of Wildlife Management,* **79:** 425-434.

Keywords: predator-prey relationship, red fox, brown hare, population dynamics, before–after control-impact, wildlife management

(keynote)

Coexistence between wildlife and humans: contrasting insights from wildlife management and conservation biology

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As we move into the 21st century and the Anthropocene it is becoming increasingly urgent to find ways to conserve the planet's wildlife. The popular discourses about wildlife conservation are all too often focused on endangerment, decline and extinction, or on human-wildlife conflicts in areas where wildlife persists. The relatively new discipline of conservation biology is widely viewed as that which is best poised to assist global wildlife conservation endeavors, but there is a high degree of frustration within the discipline at the challenges associated with moving form study and theory to implementation and action. In contrast, the discipline of wildlife management has existed for more than a century. During this time, wildlife management has delivered substantial action on the ground, for example through promoting the dramatic recovery and restoration of the game species (e.g. ungulates) valued by hunters across Europe and North America. In this talk I will compare and contrast these two disciplines, and examine their strengths and limitations at delivering on the conservation of wildlife (using wild ungulates and large carnivores as cases). The central thesis being advanced is that while neither discipline can achieve success on its own, both disciplines have very complimentary elements that when combined can potentially allow conservation to make great advances. However, to avail of these synergies, there are several major barriers that need to be overcome.

(oral)

An Integrated Method for Evaluating Density of Roe Deer Based on Camera Trapping and Capture-Mark-Recapture in a Forested Area of High Mountain

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We performed an experimental survey of roe deer (*Capreolus capreolus*) in the Chepino Game Hunting Station (Southwestern Bulgaria) in spring 2014 using a camera-trap network. We established a network with a density of one camera per 2 ha of forest. Traps remained activated for five days in one sampling plot of 80 ha. Camera traps triggered by animal movements were set to take successive pictures with tensecond time lapses. Camera trap records were examined by three independent groups of researchers and allowed for a very high rate of individual recognition (up to 82% of individuals pictured were classified by sex and age class). We identified a minimum of 29 roe deer individuals corresponding to a density of 36 individuals/km2 , with a male/female ratio of 0.71, and a fawn/doe ratio of 1.33. This density was surprisingly high as compared to the known Bulgarian standards, and indicated a good conservative management of the roe deer population in the Chepino Region. Further, our estimates were confirmed by performing a capture-mark-recapture study of roe antlered bucks which were easy recognisable. We found a detection probability of 0.91 and a population density of 36.25 deer/km2 . Therefore, camera networks could be used as a reliable monitoring method to estimate roe deer population density and to get a reliable population structure in areas where alternative monitoring methods are not possible or are too expensive. We recommend this method to be adopted by game reserves in Bulgaria in order to improve knowledge about roe deer population demography and for improving the management of its populations.

Keywords: Population estimate, camera-trapping, roe deer, reliability, capture-mark-recapture, Bulgaria

(oral)

Generalized Structural Equations improve sexual-selection analyses

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Sexual selection is an intense evolutionary force, which operates through competition for the access to breeding resources. In lek breeding, selective pressure is maximal, because large numbers of males and females congregate in small arenas, copulatory success is highly asymmetric, and few males are able to sire most females. Two main hypotheses were proposed to explain this asymmetry: “female choice” and “male dominance”.
The literature reports contrasting results. This variability may reflect actual differences among studied populations, but it may also be generated by methodological differences and statistical shortcomings in data analysis. A review of the statistical methods used so far in lek studies, shows a prevalence of Linear Models (LM) and Generalized Linear Models (GLM) which may be affected by problems in inferring cause-effect relationships; multi-collinearity among explanatory variables and erroneous handling of non-normal and non-continuous distributions of the response variable.
We used a dataset on lekking fallow deer (Dama dama), to contrast the methods and procedures employed so far, and we propose a novel approach based on Generalized Structural Equations Modelling (GSEMs). GSEMs combine the power and flexibility of both SEM and GLM in a unified modeling framework.
We showed that LMs fail to identify several important predictors of male copulatory success and yields very imprecise parameter estimates, GLMs improved the analysis, but GSEMs provided better results, because the use of latent variables decreases the impact of measurement errors. Using GSEMs, we were able to test contrasting work hypotheses and calculate both direct and indirect effects, and we reached a high precision of the estimates, which implies a high predictive ability.
In synthesis, we recommend the use of GSEMs in studies on lekking behaviour, and we provide guidelines to implement these models.

Keywords: Generalized Structural Equation Model, statistics, comparative analysis, evolutionary biology, ecology, Fallow Deer, ungulates

(oral)

Ecology of the European hare in a farmland area of Northern Italy

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Since the mid 1960s, the number of European hares *Lepus europaeus* in Italy declined, as well as in the whole Europe, possibly because of habitat changes, agriculture intensification, urbanization, and diseases [1]. The present work describes several aspects of the ecology of a wild population of European hare in a farmland area of Northern Italy: population dynamics, habitat selection, survival and mortality. The study was carried out in the province of Piacenza, in a protected area ("Borgonovo Val Tidone", 909 hectares) dominated by arable lands (about 85% of the total surface). Hare density at the study site has estimated since 2012 by spotlight counts, carried out each year in late winter, when the detectability of hares is highest, and by Distance Sampling [2]. Radio telemetry has used to follow the fate of 39 hares (35 adults and 4 juveniles) since January 2015. A kernel analysis was used to produce home-range estimates. We analyzed habitat selection of Johnson's second and third order [3] using permutation based combination of sign tests by the R package "phuassess" [4, 5]. Moreover we analyzed habitat selection for resting places comparing micro-habitat characteristics of forms to those of an equal number of random points selected in the same habitat types. We tested for the differences between forms and controls by The Wilcoxon test and by a Conditional Logistic Regression Analysis (CLRA). Survival was calculated using the Kaplan-Meier function, and the Mantel-Cox test was used to detect the existence of differences between sexes. Cox regression was used to individuate the factors affecting the death probability of hares.
The best detection function was the hazard rate (AIC=4137.98, ESW=97.2, CV=4.3); pre-reproductive density declined over the study period, halving from 2012 (37 hares per Km^2, SE=0.5) to 2016 (17 hares per Km^2, SE=0.5). At the second order of selection the habitat use was significantly different from a random one (P=0.0001); in particular alfalfa, and unpaved roads were selected while fallows and ploughed fields were avoided. Also at the third order of selection habitat use was significantly different from a random one (P=0.0003); urban areas and unpaved roads were significantly avoided, while the other habitats were used as available. Hares showed a preference for cover at their resting places throughout the year, selecting fields in the good season, and hedgerows in the limiting one, when open fields are characterized by little or no vegetation, and do not offer an adequate cover. The forms in respect to the control points were characterized by a greater cover of the scrub layer, higher herbaceous layer, and higher vegetation. The CLRA showed a positive and significant effect of the height of the dominant herbaceous species on the form probability and a negative one of the brightness (Table 1). Average survival of radio-tagged hares was of over 300 days, which is among the highest values recorded for the species. We did not detect differences between males and females (Mantel-Cox test, P = 0.72) (Fig. 1). Eighteen hares survived over 250 days. Among mortality causes, we found both poaching and predation, but, in the majority of cases, the advanced state of decomposition of carcasses did not allow us to determine the cause of death. The Cox regression showed positive effects on death probability of the percentage of alfalfa and maize in the home-ranges and a negative effect of the home-range size (Table 2). The low number of juveniles captured, together with the high survival rate of adults, lead us to hypothesize that the decline of this population may be due to a high juvenile mortality, which determines a low recruitment rate. The loss of cover habitats could further contribute to the decline of populations living in intensively cultivated areas.

***Table 1:** Results of the Conditional Logistic Regression Analysis of resting places vs. controls*

Micro-habitat variables	B (SE)	Wald	P	Exp (B)
Grass cover (%)	-0,06 (0,02)	7,03	0,008	0,94
Grass height (cm)	0,18 (0,05)	10,26	0,001	1,18
Brightness (lux)	-2,51 (0,72)	12,14	<0,0001	0,08
Chi-square = 29,96 df = 3 P<0,0001				

Fig. 1: Survival functions for males (green; 322 days) and females (blue; 351 days)

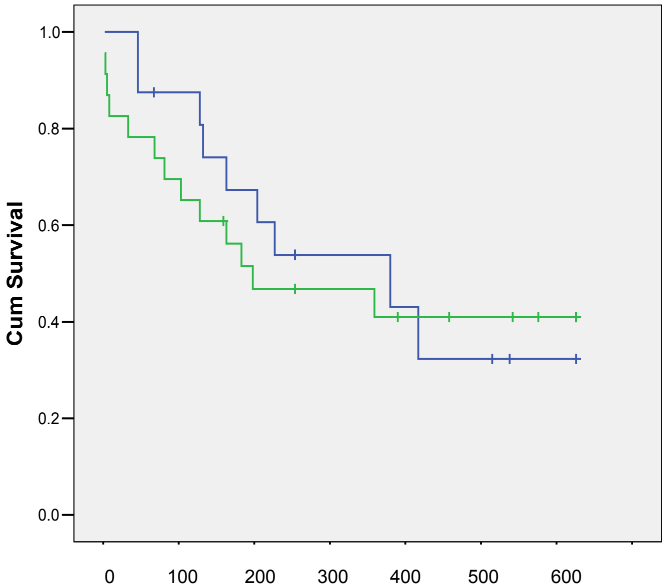

Table 2: *Results of the Cox Regression Analysis for death probability of hares vs. home range variables*

Home range variables	B	SE	P
Average distance from capture place (m)	- 0.002	0.007	0.820
Maximum distance from capture place(m)	0.009	0.006	0.100
Home range size	- 0.092	0.046	0.045
Habitat diversity	-1.335	2.872	0.640
Hedgerows (%)	0.465	0.406	0.250
Winter cereals (%)	0.041	0.067	0.540
Sunflowers (%)	0.032	0.068	0.640
Alfalfa (%)	0.262	0.106	0.014
Mais (%)	0.129	0.053	0.015
Chi-square = 26.82, df = 9, P < 0.001			

References

[1] **Smith R.K., N.V. Jennings & S. Harris** (2005). A quantitative analysis of the abundance and demography of European hares Lepus europaeus in relation to habitat type, intensity of agriculture and climate. *Mammal Review,* **35:** 1–24.

[2] **Thomas L., S.T. Buckland & E.A. Rexstad** (2010). Distance software: design and analysis of distance sampling surveys for estimating population size. *Journal of Applied Ecology,* **47:** 5–14.

[3] **Johnson D.H.** (1980). The comparison of usage and availability measurements for evaluating resource preference. *Ecology,* **61:** 65-71

[4] **Fattorini, L., C. Pisani, F. Riga & M. Zaccaroni** (2014). A permutation-based combination of sign tests for assessing habitat selection. *Environmental Ecological Statistics,* **21:** 161-187.

[5] **Fattorini, L., C. Pisani, F. Riga & M. Zaccaroni** (in press). The R package "phuassess" for assessing habitat selection using permutation-based combination of sign tests. *Mammalian Biology*

Keywords: Agriculture, habitat selection, home range, *Lepus europaeus*, survival

(oral)

Assessing the sustainability of European Turtle-dove (*Streptopelia turtur*) hunting along the European western flyway

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The implementation of relevant guidelines for management of wild animal species exploited by man requires an initial assessment of whether current exploitation generates additional mortality and whether populations are able to sustain any such additional mortality. To do so, using the maximum population growth rate of a population, one can calculate a maximum harvestable population fraction allowed by excess growth and then to compare this value with actual harvest in order to detect eventual overharvest.

Ideally, the estimation of population growth rate should rely upon models combining a set of demographic data such as age specific survival rates, productivity, age at 1st breeding, sex-ratio. However, for many bird species, demographic data are often unavailable or limited in their temporal and geographic scope. In order to identify overharvested bird populations from incomplete data, an alternative approach was developed by [1] (Demographic Invariant Method - DIM) in which the maximal growth rate (λ_{max}) that a population can theoretically achieve in optimal conditions requires only adult survival rate and age at first breeding.

The European Turtle-dove, *Streptopelia turtur*, is an example of a widely hunted species for which there is limited demographic information. This migratory species has undergone a dramatic population decline in Western Europe and was recently listed as 'Vulnerable' on the IUCN Red list [2]. Changes in agricultural practices and associated degradation of breeding habitats are known to negatively affect breeding performances of this species and ultimately population dynamics [3] but there has been no assessment of the sustainability of current human exploitation of this species, which is hunted in eleven European countries and in some of its sub-Saharan wintering grounds [4]. In accordance with the Birds directive (Art. 7(4), Council Directive 2009/147/EC [5]) which recommends "to ensure that hunting of species does not exceed the range between 'maximum' and 'optimum' sustainable yields", the aim of the present work was therefore to assess the sustainability of current hunting levels in Europe. Most European countries have provided quite recent estimates of national turtle dove breeding population sizes [4], but only limited demographic data are available. We therefore used the DIM method to estimate λ_{max} and then calculated PBR. Finally, we compared the European hunting bag with PBR to detect eventual overharvest.

We focused our analysis on Western Europe, as a recent study has shown turtle doves used distinct migratory flyways, according to their breeding location [6]. The western flyway involves breeding populations from the UK, Germany, Netherlands, Belgium, France and Iberian peninsula, which migrate mainly through France, Spain and Portugal, where large numbers of turtle doves are legally hunted during August and September [4].

The analysis was conducted using the following method: using recent national estimates of breeding population sizes in countries along the western flyway [4] and respective annual rates of change in abundance (multiplicative slope) obtained from national monitoring schemes, we first derived a lower and upper estimation of population size for the year 2016. To this, we added a predicted juvenile population, assuming either low or high productivity rates (1.3 - 2.71 young/pair, respectively [3,7]) Thirdly, we estimated three distinct value of λ_{max} (low, intermediate or high), related to respectively high, medium and low survival rates (range: 0.75 – 0.59). Age at first breeding was set to one year. Having these different parameters, we calculated the maximum harvestable population fraction (PBR) following [8], with PBR **=** $N \times b(\lambda_{max} - 1)$, using different scenarios, from the most conservative (lowest estimates of population size, λ_{max} and productivity) to least conservative (upper estimates for all these parameters). Initially we excluded Italy (breeding population size and hunting bags) from our calculations as this country seems to contribute only marginally to the western flyway [6]. However, we checked the effect of including the northern fraction of the Italian breeding and hunting bag data on our conclusions.

We developed 12 scenarios and associated estimates of PBR, which were compared against the most recent estimates of national hunting bags summed across countries along the western flyway. Results indicated that, when considering the upper estimates of 2016 population size, harvest exceeded PBR in most scenarios (8/12), with proportions ranging from 19 to 74%. Hunting sustainability was detected in only 4 scenarios, considering the most optimistic values (highest productivity rate and medium to high λ_{max}), but with harvest being close to PBR (2 to 10% below). When considering lower estimates of population size, overharvest occurred in all scenarios, with harvest exceeding PBR from 43 to 166%. Overharvest is probably further underestimated as doves hunted in Africa are not taken into account.

Our results suggest that current levels of hunting in Western Europe appear unsustainable. Such approach is only a first step; in particular, it would be relevant to determine the proportion of juveniles in hunting bags as, in a species like turtle dove, the additive character of mortality associated with hunt might be inversely correlated with the proportion of juveniles found in harvests. In the longer term, more reliable annual information on hunting bags, demographic rates and population changes is urgently required from across the breeding range of turtle doves. Implementation of adaptive harvest management for this species will require a step-change in the current level of data collection and constructive collaboration between policy makers, hunting and conservation organisations.

References

[1] **Niel, C. & J.D. Lebreton** (2005). Using demographic invariants to detect overharvested bird populations from incomplete data. *Conservation Biology,* **19(3):** 826–835.

[2] **Birdlife International European Red List of Birds** (2015). Luxembourg: Office for Official Publications of the European communities

[3] **Browne, S.J. & N.J. Aebischer** (2004). Temporal changes in the breeding ecology of European Turtle Doves *Streptopelia turtur* in Britain, and implications for conservation. *Ibis,* **146:** 125–137.

[4] **Fisher, I., J. Ashpole, T. Proud & M. Marsh** (compilers) (2016). Status Report for the European Turtle-dove (*Streptopelia turtur*). Report of Actions A6, 8, 9 and 10 under the framework of Project LIFE EuroSAP (LIFE14 PRE UK 002). RSPB (unpublished report).

[5] **Directive 2009/147/CE** (2009). Directive of the European Parliament and of the Council of 30 november 2009 on the conservation of wild birds.

[6] **Marx, M., F. Korner-Nievergelt & P. Quillfeldt** (2016). Analysis of ring recoveries of European Turtle Doves *Streptopelia turtur* — flyways, migration timing and origin areas of hunted birds. *Acta Ornithologica.* **51:** 55–70.

[7] **Fontoura, A.P. & S. Dias** (1995). Productivity of the Turtle Dove (Streptopelia turtur) in the Northwest of Portugal. Proceedings of the International Union of Game Biologists, XXII Congress “The Game and the Man”, Sofia, Bulgaria, Sept 4-8, 1995.

[8] **Wade, P.R.** (1998). Calculating limits to the allowable human-caused mortality of cetaceans and pinnipeds. *Marine Mammal Science,* **14:** 1-37.

Keywords: “*Streptopelia turtur*”, hunting sustainability, demographic invariant method, Europe

(oral)

Can the restoration of heather habitat mitigate the impact of raptor predation on red grouse?

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Conflicts between wildlife conservation and other human interests are an increasingly global problem. Where gamebirds are of high economic importance, conflict can emerge between gamebird management and raptor conservation, as raptors may reduce the numbers of gamebirds available for hunting [1]. One well-documented example is the conflict between red grouse *Lagopus lagopus scotica* shooting and the conservation of hen harriers *Circus cyaneus* in the uplands of Britain [2]. Despite legal protection, hen harriers are persecuted due to their ability to limit grouse numbers and reduce shooting bags to the extent that shooting becomes uneconomic. Some human-wildlife conflicts can be reduced by habitat modification, e.g. by providing more cover to reduce the risk of predation. Red grouse are found on heather *Calluna vulgaris* moorland. However, during the past decades there has been widespread loss and degradation of heather moorland due to overgrazing and afforestation, which has been associated with long-term declines in grouse numbers [3].
Here, we consider whether increases in heather cover following reduction in sheep grazing may reduce the susceptibility of grouse to raptor predation, and thus increase grouse productivity and survival. After reducing sheep grazing pressure, heather cover increased. Grouse pre-breeding densities were higher in areas with more heather, however, there was no relationship between heather cover and post-breeding densities, productivity, adult summer survival or overwinter survival. Temporal changes in heather cover during the study period were also not associated with changes in grouse productivity or survival. Finally, there was no difference in heather cover between home ranges of radio-tagged grouse relative to whether that grouse had survived the breeding or overwinter period or whether it had died. Our results suggest that there is only limited scope for heather habitat recovery to directly improve grouse productivity or survival.

References

[1] **Valkama, J. et al.** (2005). Birds of prey as limiting factors of gamebird populations in Europe: a review. *Biol Rev,* **80:** 171-203.

[2] **Thirgood, S. & S. Redpath** (2008). Hen harriers and red grouse: science, politics and human-wildlife conflict. *J Appl Ecol,* **45:** 1550-1554.

[3] **Thirgood, S. et al.** (2000). Habitat loss and raptor predation: disentangling long- and short-term causes of red grouse declines. Proc R Soc Lond B, **267:** 651-656.

Keywords: habitat management, conflict resolution, predation, red grouse, raptors

(keynote)

Getting started with adaptive management of migratory waterbirds in Europe: the challenge of multifaceted interests

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The status of migratory waterbird populations in Europe range from endangered to overabundant. For all populations within this spectrum, transboundary and dynamic decision making instruments are required for their effective management and conservation, but decision making is often hampered due to gaps in knowledge or conflicting human interests. Adaptive management (AM) provides a decision making framework precisely designed for situations where there are sources of difficulty in decision making, in particular uncertainty about an ecological system and the impact of management actions and potentially conflicting management objectives. It promotes the participation of stakeholders to agree on clearly defined and measurable objectives, whereby in developing and implementing alternative actions, along with their continued evaluation, stakeholder groups can learn from the process and each other. By gaining better understanding of ecological system dynamics, different social values, desired outcomes and potential risks, stakeholders can work towards the collaborative management of challenging situations. Hence, AM has the potential to embrace different cultural and political viewpoints and values within a democratic and accountable process.

Under the auspices of the Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA), AM has now been introduced in Europe, in the first instance for the Svalbard population of the Pink-footed Goose (Anser brachyrhynchus) and the Taiga Bean Goose (Anser f. fabalis), examples of an overabundant and a threatened species, respectively. Both populations are huntable in parts of their ranges, and an adaptive harvest management framework has been instigated. In case of the Pink-footed Goose, a population target has been internationally agreed, which, on the one hand, serves as a safety net under the population while ensuring a sustainable harvest and, on the other hand, a social compromise to avoid an explosion of the population which will cause serious conflicts with agricultural interests and degradation of vulnerable tundra in Svalbard. The harvest is adjusted annually in an attempt to maintain the population around the target. In case of the Taiga Bean Goose, studies of connectivity have justified that the population is divided into four management units. Population recovery targets have been agreed for each management unit and the recommendation is to adjust harvest levels (which includes a hunting moratorium) according to the status of a given management unit in light of the target. In order to maintain or achieve favourable conservation status, objectives have also been agreed on maintaining the range and the ecological integrity of the populations. This requires that any harvest management action shall not cause a range contraction nor a reduced usage of key habitats in the course of the annual cycle. Furthermore, due to the risk of wounding of birds by shotgun shooting, some stakeholder groups have argued that hunting has to be performed in a way which is socially acceptable, i.e., wounding of geese shall be reduced. In case of Pink-footed Geese, it has been agreed that the rate of wounding shall continuously decrease, despite of an increasing harvest pressure. The apparent conflicting objectives of maintaining a stable population using hunting as a management tool, while ensuring against range and habitat contractions as well as reducing wounding, have been addressed by improved local organization of hunting, tuning of hunting methods and teaming up of hunters. The first results are encouraging, but it is realized that it will require constant awareness, push and adjustments of efforts in order to strike a balance. The willingness of hunters to engage and cooperate in such integrated management is essential to ensure sustainable waterbird populations and maintain hunting opportunities.

(poster #43)

Range expansion of the Raccoon (*Procyon lotor*) in France

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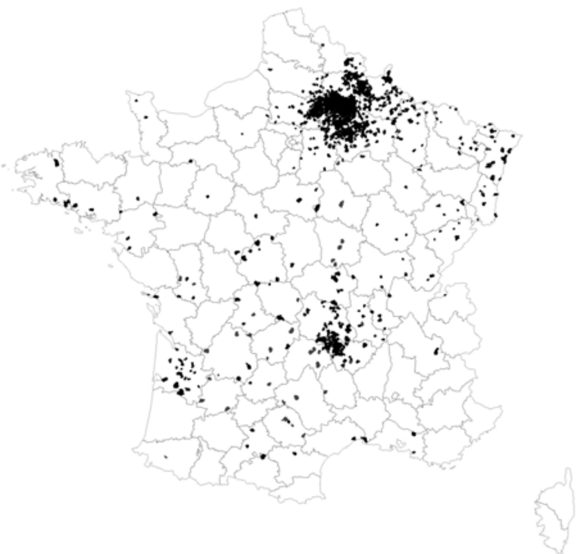
Generally speaking, invasions of non-native mammals are of major concern as they can threaten native biodiversity and may affect economy and human and animal health. Raccoon (*Procyon lotor*) is one of these invasive species in Europe. This species was introduced in different European countries, directly or escaping from animal fur farms. Raccoons are still currently kept in zoos and also by private owners as pet; risk of accidental releases is still great. In France, three main wild populations of raccoons are observed: the oldest one is located in the North of France with a recent contact with animals from Germany due to migration and colonization to neighbouring countries. A second population is observed in the centre of France with dispersion of animals through the Massif Central. A recent wild population seems active (ie with reproduction) near Bordeaux since 2007 with a suspected zoo origin.

Thus, our data confirm the spread of feral raccoons throughout the country. These results claim for a strengthening of captivity conditions in zoos and by private owners (no fur farms are still active). A recent study confirms that multiple introductions, especially of individuals from genetically disparate source populations, may increase invasion success of raccoons through Europe [1].

Recent regulation by the European Union prohibits Raccoon possession by private owners and requires zoos to present a high security system (http://eurlex.europa.eu/legal-content/FR/TXT/?uri=CELEX%3A32014R1143). This regulation also urges EU State members to control invasive populations. In France, trapping and hunting are the main mortality factors for raccoons (with road killing) but seem ineffective to stop their spread. Our poster will present which kind of management actions can be set up in the coming years to halt, or at least slow down, Raccoon progression in France.

Figure 1: *observations of raccoons from 2001 to 2013 in France*



References

[1] **Fischer, M.L., I. Salgado, J. Beninde, R. Klein, A.C. Frantz, M. Heddergott, C.I. Cullingham, C.J. Kyle & A. Hochkirch** (2017). Multiple founder effects are followed by range expansion and admixture during the

invasion process of the Raccoon (*Procyon Lotor*) in Europe. Edited by Brian Leung. Diversity and Distributions.
[2] **Léger, F. & S. Ruette** (2014). Raton Laveur et Chien Viverrin: Le point sur leur répartition en France. *Faune Sauvage,* **302:** 9–16.

Keywords: invasive species, Raccoon (*Procyon lotor*), France, population control, European regulation, national strategy concerning invasive non-native species, management actions

(oral)

Integrating harvested wing data and mark-recapture data for age-specific abundance estimates of Northern Bobwhite populations

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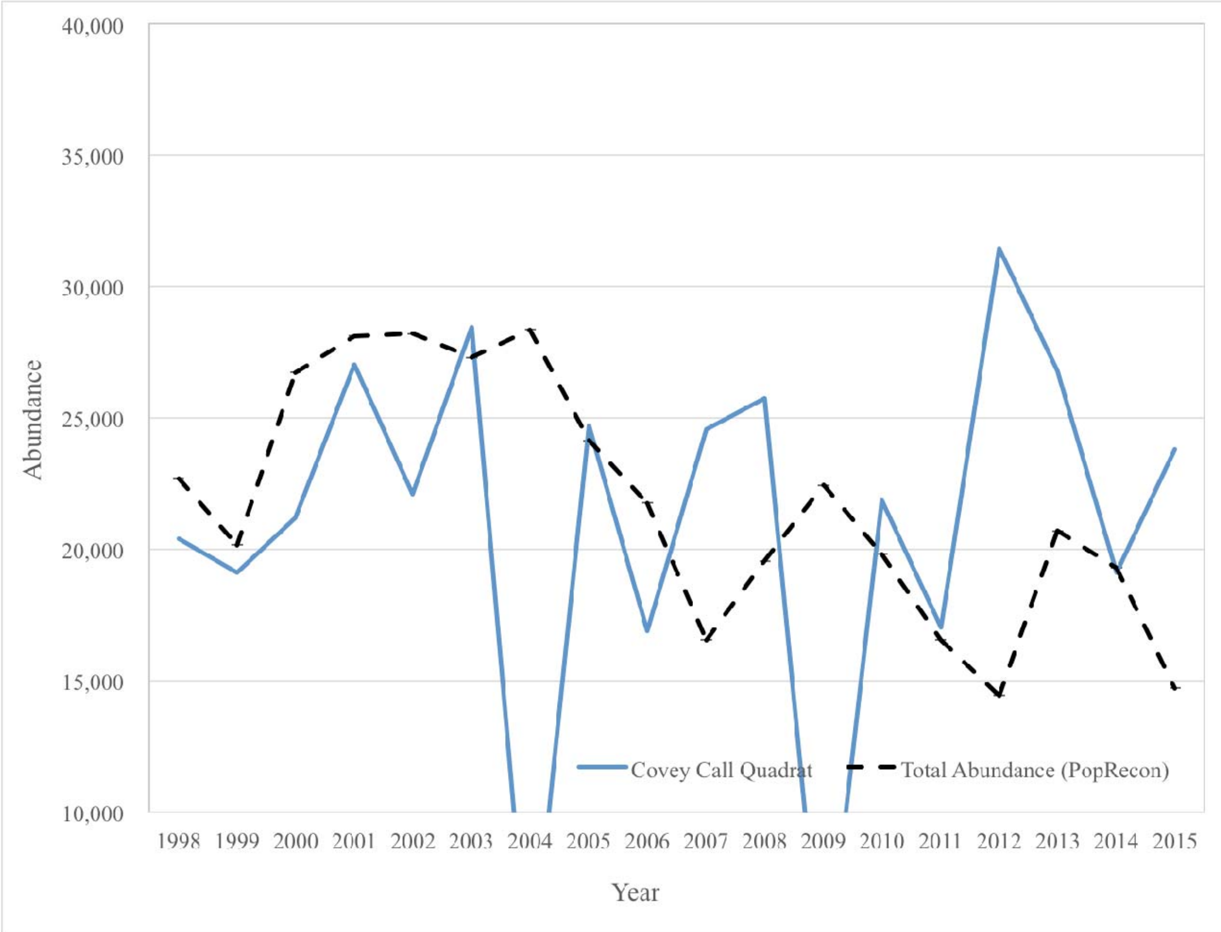
Despite the widespread collection wings from harvested Northern Bobwhite (*Colinus virginianus*) by state wildlife agencies and private entities, age-at-harvest information has been largely underutilized for guiding management decisions for this species. Reliable estimates for annual abundance and uncertainty associated with the estimates are essential for guiding management and conservation decisions, but these data can be impractical or difficult to obtain. Statistical techniques that integrate age-specific count data from harvested wings with other demographic data can provide robust estimates of abundance as well as the uncertainty surrounding the estimates, providing a valuable tool for monitoring trends and the status of bobwhite (and other game bird) populations. These integrated methods involve analysis of a joint likelihood, or the multiplication of the single likelihoods for individual data sets, with one or more common parameters in several components of the likelihood. We evaluated the utility of an integrated, frequentist approach (PopRecon2 software) to reconstruct annual abundance and demographic attributes for a northern bobwhite population in southwest Georgia. Age-specific count data was collected during 1998 – 2016 using collected wings from harvested birds (n = 17,448; n_{annual} = 969 ± 104) Mark-recapture methods during this same time provided additional data on survival. We derived independent estimates of fall abundance from the same site using covey call counts and a standardized measure of hunting success (coveys moved per hour). The integrated model suggested that population change was stable (λ = 1.00; CV = 0.19) compared to moderate population growth (λ = 1.05; CV = 0.29) indicated by the covey call quadrat method. Abundance estimates from the integrated model and covey call counts were moderately correlated (r = 0.48) with only 3 out of 18 years statistically different (Figure 1). Interestingly, abundance estimates from the integrated model and hunting success (coveys moved per hour) was highly correlated (r = 0.86). The integrated model provides valid, conservative abundance estimates for bobwhite age at harvest data and could be a useful tool where age-at-harvest, hunter effort and another source of demographic data are readily available. Given that the collection of harvested wings is simple and low cost, we recommend managers and state agencies consider incorporating this technique into their management program. Bayesian analysis of similar integrated models may provide further utility and will be explored as a future step with this data set. Additionally, the relative utility of different demographic data inputs (mark-recapture, known-fate telemetry data, chicks produced per hen, etc.) to provide precise abundance estimates will also be explored; various data inputs likely influence demographic estimation and precision differently, substantiating the need to further investigate how sensitive these models are to specific demographic data.

Figure 1. Annual abundance estimates for Northern Bobwhites derived from integrated models using PopRecon2 and traditional covey call counts, during 1998 – 2015.



Keywords: age, harvest, *Colinus virginianus*, northern bobwhite, integrated population model, wing data

(poster #44)

Current status, distribution and recovery plan of *Cervus elaphus corsicanus*

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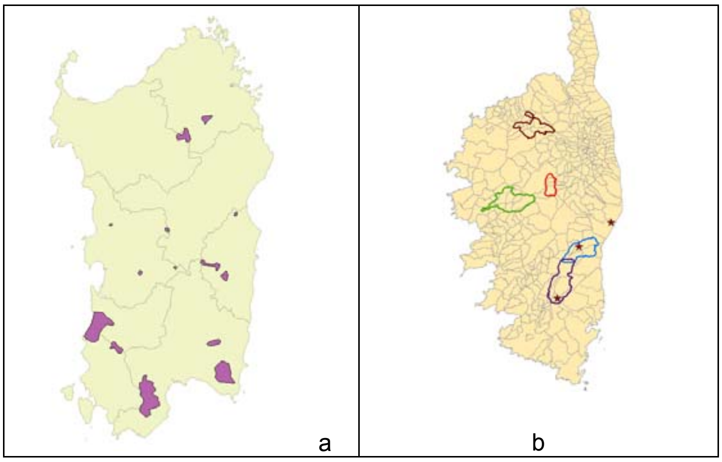
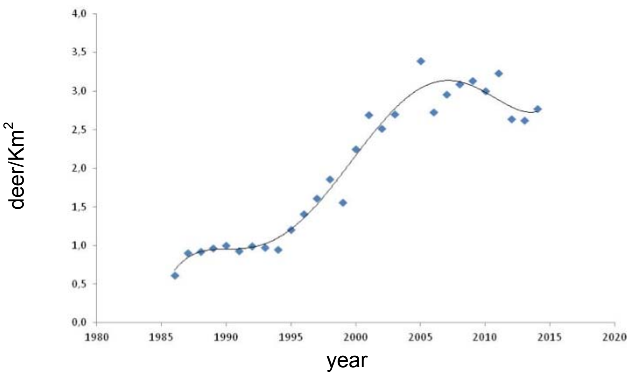
In the past, Corsican red deer (*Cervus elaphus corsinanus*) inhabited all wooded areas of Sardinia and Corse. Its presence is proven since the Nuragic period by numerous bronzes statues depicting deer in various activities, and Historical accounts show that between late 1700s and early 1800s, the species was still abundant on the island and it was highly regarded as hunter prey and for its economic value [1,2]. In fact there's evidence of the trade of living deer, skins and antlers. In a more recent period, however, the condition of *C. e. corsicanus* worsened dramatically, due to many factors acting together: the indiscriminate cutting of the woods, overhunting, fires and the increase of domestic animals breeding. This has led to the fragmentation of the suitable habitat and a remarkable reduction of the population size, two conditions particularly dangerous for the species conservation. After the WWII, in spite of the prohibition of hunting established in 1939, the range of the species was further reduced: The last natural populations of deer in Sardinia were all located in the province of Cagliari (Settefratelli, Sulcis, Costaverde) and the nuclei within these ranges occupied a total area of about 300 square kilometres; in Corse after the band of the deer hunting in 1948, the poaching continued until the complete extinction of the species in the island in 1970 [2,3].
In Sardinia, thanks to the raising awareness campaigns and to conservation actions, in recent years there has been an increase both in the number of individuals and in their distribution (due to reintroduction programs). In Corse, immediately after the extinction, a conservation programme was planned in order to reintroduce deer, bringing founder individuals from Sardinia. The current distribution range of the subspecies is shown in Fig. 1, it originated from the expansion of historical Sardinian populations and reintroduction programs carried out in Sardinia and Corse.
Since 1986, Forestas, the Sardinian forest agency, monitors the status of the historical population counting the roaring stags in the reproductive period (early September)[4,5]: populations rapidly increased from 1995 to 2010, from 2011 to present density values are stable or slightly decreased. In Corse too, the Regional Natural Park carries out annual count of roaring stags.

Figure 1: *Current range of* Cervus elaphus corsicanus: a) *Sardinia and b) Corse, stars are the deer fences.*



In Tab. 1 are reported the estimates of deer numbers in natural and reintroduced population; however, in Sardinia roaring male counts is carried out only in the areas managed by Forestas, not in the whole range of distribution of the species (especially in Costaverde and Sulcis areas).

Figure 2: *- Overall density of the roaring males in historic presence areas and trend line (1986-2014).*



Therefore the actual number of deer inhabiting Sardinia, could be larger than that shown in the table. In fact, estimates of deer population by nocturnal distance sampling performed in Costaverde area (in 2009) and Sulcis (in 2014) resulted in 4.463 and 2.700 deer respectively. In total, the population of *Cervus elaphus corsicanus* is about 7.000 heads in Sardinia and 1.400 in Corse.

Table 1: *estimates of Corsican deer populations by roaring method.*

Region	Area	Year	Total population estimates (n. deer)
Sardinia	Settefratelli	2014	1.025
Sardinia	Sulcis	2014	1.285
Sardinia	Costaverde	2015	470
Sardinia	Montimannu	2015	255
Sardinia	Montelinas	2015	35
Sardinia	Usellus	2016	59
Sardinia	Laconi	2015	65
Sardinia	Neoneli	2016	40
Sardinia	Santu Lussurgiu	2016	55
Sardinia	Mt. Lerno	2015	405
Sardinia	Montarbu	2014	70
Sardinia	Ulassai	2014	85
Sardinia	Mt. Olia	2014	375
Sardinia	Sa Conchedda	2014	115
Corse	Montifau	2015	140
Corse	Venacais	2015	160
Corse	Plaine F-O	2015	150
Corse	Chisà	2015	110
Corse	Vallée de Quenza	2015	400
Corse	Basse Vallée Cuscionu	2015	115
Corse	Gragnu	2015	190
Corse	Letia	2015	130

In 2011 started the program Life+ Nature "One deer, two Island" aimed at the full recovery of this taxon, its priority target are: establishing new wild population in Sardinia, promoting the natural expansion of the deer populations in Sardinia, creating a metapopulation, through ecological corridors identified by models of habitat suitability developed for the Sardinian-Corsican red deer, in order to allow the interconnection between all the populations present in nature; increasing the genetic variability of deer populations inhabiting Corse.

References

[1] **Beccu, E.** (1989). Il Cervo sardo. *Carlo Delfino Editore, Sassari*.

[2] **Kidjo, N., G. Feracci, E. Bideau, G. Gonzalez, C. Mattéi, B. Marchand& S. Aulagnier** (2007). Extirpation and reintroduction of the Corsican red deer *Cervus elaphus corsicanus* in Corse. *Oryx*, **41(4):** 488-494.

[3] **Carnevali, L., L. Pedrotti, F. Riga & S. Toso** (2009). Banca Dati Ungulati: Status, distribuzione, consistenza, gestione e prelievo venatorio delle popolazioni di Ungulati in Italia. Rapporto 2001-2005. *Biol. Cons. Fauna*, **117:** 1-168. [Italian-English text].

[4] **Mazzarone, V., N. Siemoni, P. Pedone, C. Lovari & L. Mattioli** (1991). A method of red deer (*Cervus elaphus* L.) census during the roaring period in a forested area of the northern Apennines (central Italy). ***Proc. 20th Congress of the International Union of Game Biologist* (Godollo, Hungary):** 140-145.

[5] **Ciucci, P., G. Catullo & L. Boitani** (2009). Pitfalls in using roaring stags to index red deer (*Cervus elaphus*) population size. *Wildlife Research*, **36:**126-133.

Keywords: *Cervus elaphus corsicanus*, status, range, reintroductions

(oral)

Life on the Fringe - can grey partridge thrive on a modern farm?

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With intensified farming across more than 9.7 million ha in Alberta the hunting opportunity for farmland game birds has diminished substantively, particularly in the past 40 years. We established a partnership with an irrigated working farm to evaluate approaches for establishing vibrant farmland game bird densities while maintaining a profitable farming operation. Irrigated land is roughly twice the value of dry farmland but also offers unique opportunities for wildlife. Focus is intensified under the pivot but fringe areas along the edge and corners are often underutilized space that can benefit wildlife. We trial habitat treatments and water management practices that aim to increase the breeding density and reproductive success of grey partridge as well as establish a naturalized pheasant population. Early enhancements have focused on creating territorial edge and nesting cover, as well as establishing wetlands around the fringe. The 542 ha farm has 361 ha of irrigated cropland with 13 km of territorial edge to date. Spring partridge pair counts have risen from 10.1 pairs/km^2 in 2014 to 27.9 pairs/km^2 in 2016. Approximately 200 cock pheasants are released annually for shooting in the fall but until 2014 pheasants were not resident on the farm. We began trialling soft release techniques in 2014 to establish a pheasant population. Predator control has not been undertaken to date. We also monitor a range of non-target species to assess the impact of our actions on biodiversity. We will monitor hen survival and reproductive success in the coming years to better understand the interaction between density and predation, and the benefit habitat applications will have on these relationships.

Keywords: farming, grey partridge, habitat creation, wetland, pheasant

(poster #45)

Sociospatial structure explains marked variation in brucellosis seroprevalence in an Alpine ibex population

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In a context of (re)emerging infectious diseases associated with wildlife reservoirs, understanding how animal ecology shapes epidemiology is a key issue [1,2]. Wild ungulates that share similar foraging needs, behaviour and pathogens with domestic herbivores, and whose spatial ecology (e.g. area-restricted space use) and grouping patterns (e.g. sexual and/or social segregation) make disease dynamics in these species particularly complex, are of particular interest in this context [3]. We focused on the first report of persistence of brucellosis *Brucella melitensis*, a virulent zoonosis, in a wild ruminant species (i.e. Alpine ibex *Capra ibex*) and the first report of spillover from wildlife to domestic ruminants and humans that occurred in a mountainous area of high agricultural value from northern French Alps (Bargy massif, [4]). We investigated the relationships between the spatial ecology of Alpine ibex and the epidemiology of brucellosis in this population. Using home range overlap between 37 GPS-collared individuals, we revealed that females were spatially segregated in at least 4 groups all year round, whereas males were more prone to move between female units, in particular during the rutting period. In addition to ibex age, the spatial structure in females largely explained variation in brucellosis seroprevalence in the whole population. These results provide crucial information on the most likely pathways of intraspecific transmission in this ibex population, i.e. non-sexual transmission. Accounting for wildlife spatial ecology was hence decisive in improving our ability to better understand this complex health challenge involving a wildlife reservoir.

Figure 1: Hierarchical classification tree representing the structure in 37 GPS-collared Alpine ibex *Capra ibex* from the Bargy massif based on overlap between annual home ranges as a measure of distance between individuals.

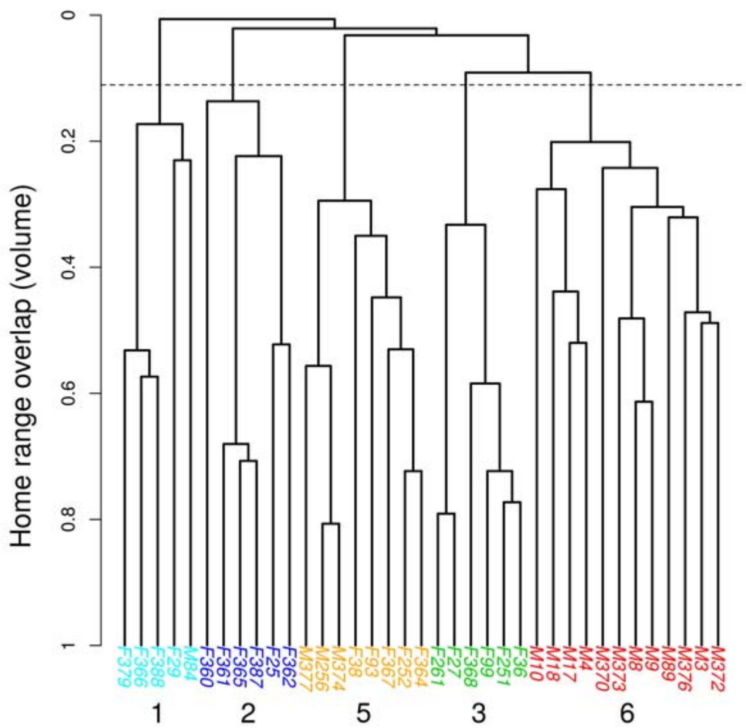


Figure 2: Annual home ranges of GPS-collared Alpine ibex *Capra ibex* (A) females and (B) males from the Bargy massif (northern French Alps). The colors correspond to the different units identified using overlap between annual home ranges as a measure of distance between individuals (see Fig. 1). The black triangle represent the area where we did not equip any female with GPS collars but where some ibex were captured or slaughtered.

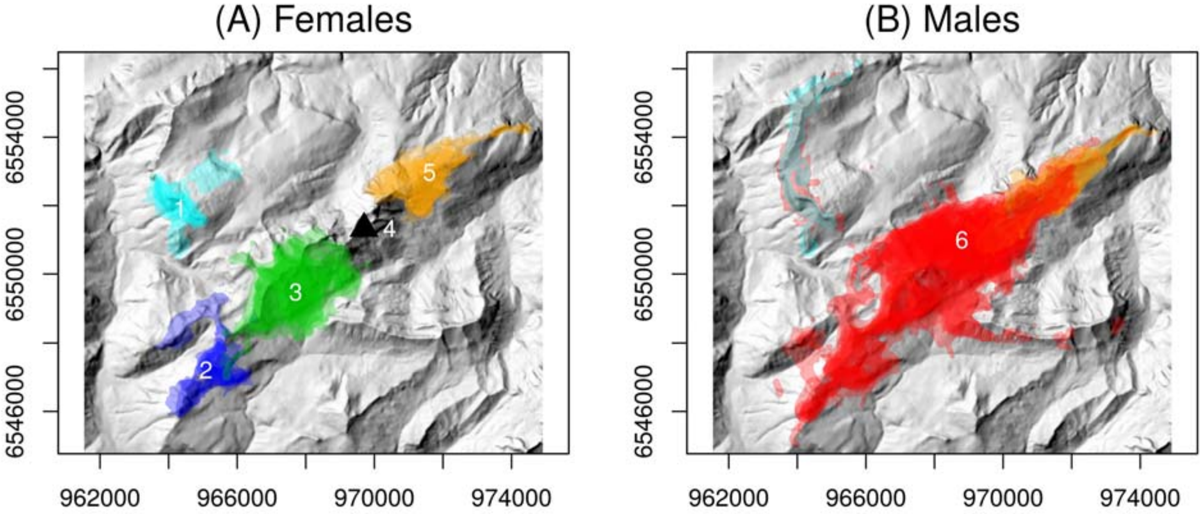
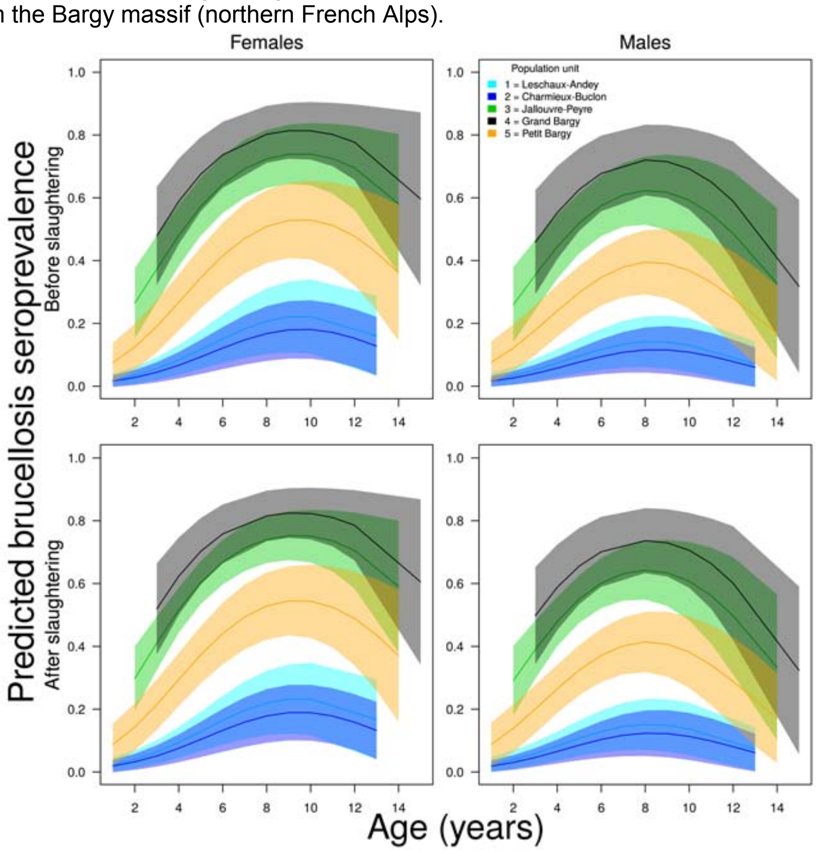


Figure 3: Predictions from the model-averaging procedure investigating the influence of the sociospatial structure identified, gender, age (quadratic term) and slaughtering operations on brucellosis *Brucella melitensis* seroprevalence in the Alpine ibex *Capra ibex* from the Bargy massif (northern French Alps).



References

[1] **Daszak, P., A.A. Cunningham & A.D. Hyatt** (2000). Emerging infectious diseases of wildlife–threats to biodiversity and human health, *Science,* **287:** 443-449.

[2] **Kruse, H., A.M. Kirkemo & K. Handeland** (2004). Wildlife as source of zoonotic infections, *Emerging Infectious Diseases,* **10:** 2067-2072.

[3] **Jolles, A.E. & V.O. Ezenwa** (2015). Ungulates as model systems for the study of disease processes in natural populations, *Journal of Mammalogy,* **96:** 4-15.

[4] **Mick, V., G. Le Carrou, Y. Corde, Y. Game, M. Jay & B. Garin-Bastuji** (2014). *Brucella melitensis* in France: persistence in wildlife and probable spillover from Alpine ibex to domestic animals, *Plos One,* **9:**1-9.

Keywords: *Brucella melitensis*; Capra ibex; spatial segregation; space use; GPS collars; wildlife reservoir.

(poster #46)

Spread of RHDV2 in rabbit and hare populations in France. Evidence for frequent species jumps

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Rabbit haemorrhagic disease (RHD) is a highly infectious and fatal viral disease of European rabbits (*Oryctolagus cuniculus)* caused by a lagovirus (Family *Caliciviridae*). In 2010, a new genotype of RHDV, named RHDV2, with specific pathogenic, genetic and antigenic profiles, was identified in France. It has rapidly spread throughout wild rabbit populations and has almost completely replaced previous RHDV strains. Since early 2011 it was present throughout France and since mid 2011 it was responsible for > 95% of RHD outbreaks.

Contrary to RHDV, which is known to infect only rabbits, RHDV2 has jumped to several hare species (*Lepus europaeus, Lepus capensis mediterraneus, Lepus corsicanus, Lepus timidus*) causing a disease similar to the European Brown Hare Syndrome (EBHS) whose aetiological agent is another lagovirus which infects several hares species. We conducted an exhaustive molecular epidemiological study to estimate the prevalence of RHDV2 dead hares in 2015. We detected 87 cases of hares showing clinical signs compatible with EBHSV and infected by a lagovirus. Among them, 32 were infected by RHDV2 (37%), 54 by EBHSV (62%) and 1 (1%) by both.

Complete VP60 sequences of RHDV2 were obtained in a sample of infected rabbits and hares to perform phylogenetic analyses. These analyses showed a strong epidemiological link between RHDV2 outbreaks that occurred in hare and rabbit populations, both species sharing locally closely related viral strains. Viral strains isolated in hares don't belong to a separate lineage that would have jumped once from rabbits to hares and that would have evolved separately.

Our data show that RHDV2 has quickly become the main cause of RHD in rabbits, cases of RHD caused by former RHDV being rare since mid 2011. The high prevalence and the large geographic distribution of RHDV2 cases in hares in 2015 suggest that this virus is also becoming a major agent of EBHS-like disease in French hare populations and raises the question of the possible replacement of EBHSV by RHDV2. In addition, the enlargement of the host range of RHDV2 to *Lepus europaeus* may change the circulation pattern of the virus and consequently may change the epidemiology of the disease in both hare and rabbit populations since our result provide evidence for frequent species jumps.

Keywords: RHDV2, *Oryctolagus cuniculus*, *Lepus europaeus*, spread, species jump

(poster #47)

Using bioacoustics to estimate Rock ptarmigan (*Lagopus muta*) numbers in spring: comparison with the point count method

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The cost-effectiveness and the low workforce needed to setup acoustic devices makes bioacoustics a growing mean to monitor wildlife. This is typically the case for secretive species that are difficult to access such as marine mammals [1] or birds [2]. These species use acoustic to communicate in numerous social contexts, for example: territoriality contest. Numerous studies showed that acoustic signals convey information about the emitters. The acoustic characteristics of the vocalizations are different for each individual and are a proxy of physiological differences among individuals. This variability allows animals to recognize each other. Thus, bioacousticians can discriminate each recorded individual from others and then count them in a given study area [3]. However, there are only few real comparisons of the acoustics censusing with estimates from standard census protocols [4]. The present study aims to compare two different methods to assess the number of territorial rock ptarmigan males in spring. In the French Alps, this species lives at high altitudes and sings at dawn. Traditionally, rock ptarmigan numbers are estimated in May-June by counting singing males from a set of census points [5]. We compare this census method with the numbers obtained by acoustic analyses of the males' vocalizations during two years. We performed clustering analysis to separate the males thanks to their vocalizations acoustic parameters. We found that acoustic individual variability can discriminate the males and can be used to estimate their numbers. In 2016, we could identify 5 different males by acoustic means while the estimations resulting from 2 point counts varied between 4 and 6 males. Furthermore, the performance greatly varies from one observer to another. The difference of vocalizations heard for the same counting point between two observers can be up to 31%. Various factors could explain this: experience of the area, the species and males' territory knowledge. By reducing both observer bias and risk of double counting, bioacoustics should be used in addition with traditional counting methods to get more accurate estimates of rock ptarmigan numbers.

References

[1] **Castro, J.., M. Rivera & A. Camacho** (2015). Automatic manatee count using passive acoustics. *Proceedings of Meetings on Acoustics*, **23.1:** 010001.
[2] **Adi, K., M.T. Johnson & T.S. Osiejuk** (2010). Acoustic Censusing Using Automatic Vocalization Classification and Identity Recognition. *Journal of the Acoustical Society of America*, **127.2:** 874-883.
[3] **Budka, M., L. Wojas & T.S. Osiejuk** (2014) Is it possible to acoustically identify individuals within a population? *Journal of Ornithology*, **156:** 481-488.
[4] **Peake, T.M. & P.K. McGregor** (2001). Corncrake *Crex crex* census estimates: a conservation application of vocal individuality. *Animal Biodiversity and Conservation*, **24.1:** 81–90.
[5] **Léonard, P.** (1995). Méthode de dénombrement des lagopèdes alpins mâles au chant et présentation des résultats. *Suppl. Bull. Mens. ONC,* **199:** 29-32.

Keywords: bioacoustics, censusing, individual variability, monitoring, point count protocol

(oral)

Causes and consequences of age at first reproduction in male moose

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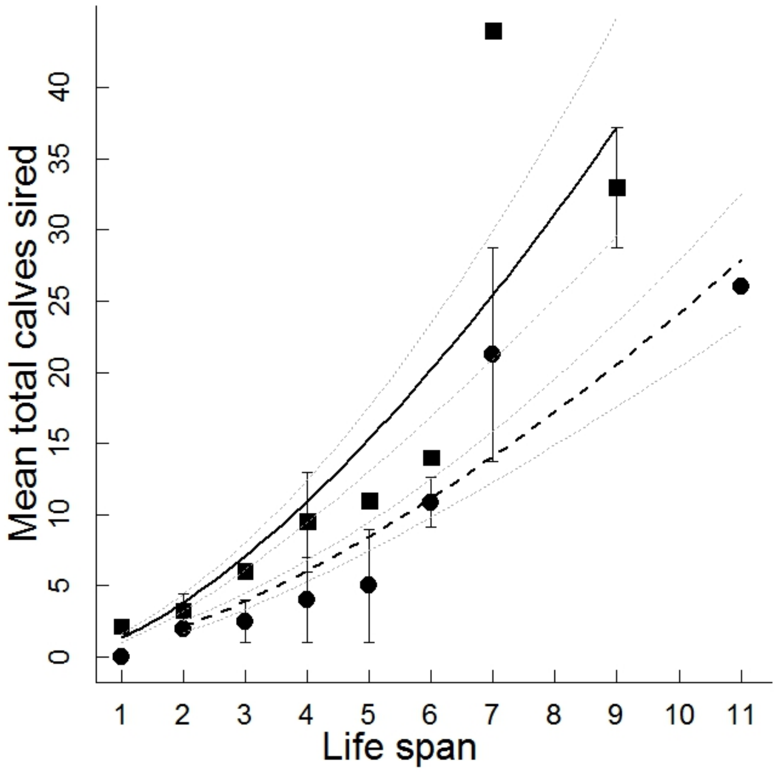
Age at first reproduction plays a crucial role in determining individual fitness and in turn the population dynamics [1,2]. Within species, early-maturing individuals can have higher lifetime reproductive success than late-maturing individuals as they may obtain a higher number of successful reproductive events [3-5]. However, as early start of reproduction may also involve a fitness cost, such as reduced growth, survival and future reproduction [6,7], individuals are expected to optimise their reproductive effort in early life according to their phenotypic quality. Moreover, as the costs and benefits of mating may vary with population density, sex ratio or age structure, the mating success at a given age is likely to also depend on the current conditions [8-10]. Whereas much is known regarding such trade-offs among females, few studies have examined this in males, particularly for vertebrates [11,12]

Using 27 years of data on demography, morphology and genetic relatedness in a small island population of moose, we quantified the survival and reproductive success of males using multi-state models. We then examined the effects of individual qualities (age, body mass and antler size) and population sex- and age structure on the variation in age at first reproduction in males, and examined the consequences for longevity and lifetime reproductive success.

Males adjusted their mating effort according to their age and body condition at rut, as well as the sex- and age structure of the population. Proportionally more males were successfully breeding in years with strongly female-biased sex ratios and low mean age of competing males. In addition, a large body mass and antler size increased the chance of siring calves. Males that were successfully mating as yearlings were also more likely to successfully contribute in the next rutting season. The same was true for older males, indicating a strong quality effect on productivity in males. Males that successfully mated as yearlings had higher probability to sire three or more calves, compared to those that were successfully mating first at the age of 2 or older. The total number of calves sired by males depended on their life span and age at first reproduction, where those that started to mate as yearlings sired a higher number of calves at a given age at death than those who successfully started to mate later (Figure 1). The results suggest high individual heterogeneity in male reproductive performance, explained both by phenotypic differences as well as dynamics in the population properties.

Figure 1: *Mean number of calves sired ±SE by male moose in relation to life span. ■ = first successful mating as yearlings, ● = first succesful mating as 2-4 years old.*



References

[1] **Cole L.C.** (1954). The population consequences of life history phenomena. *Q. Rev. Biol.*, **29:**103–137.

[2] **Bell, G.** (1980). The costs of reproduction and their consequences. *Am Nat*, **116:** 45-76.

[3] **Stearns, S.** (1992). *The evolution of life histories*. Oxford University Press, Oxford, UK.

[4] **Oli, M.K. & F.S. Dobson** (1999). Population cycles in small mammals: the role of age at sexual maturity. *Oikos*, **86:** 557-566.

[5] **Herfindal I., M. van de Pol, J.T. Nielsen, A.P. Møller & B.-E. Sæther** (2015). Climatic conditions cause complex patterns of covariation between demographic traits in a long-lived raptor. *J Anim Ecol*, **84:** 702-711.

[6] **Descamps S., S. Boutin, D. Berteaux & J.M. Gaillard** (2006). Best squirrels trade a long life for an early reproduction. *Proc R Soc B,* **273:** 2369–2374.

[7] **Lemaître, J.-F., V. Berger, C. Bonenfant, M. Douhard, M. Gamelon, F. Plard & J.M. Gaillard** (2015). Early-late life trade-offs and the evolution of ageing in the wild. *Proc R Soc B*, **282:** 20150209.

[8] **Stevenson, I.R. & Bancroft, D.R.** (1995). Fluctuating tradeoffs favour precocial maturity in male Soay sheep*. Proc R Soc B,* **262:** *267–275.*

[9] **Mysterud, A, Ø. Holand, K.H. Røed, H. Gjøstein, J. Kumpula & M. Nieminen** (2003). Effects of age, density and sex ratio on reproductive effort in male reindeer (Rangifer tarandus). *J Zool (London)*, **261:** 341-344.

[10] **Sæther, B.-E., E.J. Solberg & M. Heim** (2003). Effects of altering sex ratio structure on the demography of an isolated moose population. *J Wildl Manage*, **67:** 455-466.

[11] **Hamel S., J.M. Gaillard, N.G. Yoccoz, A. Loison, C. Bonenfant & S. Deschamps** (2010). Fitness costs of reproduction depend on life speed: empirical evidence from mammalian populations. *Ecol Lett*, **13:** 915-935.

[12] **Bleu, J., M. Gamelon & B.-E. Sæther** (2016). Reproductive costs in terrestrial male vertebrates: Insights from bird studies. *Proc R Soc B*, **283:** 20152600.

Keywords: male mating success, age structure, sex ratio, individual quality, age at maturity, cost of reproduction

(poster #48)

On the hunt: Analysis of the behaviour of geocachers at the Untersberg (Salzburg, Austria)

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Geocaching is similar to a treasure hunt supported by navigation devices (like GPS-enabled device, smartphone)[1]. It often takes place off-trail and in sensitive areas [2] at day- and night-time and at every season [3]. Geocachers document their activities through "logs" and comments on specific websites (e.g. geocaching.com) and/or on logbooks on site if the cache has been found.

With the establishment of activities like off-trail ski tours, off-trail mountain biking or geocaching and an increasing mobility and time for recreation, people are likely to be outdoors more often and therefore to intrude into animal´s retreat areas [3]. As human activities may negatively affect animals [1], it is of peculiar interest to assess the impacts of activities such as geocaching in a circumscribed study area and to derive their influence on wildlife.

Study area

The study area "Untersberg" is situated in direct vicinity to the city of Salzburg and the Austrian-German border. The Untersberg is a popular recreational area for people from adjacent municipalities as well as from the City of Salzburg and often visited by tourists, too.

The Untersberg is characterised by its distinctive massif, steep slopes, caves and forests with spruce, beech, larch and fir as well as alpine uncultivated land mainly overgrown with dwarf pine. The forests and open patches are important habitats for ungulates such as roe deer (*Capreolus capreolus)*, red deer (*Cervus elaphus)*, Alpine chamois (*Rupicapra rupicapra)* and European mouflon (*Ovis orientalis*) [4].

Aims and Methods

The aim of the study was to find out about the temporal and spatial usage of the study area by geocachers as well as their behaviour to estimate potential effects on wildlife. Using GIS, the spatial distribution of geocaching considering paths and trails as well as hunting facilities (animal feeders, salt licks, high seats) were analysed. Furthermore, a qualitative content analysis [5] of the 10.080 online logs of 78 caches was carried out. Moreover, the on-site logbooks of five geocaches containing 789 logs were analysed to find out preferences for online or on-site log entries.

Main Results

In 2016, 78 geocaches were hidden in the study area. 73% of the caches are traditional caches (container at given coordinates) and 15% mystery caches (involves puzzles to determine the correct coordinates).

The analysis of 10.080 online log entries showed a peak in the number of activities at a cache shortly after its publication and – with increasing age – a decline in the number of logs.

In the study area, two third of the caches are situated in forested areas. 72% of the caches are hidden within a distance of 100 m from paths; the others are located up to 600 m from trails. Almost one third of the caches are hidden near hunting facilities whereas eight caches are situated within 300 m to those. In the log entries of 17 caches geocachers reported the sight of one or more ungulates – seven of those are the abovementioned caches within 300 m of hunting facilities.

The origin of two third of the cachers who visit the study area is unknown as they are not obliged to reveal their origin on geocaching websites or in log entries. Of the remaining geocachers who were/are active in the study area, nearly 50% live in Germany, 35% in Austria and 7% in Czech Republic. The analysed log entries showed that the majority of cachers does geocaching in groups up to seven persons; furthermore, they often take (unleashed) dogs with them.

The online log entries showed that nearly 80% of the geocaches are sought in the twilight or during night. June, August, October and September are the most popular months for caching. 85% of the caches in the study area are sought in winter, too – except for those on the top of the Untersberg, where snow cover may hinder the geocachers.
The analysis of the online log-entries revealed that technical problems (e.g. GPS-problems), failures of the cachers themselves or difficult terrain near the hiding spot of the cache can provoke to leave the trails, longer stays at the hiding locations and intensive search in the surroundings. Ticks (*Ixodida)*, mosquitoes or plants such as stinging nettle (*Urtica* sp.) or blackberries (*Rubus fruticosus*) discourage geocachers from longer stays at the cache location.
Several geocaches in the study area and their logbooks were searched on-site. The comparison of log entries of several caches (in total 1.115 online and 789 on-site logs) showed that most of the cachers log their finds online as well as in the logbooks on-site. However, the online logs include failed searches for caches and often give reasons for the failure to find the cache.

Conclusions

The results clearly underline that geocaching is an activity which is carried out on all seasons and all-day and night-time and therefore has high potential to affect wildlife in an area. Especially new caches in an area attract geocachers - whereby interest for older caches decreases over time. Geocachers who were active in the study area demonstrate high mobility and often origin from afar; this may be due to the direct vicinity of the City of Salzburg, which is a popular destination for tourists and visitors.
As the comparison of online and on-site log entries showed little differences, this indicates that online log entries represent valid numbers and allow for an assessment of activities at a cache location.

Acknowledgements

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References

[1] **Schneider, J. & V. Jadczaková** (2016). Mutual Impacts of Geocaching and Natural Environment. *ACTA Universitatis Agriculturae et Silviculturae Mendelianae Brunensis*, **64/192 (5):** 1739-1747
[2] **Patubo, B.G.** (2010). Environmental Impacts of Human Activity associated with Geocaching. Social Sciences Department California Polytechnic State University San Luis Obispo
[3] **Louis, H.W., S.S. Meléndez & K. Steg** (2011). Zivilrechtliche Probleme des Geocaching. *Natur und Recht,* **33/2011:** 633-539. Springer-Verlag. Heidelberg
[4] **OEAV (Hrsg.)** (2012). Naturkundlicher Führer Bundesländer Band 6: Landschaftsschutzgebiet Untersberg. Naturkundlicher Wanderführer Untersberg. Anif, Grödig, Stadt Salzburg. Eigenverlag Österreichischer Alpenverein. Salzburg
[5] **Mayring, P.** (2002). Einführung in die qualitative Sozialforschung: Eine Anleitung zum qualitativem Denken. 5. Auflage. Beltz Verlag. Weinheim und Basel

Keywords: geocaching, recreational activitiy, log-entries

(poster #49)

Where's the pulse to have the finger on? A retrospective analysis of Alpine Galliforms (Aves: Galliformes) census and game bag data in Italy

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Despite three out of five Alpine Galliform species are listed as Vulnerable on the Italian Red list of birds (Peronace et al., 2012) there is no national survey on Galliforms in Italy. As a consequence, there are no reliable estimates of the current status and trend of the Italian Alpine Galliforms populations (BirdLife, 2015). Indeed, known population sizes are outdated and mostly derive from extrapolations of local data to national scale (Brichetti and Fracasso, 2004). Short- and long-term population trends are based on expert knowledge and do not rely on field data (Nardelli et al., 2015). Similarly, Italy does not have a national archive of Galliforms bags. Thus, hunting districts bird counts and bag data actually provide the longest and most widespread survey, but application of census methods can markedly differ between hunting districts and provinces, since hunting in Italy is mostly under provincial authority. In our study, we assessed the status in Italy of Black grouse (*Lyrurus tetrix*, hereinafter BG), Alpine rock ptarmigan (*Lagopus muta helvetica*, PTA) and Alpine rock partridge (*Alectoris graeca saxatilis*, PAR) using counts and bag data, testing whether they provide similar trends and the influence of hunting policies and hunting effort on the estimated trends.

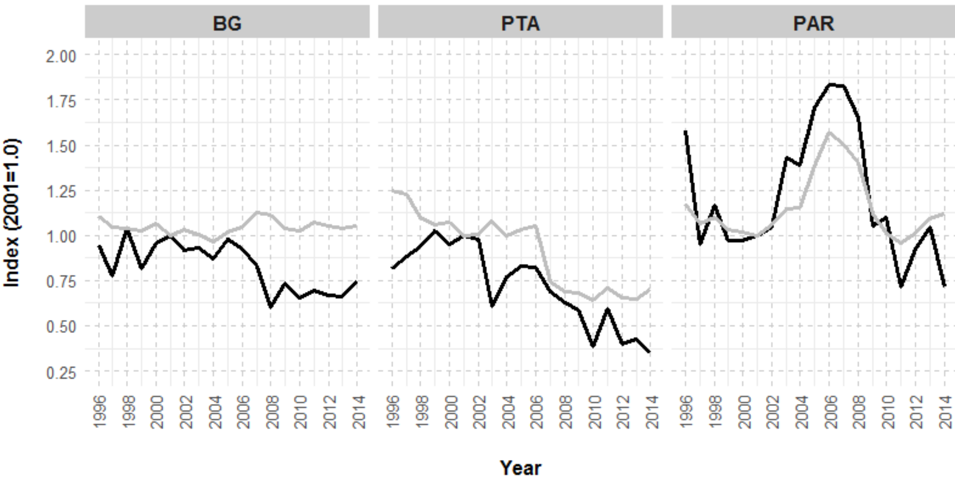
We collected all available data on post-breeding counts, hunting plans and bags sizes from each game management district (n=72) of the Italian Alps, except from Bolzano/Bozen province. Post-breeding counts were chosen as state variable since only few districts regularly perform pre-breeding counts. Data series lengths were uneven by species, variables and districts. Population trends were estimated using TRIM (Pannekoek & van Strien, 2001) on game bags and count data series separately. Due to unequal time series length, we limit our data set from 1996 to 2014. For each species and state variable, we calculated 3 models (linear model, linear model with province as covariate, time effect non-linear model), to test for hunting management influence (related to provinces) and non-linear trends. Then, we tested the consistency of bags and/or counts as proxies for population abundance. We fitted counts and bags indices provided by TRIM in the same linear model (GLS with autoregressive term), with year, proxy and the interaction term as regressors to assess significant differences in slopes. Then we calculated Pearson's correlation between bags and count indices and between residuals deriving from linear regressions on each proxy separately to check for spurious correlations. Bias deriving from hunting effort variation in time was tested by regressing the bag/plan ratio against years for each district.

Bags and counts trend estimates resulted consistent for PTA and PAR, showing a severe decline for the former (yearly -0.039/-0.053) and a relative stable trend with a major population peak in 2006-2007 for the latter. Slopes were not significantly different as resulted from the GLS regression and correlation of indices was high (respectively, $r=0.80$ and $r=0.89$, all $p<0.01$), despite residuals were not correlated for PTA, evidencing a possible spurious correlation. These trends are consistent with French data (Géhin and Montadert, 2016). Conversely, estimated BG trends differ between bags and counts, as evidenced by a significant difference of the interaction term in the regression and absence of correlation of both indices and residuals. This lack of consistency may result from hunting policy changes that occurred after 2005-2006, when in many Natura2000 sites hunting restrictions were enforced in management plans. Similarly, PTA bag and count trends showed a sudden drop in 2007, when PTA hunting in SPAs was prohibited in Italy. Province covariate was always significant (Wald test, $p<0.01$) in covariate models, showing the effect of management policies on data. Moreover, count data were greatly overdispersed with respect to bags, evidencing that count effort markedly differ among districts according to management policies and local traditions. Finally, a hunting effort change over the considered period was detected in less than 20% of the districts.

Table 1: *TRIM models results. According to model type, Wald test values refer to slope, covariate and deviations from linear trend significance. Significance is indicated by asterisks (* p<0.05; ** p<0.01, *** p<0.001). Overdispersion is calculated with respect to a Poisson data distribution.*

Species	proxy	n_sites	n_obs	% imputed	Model	overdisp.	AIC	Wald test		Slope
BG	Bags	72	1368	11.5	Linear	2.598	897.0	73.7	***	-0.023
					Covariate	2.339	595.2	80.6	***	-0.024
					Time eff	2.385	499.9	152.5		-0.021
BG	Counts	52	988	31.7	Linear	17.327	9523.9	0.6		-0.002
					Covariate	15.868	8579.6	38.3	***	0.001
					Time eff	16.945	9571.5	28.4	*	-0.005
PAR	Bags	60	1140	36.1	Linear	4.283	1867.7	6.2	*	-0.009
					Covariate	3.901	1568.5	34.4	***	-0.012
					Time eff	2.964	631.8	244.2	***	-0.012
PAR	Counts	50	950	32.0	Linear	22.102	15396.5	0.4		-0.004
					Covariate	20.189	13707.5	34.6	***	0.002
					Time eff	16.764	9215.8	109.5	***	0.002
PTA	Bags	39	741	35.4	Linear	2.23	287.0	71.4	***	-0.049
					Covariate	2.095	204.9	24.9	**	-0.050
					Time eff	1.996	44.1	71.8	***	-0.053
PTA	Counts	30	570	35.1	Linear	10.044	3604.3	71.9	***	-0.054
					Covariate	7.315	2253.3	80.3	***	-0.039
					Time eff	10.103	3466.0	30.3	*	-0.051

Figure 1: *Population trends or the three target species. Black line represent bags, grey line represent counts.*



References

[1] **BirdLife International** (2015). European Red List of Birds. *Office for Official Publications of the European Communities, Luxembourg.*

[2] **Brichetti P. & G. Fracasso** (2004). Ornitologia italiana. Vol. 2 – Tetraonidae-Scolopacidae. *Alberto Perdisa Editore, Bologna*. 396 pp.

[3] **Géhin B. & M. Montadert** (2016). Bilans demographiques 2016 des galliformes de montagne - massif alpin. *Observatoire des Galliformes de Montagne.*

[4] **Nardelli R., A. Andreotti, E. Bianchi, M. Brambilla, B. Brecciaroli, C. Celada, E. Dupré, M. Gustin, V. Longoni, S. Pirrello, F. Spina, S. Volponi & L. Serra** (2015). Rapporto sull'applicazione della Direttiva 147/2009/CE in Italia: dimensione, distribuzione e trend delle popolazioni di uccelli (2008-2012). *ISPRA, Serie Rapporti, 219/2015*, *Ozzano nell'Emilia*

[5] **Pannekoek J. & A. Van Strien** (2001). TRIM 3 Manual. (TRends and Indices for Monitoring data). *Research paper no. 0102. Statistics Netherlands, Voorburg*

[6] **Peronace V., J. Cecere, M. Gustin & C. Rondinini** (2012). Lista Rossa 2011 degli uccelli nidificanti in Italia. *Avocetta*, **36:** 11-58.

Keywords: Alpine Galliforms, status, Italy, hunting bags, hunting management

(keynote)

Mitigating human-wildlife conflicts in an overcrowded continent: is fertility control a solution?

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Current trends in human and wildlife population growth and in landscape development suggest that human-wildlife conflicts are escalating worldwide. This is particularly important for Europe, where the density of the human population is high and some wildlife species have increased in numbers and range. The debate about how to mitigate these conflicts is often polarised, with stakeholder groups holding irreconcilable views. Lethal control, traditionally used to manage wildlife populations, can be ineffective in the long term, unfeasible, illegal in some contexts or unacceptable for its impact on the environment and on animal welfare. Non-lethal options such as fertility control are increasingly advocated as humane, effective and socially acceptable solutions to manage human-wildlife conflicts. Immunocontraceptive vaccines, now successfully employed on a number of wildlife species and contexts, provide an alternative to lethal control. The majority of current practical applications for wild mammals use injectable immunocontraceptive vaccines and the recent development of single-dose formulations that result in several years infertility have considerable further potential. The only orally delivered contraceptives registered for wildlife control are the avian contraceptive nicarbazin and the mammalian contraceptive ContraPest ® developed to sterilise small rodents. Several promising new approaches are currently being explored, including novel oral contraceptives

The first part of this presentation will review the factors that in Europe are associated with the increase of human-wildlife conflicts and illustrate recent advances in research and development on fertility control as a tool to manage wildlife and feral animals. The second part of the talk will summarise case studies, in Europe and in other parts of the world, where fertility control has been used to mitigate human-wildlife conflicts. The third part of the study will highlight advantages and limitations of this method, research gaps, applications and contexts for fertility control to manage wildlife.

(oral)

Camera traps in wildlife research: a look to the future

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Camera traps have revolutionised the way we detect animal presence, monitor wildlife behaviour and estimate population densities. In the last decade, we have witnessed a significant increase in the use of camera traps as tools in wildlife management and conservation. This increase is due to improvements in the technology, decrease in cost of camera traps, and availability of a large number of models and brands of camera traps. In parallel, a theoretical framework has been developed that underpins a rigorous approach to the analysis of data collected through camera traps.

We present an overview of the use of camera traps in wildlife management and conservation, illustrated by case studies derived from our work at the National Management Centre, UK, which include the use of camera traps to record animal behaviour, to estimate species distributions and densities and to collect data on population dynamics.

In the last part of the presentation we offer a SWOT (Strengths, Weaknesses, Opportunities and Threats) analysis to stimulate discussion about the future of this method for wildlife research.

(oral)

Moose-adapted winter harvesting of Scots pine for integrated wildlife and forest management

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Increasing ungulate densities in the northern hemisphere often create conflicts with forestry or agriculture. In Norway, moose (*Alces alces*) populations have increased in the 1970's, and stabilised at high densities [1]. However, forage availability for moose is largely controlled by clear felling in commercial forestry. Because of changes in forestry the last decades, forage availability for moose has decreased, whilst the population density has been rather stable or slightly [2]. This has led to an increase in problems with browsing damage on commercial pine forestry. At the same time, moose reproduction and slaughter weights have decreased, indicating consequences for moose carrying capacity. In order to have a healthy and harvestable moose population whilst still maintaining an acceptable number of undamaged pine stems for timber production, one solution is to produce more and better quality moose forage through moose-adapted forestry. We have investigated the use of forestry residues from winter harvesting of pine as moose forage. Final logging of pine stands can produce 1-10 kg moose forage per hectare [3,4]. Tops of mature trees may be more palatable than young pine trees [5,6], and may divert moose browsing to logged stands rather than pine plantations. However it is important that increased forage availability does not lead to increased population size. We have used simple adaptations such as avoiding driving over logging residues, but placing them on the sides of logging tracks. Tops and branches were raised above the snow in piles, to reduce snow cover and provide biting resistance. Moose-adapted slash treatment doubled the amount of moose forage available compared to normal logging practices. Biomass consumption by moose increased with biomass of pine made available, which indicates that adaptation can increase use of slash. Consumption also increased with distance from forest roads, but decreased with the proportion of driving tracks in the stand, and varied considerably between years and study areas. Utilisation increased with the height of piles of forestry residues, and was higher on tops than branches. The utilisation of pine residues was higher when snow was deep, and during migration periods. Better adaptation could increase moose use, but even simple forestry adaptation has a large potential in creating good quality moose forage and is used by moose to a varying degree. However, the economic costs and benefits have to be evaluated more closely, in addition to the effect on young pine stands and on moose population growth.

References

[1] **Lavsund, S., T. Nygren & E. Solberg** (2003). Status of moose populations and challenges to moose management in Fennoscandia. *Alces*, **39**: 109-130.

[2] **Milner, J. M., F.M. van Beest & T. Storaas** (2013). Boom and bust of a moose population: a call for integrated forest management. *European Journal of Forest Research*, **132**: 959-967.

[3] **Månsson, J., R. Bergström, A. Pehrson, M. Skoglund & C. Skarpe** (2010). Felled Scots pine (*Pinus sylvestris*) as supplemental forage for moose (*Alces alces*): Browse availability and utilisation. *Scandinavian Journal of Forest Research*, **25**: 21-31.

[4] **Edenius, L., J.M. Roberge, J. Månsson & G. Ericssson** (2014). Ungulate-adapted forest management: effects of slash treatment at harvest on forage availability and use. *European Journal of Forest Research*, **133**: 191-198.

[5] **Danell, K., R. Bergström & K. Dirke** (1983). Moose browsing on juvenile and adult birches (Betula pendula and B. pubsecens): test of a hypothesis on chemical defence. *Proceedings of the XVI International Congress of Game Biologists.*

[6] **Nordengren, C., A. Hofgaard & J.P. Ball** (2003). Availability and quality of herbivore winter browse in relation to tree height and snow depth. *Annales Zoologici Fennici*, **40**: 305-314.

Keywords: *Alces alces*, *Pinus sylvestris*, logging, slash treatment, browsing damage, forage

(oral)

Declining breeding success in European hare (*Lepus europaeus*) populations in France

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During the last ten years, some game managers in France have reported a low proportion of young hares (*Lepus europaeus*) in the hunting bag in their territories. This is worrying because the growth rate of European hare populations is dependent on breeding parameters [1]. Even if the age structure is known to fluctuate over time, we aimed to test the hypothesis of an age-ratio diminution. We pooled eyes-lens weight data collected by some hunters associations between 1980 and 2010 in 150 sites in France.

A first global analysis revealed a significant decrease of the proportion of young hares in the hunting bag since 1980. However this tendency appeared to be mainly due to data collected in the Massif Central area (low mountains and grassland areas in central France).
Then we narrowed the analysis between 2000 and 2010, selecting the 18 sites for which data was available for most of those 11 years. Again the decline was statistically significant for the Massif Central area, and not significant for other sites.
Lastly we focused on the Normandie region (north-western France) where age structure have been assessed in 1989, 1990 and 1991 and then in 2010, 2011 and 2012. The proportion of young hares in the hunting bag has declined between those two periods, from 74% to 59%, especially in arable areas.

Our results suggest that the breeding success of European hares has been declining during the last decades in some large areas in France even if it may not be a completely widespread pattern. The causes of this decline are not completely identified and understood.

Acknowledgments : We thank all Departmental Hunters Associations (FDC) which entrusted us their data on age structure of hare hunting bags.

References

[1] **Marboutin, E., Y. Bray, R. Péroux, B. Mauvy & A. Lartiges** (2003). Population dynamics in European hare: breeding parameters and sustainable harvest rates. *Journal of Applied Ecology*, **40(3):** 580-591.

Keywords: population dynamics, age structure

(poster #50)

The French Hare Network : a tool to study European hare populations dynamics on a large scale

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The French Hunting and Wildlife Agency (ONCFS) and the French Hunters Association (FNC) coordinate the French Hare Network which includes 25 territories that apply standardized monitoring protocols of European brown hare (*Lepus europaeus*) populations.

The first objective of this network is to study and to understand population dynamics in various regions and habitats in France (Figure 1). The territories extend from 5 000 to 50 000 ha and can be classified into five types of habitat: mainly cereals, diversified crops, grasslands, mixture of grasslands and crops, and vineyards. Population abundance (encounter rate) is estimated by three spotlight counts in winter, either by points or line transects, depending on the habitat characteristics. In some territories, distance sampling allows to estimate hare and fox densities. The age structure of the hunting bag is estimated by eyes lens weight. Hunting bag, management measures and data on habitat composition and meteorological conditions are also collected. The other objective of the French Hare Network is to favour knowledge and experiences exchanges between game biologists and managers.

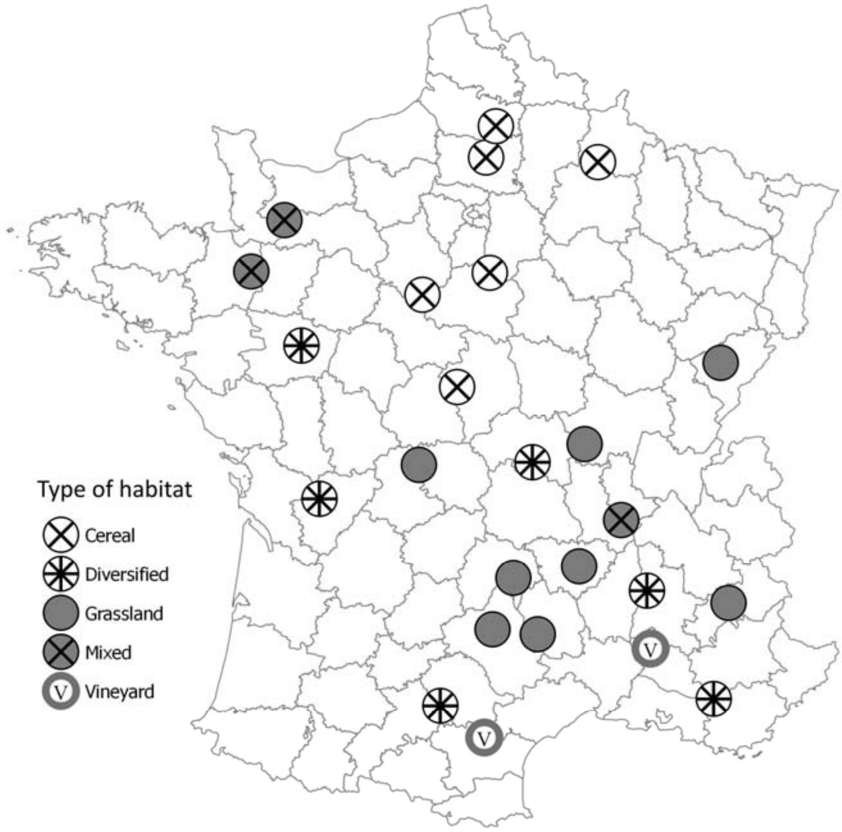
The French Hare Network is in its early stages and data have only been collected since 2015. The first results confirm that hare abundance depends on the habitat, and particularly on the proportion of cereals. The age structure is variable and the proportion of young appears quite low when compared to data collected before 2000.

In the future, thanks to these protocols, we may assess more precisely the relation between age structure, population growth rate and several environmental factors such as meteorological conditions or habitat characteristics. We also aim to study for example the spatial scale of population dynamics synchrony and the spatial variability of the breeding season length.

This network of study sites is also an opportunity to plan complementary studies based on additional protocols to assess for example fecundity, sanitary status or habitat selection of individuals and to describe more precisely habitat characteristics. European researchers on hare population dynamics are encouraged to ask for potential collaborations that would benefit of these study sites.

Acknowledgments : We thank the technical staffs of Departmental Hunters Associations (FDC) and hunters who collect the data on the 25 territories.

Figure 1: *Location and type of habitat of study territories*



Keywords: *Lepus europaeus*, habitat, demography

(oral)

Estimating Northern Bobwhite recruitment using integrated population models

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Understanding game bird recruitment is essential for determining harvest regulations because density-dependent recruitment and survival are cornerstones of sustainable yield theory. However, density-dependent recruitment is rarely quantified or incorporated into gamebird population models. Similarly, the effects of environmental factors on recruitment remain largely unexplored. We hypothesized that a combination of density-dependent and density-independent factors influences bobwhite recruitment and investigated this using integrated population models (IPMs). We used a combination of capture-recapture and harvest information and used an IPM to estimate population abundance, annual survival, and per-capita recruitment. We modeled the effects of population abundance, breeding season rainfall, and temperature as covariates of per-capita recruitment. Model selection results indicate a time-varying recruitment model was most-supported by deviance information criteria (DIC). Per-capita recruitment averaged 1.66 over the 42-year time series and ranged from 0.01-7.43. Our best supported covariate model showed a negative effect of population abundance on recruitment (β_1 = -0.12; 95% CRI [-0.15, -0.09]). Our results support the density-dependent hypothesis for bobwhite recruitment. We found no support for the effects of breeding season temperature or rainfall on recruitment as evidenced by DIC. Therefore, our results do not suggest that density-independent factors alone impact bobwhite recruitment.

(oral)

Is there a real conflict of interest between hunters and caracals in the Mediterranean Turkey?

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The caracal (*Caracal caracal* Schreber, 1776), protected species since 2003, is one of the rarest felid species in Turkey. Caracals inhabits human dominated Mediterranean landscapes below 1000 meters in the south. Small and big game hunters are also wide-spread in the Mediterranean region because montane areas are more accessible due to increasing tourism activities. Although common game species in the region are brown hares (*Lepus europaeus*), chukar (*Alectoris chukar*) wild goats (*Capra aegagrus*), several groups of people, including hunters, game wardens and some researchers get used to claim that caracals were responsible from the predation on kids of wild goats and killing female wild goats [1]. We think that caracals' cryptic behaviours and charisma may lead to some mysterious believes in the Mediterranean people of Turkey without hard evidences.

We tested this claim that whether caracals can prey on wild goats by using camera traps at very touristic human dominated landscape, Köyceğiz Wildlife Reserve, Muğla, having high abundances of wild goat population along with known caracal distribution. This wildlife reserve is one of the best destinations for trophy hunters to obtain the longest horns of male wild goat. Prey-predation theory assumes that activities or usage of habitats of prey and predators should overlap due to the requirement of minimum energy consumption. Therefore, we conducted opportunistic camera trap survey at 30 stations distributed mainly over cliffs covered maquis vegetation and flatland forests, from sea level up to 750 meters elevation above sea level in the Mediterranean Turkey. We also calculated the caracal and wild goat densities by using random encounter modelling [2] in the wildlife reserve to understand how caracals' possible predation on wild goats affect their populations.

Results of this survey (2249 camera trap days) revealed high percentages of habitat segregation between caracal and wild goat and allocation in temporal activity patterns, but a high overlap with the patterns of brown hares and chukar. Wild goats occurred in steep slopes and narrow valley bottoms of the wildlife reserve; whereas more than 90% of the caracal occurrence registered in high forest flatland where wild goat occurrence was less than 10%. We revealed that the population densities of caracals and wild goats from south-western Turkey are 7.0 and 279.0 respectively per 100 km^2 in this area.

Although the density of caracals is in medium level compared to South Africa and India, the results of this study do not demonstrate a strong prey-predator dynamic between wild goats and caracals, due to their spatial and temporal segregation. Besides, the population abundance of wild goats is one of the highest in Turkey where trophy hunters and game wardens speculate on the predation activity of caracals. As a result, there is no actual conflict of interest between caracal and hunters on wild goats except biased perceptions of hunters. Therefore, conservation and management of caracal and wild goat populations require more public relations such as awareness raising at local and national level and promoting citizen science to increase the participation of all stakeholders.

References

[1] **İlemin, Y. & B. Gürkan** (2010). Status and activity patterns of the Caracal, *Caracal caracal* (Schreber, 1776), in Datca and Bozburun Peninsulas, Southwestern Turkey. *Zoology in the Middle East.,* **50:** 3-10

[2] **Lucas, T.C.D., E.A. Moorcroft, R. Freeman, J.M. Rowcliffe & K.E. Jones** (2015). A generalised random encounter model for estimating animal density with remote sensor data. *Methods in Ecology and Evolution,* **6:** 500–509

Keywords: Caracal caracal, wild goat, Turkey, prey-predator, hunting, brown hare

(oral)

Prey preferences of Anatolian lynx in three different ecosystems of Turkey

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Eurasian lynx (*Lynx lynx*) is one of the most widespread but least studied felid species in southwest Asia. We studied its diet by collecting scats in three different ecosystems of Turkey from Mediterranean in south to Euro-Siberian in Caucasus via xero-euxine and Irano-Turanian mixed ecosystem in central-west Anatolia (Asian part of Turkey) where lynx live in sympatry with at least two ungulate species. At two of those study areas, we conducted camera trapping surveys to assess the species densities [1, 2] and prey biomasses, and used published data for the Mediterranean ecosystem [3]. From the analyzed scat samples (n = 195), main prey of lynx was revealed as brown hare (*Lepus europaeus*). The biomass of brown hares in the lynx diet decreased from 98.5% in Mediterranean via 83.9% in central Anatolia to 77.4% in lesser Caucasia. In all three study areas, brown hare was the only dominant preferred prey among several other herbivore species. Even in the presence of higher portion of available ungulate biomasses as in forest-steppe mosaic ecosystem with red deer (*Cervus elaphus*) (34.7 %) and Euro-Siberian ecosystem with wild goat (*Capra aegagrus*) (51.6 %), lynx stuck to a diet based on lagomorph prey (Chesson's α is 0.97 and 1.00 respectively). In forest-steppe mosaic ecosystem, with the highest available biomass (34.7 %) among three types of herbivore prey species, red deer was completely avoided. In contrast, with only 3 kg/km^2 brown hare biomass availability (3.8 %) in Caucasus, lynx diet consisted 77.4 % of this prey species. Hence, Chesson's selectivity equation [4] gave Zero preferences for those ungulate species in both areas. Even though lynx fed on wild boar (*Sus sucrofa*) in three different sampling areas, this species was also avoided. The result of diet analysis from three different ecosystems, inhabited by at least two ungulate species, showed that lynx continue to selectively prey on brown hare, even in the presence of lower biomass of it and higher biomass of mid-sized and large ungulate species. This is very contradicting with the foraging ecology of European lynx where even juvenile lynx (~12 kg body size) preys on fully-grown medium sized ungulates such as roe deer (*Capreolus capreolus*) and reindeer (*Rangifer tarandus*) and also fawns, yearlings and females of red deer [5, 6]. Red deer was totally avoided in forest-steppe mosaic ecosystem; neither adult deer nor juveniles and fawns were in the prey list of the lynx populations in Anatolia. Wild boar is present in the diets of three different Anatolian lynx populations, but is avoided considering the Chesson index. Therefore, any conservation program of Eurasian lynxes in south western Asia should also include the status of brown hare and effect of hunters on them to implement effective conservation actions.

References

[1] **Ambarlı H. & C. Bilgin** (2013). Firs record of melanistic golden jackal (*Canis aureus*, Canidae) from Turkey. *Mammalia*, **77:** 219-222.
[2] **Rowcliffe M., J. Field, S.T. Turvey & C. Carbone** (2008). Estimating animal density using camera traps without the need for individual recognition. *Journal of Applied Ecology*, **45(4):** 1228-1236
[3] **Avgan B., F. Zimmermann, M. Güntert, F. Arıkan & U. Breitenmoser** (2014). The first density estimation of an isolated Eurasian lynx population in southwest Asia. *Wildlife Biology,* **20(4):** 217-221
[4] **Chesson J.** (1978). Measuring Preference in Selective Predation. *Ecology*, **59:** 211-215
[5] **Okarma H., W. Jedrjezewski, K. Schmidt, R. Kolwalczyk & B. Jedrjezewska** (1997). Predation of Eurasian lynx on roe deer and red deer in Bialowieza Primeval Forest, Poland. *Acta Theriologica*, **42:** 203-224
[6] **Sunde, P., T. Kvam, J.P. Bolstad & M. Bronndal** (2000). Foraging of lynxes in a managed boreal-alpine environment. *Ecography*. **23:** 291–298

Keywords: prey preferences; Anatolian lynx; brown hare; diet; Turkey

(poster #51)

Density and productivity of Roe deer in dry crop plain of North-western Italy

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Among European wild ungulates, roe deer is the most widespread with a range covering 7.2 millions of km^2 and a population of 9.5-10 millions of individuals. The densities are highly variables and often very high (>30 individuals per km^2) in particular in Western Europe where environmental conditions are more favourable for the species [1]. In Italy an increase higher than 200% has been recorded from the half of the eighties to early 2000 [2]. Currently the species is colonizing several cultivated areas of the Po plain in particular the dry crop plain between the Po river and the Apennines. In these areas roe deer can find high food availability represented by crops (cereals, alfalfa, soybean, hay field) on the other hand it can suffer the lack of shelter represented by woodland and scrubland. In 2016 we carried out a survey of two populations of roe deer in two protected areas of the province of Piacenza (North-western Italy) to assess the main demographic parameters (population density, structure, and reproductive success). The two study areas (Trebbia, 41.1 km^2, and Nure, 35.6 km^2) are mainly cultivated with rotational crops (56.7 %), they each include a river with riparian and pebbly shore bushy vegetation (30.5%), hedgerows and tree rows (2.2%) as well as settlements (10.6%). We carried out spotlight counts in March to estimate population density by Distance Sampling [3]; moreover we collected deer observations on itineraries crossing the study areas from a car in the first 3 hours after sunrise and before the dusk, from March to September, to evaluate population structure and reproductive success. Density estimates were 9.2 deer per km^2 (SE=0.95; CV%=10.4; 95%CI=7.5-11.2) in Trebbia study area and 11.4 deer per km^2 (SE=1.19; CV%=10.4; 95% CI=9.3-14.0) in Nure study area with no significant differences between study areas (Fig. 1). Sex ratio (females/males) was significantly biased toward females in both study areas (Trebbia: 1.6, χ^2=5.65, df=1, P=0.017; Nure: 1.5, χ^2=3.97, df=1, P=0.046), in particular for adults (1.6, χ^2=6.43, df=1, P=0.011) while for juveniles and sub-adults we did not find significant differences from the expected sex ratio of 1 (Fig. 2). In Trebbia study area 23.5% of the observed deer were juveniles while 15.7% were sub-adults and 60.8% were adults; in Nure study area the proportions of the three age classes were 22.5%, 23.4% and 54.1% respectively (Fig. 3). The differences between the two study areas were not significant. In Trebbia study area the ratio between juveniles and females was 0.74 and 0.92 when only adult females were considered, whereas in Nure study area it was 0.65 and 0.92 respectively. The percentage of successfully reproduced females was 43.5% in Trebbia and 38.5% in Nure area; the difference was not significant (Likelihood ratio=0.25, df=1, P=0.683). The monitored populations seem at low density if compared to those of the Apennines hilly areas from which they originated; also the productivity is lower than that reported in European studies. Despite the high food availability of croplands the low shelter availability can reduce both densities and reproductive success.

***Fig. 1:** Detection probability curve.*

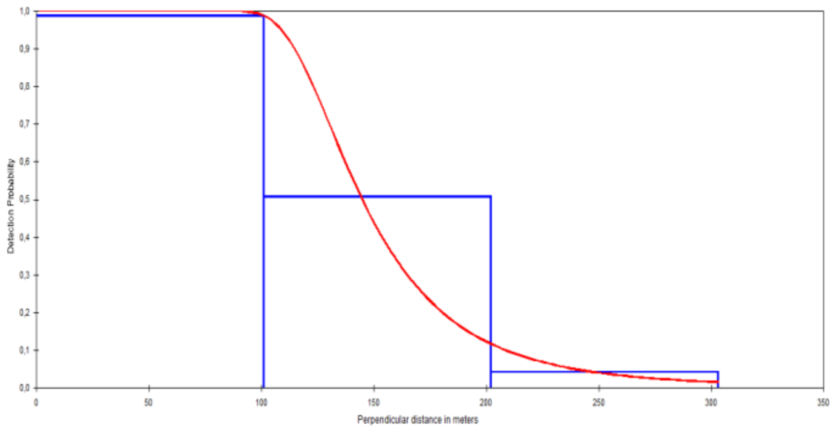


__Fig. 2:__ Sex ratio in the two study areas.

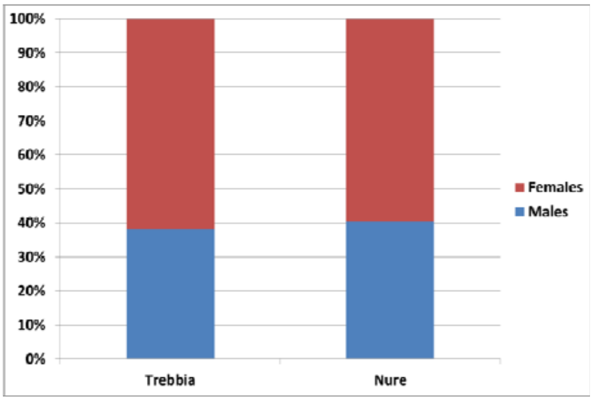
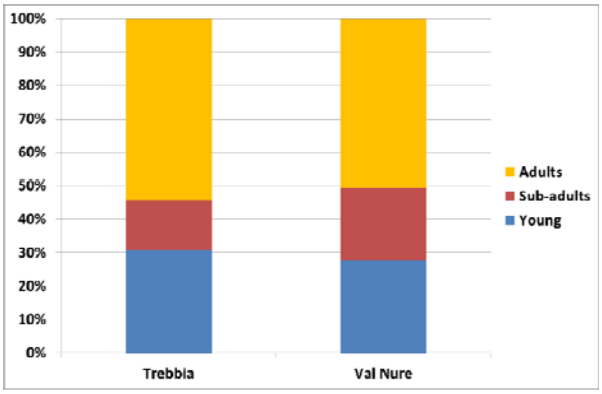


__Fig. 3:__ Population structure in the two study areas.



References

[1] **Burbaite L. & S. Csanyi** (2009). Roe deer population and harvest changes in Europe. *Estonian Journal of Ecology,* **58:** 169-180.

[2] **Apollonio M., R. Andersen & R. Putman** (2010).European Ungulates and their management in the 21st century. Cambridge University Press.

[3] **Thomas L., S.T. Buckland & E.A. Rexstad** (2010). Distance software: design and analysis of distance sampling surveys for estimating population size. *Journal of Applied Ecology* **47:** 5–14.

Keywords: Abundance estimate, *Capreolus capreolus*, population structure, reproductive success, sex ratio

(poster #52)

Factors affecting habitat occupancy and densities of the Red-legged partridge in introduction areas of north-western Italy

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Introduction. The Italian range of the red-legged partridge changed markedly in the time together with population abundance because of habitat changes, overhunting, and releases of hand-reared birds. Currently self-sustaining populations are recorded in plain areas outside the historical range that possibly originated by natural colonization and/or introductions carried out with partridges from game farms. . Historic range of red legged partridge in Italy extended mainly along the northern Apennine chain from the Southern Alps to the west, to the province of Modena in Emilia-Romagna region to the east, both on the south and north slopes. In central Italy the presence of the species was recorded in Tuscany, Umbria and Marche regions, approximately down to the Mount Vettore (29 provinces and 8 regions). In the years between 1980 and 1990 the red legged partridge was present in 18 provinces and 5 regions. The populations in central Italy disappeared with the exception of the Elba Island, and a strong decline and local extinctions were recorded for the population in northern Apennines. On the contrary massive releases of hand-reared partridges from the game farm of the region Emilia-Romagna caused an increase of the eastern part of the range that reached the provinces of Bologna, Ravenna, and Forlì-Cesena [1]. At the end of the past century, the hunting districts established by the National Law 157/92 and private estates carried out releases of red legged partridges from game farms outside the historical range causing an important range expansion, in particular in the Po plain and in central Italy (39 provinces and 9 regions).

Methods. To collect information on the factors affecting the current distribution and abundance of red-legged partridge in new-colonized areas we carried out call spring counts in two (2015) and three (2016) protected areas located in the dry crop Po plain in the Piacenza province. The three study areas covered 9.2 (Borgonovo study area), 41.1 (Trebbia s. a.), and 35.6 km^2 (Nure s. a.). They were mainly cultivated; the main crops were winter cereals (18.9%), maize (11.9%), vegetables (7.6%), alfalfa (7.0%) and hay fields (5.0%). Settlements occupied 10.7% of the study areas. Two main streams cross Trebbia and Nure study areas with pebbly shores occupying in total 20.0% of the surface. We carried out call counts with tape recorded call from random listening points (34 points in 2015 and 92 in 2016) in April and May from the sunrise until 9.30 a.m., recording the calling males of partridges and pheasants [2]. The densities were calculated using a 300 m fixed radius from the points. Moreover in each buffer of 300 m we calculated the percentages of the main land use classes and the main landscape metrics. We analyzed habitat selection by red-legged partridges by means of Resource Selection Probability Functions (RSPF) formulated by Binary Logistic Regression Analyses (BLRA) of presence points vs. an equal number of random points in which we calculated the same habitat variables (use vs. availability approach, [3]). Moreover we examined the effect of habitat variables on the partridge density by Multiple Regression Analyses (MRA) carried out considering only the presence points. For both analyses we selected the best models by the correct Akaike Information Criterion (AICc) [4]; the performance of logistic model was tested by ROC analysis and that of multiple regression model by the correlation between the predicted and observed values. We verified the multicollinearity of predictor variables by the Variance Inflation Factor (VIF), the normality of residual distribution by the Kolmogorov-Smirnov test, and the residual autocorrelation by Durbin-Watson test [5].

Results. The average density varied from 2.1 (SE=0.42) to 3.2 (SE=0.39) in 2015 and from 2.9 (SE=0.63) to 3.7 (SE=0.88) in 2016 without significant differences between years and study areas. For 15 habitat variables we found significant differences between presence and control points (Mann-Whitney U test, $P<0.05$); in particular winter cereals, pebbly shores, hedgerow density, Shannon diversity index, the patch number, edge density, and mean perimeter area ratio had greater values in presence points. Three habitat variables (winter cereals, pebbly shores and habitat diversity) entered the best logistic model with a positive effect on the presence probability of red-legged partridge. The model explained 37.0% of the variance and correctly classified 71.2% of the original cases (presence: 77.8%; controls: 64.9%); ROC analysis showed a good performance of the model (AUC=0.82, SE=0.048, $P<0.0001$) (Table 1). We found significant positive correlations between the partridge density and percentage of unpaved roads (study areas pooled r= 0.442, n=39, P=0.005), hedgerows (Trebbia study area r=0.661, n=16, P=0.005), hay fields (Trebbia s. a. r=0.601, n=16, P=0.013), and patch size SD (Nure s. a. r=0.648, n=13, P=0.017).Considering the study areas pooled the best regression model explained 31.8% of the density variance by the inclusion of four habitat variables of which the percentage of unpaved roads, and the edge density with significant positive effects, and the patch number with negative ones (Table 2); predicted and observed density values were highly correlated (r=0,624; n=39; P<0.0001).

Discussion. The expansion and shift of the species range occurred mainly because of releases carried out in recent times by hunting districts leading to the occupancy of unsuitable areas (irrigated plain) by unstable or low density populations. Low density populations can survive in dry crop plain and low hills characterized by high crop diversity and by the traditional rotation farming. Favourable characteristics are: prevalence of winter cereals (rotational crops), medium presence of hedgerows and tree rows, presence of river with large pebbly shores, unpaved road network, high habitat diversity, small field size, high landscape patchiness and complexity, and low pheasant density. Based on these characteristics it would be possible to identify suitable areas outside the original range to plan species introductions with partridges from game farms free from hybridization with *Alectoris chukar*. This can lead to the recovery of the species by putting it safe from the habitat losses in the historical range that can be considered the main threat for red-legged partridge conservation.

Table 1: *Results of the BLRA of presence points vs. control ones.*

Habitat variables	B	SE	Wald	P	Exp(B)	VIF
Winter cereals (%)	0.03	0.02	4.27	0.039	1.03	1.08
Pebbly shores (%)	0.04	0.02	5.89	0.015	1.04	1.08
Shannon index	3. 4	1.03	10.71	0.001	29.49	1.07
Intercept = -5. 7 SE = 1.69						

Table 2: *Results of the MRA of red-legged partridge density vs. habitat variables.*

Habitat variables	B	SE	t	P	VIF
Roads (%)	0.7	0.22	3.38	0.002	1.09
Patch number	-0.1	0.05	2.63	0.013	1.64
Edge density	1338.0	620.43	2.16	0.038	1.76
Maize (%)	4.4	0.02	1.40	0.169	1.04
Intercept = 4.4 SE=1.25 R^2=0.318 SEE=2.20 $F_{4,34}$=5.42 P=0.002					

References

[1] **Spanò, S.** (2010). La pernice rossa. Gavi: Edizioni Il Piviere.
[2] **Jakob, C., F. Ponce-Boutin, A. Besnard & C. Eraud** (2010). On the efficiency of using song playback during call count surveys of Red-legged partridges (*Alectoris rufa*). *European Journal of Wildlife Research,* **56:** 907–913.
[3] **Boyce, M.S., P.R. Vernier, S.E. Nielsen & F.K.A. Schmiegelow** (2002). Evaluating resource selection functions. *Ecological Modelling,* **157:** 281–300.
[4] **Anderson, D.R., W.A. Link, D.H. Johnson & K.P. Burnham** (2001). Suggestion for presenting the results of data analyses. *Journal of Wildlife Management,* **65:** 373–378.
[5] **Zuur, A.F., E.N. Ieno & C.S. Elphick** (2010). A protocol for data exploration to avoid common statistical problems. *Methods in Ecology and Evolution,* **1:** 3–14.

Keywords: *Alectoris rufa*, breeding density, habitat selection, presence, resource selection functions

(poster #53)

Coexistence of Eurasian lynx and wolf with no dietary niche overlap in north-west Anatolia

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Eurasian lynx (*Lynx lynx*) and wolf (*Canis lupus*) often occur together, sharing the same habitats. Having similar body sizes, they are able to prey on the same species [1]. Therefore, the niche overlap between these two species is one of the key questions to understand the relations of these two predators.
Albeit there are studies on wolf and lynx co-occurrence and interactions in Europe, there are none yet in Turkey, although both species are present here. As this two predators being able to coexist in Anatolia [2, 3], the question of the niche overlap and possible competition rises up. To quantify the level of dietary niche overlap between wolf and lynx, we implemented a diet analysis study of both species based on scat samples. We collected and analysed 69 lynx and 54 wolf samples in a steppe-forest mix ecosystem in central north-west Anatolia. Diet analysis revealed 8 prey items for each predator, wild boar (*Sus scrofa*) and brown hare (*Lepus europaeus*) being the only two common prey species for both predators. While wild boar made up 58.6 % of the biomass for wolf diet, biomass in lynx diet consisted of 90% brown hare. The second main wolf dietary item was red deer (*Cervus elaphus*) with 16% biomass; the remaining prey species showed all less than 10% including Anatolian wild sheep (*Ovis gmelinii anatolica*) and domestic livestock (*Ovis musimon*). After calculation of Pianka´s index [4], the difference in diet of those two predators became more prominent with only 1.9% niche overlap.
In contrast to the very little overlap in dietary niche in our study area, the niche overlap calculated by Pianka´s index can go from 90% up to 99% in Eastern Europe [1; 5]. Thus, even while sharing the same prey species, wolf and lynx can get along in coexistence. Moreover, they don´t avoid each other but have overlapping territories in Poland [6] and Nallıhan. The huge difference in niche overlap values between Eastern Europe and Anatolia is mainly caused by species predated by lynx. While wolves prey mostly on ungulates in both regions, lynx diet differs in Anatolia. Like wolf, lynx preys on ungulates in Eastern Europe [1; 5] but it seems to be more specialized on brown hare in Anatolia, what also indicates the importance of ecological studies on lynx in different regions.

References

[1] **Jedrzejewski, W., B. Jedrzejewska & A. Szymura** (1989). Food Niche Overlaps in a Winter Community of Predators in the Bialowieza Primeval Forest, Poland. *Acta Theriologica,* **34:** 487-496.
[2] **Mengüllüoğlu, D.** (2010). An inventory of medium and large mammal fauna in pine forests of Beypazarı through camera trapping. MSc Thesis, METU.
[3] **Ambarlı, H., & C. Bilgin** (2013). First record of melanistic golden jackal (*Canis aureus*, Canidae) from Turkey. *Mammalia,* **77:** 219-222.
[4] **Pianka, P.R.** (1973). The structure of lizard communities. *Annual Review of Ecology and Systematics,* **4:** 53-74
[5] **Valdmann, H., Z. Andersone-Lilley, O. Koppa, J. Ozolins & G. Bagrade** (2005). Winter diets of wolf Canis lupus and lynx Lynx lynx in Estonia and Latvia. *Acta Theriologica*, **50(4):** 521-527.
[6] **Schmidt, K., W. Jedrzejewski, H. Okarma & R. Kowalcyk** (2009). Spatial interactions between grey wolves and Eurasian lynx in Białowieza Primeval Forest, Poland. *Ecological Research,* **24:** 207-214

Keywords: *Canis lupus*, *Lynx lynx*, diet, niche overlap, Turkey, Anatolia

(oral)

Unsuspicious immigrant or ecological threat – a long-term field study on the introduced raccoon (*Procyon lotor*, Carnivora: Procyonidae) in Germany

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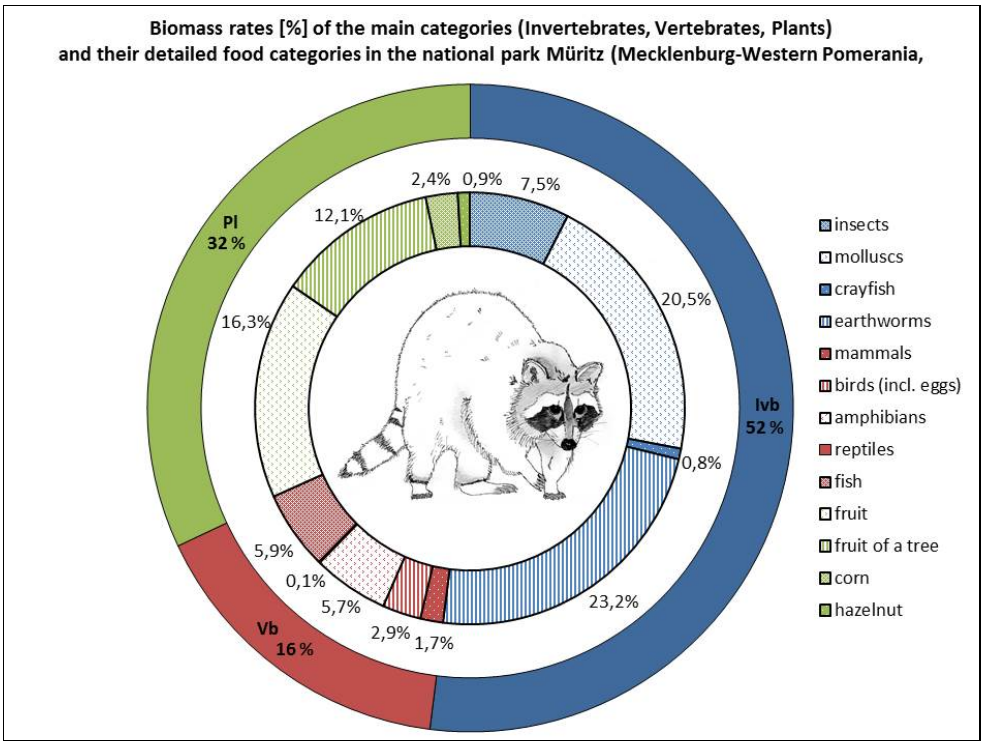
Alien species like the North American raccoon (*Procyon lotor*) can play a significant role in the ecological balance of their newly encountered biotope, particularly as their habits might overlap and compete with that of native animals. Raccoons are meanwhile naturalised in large areas of Europe and are regarded as a paramount example for a succesful establishment [1]. Against the background of a vast increase of raccoon numbers in Germany over the last years, a controversial discussion arose regarding the influence of the new inhabitant on indigenous resp. protected species and the potential transmission of diseases and parasites [2] However, extensive knowledge about the effects of raccoon settlement, primarily in natural landscapes, and the possible occupation of an ecological niche is entirely lacking so far. Until recently raccoons were ranked among the least investigated carnivores in Europe [3]. The numerous American studies concerning the nutrition biology of raccoons (e.g. [4-8]) are only of limited use for the evaluation of the influences in the central european habitat [9]. Aiming to elucidate the wildlife biology of this introduced species, a large perennial project has been conducted from 2006 to 2011 in the northeastern area of distribution in Germany (Müritz National Park, Mecklenburg-Western Pomerania; www. projekt-waschbaer.de). In 16 different sub studies and by telemetric control of 69 raccoons, profound data on the population biology in the allochthonous distribution area could be ascertained for the first time [10]. As raccoons are highly adaptable, especially in terms of different food sources, it is difficult to evaluate the nourishment composition against the background of a potential threat to indigenous species. Profound investigations concerning the nutrition ecology and parasitology were conducted as part of the described project; with scat analysis as the most informative approach [11]. For this purpose 113 different raccoon latrines were sampled over an area of 1.800 ha, resulting in a total of 1280 fecal samples. The feces were evaluated concerning frequency of occurrence and the consumed biomass of the various food components. However, based on nutrition analysis alone, predictions on the relevance of predation cannot be stated. A requirement is the possibility to relate the prey categories to the available resources in the study area. Data of the local population density and knowledge about the population structure allowed us to calculate the number of consumed individuals. This is a first time approach to estimate prey rates in order to assess local impact of predators.

We were able to confirm that raccoons are omnivorous and have an opportunistic dietary behavior. They can easily adapt to the local range of available food sources, whereby components are preferred which are easily available in large amounts. The nourishment of the raccoons in the national park basically consisted of the three main categories invertebrates (52 %), plants (32 %) and vertebrates (16 %, figure 1), showing distinct seasonal variances. Our results expose that no rare resp. endangered species were predated at a high rate. The results rather clarified the outstanding importance of invertebrates (especially aquatic molluscs and earthworms) in the diet of the raccoons throughout the year. The feeding analysis provided no evidence indicating a negative ecological impact on the autochthonous fauna in the Müritz National Park. Based on our results we conclude that due to the lack of food specialization, an endangerment of native species in the future is unlikely.

Figure 1: *Percentages of consumed biomass of the various food components by the raccoons in the Müritz National Park (n=982 fecal samples; 2006-2011). Abbr.: Ivb=Invertebrates, Vb=Vertebrates, Pl=Plants; drawing: B. Michler.*



References

[1] **Nehring, S., W. Rabitsch, I. Kowarik & F. Essl** (2015). Naturschutzfachliche Invasivitätsbewertungen für in Deutschland wild lebende gebietsfremde Wirbeltiere. Positionspapier des Bundesamtes für Naturschutz, BfN-Skript 409.

[2] **Michler, F.-U. & B.A. Michler** (2012). Ökologische, ökonomische und epidemiologische Bedeutung des Waschbären (*Procyon lotor*) in Deutschland – eine aktuelle Übersicht. *Beiträge zur Jagd- und Wildforschung,* **37:** 387-395.

[3] **Hohmann, U.** (2000). Raumnutzung und Sozialsystem des Waschbären in Mitteldeutschland. *Wildtier Schweiz*, **8/9:** 16 S.

[4] **Stains, H.J.** (1956). The raccoon in Kansas: Natural history, management, and economic importance (Miscellanous Publications 10). University of Kansas Museum of Natural History and State Biological Survey.

[5] **Johnson, A.S.** (1970). Biology of the raccoon (*Procyon lotor* varius Nelson and Goldman) in Alabama. *Auburn University Alabama Agricultural Experiment Station Bulletin,* **402:** 1-148.

[6] **Dunn, J.P. & J.A. Chapman** (1983). Reproduction, physiological responses, age structure, and food habits of raccoon in Maryland. *Mammalian Biology,* **48:** 161-175.

[7] **Smith, R.A., M.L. Kennedy & G.D. Baumgardner** (1987). Food habits of the raccoon (*Procyon lotor*) at Land Between the Lakes. *Journal of the Tennessee Academy of Science,* **62:** 79-82.

[8] **Parsons, A.W., T.R. Simons, A.F. O'Connell & M.K. Stoskopf** (2013). Demographics, diet, movements, and survival of an isolated, unmanaged raccoon *Procyon lotor* (Procyonidae, Carnivora) population on the Outer Banks of North Carolina. *Mammalia,* **77:** 21-30.

[9] **Holtmeier, F.-K.** (2002). Tiere in der Landschaft: Einfluss und ökologische Bedeutung. - Verlag Eugen Ulmer, Stuttgart.

[10] **Michler, F.-U.** (2016). Säugetierkundliche Freilandforschung zur Populationsbiologie des Waschbären (*Procyon lotor* Linnaeus, 1758) in einem naturnahen Tieflandbuchenwald im Müritz-Nationalpark (Mecklenburg-Vorpommern). Dissertation Technische Universität Dresden, 381 S.

[11] **Putman, R.J.** (1984). Facts from faeces. *Mammal Review,* **14:** 79-97.

Keywords: raccoon, invasive species, nutrition ecology, ecological impact

(oral)

Beliefs and support for use of nontoxic shot among Mourning Dove (Zenaida macroura) Hunters in Illinois, U.S.A.

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Trends from annual hunter harvest surveys suggest participation in mourning dove (*Zenaida macroura*) hunting in the state of Illinois, U.S.A. is declining [1]. Little is known about dove hunters and dove hunting in Illinois, and questions surrounding declining dove hunter involvement remain. Factors such as lack of access, poor habitat conditions, and lower dove populations have been proposed as contributing to the decline.

It has been suggested that use of lead shot is a factor in declining dove populations. Estimates exceed more than 50 million shot shells expended annually during dove hunting in the U.S. to harvest 12-18 million birds [2]. Given this relatively high amount of shot expended during the average dove hunting season nationwide, some researchers have proposed lead shot ingestion as a mortality factor among dove populations (see for example [3]). Castrale found densities of lead shot had significantly increased in fields used for dove hunting following the hunting season, compared with pre-season samples of the same fields [4]. Results of this study supported those found by Anderson; he found significantly greater amounts of spent lead shot in fields where dove hunting occurred [5]. Schultz et al. collected soil samples from 2 dove fields, one field hunted using non-toxic shot and the other with lead shot [6]. Post-season shot density for the non-toxic shot site was approximately 65% of that for the site allowing lead shot; doves retrieved from the non-toxic shot site contained significantly more ingested shot than those from the lead shot site. This difference led the authors to hypothesize that doves from the latter site that ingested shot died of lead shot toxicosis, although this hypothesis was not followed with testing to determine if those deaths occurred.

Lead shot bans for dove hunting have been proposed in several states of the U.S., however this action has been contentious. Moreover, past experiences related to hunter reactions to the prohibition of lead shot use in waterfowl hunting has prompted state wildlife agencies to gather data on hunter beliefs and attitudes toward nontoxic shot before imposing a ban on use of lead. Lead shot has been banned for use in waterfowl hunting throughout the United States since 1994. The Illinois Department of Natural Resources was exploring a ban on lead shot during 2012. The purpose of this study was to examine hunter attitudes and beliefs toward use of steel shot for dove hunting in Illinois, specifically between waterfowl and non-waterfowl hunters.

We conducted a repeat-wave mail survey of dove hunters in Illinois beginning 29 November 2012 and ending 5 April 2013. Samples of 3,000 hunters who reported they had hunted doves were selected from registrants of the Illinois Harvest Information Program (HIP) for each of the years 2009, 2010, and 2011, for a total sample of 9,000. We measured hunter participation in waterfowl hunting and beliefs toward nontoxic shot. The questionnaire contained 10 statements measuring beliefs about effectiveness, need, and expense regarding lead versus nontoxic shot. A total of 5,151 completed questionnaires were received for a response rate of 59%.

Independent samples t-tests (2-tailed) compared responses for belief statements from dove hunters with waterfowl hunting experience and those with no waterfowl hunting experience. Significant differences ($p < 0.001$) were found for 7 of the 10 statements; hunters with waterfowl hunting experience responded more negatively for statements regarding effectiveness and need for nontoxic shot (Table 1). Differences for expense of nontoxic shot were not significant. Significant differences ($t = 2.17$, $p < 0.03$) were reported for support for a ban on lead shot, with waterfowl hunters less supportive than non-waterfowl hunters.

Table 1. *Support for lead shot ban for dove hunting, by waterfowl hunting experience. (Illinois, U.S.A.)*[1]

		Strongly Disagree (%)	Disagree (%)	Slightly Disagree (%)	Unsure (%)	Slightly Agree (%)	Agree (%)	Strongly Agree (%)
I support the ban on lead shot for dove hunting.	Non-waterfowl Hunters	25	25	9	29	5	6	2
	Waterfowl Hunters	33	24	8	18	6	8	3

[1] Totals may exceed 100% due to rounding; $X^2 = 77.52$, $V = 0.131$, $p<0.001$

Table 2. *Beliefs about nontoxic shot for dove hunting, by waterfowl hunting experience. (Illinois, U.S.A.)*

		Mean	SD	t	*p*	*d*
Steel shot kills doves as effectively as lead shot	Non-Waterfowl Hunters	3.97	1.56	13.45	<0.001	0.456
	Waterfowl Hunters	3.20	1.81			
Steel shot can kill doves at the same distance as lead shot	Non-Waterfowl Hunters	3.78	1.40	14.47	<0.001	0.489
	Waterfowl Hunters	3.03	1.66			
I would cripple more doves if I used non-lead shot	Non-Waterfowl Hunters	4.07	1.40	8.30	<0.001	0.274
	Waterfowl Hunters	4.50	1.73			
I am not convinced that lead shot causes as much harm as people say	Non-Waterfowl Hunters	4.76	1.56	0.37	0.714	0.012
	Waterfowl Hunters	4.78	1.77			
Too much lead shot is ingested by wildlife	Non-Waterfowl Hunters	3.48	1.34	2.15	0.032	0.074
	Waterfowl Hunters	3.37	1.58			
Doves that eat lead do not get as sick as people think	Non-Waterfowl Hunters	4.23	1.15	4.58	<0.001	0.157
	Waterfowl Hunters	4.04	1.28			
I would rather spend the money I would spend on non-lead shot on something else	Non-Waterfowl Hunters	4.70	1.56	0.96	0.335	0.036
	Waterfowl Hunters	4.64	1.78			
Non-lead shot is too expensive for me to use for doves	Non-Waterfowl Hunters	4.95	1.58	0.64	0.522	0.018
	Waterfowl Hunters	4.92	1.83			
It is my right to decide what kind of ammunition I want to shoot at doves	Non-Waterfowl Hunters	5.07	1.62	5.06	<0.001	0.174
	Waterfowl Hunters	4.77	1.83			
Animal rights groups are responsible for the push to use non-lead shot	Non-Waterfowl Hunters	4.82	1.43	3.96	<0.001	0.387
	Waterfowl Hunters	4.62	1.62			

Dove hunters with waterfowl hunting experience were less supportive of a ban on lead shot for dove hunting than hunters who had not hunted waterfowl. Considering that lead shot has been banned for waterfowl hunting for 20 years prior to this study, results were surprising and suggest that use of nontoxic shot has not produced support among hunters. Results contradict harvest data that suggests duck and goose harvest and crippling has declined since the inception of the lead shot ban in Illinois (C. Miller, unpublished data). Discussion will focus on how beliefs are developed toward nontoxic shot and approaches to dispel them, and will also include relating this study to current efforts underway by FACE and member organizations regarding lead ammunition ban in the European Union.

References

[1] **Alessi, M.G., C.A. Miller & L.K. Campbell** (2012). 2011-2012 Illinois Waterfowl Hunter Survey. Job Completion Report, Federal Aid in Wildlife Restoration W-112-R-21. Human Dimensions Research Program Report HR-12-03/INHS Technical Report 2012 (20). Illinois Natural History Survey, Champaign, IL. 60 pp.

[2] **Raftovich, R.V., K.A. Wilkins, S.S. Williams & H.L. Spriggs** (2012). Migratory bird hunting activity and harvest during the 2010-2011 hunting seasons. U.S. Fish and Wildlife Service, Laurel, Maryland, USA.

[3] **Fisher, I. J., D.J. Pain & V.G. Thomas** (2006). A review of lead poisoning from ammunition sources in terrestrial birds. *Biological Conservation,* **131:** 421-432.

[4] **Castrale, J.S.** (1989). Availability of spent lead shot in fields managed for mourning dove hunting. *Wildlife Society Bulletin,* **17(2):** 184-189.

[5] **Anderson, W.L.** (1986). Investigations of abundance of spent shotgun pellets in soil and sediment in Illinois. Pages 43-49 in J. S. Feierabend and A. B. Russell, eds. Lead poisoning in wild waterfowl: a workshop. National Wildlife Federation, Washington, D.C.

[6] **Schultz, J.H., J.J. Millspaugh, B.E. Washburn, G.R. Wester, J.T. Lanigan & J.C. Franson** (2002). Spent-shot availability and ingestion on areas management for mourning doves. *Wildlife Society Bulletin,* **30 (1):** 112-120.

Key Words: Lead shot, nontoxic shot, bird hunting, beliefs, surveys, harvest

(poster #54)

The costs of wolves – Adaptive management for forest companies considering the comeback of large carnivores into Austria

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Public and private landowners in Austria earn their operating income not only from forestry and agricultural activities but also from the hunting branch of their business, hunting rights being bound to landownership in Austria. The current management of wildlife populations also assigned to the landowners, consists of a well-directed spatio-temporally and demographic influence and control of populations of ungulates. By this means, depending on the business aim, economic revenues from hunting are achieved and damages to forestry (caused by game) are minimized respectively.

Hunting and forestry practices, such as feeding game during the winter and the use of fenced winter preserves for Red Deer (*Cervus elaphus*) are common, thus prohibiting natural migration of these ungulates or use of open landscape while on the other hand enabling high densities of stocks. If large carnivores appear in the territory massive disturbances of the regular management processes are often feared.

We conduct a survey among managers, professionals and hunting clients of the ÖBf (Austrian Federal Forests), the largest ecosystem manager in Austria, to monitor the assumed difficulties with the increasing presence of large carnivores in the Alps.
In an innovative approach, the economic impact of large carnivores is addressed for the first time: Biological, sylvicultural, economic and political components of the problem are integrated into custom scenarios. On the basis of the results the ÖBf AG can consequently develop strategies for new adapted wildlife management options at the presence of large carnivores. By developing scenarios that also comment on current legal and political framework conditions the study is contributing to an improvement in dealing with large predators within a legal framework that binds hunting rights to landownership.

Keywords: Large Carnivores, Red Deer, wildlife management, hunting management, forestry

(oral)

Treasure in the bag – Analysis of hunting statistics and trophies proves unsustainable management of Chamois (*Rupicapra rupucapra L.)* in Bavaria, Germany

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Chamois (*Rupicapra r. rupicapra* L.) are protected under Annex V of the EU-FFH directive. Yet, in the alpine region of Bavaria (Germany) the indigenous chamois population is heavily hunted, because of surmised conflicts with foresty in the wintering habitats of the species. Over the last 30 years hunting pressure has steadily increased. Explicit culling programs by the State Forestry Board are enforced within the preferred wintering grounds. Neither is the overall hunting quota based on any population related data, e.g. monitoring. Nor are there any systematic records of the age and sex of the shot and culled animals. Yet there is increasing circumstantial evidence that the populations are severely depleted.
In lack of direct monitoring and of any official data to allow the reconstruction of the living populations and its demographic trend over the last two decades, the annual mandatory trophy shows in the area offer the unique opportunity to provide managers with the necessary data to evaluate the actual hunting quota as sustainable or not.
The analysis of the age and sex structure of the hunted population in relation to geographical data of areas with different hunting pressures and harvesting indicates (1) a substantial over-estimation of the living population, (2) subsequently a continuous overharvest of the Chamois populations in the Alpine region of Bavaria (Germany) and (3) a marked deterioration of the natural sex and age structure of the living population. This allows to demonstrate that the chamois population in Bavaria (Germany) is not managed sustainably and the Bavarian hunting regulations are in breach of the EU FFH directive. A guideline for future hunting management of chamois in Germany are developed on the basis of the current situation.

Keywords: chamois, hunting bag, population trend, population decline, hunting management

(oral)

Field evidence of neonicotinoid direct toxic effects on birds

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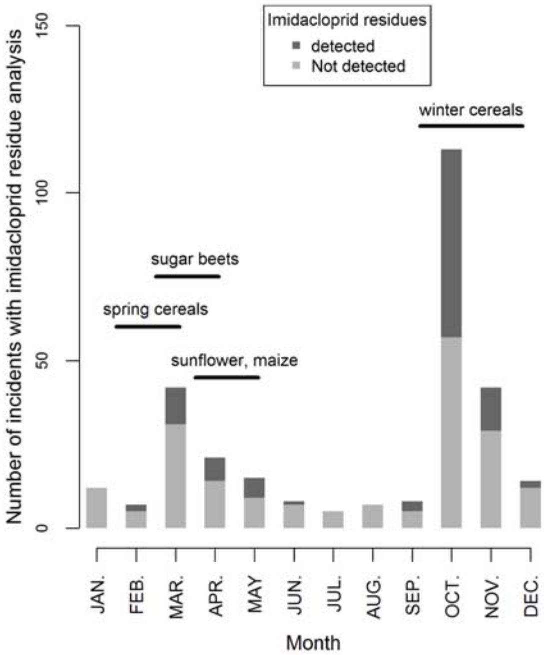
There are growing concerns about the potential adverse effects of the large-scale use of neonicotinoid insecticides on biodiversity and ecosystem functioning [1]. These concerns were firstly focused on invertebrates, especially pollinators. Neonicotinoids are insecticides that act as nicotinic acetylcholine receptor (nAChR) agonists. They have a greater affinity for insect nAChRs than to those of vertebrates [2]. As a result they are generally thought to be less harmful to mammals and birds. However concerns for vertebrates, especially birds, have also been raised. Hallmann et al [3] showed that birds have declined faster in areas with higher neonicotinoid concentrations in surface water. Because of the low toxicity of neonicotinoids to vertebrates and the diet of birds studied (mainly insectivorous), these authors argued that it is more likely that the observed declines are the result of knock-on effects of the widespread depletion of the insect populations caused by neonicotinoids. Nonetheless, as their results are derived from correlation, adverse consequences on bird populations due to direct lethal or sublethal effects cannot totally be excluded. All the more so that, at concentrations relevant to field exposure scenarios, neonicotinoids have the potential to cause direct adverse effects (e.g. [4], [5]). Yet, field evidence of neonicotinoid direct toxic effects on birds remains scarce.
In France the SAGIR Network performs the surveillance of pesticide unexpected acute effects on free-ranging wild birds and mammals. It is a generalist incident-based surveillance network for epidemiological vigilance towards wildlife diseases. It aims at detecting, as early as possible, abnormal mortality or morbidity signals and investigating the aetiologies of the ongoing morbid process. In order to investigate whether there is field evidence of neonicotinoid direct toxic effects on birds we reviewed wildlife incidents reported by SAGIR for which a real exposure to imidacloprid was confirmed (i.e. residues of imidacloprid detected in carcasses). Such cases are hereafter called "incidents". Here, we focused on imidacloprid because (i) it is considered as highly acutely toxic to some bird species - for example its oral median lethal dose (LD50) is 13,9 mg/kg for the grey partridge (*Perdix perdix*) - and it has been identified as a risk for granivorous birds when it is used as seed treatment [4] ; (ii) it is largely used around the world and mainly as seed treatment [6] ; (iii) a few wild bird poisoning events due to the ingestion of imidacloprid-treated seeds have already been recorded [7].
For each of these incidents we assessed whether imidacloprid poisoning may have been the root cause of these casualties. Diagnosis of poisoning relies usually on the acute toxicity of the suspected substance, the certainty of exposure, the amount of chemical ingested, and the relevance of the clinical picture. However, this information is often partial regarding wildlife casualties or references are absent. For example acute toxicity laboratory tests (e.g. LD50) are rarely available for wildlife species. So, we developed a decision tree based on eco-epidemiological criteria and a weight-of-evidence (WOE) approach to i) establish the link between the clinical effect (i.e. the mortality) and the exposure to imidacloprid and ii) estimate the intensity of the link [8]. In addition, epidemiological, agricultural and ecological circumstances associated with the discovery of these incidents were reviewed in order to investigate the potential risk factors that could explain the occurrence of these events.
From the 1st January 1995 to the 31st December 2014, the SAGIR network reported 101 incidents consistent with an agricultural use of imidacloprid. These incidents gathered at least 734 dead or dying individuals of at least 11 species of birds and 1 mammal. "Pigeons" (*Columba palumbus*, *Columba livia*, and *Columba oenas*) and grey partridges were involved respectively in 51% and 38% of the incidents. Since 1995, the yearly number of incidents varied between 0 (in 2009) and 10 (in 2010 and 2011). Incidents were more frequently reported in October-November and February-May periods, coinciding respectively with the "optimal" sowing period of winter cereals, spring cereals, sugar beets, sunflower and maize (Fig. 1). For these crops, imidacloprid is (or was) authorised as seed treatment. Dressed seeds were reported in digestive contents of carcasses for about two third of incidents. Autumn incidents (from September to December) represented 73% of the total incidents and they involved more individuals than spring incidents (February to June; Mann-Whitney U test, p-value <0.01; number of animals (median [min-max]): spring incidents: 1 [1 - 20] / autumn incidents: 3 [1-100]). Nervous disorders (sudden fall in flight, ataxia, paralysis or paresis, behaviour disturbance, disorientation, impaired alertness, apathy) were described in about 40% of incidents According to our weight-of-evidence

approach, the diagnosis of poisoning by imidacloprid-treated seeds in the agricultural context was classified as "very likely", "likely" and "possible" for 21%, 49% and 30% of the incidents, respectively.
As a result, through original approach (WOE approach) that will be detailed in the presentation, this work provides clear evidence that in real conditions granivorous birds are regularly exposed to imidacloprid-treated seeds that can result in acute lethal or sublethal effects.

Figure 1: *Monthly distribution of incidents (reported by SAGIR from 1st January 1995 to 31st December 2014) for which residue analysis of imidacloprid has been performed (and detection status), and corresponding sowing periods of maize, spring and winter cereals, sunflower, and sugar beet.*



References

[1] **van der Sluijs, & al.** (2015). Conclusions of the Worldwide Integrated Assessment on the risks of neonicotinoids and fipronil to biodiversity and ecosystem functioning. *Environmental Science and Pollution Research*, **22:** 148-154.

[2] T**omizawa, M & J.E. Casida** (2005). Neonicotinoid insecticide toxicology: mechanisms of Selective Action. *Annual Review of Pharmacology and Toxicology*, **45**G 247-268.

[3] **Hallmann, C.A., R.P. Foppen, C.A. van Turnhout, H. de Kroon & E. Jongejans** (2014).Declines in insectivorous birds are associated with high neonicotinoid concentrations. *Nature*, **511:** 341-343.

[4] **Gibbons, D., C. Morrissey & P. Mineau** (2015). A review of the direct and indirect effects of neonicotinoids and fipronil on vertebrate wildlife. *Environmental Science and Pollution Research*, **22:** 103-118.

[5] **Lopez-Antia, A., M.E. Ortiz-Santaliestra, F. Mougeot & R. Mateo** (2015). Imidacloprid-treated seed ingestion has lethal effect on adult partridges and reduces both breeding investment and offspring immunity. *Environmental Research*, **136:** 97-107

[6] **Jeschke, P., R. Nauen, M. Schindler & A. Elbert** (2011). Overview of the Status and Global Strategy for Neonicotinoids. *Journal of Agricultural and Food Chemistry*, **59:** 2897-2908

[7] **Bro, E., A. Decors, F. Millot, D. Soyez, M. Moinet, P. Berny & O. Mastain** (2010). Intoxications des perdrix grises en nature. Nouveau bilan de la surveillance « SAGIR ». *Faune Sauvage*, **289:** 26-32

[8] **Millot, F., A. Decors, O. Mastain, T. Quintaine, P. Berny, D. Vey, R. Lasseur & E. Bro** (2016). Field evidence of bird poisonings by imidacloprid-treated seeds: a review of incidents reported by the French SAGIR network from 1995 to 2014. *Environmental Science and Pollution Research,* doi.10.1007/s11356-016-8272-y

Keywords: Imidacloprid, dressed seeds, birds, mortality, *in situ*, wildlife

(poster #55)

Sex and age structure of grey partridge (*Perdix perdix* L.) populations during different seasons of the year

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In recent decades, the populations of grey partridge (*Perdix perdix* L.) have been declining in Europe due to disturbance to different habitats influencing the population structure. The age and sex structure of grey partridge populations can provide the insight into the stability of the population dynamics. Therefore, continuous monitoring of the abundance is required during different seasons of the year for at least five years, as well as spatial and temporal distribution of individuals belonging to different sex and age classes.

We analyzed the sex and age structure of grey partridge populations in the hunting ground "Nišava" (hunting association "Niš", Serbia) during February, August, September and October of 2014-2016. A total of 110 individuals were captured with mist nets and released after examination. Their sex was determined by plumage characteristics and primary-feather length indicated their age. We grouped individuals in four sex-age classes: subadult males, adult males, subadult females and adult females.

The abundance of adult males and adult females was approximately equal during February. During August, the majority of captured individuals were subadult males, while the rest were adult males. In September, adult males comprised the majority of the sample, followed by subadult males and adult females. In October, subadult males were the most abundant, while adult females were the least abundant sex-age class. Our results showed that adult and subadult males comprised the majority of the total sample, unlike adult females which were the least abundant. These results suggest the higher rates of males to females in grey partridge populations investigated during the analyzed seasons of the year.

Considering the differences between sex-age classes in different seasons of the year can be of great importance for conservation and management of grey partridge populations.

Keywords: grey partridge, *Perdix perdix*, sex and age structure, conservation, management

(poster #56)

Invasion of Shorebirds into Inland Wetlands of Ayyanar Lake, Thanjauver, Southern India

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The loss of feeding areas in the intertidal coastal wetlands may pose a threat to many wintering waders such as plovers and sandpipers. Wetlands are the major feeding habitats for water and shorebirds. The birds were estimated by total count method during 06.00 am to 06.00 pm weekly. Totally ten species of plover and sandpiper were observed from January-2013 to December-2014. The overall bird density was noted maximum during the monsoon period of first and second years. The density, diversity, and species varied significantly between the years and among the seasons. The present indicated that the shorebirds such as plovers and sandpipers are shifting their feeding ground from coastal mudflats into inland.

(oral)

Do hunting bag changes match the population trends of Turtle Dove? The case of Spain

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Turtle dove (*Streptopelia turtur*) is a trans-Saharan migratory species recently up-listed to Vulnerable status in the Red List of Threatened Species [1]. Breeding populations of turtle doves are declining throughout Europe, declines being particularly severe in certain countries (e.g: England, where the population has declined by 93% since 1995) [2]. Current estimates attribute 75% of the global breeding population to Europe, the remainder occurring in North Africa and Asia [3]. This fact is especially relevant since turtle dove hunting is allowed in eleven of the member estates of the EU, where large numbers of turtle doves are hunted annually. The European country where the greatest amount of turtle doves is hunted is Spain (around 701.600 birds in 2014), through which also passes the main migratory route for western European turtle dove populations [4] [5].

We analyzed turtle dove population trends for the different regions of Spain and for the whole country using available data from SACRE (Spanish contribution to the Pan-European Common Bird Monitoring Schemes (PECBMS) designed by the European Bird Census Council, and carried out in Spain by SEO/Birdlife International). Data from this program (kindly provided by SEO) included observations of turtle doves in 10x10 km quadrats in most of the Spanish regions from 1996 to 2016. Additionally, we compiled the number of birds hunted in each region from the official hunting statistics available since 2006 in the Ministry of Agriculture, Fishing, Food and Environment (before 2006, official statistics did not separate turtle doves hunted from other bird species).

We show that Turtle dove abundance in Spain declined around 40% since 1996. The decline happened in most of Spanish regions and it was especially remarkable in the North, where hunting is relative unimportant. Therefore, it seems that hunting is not the main reason behind the declines. Nonetheless, annual variation in the number of turtle doves hunted in each region was unrelated to annual variation in turtle dove abundance. Globally, hunting pressure (numbers shot) has not significantly diminished since 2006, despite observed population declines. Thus, although hunting is not the main driver of the decline, results also indicate that it could be an aggravating factor, and that current tools to determine the number of turtle doves that may be hunted are not efficient enough, or not correctly applied.

References

[1] **IUCN** (2016). *The IUCN Red List of Threatened Species. Version 2016-3.*
[2] **Harris, S.J., D. Massimino, S.E. Newson, M.A. Eaton, J.H. Marchant, D.E. Balmer, D.G. Noble, S. Gillings, D. Procter & J.W. Pearce-Higgins** (2016) *The Breeding Bird Survey 2015. BTO Research Report 687*. British Trust for Ornithology, Thetford.
[3] **Birdlife International** (2015) *Streptopelia turtur*. European Red List of Birds. Office for Official Publications of the European Communities, Luxembourg.
[4] **Cramp, S.** (1985) Handbook of the birds of Europe, the Middle East and North Africa. Volume IV, Terns to Woodpeckers: 353-363. Oxford University Press, Oxford.
[5] **Rocha Camarero, G. & S.J. Hidalgo de Trucios** (2002) La tórtola común (*Streptopelia turtur*). Análisis de los factores que afectan a su status. Servicio de Publicaciones de la Universidad de Extremadura, Cáceres.

Keywords: Turtle doves, population trends, hunting bag

(oral)

Pesticide-coated seeds as a threat to red-legged partridges and other granivorous farmland birds: evidence from studies conducted in Spain

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The coating of seeds with pesticides is widely used in agriculture, and is increasingly recognized as a significant threat to farmland birds. During the sowing season, spilled and unburied seeds constitute an abundant and easily accessible resource for granivorous animals. Farmland birds may be attracted by, and feed on some of these seeds, with the consequent risk of ingesting large amounts of pesticides in a short time and suffering toxic effects. We review here recent knowledge gathered on risks and effects of pesticide-coated seed ingestion in the red-legged partridge *Alectoris rufa* in Spain, and present future directions for research on this topic. Experiments conducted on captive partridges exposed to seed coated with fungicides (difenoconazole, thiram) or insecticides (imidacloprid, fipronil) have shown a wide range on effects, from increased mortality to reduced reproductive output, as well as adverse effects on bird physiology and condition. We briefly review these effects, depending on the dose and the chemicals used. We also review information on the palatability and availability in the field of pesticide-coated seeds, and on their prevalence in the gizzard of red-legged partridges hunted in Spain. Finally, we present current research plans aimed at: i) validating biomarkers of exposure using non-invasive methods, ii) refining exposure assessment of wild red-legged partridges through a better understanding of space use and diet, and iii) testing the effectiveness of measures aimed at minimizing the risk of treated seed ingestion by partridges and other farmland birds.

Keywords: Red-legged partridge, agriculture, pesticide, coated seeds, conservation

(oral)

Sarcocystosis in European wildfowl and the hunters' role in surveillance of an apparently emerging wildlife infection

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Sarcocystosis or "rice breast disease" appears to be an emerging disease of wildfowl in Europe. The causative protozoal parasite, *Sarcocystis* spp. has an indirect life cycle using birds as intermediate hosts and their carnivorous predators as definitive hosts [1]. In the USA, the disease has a widely variable prevalence in dabbling ducks (*Anas* spp.) of between 5-65%, depending on the geographical location, age and species affected [2,3]. Notable recent observations occurring in Lithuania [4] have suggested possible European spread.

In the UK, the Wildfowl & Wetlands Trust's long term wildlife disease passive surveillance system examining found dead wildfowl has identified a small number of cases of suspected sarcocystosis in dabbling ducks since 2011. An original anecdotal report to WWT from a wildfowler in ~2005 has been followed by similar reports since 2010.

The characteristic "rice grain" lesions of the disease are readily identifiable in the pectoral and thigh musculature of affected duck carcasses [1]. These striking pathognomonic lesions present an opportunity for hunters to become an important part of a nationwide surveillance programme in hunted birds to assess both distribution, and temporal changes in prevalence of disease amongst shot wildfowl and therefore evidence for emerging status. Hence, a project was established to create awareness of the disease amongst wildfowlers, encourage reporting of cases in the UK and survey hunters of their personal experience of the disease over lifetimes of hunting activity to explore temporal and spatial incidence of the disease across Europe.

This abstract reports findings available at the time of writing and the presentation will provide fuller results of the whole project.

Methods

UK: Between 2015 and 2017 awareness raising within the shooting community was undertaken via articles in the British shooting press and via the British Association for Shooting and Conservation's (BASC) newsletters to wildfowling members. A website was created www.sarcocystissurvey.org.uk and reports of finding birds with typical sarcocystosis lesions in pectoral muscles were submitted during the wildfowling season, with additional ad hoc reporting directly to those involved in the project. Tissues were retained by some of the hunters, either chilled or frozen, and subsequently submitted to the project. Samples of macrocysts present within affected muscle were genetically analysed for Sarcocystis species identification. Histological assessment of affected muscle was undertaken to look for any evidence of negative impacts the parasite may be having on host health, in particular myositis which has been previously reported [5].

European Questionnaire Survey: a questionnaire and survey methodology were designed and then rolled out by BASC to its wildfowling members in the UK; and by the European Federation of Associations for Hunting & Conservation (FACE) which facilitated both translation of the questionnaire and the surveying of hunters of their continental member organisations.

Results

During the first season of the project in the UK (2015/16) some seven reports of infected wildfowl were submitted, with this increasing to >30 in the following shooting season (2016/17). The vast majority of cases were dabbling ducks but infection was also reported in a greylag goose *Anser anser* and woodpigeon *Columba palumbus*. Reports were submitted from across the UK suggesting widespread infection.

It is not clear whether the increase from 2015/16 to 2016-17 is due to raised awareness of the reporting mechanism or actual increase in incidence of the infection or both.

At the time of writing, results from both the diagnostic work on the parasite involved and the questionnaire survey are awaited.

The project will explore issues around the emergence of the infection, reasons behind this emergence, potential impact of the infection on populations of birds, and will speculate on which carnivore(s) is involved in the lifecycle of the parasite.
The project represents an example of partnership working and a citizen science approach to surveillance with potential conservation benefits for European dabbling duck populations and for the stakeholders involved that could readily be expanded to other countries and regions.

References

[1] **Friend, M. & J.C. Franson** (1999). Sarcocystis. In: Field Manual of Wildlife Diseases. General field procedures and diseases of birds (No. ITR-1999-001). Geological Survey Madison WI, Biological Resources Div. pp. 219-222.
[2] **Hoppe, D.M.** (1976). Prevalence of macroscopically detectable Sarcocystis in North Dakota ducks. *Journal of Wildlife Diseases*, **12(1):** 27-29.
[3] **Costanzo, G.R.** (1990). Sarcocystis in American black ducks wintering in New Jersey. *Journal of Wildlife Diseases*, **26(3):** 387-389.
[4] **Kutkienė, L., P. Prakas, A. Sruoga & D. Butkauskas** (2011). Identification of *Sarcocystis rileyi* from the mallard duck (*Anas platyrhynchos*) in Europe: cyst morphology and results of DNA analysis. *Parasitology Research*, **108 (3):** 709-714.
[5] **Wobeser, G. & R.J. Cawthorn** (1982). Granulomatous myositis in association with Sarcocystis sp. infection in wild ducks. *Avian diseases*, **26(2):** 412-418.

Keywords: infection, emerging, rice breast disease, sarcocystis, wildfowl

(oral)

Competition between a native and a non-native ungulate – is mouflon an invasive species within Hungarian fauna?

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The impact of mouflon on rock grasses has been a subject of debate in Hungary since the mid-1970s. The damages mouflons cause through grazing and trampling are correlated to its non-native species status. To demonstrate these effects, several exclosure experiments were implemented. However, the interpretation of the results was mainly speculative for several reasons. Firstly, in most cases it is impossible to distinguish the effects of mouflon from that of its sympatric species (e.g. red deer). Secondly, a complete exclusion of ungulates from the control territory cannot reflect a natural process. Finally, and most importantly, the 3-5 year timeframes of the experiments could not provide reliable results because inconstant environmental factors, such as rainfall distribution, can obscure the effect of grazing [1].

Our objective was to gather more information about the ecological role of the mouflon, its impact on the habitat, and thereby determine if it should be considered an invasive species. We estimated mouflon habitat preference with pellet group counts using Ivlev-index [2] and tested for significance with the Bonferroni Z-test [3]. We compared the autumn-winter diet of mouflon by microhistological analysis of the rumen content [4] in two consecutive years with different snow conditions. With the microhistological analysis of the pellet groups, we compared the year-round diets of mouflon and red deer. To test the homogeneity between the samples originating from the two species over the four seasons, we utilised the chi-square test. For the measurement of species diversity, the Shannon index that is sensitive to rare species was used [5]. Differences between the diversities were tested by the Shannon diversity t-test, the bootstrap method, and diversity ordering. Food preference was calculated using an Ivlev-index tested for significance with the Bonferroni Z-test. The dietary niche width of mouflon and red deer was calculated with the Levins' formula [6]. The niche overlap between the two species was determined with the Renkonen index [7]. To calculate competitive pressure, we employed the Levins' formula.

The investigation was performed in the North Hungarian Mountains, where the highest peak is 938 m above the sea level. As for the terrain, beech forests are characteristic on the northern and north-western slopes, while the southern and south-eastern slopes are covered mainly by oak and hornbeam forest stands interspersed with rock grasses.

Our results show that mouflon preferred open grassy areas, old growth turkey oak / sessile oak forests, and young reforestations; all of these habitat types possess dense ground cover vegetation. Mouflon shunned dense thickets and medium-age stands. Mouflon and red deer adapt their feeding habits according to following: the season, changes in their habitat (e.g. snow cover), and their dietary overlap. In the case of mouflon, grasses make up 56% of food intake. The consumption of grasses decreased only during snowy winters when the overwhelming majority of its diet was beech twigs (84%). Due to the scarce food supply of the shrub cover that is characteristic to mountainous habitats, red deer became predominantly grass and roughage eater; more than 50% of its diet was grass. Consequently, there is significant competition for food between red deer and mouflon. The niche overlap between the two species, measured with the Renkonen-index, was the highest in winter (58.17 %). This decreased in spring (54.52%) and summer (52.12%) and was the lowest in autumn (40.78%).

Our results show that the mouflon is a generalist food consumer. Instead of changing its habitat, the mouflon adapts to worsening habitat conditions by narrowing its dietary niche and/or becoming a generalist feeder. Being an intermediate feeder in forested areas, the diet of red deer was mainly composed from twigs, bark and leaves of arboreal plants. However, in high mountainous areas it becomes a grass eater [8]. Although our research site was located a forested area, the shrub layer was very scarce; consequently, there was a high ratio of grass in the diet composition of deer. This shows a relatively large niche overlap with mouflon. The competition for food between the two species was relatively low for most of the year and increased only in late-winter/early-spring when food supply was scarce. The potential competitive pressure of mouflon was higher on red deer then it was the other way around. The most probable reason for this was that the food supply of the territory was more suitable for mouflon than it was for red deer.

In conclusion, our results emphasize that the damages inflicted on rock grasses by mouflon are not a consequence of the non-native status of the species. Although the species is allochthonous, it cannot be considered invasive, as it poses no threat to the native biological diversity (definition by [9]) any more than the native red deer does. The only threat it could possibly pose is overabundance, but this holds true for red deer also. However, the above results do not mean that the mouflon's presence in nature protected areas or in the Hungarian fauna has any justification at all. The role of the mouflon should be considered instead by means of evolutionary biology and the historical evolution of fauna, not on the basis of the damages made to rock grasses.

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References

[1] **Dremmel, L.** (2014). Feeding of mouflon and red deer and habitat preference of the mouflon and its effect on the ground cover vegetation of specific forest associations in the North-West Börzsöny. PhD Thesis, University of West Hungary, Sopron, 89 pp.
[2] **Ivlev, V.S.** (1961). Experimental Ecology of the Feeding of Fishes. Yale University Press, New Haven, Connecticut, USA, 302 pp.
[3] **Byers, C.R., Steinhorst R.K. & P.R. Krausman** (1984). Clarification of a technique for analysis of utilization-availability data. *The Journal of Wildlife Management,* **48:** 1050-1053.
[4] **Heroldová, M.** (1997). Trophic niche of three ungulate species in the Pálava Biosphere Reserve. *Acta scientiarum naturalium Academiae Scientiarum Bohemiacae*, **31(1):** 52 pp.
[5] **Pielou, E.C.** (1966). The measurement of diversity in different types of biological collections. *Journal of Theoretical Biology,* **13:** 131-144.
[6] **Levins, R.** (1968). Evolution in changing environments: Some theoretical explorations. Princeton University Press, Princeton, N.J., 120 pp.
[7] **Krebs, C.J.** (1989). Ecological methodology. Harper Collins Publishers, New York, 654 pp.
[8] **Suter, W., U. Suter, B. Krusi & M. Schutz** (2004). Spatial variation of summer diet of red deer *Cervus elaphus* in the eastern Swiss Alps. *Wildlife Biology,* **10(1):** 43-50.
[9] **IUCN** (2000). Guidelines for the Prevention of Biodiversity Loss Caused by Alien Invasive Species. Gland, Switzerland: SSC Invasive Species Specialist Group.

Keywords: mouflon, red deer, non-native species, competition, damage

(oral)

Video and camera traps to investigate animal ecophysiology and enhance wildlife management: case study on bees and elephants interactions in Gabon

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Crops are often sources of conflict between humans and wildlife. Wildlife damage to crops can drastically reduce income, amplifying poverty and creating a negative perception of wild animal conservation among rural people. In this context, crop-raiding animals like elephants quickly become “problem animals”. To deter elephants from raiding crops beehives have been successfully employed in East Africa while providing honey for the farmers. Whether such a technique could work on forest elephants (*Loxodonta Africana cyclotis*) in Central Africa is still unknown. An ecophysiology-based trial consisting on bees and elephants interactions assessment was conducted in Gabon. It aimed to evaluate whether the presence of *Apis mellifera adansonii*, the African honey bee species present in Central Africa, deters forest elephants from feeding on experimental wild fruit trees. For this purpose video cameras were used to record activities of bees in fourteen beehives hung on seven wild trees (4 *Irvingia gabonensis* and 3 *Sacoglottis gabonensis* trees) each equipped with a camera trap to record elephants feeding behaviors on those trees. This experimental apparatus was monitored during 70 consecutive weeks from 2012 to 2013.

We captured 8151 photos representing 4h31min42s of time spent by elephants at experimental trees and more than 75 videos of bees activities from where we extracted genuine results. Our results show a significant correlation between the effectiveness of beehives as deterrents of elephants and bee activity. Although elephant disturbance of hives does not inhibit honey production, there is a tradeoff between deterrence and the quantity of honey produced. More interestingly, to best achieve the dual goals of deterring elephants and producing honey colonies must maintain an optimum activity level of 40 to 60 bee movements per minute. Thus *Apis mellifera adansonii* bees can effectively deter elephants but beehives must be actively managed to maintain bees’ colonies at the optimum activity level.

Reference

[1] **Ngama, S., L. Korte, J. Bindelle, C. Vermeulen & J.R. Poulsen** (2016). How bees deter elephants: beehive trials with forest elephants (Loxodonta africana cyclotis) in Gabon. *PLoS ONE,* **11(5):** e0155690. doi:10.1371/journal.pone.0155690

(poster #57)

Magnetic alignment in European hares? Preliminary results on form direction

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Mammals show a directional respond to the geomagnetic field. This magnetic alignment represents a spontaneous, fixed directional response in which mammals align their bodies along or perpendicular to the magnetic field lines. We tested the potential effect of the geomagnetic field on the position of forms used by European hares (*Lepus europaeus*) in an arable landscape in Lower Austria. For 400 forms we determined their direction to the nearest 5° and classified them into the categories N, NE, E, SE, S, SW, W, NW. The statistical analysis revealed no significantly preferred direction but a rather uniform alignment (Rayleigh-Test: p= 0.4798, Chi-square: p = 0.05877). There is no evidence for dependence of form direction on vegetation height, ground cover or main wind direction in our study site. Effects of agricultural land orientation on form alignment could only be explored in cropland with cereal grain only. We suggest hares adjust form alignment on small-scale structures like machine tracks or plow furrow and on prevalent environmental conditions. To sum up, magnetic alignment in European hare seems to be negligible under natural conditions and largely suppressed by numerous other orientation determining factors.

Reference

[1] **Begall, S., J. Červený, J. Neef, O. Vojtěch & H. Burda** (2008). Magnetic alignment in grazing and resting cattle and deer. *PNAS,* **105:** 13451–13455

Keywords: Lepus europaeus, European hare, magnetic alignment, geomagnetism

(poster #58)

Responses of captive wolves (*Canis lupus*) to novel visual, acoustic and olfactory stimuli

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Neophobia, or the fear of novelty, is an important element to consider for predator management, as novel elements placed on the landscape might lead predators to avoid sensitive areas such as livestock pastures. Since the act of predation involves a process of sensory orientation, novel stimuli affecting predators' sensory channels may be particularly effective. Exploring the relative effect of various novel visual, acoustic and olfactory stimuli on predators' feeding behaviour can help increase the relevance of species-specific repellents. Wolves' response to various repellents has seldom been studied. The aim of our study was to assess the relative effect of various novel sensory stimuli on sub-adult, captive and naïve wolves during feeding. We simultaneously presented feeding points associated with various visual, acoustic and olfactory stimuli and with a control to a group of five captive wolves over up to 12 trials. Stimuli tested differed in nature and activation mode, and included simple visual objects, intermittent light, motion-activated light, intermittent sounds, continuous sounds, motion-activated ultrasounds, artificial smell, and organic smell. We compared mean latencies to approach and consume feeding points, and carried out Principal Component Analyses (PCA) to uncover factors related to wolves' response to novelty.

Latencies to approach and consume feeding points associated with simple visual objects and intermittent sounds were much larger than for those associated with continuous sounds, ultrasounds, lights, and olfactory cues. Unlike what literature suggests, we found that motion-activated devices (lights and ultrasounds) repelled wolves less effectively than permanent and intermittent stimuli. Hence, neotic responses of wolves depended more on the nature of the acoustic and visual stimuli rather than on their activation mode. PCA revealed weak correlations between latency to approach and latency to consume the feeding point associated with intermittent sounds, indicating that wolves were torn between avoidance and investigative behaviour. Number of approaches tended to decrease over trials for the visual objects. Thus, wolves were more perseverant in approaching intermittent sounds than simple visual objects, which resulted in earlier habituation. Longer latencies to approach were associated with less wolves approaching the visual objects, and with less approaches and less wolves approaching the intermittent sounds, indicating the existence of a group effect. Individual boldness may also partly explain this result.

While our results do not directly reflect the effect of disruptive stimuli on adult and possibly hungry free-ranging wolves, they do indicate the relative impact of various sensory stimuli on wolves' feeding behaviour. Such explorative study could help finding relevant sensory characteristics for species-specific repellents. For future research, we recommend to focus on comparing specific stimulus properties in order to narrow down conclusions. Various factors, unrelated to stimuli properties, should also be addressed to understand their feedback on species' neophobia, including rotating stimuli to delay habituation, the effect of conspecifics' presence and the effect of the familiarity with the environment. Such research should be carefully planned in order to minimize biases and test specific research hypotheses.

Keywords: behaviour, *Canis lupus,* disruptive, neophobia, novelty, sensory stimuli

(poster #59)

Effect of a conspecific's presence on grey wolf's (*Canis lupus*) reaction to novelty

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Neophobia is a highly labile trait, and varies according to intrinsic and extrinsic factors. As wolf packs display high sociality, individual behaviour may be influenced by other group members' actions and decisions. Social facilitation can speed up the process of familiarization to novelty. Innovative behaviours, such as learning to by-pass livestock protection systems, could thus spread among individuals. The aim of the present study was to assess a wolf's behavioural response to various novel stimuli before, during and after presence of a bold conspecific.

The experimental subject was a shy 1-year-old female wolf who had been raised with minimal human contact. The female's response to novelty was assessed using 4 feeding points randomly dispersed in the enclosure, one associated with a novel visual stimulus, one with a novel acoustic stimulus, one with a novel olfactory stimulus, and one as a control. 16 daily trials were conducted, and on each trial the female was exposed to feeding points over three successive 2-h phases: 1) alone, 2) in presence of a bold 2-years-old male conspecific, and 3) alone again. Prior to the experiment, it had been verified that the bold conspecific was oblivious to the novel stimuli tested. Latencies to approach and consume were recorded for each feeding point and each test phase.

Regardless of the test phase, our female subject approached and consumed feeding points associated with the control and olfactory stimulus the fastest, followed by acoustic stimulus, and visual stimulus. The control feeding point and feeding point associated with the olfactory stimulus were consumed fast even before presence of the bold individual. As opposed to the control, mean latencies to approach and consume feeding points associated with the visual stimulus and the acoustic stimulus were shorter after presence of the conspecific. Throughout trials, the subject never consumed feeding points associated with the visual stimulus before presence of the conspecific. After 4 daily trials, the subject started to consume faster feeding points associated with the acoustic stimulus both after and before presence of the bold conspecific.

The female did not show any sign of neophobia towards the olfactory stimulus, which is consistent with previous results. On the other hand, indications of neophobia towards the acoustic and visual stimuli were found. The presence of a conspecific contributed to abate the subject's fear towards the acoustic stimulus over test phases and over time. However, for the visual stimulus evoking a particularly strong emotional reaction from our subject, we found that the presence of a conspecific did not contribute to consistently reduce neophobia over time. Studying an individual's level of neophobia is a way of measuring its boldness, which is one of the most commonly studied personality trait. However, the measure of boldness may be influenced by social interactions. Our results indicate that although the presence of a bold conspecific may facilitate wolf's habituation to novelty, social facilitation depends on the initial level of neophobia evoked by a specific novel stimulus.

Keywords: *Canis lupus*, conspecific, neophobia, novelty, social facilitation

(oral)

How to promote the cooperation of wildlife management by using inclusion as a tool in collaborative management

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Wildlife management raises more and more discussions and disputes in the Finnish society today. Studies show that the relation to nature and wildlife is changing rapidly in the urbanized areas, while a closer relation and more traditional values still remain in the rural areas. In addition, changes in the society pose new challenges to the traditional methods used in natural resource management. Political conflicts of interests between the urban and rural society, the uprising of radical movements and the increased use of social media has resulted in an intolerance and aggressiveness, that is reflected by indifference and disregard towards other stakeholders and local citizens.

Parks & Wildlife Finland administers more than 12 million hectares of state-owned land and water areas. The main tasks are to protect and manage species, habitats and cultural heritage, and to provide outdoor recreation services for hikers, hunters and fishers and grant land use permits. Management and land-use plans are devised for the nature conservation, wilderness and hiking areas. Throughout the planning process, stakeholders and the general public have the opportunity to influence the plan through a framework of community-based natural resource management. Management and land-use plans, produce the guidelines for hunting and fishing activities as well.

This framework is also used as a part of conflict management during the implementation of the plans and the continual game and fisheries management. Stakeholders are included as a part of the management strategy, when defining the problem, analysing the pros and cons, and when agreeing on actions. However, the changes in the society have increased the intolerance between stakeholders and towards the managers. This phenomenon, has forced wildlife managers to create and introduce new tools on how to include stakeholders in the conflict management of natural resources.

Keywords: wildlife management, conflict, inclusion

(oral)

Location, location, location! Fitness consequences of choosing among habitats

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The increasing availability of movement data has led to a huge number of studies explaining variation and mechanisms related to animal space use patterns [e.g. 1,2]. However, studies about how these processes translates to individual variation in fitness or life history traits have been lagging behind [but see 3,4]. Given the expectation that the time an animal spend in any location should reflect the location's value [5], it is paramount to assess this assumption with the statistics calculated, when data is available in order to avoid measuring for the sake of measuring [6].
Such knowledge is important for a joint management of habitats and wildlife. Here we first describe seasonal variation in habitat utilisation of a harvested moose population, and second, relate individual variation in fitness-related traits to habitat associations during summer and winter.
With seasonal changes in environmental conditions and resource quality and quantity, one would expect corresponding changes in the moose's foraging niche. As a capital breeder where body mass is a key trait for maternal investment [7], the moose should adapt its habitat use accordingly throughout the year, otherwise risk suffering large fitness consequences [8]. We linked several fitness-related components, such as calf body mass and calving rate, to habitat utilisation during winter and summer in order to 1) assess which habitat components affect moose fitness, 2) whether this differed during summer and winter both with respect to explanatory power, and finally 3) which habitat type best explained fitness-related traits.
Space use patterns of 62 female moose were measured from GPS data. Habitat utilisation was measured as probability of use based on kernel density estimators of seasonal home ranges for each individual and year. To ensure consistency, we compared the results with alternative kernel methods.
As expected, the moose showed marked behavioural responses to the changing environment. The seasonal variation in habitat utilisation showed clear trends reflecting the trade-off between the habitat types' expected seasonal differences quality and availability. Through particular characteristics of the study site we are also able to exemplify limits of behavioural trade-offs. Furthermore, as use is dependent on availability, we also analysed the variation among individuals in shaping their home ranges to maximize the cost-benefit trade-off of using habitat types across the landscape. The variation in these seasonal changes in behaviour and habitat utilisation strategies among individuals where in most cases also reflected in several of the fitness measurements attained.
Our results suggest that the management of ungulate populations needs to take into account the entire landscape, and its seasonal importance, in order to ensure continued productivity of local populations. Moreover, land use management such as forestry and agricultural development should acknowledge the impact of their decisions of wildlife inhabiting the landscape.

References

[1] **Walter, W.D., D.P. Onorato & J.W. Fischer** (2015). Is there a single best estimator? Selection of home range estimators using area-under-the-curve. *Movement Ecology,* **3:** 10
[2] **Fleming, C.H., Fagan, W.F., Mueller, T., Olson, K.A., Leimgruber, P. & J.M. Calabrese** (2015). Rigorous home range estimation with movement data: a new autocorrelated kernel density estimator. *Ecology,* **96:** 1182-1188
[3] **McLoughlin, P., J.M. Gaillard, M. Boyce, C. Bonenfant, F. Messier, P. Duncan, D. Delorme, B.V. Moorter, S. Saïd & F. Klein** (2007). Lifetime reproductive success and composition of the home range in a large herbivore. *Ecology,* **88:** 3192-3201
[4] **Allen, A.M., A. Dorey, J. Malmsten, L. Edenius, G. Ericsson & N.J. Singh** (2016). Habitat-performance relationships of a large mammal on a predator-free island dominated by humans. *Ecol. Evol.,* **7:** 305-319
[5] **Charnov, E.L.** (1976). Optimal foraging, the marginal value theorem. *Theor. Popul. Biol.,* **9:** 129-136

[6] **Cagnacci, F., L. Boitani, R.A. Powell & M.S. Boyce** (2010). Animal ecology meets GPS-based radiotelemetry: a perfect storm of opportunities and challenges. *Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences,* **365:** 2157-2162
[7] **Testa, J.W. & G.P. Adams** (1998) Body condition and adjustments to reproductive effort in female moose (Alces alces). *J. Mammal.,* **79:** 1345-1354
[8] **Hamel S, Côté SD**. (2009) Foraging decisions in a capital breeder: trade-offs between mass gain and lactation. *Oecologia,* **161:** 421-432

Keywords: ungulate, movement ecology, fitness, habitat, space use

(oral)

New findings in dispersal, habitat-related breeding-success and predation in Danish grey partridge

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Numbers of grey partridges have declined dramatically in Denmark since the 1960s, as in other West European countries. Despite the decline and major focus on management, no studies on breeding success and predation based on radio marked wild birds have previously been conducted in Denmark. In terms of management, we largely have had to rely on results from abroad. To improve national knowledge on breeding success, predation and land use, we captured 161 grey partridges and radio collared 91 female birds. All birds were captured, released and tracked weekly or daily in the incubation period on the peninsula of Djursland during 2013-2015.

Contrary to the findings in England [1] we found that Danish partridges were very sensitive to human disturbances at the nest site. If an incubating hen was disturbed, even for a short period, she often abandoned all eggs, even full clutches with 19-20 eggs. As a result, it was necessary to maintain a distance of minimum 30 meters and use mortality sensors to monitor predation.

Contrary to the general opinion that partridges are rather stationary, we found that Danish birds disperse up to 22,5 km during spring when flock structure brakes up and breeding pairs are formed. This finding give us hope, that areas where grey partridges have disappeared can be recolonised naturally if habitats are improved.

In accordance with French findings [2] Danish birds often use conventional agricultural crops as nest site. On average 50 % of the Danish birds established their nest in crops. Winter wheat provided the necessary cover to avoid nest predation, while all breeding attempts in rape seed with open understory failed. Furthermore, we found that very few nests were located near tall trees or close to the typical Danish broad-leafed hedgerows. Those located there were all predated.

26% of the radio marked grey partridge pairs hatched a clutch of eggs successfully. 64% were predated during the period from January to August. Approximately half of the birds were predated during incubation. Predators were primarily mammals (fox and badger 30%; birds of prey 20%; domestic cat 16%; mink and ferret 12%; stone marten 4%, others and unidentified 18%). No predation was observed from corvids before hatching.

Important future management objectives:

- Predation is limiting production in Danish grey partridge stressing the importance of regulating generalist mammal predators.
- Reduce the number of tall trees and other ecological traps in the landscape.
- The modern agricultural landscape lacks areas suitable for raising partridge chicks i.e. areas with open- and species rich vegetation of flowering herbs providing the basis for a diverse fauna of insects.

References

[1] **Potts, G.R.** (2012). Partridges. HarperCollins Publishers. Pp. 465.

[2] **Bro, E., F. Reitz & J. Clobert** (2000). Nest site selection of grey partridge (*Perdix perdix*) on agricultural lands in north-central France. *Game and wildlife science,* **17:** 1-16.

Keywords: Grey partridge, breeding success, predation, dispersal, nest site, future management

(oral)

Landscape-scale removal of conifers to improve sage-grouse vital rates

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Introduction

Conifers such as western juniper (*Juniperus occidentalis*; hereafter juniper) have expanded into sagebrush ecosystems in the Great Basin of the western United States largely due to anthropogenic changes in wildfire return intervals [1]. These range expansions are considered a primary threat to greater sage-grouse (*Centrocercus urophasianus*; hereafter sage-grouse) [2], a sagebrush obligate that has undergone an approximately 50% range contraction [3]. Sage-grouse are known to avoid conifers at canopy cover levels as low as 4% [4]. Increasing juniper cover in sagebrush ecosystems may negatively affect sage-grouse vital rates due to increased predation as a result of greater hiding cover for mammalian predators and more numerous perches for avian predators. However, little is known about the demographic impacts of broad-scale removal of encroaching conifers.

A treatment area with juniper removal and a control area without any juniper removal were established as a long-term study site in Oregon, USA to assess the impact of landscape-scale juniper removal on sage-grouse. Juniper removal began in the treatment area in 2012 and the majority of removals were completed by the end of 2014. To date, juniper have been removed across approximately 13,000 ha of the treatment area. Using a before-after-control-impact (BACI) framework, we assess adult female survival, nest survival, and brood survival to test the hypothesis that removal of juniper will improve these vital rates at the long-term, study site in Oregon.

Methods

Marked female sage-grouse were tracked using VHF telemetry and GPS transmitters in the treatment area (n ~ 40 per year) and control area (n ~ 40 per year) from 2011 through 2016. Adult annual (March-February) and breeding season (April-July) survival were assessed using known fate models in MARK. Nest survival (27 days) and brood survival (54 days post-hatch; 2015-2016 only) were estimated in MARK using nest survival models and Lukacs young survival from marked adults models, respectively. Model averaging was used to account for uncertainty in model selection based on AIC.

Results

We captured and marked 277 female sage grouse in the treatment (n = 147) and control areas (n = 130) from 2011-16. We monitored 339 nests in the treatment (n = 179) and control areas (n =160) over the course of the study. A total of 62 broods were tracked in the treatment (n = 30) and control areas (n = 32) during the two years analysed here (2015-16). The overall trend was positive for annual survival, breeding season survival, and nest survival over the course of the study with the exception of 2015, when breeding season and nest survival were both lower in the treatment relative to the control (Table 1). Brood survival models indicated model averaged estimates of 0.358 (SE = 0.063) for the treatment area and 0.054 (SE = 0.027) for the control in 2015. Estimates for 2016 were 0.038 (SE = 0.022) for the treatment area and 0.067 (SE = 0.034) for the control.

Discussion

These preliminary analyses indicate an increasing trend in estimated treatment effect relative to the control area for breeding season survival and nest survival over the course of the project (Table 1). Brood survival in the post-juniper removal landscape was not consistently higher in the treatment relative to the control during the two years we analysed here. These dynamics may be more sensitive to demographic stochasticity and environmental factors than active management of encroaching juniper. However, removing juniper may buffer the effects of environmental factors and stabilize these dynamics. Adult annual female survival was consistently higher in the treatment relative to the control with the estimated treatment effect increasing each year of the project (Table 1). Sage-grouse are longer lived than most galliforms; subsequently, population growth rate (λ) is particularly sensitive to changes in adult female annual survival [5]. These results indicate that the ongoing removal of encroaching conifers such as juniper in sagebrush ecosystems may be an effective tool for increasing population growth rates and bolstering dwindling sage-grouse populations. We hope to formalize these data into integrated population models that incorporate lek counts in order to better understand how juniper removals have impacted the sage-grouse populations in the project area.

Table 1: *Annual, breeding season, and nest survival (based on 27-day incubation) estimates of female sage-grouse in southern Oregon during 2011-2016 in a treatment area (juniper removal) and control area (no juniper removal) derived from model averaged parameter estimates.*

	Year	Control (SE)	Treatment (SE)	Standardized Difference[1] (SE)
Annual Survival	2011	0.464 (0.058)	0.485 (0.057)	0.000 (0.082)
	2012	0.479 (0.044)	0.510 (0.043)	0.010 (0.062)
	2013	0.489 (0.046)	0.526 (0.045)	0.016 (0.065)
	2014	0.491 (0.050)	0.530 (0.049)	0.018 (0.071)
	2015	0.646 (0.073)	0.725 (0.065)	0.058 (0.098)
April-July Survival	2011	0.691 (0.048)	0.706 (0.046)	0.000 (0.067)
	2012	0.700 (0.035)	0.722 (0.034)	0.007 (0.050)
	2013	0.707 (0.034)	0.731 (0.032)	0.009 (0.048)
	2014	0.701 (0.040)	0.729 (0.037)	0.013 (0.056)
	2015	0.846 (0.050)	0.844 (0.049)	-0.017 (0.070)
	2016	0.842 (0.053)	0.858 (0.046)	0.001 (0.070)
Nest Survival	2011	0.286 (0.092)	0.286 (0.086)	0.000 (0.128)
	2012	0.444 (0.064)	0.476 (0.070)	0.033 (0.095)
	2013	0.463 (0.054)	0.507 (0.049)	0.044 (0.073)
	2014	0.480 (0.058)	0.532 (0.058)	0.052 (0.082)
	2015	0.583 (0.113)	0.460 (0.094)	-0.123 (0.147)
	2016	0.288 (0.072)	0.323 (0.072)	0.035 (0.102)

[1] Estimated treatment effect. The difference between control area and treatment area and standardized with the pre-treatment year (2011) set to zero.

References

[1] **Miller, R.F. & J.A. Rose** (1999). Fire history and western juniper encroachment in sagebrush steppe. *Journal of Range Management*, **52:** 550-559.

[2] **Baruch-Mordo, S., J.S. Evans, J.P. Severson, D.E. Naugle, J.D. Maestas, J.M. Kiesecker, M.J. Falkowski, C.A. Hagen & K.P. Reese** (2013). Saving sage-grouse from the trees: a proactive solution to reducing a key threat to a candidate species. *Biological Conservation,* **167:** 233-241.

[3] **Schroeder, M.A., C.L. Aldridge, A.D. Apa, J.R. Bohne, C.E. Braun, S.D. Bunnel, J.W. Connelly, P.A. Deibert, S.C. Gardner, M.A. Hilliard, G.D. Kobriger, S.M. McAdam, C.W. McCarthy, J.J. McCarthy, D.L. Mitchel, E.V. Rickerson & S.J. Stiver** (2004). Distribution of sage-grouse in North America. *The Condor,* **106:** 363-376.

[4] **Severson, J., C. Hagen, J. Maestas, D. Naugle, J. Forbes & K. Reese** (2016). Effects of conifer expansion on greater sage-grouse nesting habitat selection. *The Journal of Wildlife Management.* DOI: 10.1002/jwmg.21183.

[5] **Taylor, R., B. Walker, D. Naugle & L. Mills** (2012). Managing multiple vital rates to maximize greater sage-grouse population growth. *The Journal of Wildlife Management,* **76:** 336-347.

Keywords: BACI, conifer encroachment, sage-grouse, vital rates

(oral)

Livestock-wildlife disease interactions in the rural landscape

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Native and exotic ungulates may have a role in the transmission of diseases to domestic animals serving as reservoirs or vectors for spreading diseases. *Rhipicephalus* ticks are the vectors of cattle fever tick, which are distributed worldwide. White-tailed deer (*Odocoileus virginianus*) and nilgai antelopes (*Boselaphus tragocamelus*) are important secondary hosts for the cattle fever tick species *Rhipicephalus (B.) annulatus* and *Rhipicephalus (B.) microplus.*Nilgai were introduced to the United States from India. In 1929 and 1930, 12 nilgai were introduced to the Norias Division of the King Ranch in South Texas. The population increased to more than 200 by mid-1950, and to 4 500 and 15 000 animals by 1983 and 2004, respectively. Currently, we estimate a population of over 38 000 and individual animals and herds of up to 11 cows have been observed around Kingsville, TX., far north from the initial release site. Nilgai can be viewed as a valuable species for hunting and meat, or as an invasive species that compete for food and space with native wildlife species and it may disperse diseases. In ranches with high cattle stocking rates and low forage availability, nilgai and white tailed deer diets overlapped; under those conditions they were competing for food. When grass availability is high nilgai may also compete with cattle too since they are intermediate feeders. Recently, cattle fever ticks were found on nilgai in the Mexico border. This is important because nilgai may move ticks long distances. Nilgai male home ranges ranged from 1 135 to 29 827 ha, and for females from 1 117 to 22 662 ha, therefore, potential for spreading ticks and risk for the cattle industry may be high.

(poster #60)

Effect of parasitosis and virosis on the physiologic condition and population dynamics of wild European rabbit (*Oryctolagus cuniculus*)

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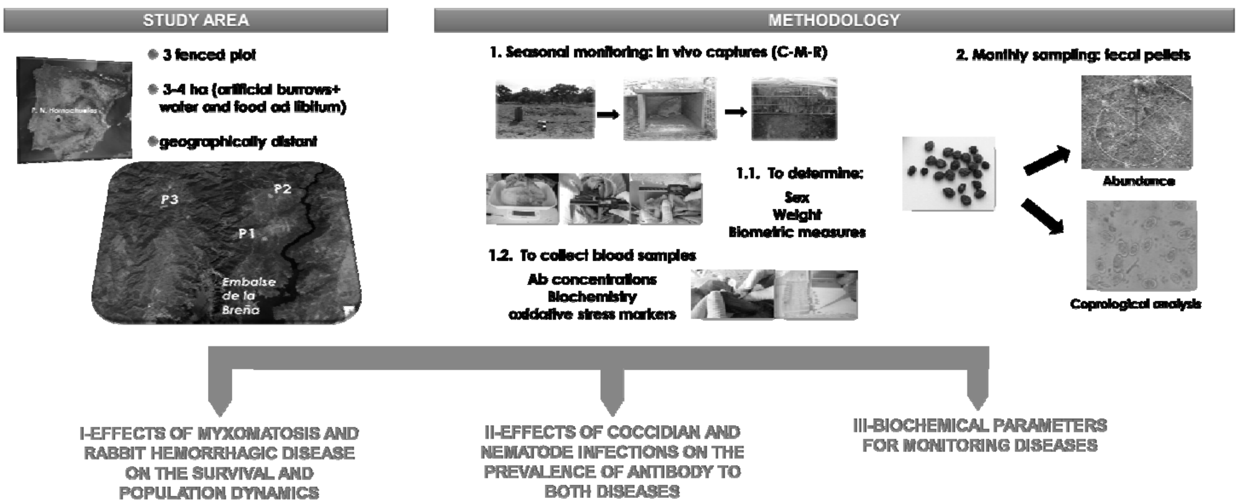
The wild European rabbit constitutes a key species in the Mediterranean ecosystems, mainly because it represents the bulk of the diet of a wide variety of Iberian predators. These include the Iberian lynx (*Lynx pardinus*) and the Spanish imperial eagle (*Aquila adalberti*), both seriously threatened. Despite being historically numerous and widespread on the Iberian Peninsula, the European rabbit populations have undergone a dramatic decline in the last century due to the emergence of two viral diseases, habitat loss and an excessive hunting pressure, within others. Certainly emerging and re-emerging infectious diseases play an important role in the population dynamics of wild species. Undoubtedly, they are one of the main threats in wildlife conservation. Despite of many years of research, there are still many knowledge gaps regarding the dynamics of infectious agents in their individual hosts, and what determines their impact on life-history traits. The present PhD project is aimed at studying eco-epidemiological parameters from a wild population by using as a model species the European wild rabbit (*Oryctolagus cuniculus*) and the two main viral diseases that affect them (myxomatosis, and rabbit hemorrhagic disease). We will use the data collected in an ongoing project entitled: ‘Scientific monitoring and enhancement of *Oryctolagus cuniculus* populations in the Hornachuelos Natural Park (Figure 1). This project provides an outstanding opportunity to study and monitor the emergence and development of diseases on wild rabbit populations. Furthermore interactions between pathogens with abiotic and biotic factors could be identified, as well as the ultimate effects on the rabbit population dynamics (Figure 1). The main aim is to improve strategies against diseases and minimizing their impact on natural populations. Ultimately the results from this PhD would improve management plans for the conservation of keystone species of the Mediterranean ecosystems and therefore the endangered predators that prey upon them.

Figure 1. *Study area and description of the methodology used in this project*



Keywords: coccidia, myxomatosis, Nematode, rabbit hemorrhagic disease, rabbit survival

(oral)

Presentation of the French National Management Plan for the Eurasian Curlew (*Numenius arquata arquata*) 2015-2020.

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The Eurasian curlew (*Numenius arquata arquata*) is a highly migratory species widely distributed, breeding across Europe from the British Isles, through north-western Europe and Scandinavia into east of Russia. It winters around the coasts of north-west Europe, the Mediterranean, Africa, the Middle East, the Indian Subcontinent, South-East Asia.
This widespread wader species remains common in many parts of its range, and determining population trends is problematic. Nevertheless, during the past 40 years declines have been recorded in several key populations in Europe, where 75% of the global population is living. In France, breeding pairs are estimated between 1 300 to 1 600, with a reduction of 25% in the last 15 years whereas the wintering population is estimated around 23 000 individuals (from 20 000 to 52 000) and seems to be slighthy increasing since the last 30 years. Changes in land-use, agricultural practices and nest predation are considered the most significant causes responsible for this decline in the EU. As a result, in 2007 the species was uplisted to the globally Near Threatened (NT) category of the IUCN Red List of Threatened Species, and Vulnerable (V) category of the IUCN European Red list in 2015.
Listed on Annex II/2 of the EU Birds Directive as a species for which hunting can be permitted in Denmark, France, Ireland and UK, the Eurasian Curlew is nowadays hunted only in France, submitted to a partial moratorium since 2012 allowing hunting at certain coastal sites from august to febrary.

After the EU Management Plan for Eurasian Curlew from 2007 to 2009, an International Single Species Action for the conservation of the Eurasian curlew was written at the end of 2015 giving action priorities to each European country in order to stabilise breeding populations and restore the favorable conservation status of the species. In France, the Government ordered to the French Game National and Wildlife Agency (ONCFS) the writing of the French National Management Plan for the European curlew, which was published in 2013.
This French National Management Plan, refreshed with all recent information, started at the end of 2015. Piloted by the Regional Direction of the Environment (DREAL) of Normandie, the plan is animated by the Regional Federation of hunters of Normandie with the assistance of NaturAgora Developpement. The plan presents a framework for the restoration of Eurasian curlew conservation status in France with an operational strategy summarized in five specific objectives corresponding to the threats previously identified, declined into 15 actions.

Keywords: *Numenius arquata arquata*, national management plan

(poster #61)

Spread and transmission dynamics of Spiculopteragia spiloptera (Gushansky, 1931) determined by population genetic structure study in roe deer from Champagne-Ardenne, France

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Goals in epidemiology are to evaluate the prevalence, the intensity, the range, to understand transmission mechanisms and the persistence of the pathogen agent in the environment, in order to determine the best strategy to control sanitary and zoonotic risks. These tenets must be applied for animal parasitic infections, which globally, are associated with significant economic losses to the livestock industry in most countries, and are of major socio-economic importance.
Among nematode parasites, *Spiculopteragia spiculoptera* is a widespread Strongylids in wild ungulate localized on the abomasum. Primarily observed in roe and red deer, it is also reported but less often in domestic livestock (sheep, goats and cattle). Little is known about its epidemiology and its pathogenicity in ruminants while it can be abundant, so it seems important to study it and explore its propagation among ruminants.
Thus, in the context of IN SITU research program, the aim of this study was to understand the genetic variation and the population genetic structure of *S. spiculoptera* nematode parasites from roe deer living in disconnected forests from Champagne-Ardenne Region to shed light on the evolution, spread and transmission dynamics of this pathogen, which can be crucial to improve the implementation of control strategy for zoonotic risks.
A total of 254 individuals *S. spiculoptera* from 23 roe deer coming from eight forests were collected along the Region and were analyzed with 12 new polymorphic microsatellite markers previously developed. Estimate of FST global value was 0.005 ± 0.002 across all sampled groups suggesting that effective dispersal is limited among forests. Isolation-by-distance (IBD) was not significant (Mantel test = 0.332, $P = 0.071$), meaning that genetic divergence was not correlated with geographic distance and individuals were not more genetically different when they were geographically distant. Finally, STRUCTURE software analysis did not detect any population structure among all parasite samples, meaning that *S. spiculopteragia* from this Region belong to only one genetic population. Hence, since this parasitic helminth is a non-mobile organism and infection dynamics are strongly influenced by host life history and its social system, our results suggest that their hosts, roe and red deer, are all in contact, even if they live in disconnected forests.

Keywords: *Spiculopteragia spiculoptera*, nematode parasite, population genetic structure

(oral)

Use of DNA technology to define moose populations for management

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Moose (*Alces alces*) management is challenging, since the population size of moose in a given area will vary throughout the year when the moose migrate between summer/fall and winter foraging areas. In Scandinavia moose management is currently based on administrative borders (e.g. among landowner associations or municipalities). Basing moose management on more biologically meaningful areas defined by annual population home ranges, including migratory routes, would be a key to better moose management. It is a general problem that wildlife management acts at a scale that is not connected to the ecological phenomena they are supposed to manage.

The traditional way of determining moose annual home range and migration routes between summer and winter ranges is to use VHF or GPS-collared animals. However, this technology is not readily available to managers due to ethical and legislative challenges concerning management-collaring, as well as due to the high costs of collaring. Here, we investigate the potential in using DNA technology as a cost effective tool for moose management, and investigate if: 1) We can discriminate among moose populations based on their genetic structure. 2) We can assign moose individuals to their original genetic population, and 3) the method is economically feasible for regional management, or if this cost has to be taken by the central wildlife authorities. We collected tissue samples from moose shot during regular hunt across Hedmark County (27 000 km2), Norway. These samples were analysed, and we identified a set of Single Nucleotide Polymorphisms (SNPs) among the sampled moose. We were able to classify four distinct genetic subpopulations inside Hedmark County. We were also able to identify gene flow in the form of migrant individuals among the populations. Due to its efficiency and relatively low economic cost, this method could serve as a valuable tool for defining more biologically meaningful management areas for moose.

Keywords: DNA, wildlife management, scale

(oral)

Rather talk than trap - why we need to change wildlife management concepts for urban areas

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An increasing number of wildlife species is living in urban environments. Cities and villages provide abundant food resources and high structural diversity as habitat features. Wildlife species adapt to human presence with behavioural changes. This development has positive and negative impacts on human inhabitants of urban areas, which range from positive effects on mental wellbeing, aesthetic and cultural values on the one side to economic damages, threats to health and security and nuisances on the other [1]. The task of wildlife management is to balance out positive and negative impacts [2]. However, there are particular challenges in urban areas to be dealt with. Urbanization leads to a shift in the socio-cultural landscape of citizens, which results in more emotional wildlife values [3] The high diversity of individual needs of urban citizens need to be considered, what complicates decision-making processes [3]. Urban societies are increasingly loosing knowledge of nature [4], which boosts conflicts in human-wildlife interactions. The choice of management interventions is limited. Lethal methods for population control are expensive and not feasible and often lack acceptance in the society [1]. Urban wildlife and the related conflicts touch a wide array of stakeholders, which need to be coordinated. This challenges communities and district administrations, which in the case of Baden-Württemberg, like in many other regions of Germany, have not yet developed sound concepts for urban wildlife management. In the federal state of Baden-Württemberg, Germany, wildlife management structures particularly for game species, focus traditionally on resource use by hunting in rural areas.
Throughout our research project on urban wildlife in Baden-Württemberg, we identified through a participatory process among stakeholder groups five key elements to improve urban wildlife management concepts:
1. Improve information: Many human-wildlife conflicts are triggered by a lack of knowledge among citizens. Correct and evidence-based information is scarcely available for the public. Well designed information campaigns and direct consulting by managers could lower human-wildlife conflicts in urban areas. Education on urban wildlife is a chance to bring back environmental understanding to citizens of urban areas.
2. Establish structures: So far, there are no authorities in Baden-Württemberg appointed to develop urban wildlife management structures. There is a need for a coordinating position on the district level to support communities in developing concepts and to establish a network of experts. Further, there is a need for an executing position at the local or community level, which can take direct action like removing problem wildlife individuals, manage wildlife accidents and educate citizens. To ensure adaptability of wildlife management, monitoring needs to be implemented: Cases should be documented and the success of management interventions need to be evaluated.
3. Capacity building: Wildlife managers in Baden-Württemberg are not educated to deal with the challenges of urban wildlife management. There is a need for capacity building in communication and conflict management, legal frameworks, handling and trapping urban wildlife and applicable management interventions in urban areas. Frequent exchange of experience by wildlife management should be established and supported.
4. Habitat management: High abundance and conflicts with urban wildlife are often triggered by habitat features like supplemental feeding through citizens. Habitat management could on the one hand reduce conflicts with nuisance species, on the other hand support endangered species in urban environments. Therefore, wildlife managers should get involved into urban planning and design. However, there is a big knowledge gap and research need about habitat use and requirements of urban wildlife.
5. Coexistence with wildlife: We need to accept that wildlife is part of the urban environment. This key element is closely related to the element of improving information, but changing the attitudes of acceptance in a positive way must be seen as a longer process.
As a result of our study, we now work on the design and implementation of urban wildlife management concepts in two model regions of Baden-Württember

References

[1] **Soulsbury, C.D. & P.C.L. White** (2015). Human-wildlife interactions in urban areas: a review of conflicts, benefits and opportunities. *Wildlife Research,* **42(7):** 541-553.
[2] **Riley, S.J. et al.** (2012). Wildlife management as a process within a system. In: Decker, D.J. et al. (eds.) (2012). Human Dimensions of Wildlife Management. 2nd ed., *The Johns Hopkins University Press*, 87-100.
[3] **Patterson, M.E. et al.** (2003). The urbanization of wildlife management: Social science, conflict, and decision making. *Urban For. Urban Green,* **1:** 171-183.
[4] **Miller, J.R.** (2005). Biodiversity conservation and the extinction of experience. *TRENDS in Ecology and Evolution,* **20(8):** 230-234

Keywords: urban wildlife management, stakeholder involvement

(oral)

Impacts of diverse ungulate communities on forestry in different land-use settings

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Large herbivores impact forest ecosystems by altering community structure and composition throughout all trophic levels [1,2]. In many parts of Sweden ungulate communities have changed from single or two species – moose (*Alces alces*) and/or roe deer (*Capreolus capreolus*) – to much more diverse communities including species such as red deer (*Cervus elaphus*), fallow deer (*Dama dama*), and wild boar (*Sus scrofa*). These ungulate communities inhabit landscapes that are increasingly modified by humans in ways that affect the ungulates, but also increase human-wildlife conflicts. In order to predict the ecological needs of species, their potential impacts on ecosystems, and their interspecific interactions, relationships between population densities and habitat structure must be understood [3].

In this ongoing study, we aim to investigate the impacts of ungulate communities (with increasing species richness) on forestry and agricultural ecosystems in Sweden. Partly we do this by linking multiple national databases on ungulate harvest, observations, and wildlife accidents with forestry damage from ungulate browsing at the scale of designated moose management areas (MMAs) of Sweden. We established the distribution and densities of these species at the national scale and observed that browsing damage to forests increases with species richness and ungulate densities. However, the extent of forest damage is also influenced by food availability in the landscape. We further discuss the implications of our results for the management of ungulates in Sweden and the ecosystem services they provide and impact. Ungulate management can be improved and adjusted on a regional scale but also forestry can get a better understanding of damage prevalence in certain areas.

References

[1] **Latham, J.** (1999). Interspecific interactions of ungulates in European forests: an overview. *Forest Ecology and Management,* **120:** 13–21.

[2] **Naiman, R.J.** (1988). Animal influence on Ecosystem Dynamics: Large animals are more than passive components of ecological systems. *BioScience*, **38(11):** 750-752.

[3] **Ferretti, F., G. Bertoldi, A. Sforzi & L. Fattorini** (2011). Roe and fallow deer: are they compatible neighbours? *Eur J Wildl Res,* **57:** 775–783.

Keywords: multispecies communities, forestry, browsing damage

(poster #62)

Habitat suitability model for *Lepus corsicanus* in Corsica (France), implications for its conservation

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The Italian hare (*Lepus corsicanus*) was introduced into Corsica during the historical period for hunting purposes. A recent study [1] has shown its extensive presence in the northern part of the island and its scarcity in the south. In Italy, its land of origin, this species is listed as «Vulnerable» in the IUCN Red List. In Sicily the species is hunted and widely distributed with good population density, but on the mainland, with often fragmented and small populations [2], it is considered to be in regression and have a protected species status. The objective of this work is to identify the species' potential distribution in Corsica in order to suggest appropriate management actions. We collected 484 confirmed observations of the species between 2002 and 2012 based on molecular or phenotypic criteria. Spatial filtering and projection on a 1x1 km UTM grid over the entirety of Corsica enabled us to define a sample of 170 species presence cells to build our model. The habitat in each cell was characterized through 18 land use/cover variables as well as aspect and altitude (Tab. 1). We used the Maximum Entropy Model [3] to define the potential distribution area of the species on the island, with the following settings : automatic feature selection, a regularisation multiplier at unity, a maximum of 500 iterations, 10 replicates by cross-validation and a convergence threshold of 10^{-5}. A map of the potential distribution of the species was constructed using the logistic output. The graph of Fig. 2 shows the receiver operating characteristic (ROC) curve, averaged over the replicate runs. The average test AUC for the replicate runs is 0.736, and the standard deviation is 0.050. In Fig. 3 for each variable the dark coloured bar corresponds to models generated with only this variable. The light coloured bar corresponds to the generated models omitting the variable. The most important predictors were the presence of gentle or no slopes (<5°, as_nodet) and the presence of grasslands. The absence of steep slopes is a characteristic of agricultural land but also of all the more anthropized areas. The map (Fig.4) shows that the species currently occupies the major favourable areas of the island, mainly in the northern half. Less favourable zones however remain unoccupied and could still be utilized. These are mostly the areas South of Bastia (A), North of Ajaccio (B) and South of the island between Porto-Vecchio and Sartène (C). Zone A has already shown a natural colonization by the species since 2013. Zone B showed over 2002 and 2012 a particularly hybridized hare population due to the introduction of *L. europaeus* and *L. granatensis*, and where *L. corsicanus* represented only 37 % of analyzed specimens during this period. Zone C showed presence of hybrids as well, and specimens of *L. europaeus* and *L. granatensis*, though only over part of the zone. In conclusion the actions planned are as follows. Zone A: Natural colonization will undoubtedly be the best chance of progression of the species, although it would be helpful to introduce individuals originating from the main range. Zones B and C: The future of the Italian hare will depend foremost on the future policy of hare populations management in Corse-du-Sud, where introduction of *L. europaeus* continues to have official support in 2017. The potential repopulation of these zones with *L. corsicanus* will indeed require not only that current introduction ceases, but also that no hare other than the Italian hare remain in the zones.

***Figure 1:** Status of* L. corsicanus *in its current range.*

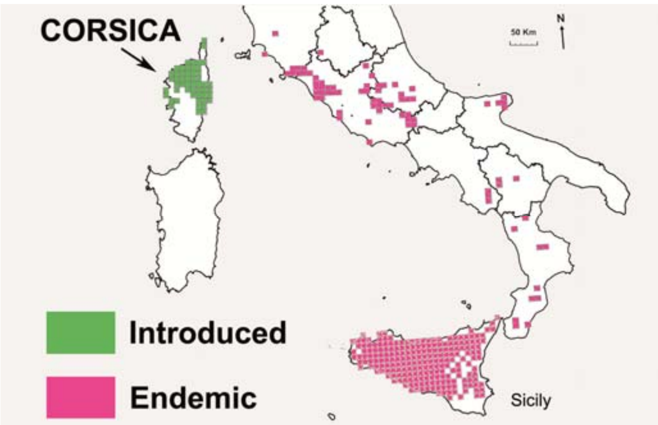

***Figure 2:** Average Sensitivity vs. 1 - Specificity for Lepus_corsicanus.*

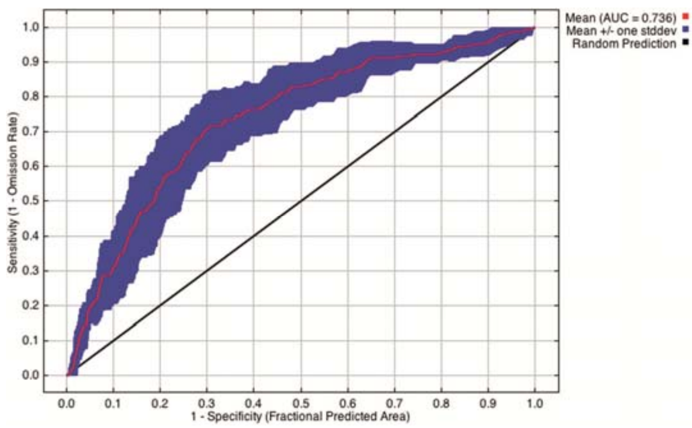

Figure 3: *Jackknife of AUC for Lepus_corsicanus.*

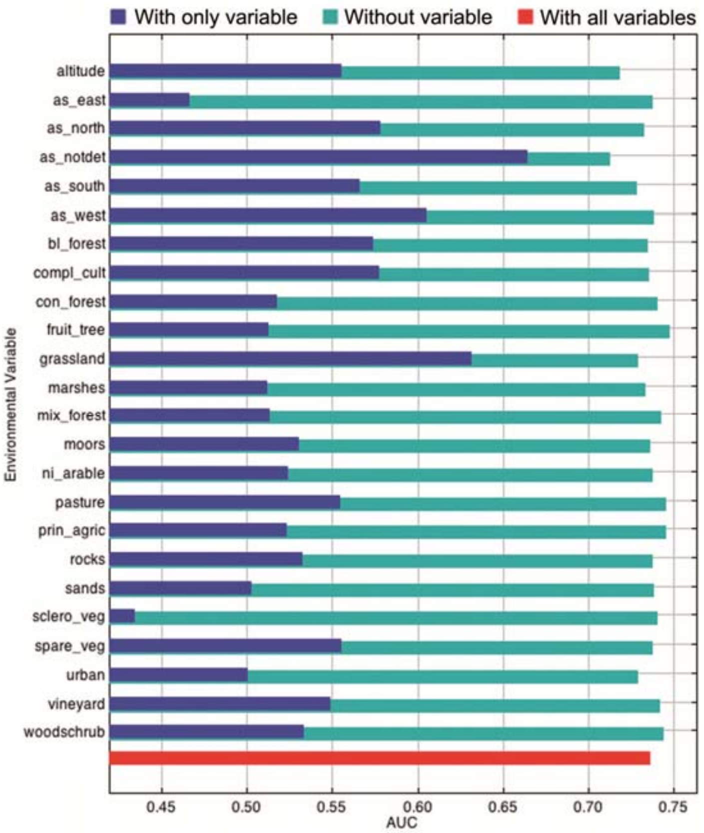

Figure 4: *Current range of* L. corsicanus *and habitat suitability in Corsica.*

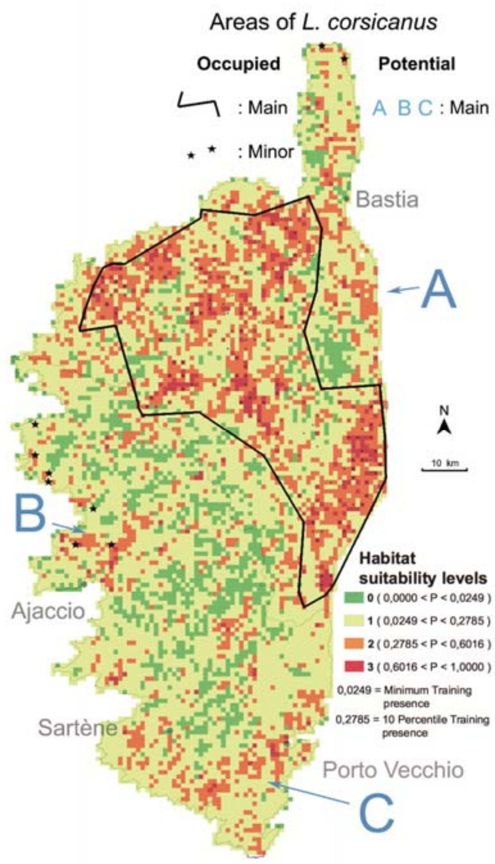

Table 1: *Environmental variables used to describe the habitat.*

	altitude	as_east	as_north	as_notdet	as_south	as_west
Meaning	Average altitude (m)	East aspect	North aspect	No or gentle slope (slope < 5°)	South aspect	West aspect
	bl_forest	**compl_cult**	**con_forest**	**fruit_tree**	**grassland**	**marsches**
Meaning (CLC categories)	Broad-leaved forest (311)	Complex cultivation Patterns (242)	Coniferous forest (312)	Fruit trees & Olive groves (222, 223)	Natural grasslands (321)	Marshes & Peat bogs (411, 412, 421, 422)
	mix_forest	**moors**	**ni_arable**	**pasture**	**prin_agric**	**rocks**
Meaning (CLC categories)	Mixed forest (313)	Moors & Heathland (322)	Non-irrigated land (211)	Pastures (231)	Land princ. occ. by agriculture (243)	Bare rocks (332)
	sands	**sclero-veg**	**spare-veg**	**urban**	**vineyard**	**woodschrub**
Meaning (CLC categories)	Beaches, dunes, sands (331)	Scleroph. vegetation (323, 334)	Sparsely veg. areas (333)	Urban or industrial areas (111 to 142)	Vineyards (221)	Transitional woodland-shrub (324)

References

[1] **Pietri C.** (2015). Range and status of the Italian hare *Lepus corsicanus* in Corsica. *Hystrix, It. J. Mamm.*, **26(2)**. DOI: 10.4404/hystrix-26.2-11412

[2] **Pietri C., F. Riga F. & M. Lo Valvo** (2015). Range map of *Lepus corsicanus* in Italy and in Corsica in 2015. Available from https://www.researchgate.net/publication/292146740_Range_map_of_Lepus_corsicanus_in_Italy_and_in_Corsica_in_2015. DOI: 10.13140/RG.2.1.2802.7927

[3] **Phillips S.J., R.P. Anderson & R.E. Schapire** (2006). Maximum entropy modeling of species geographic distributions. *Ecol. Model.*, **190:** 231–259.

Keywords: Italian hare, distribution modeling, Corsica, species management

(oral)

A razor-wired border fence as a threat for wildlife in Southeast Europe

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In November 2015, Slovenia erected a technical security barrier in the form of a razor-wired fence along the most exposed parts (178 km) of the Slovenia-Croatia border. Over a 14 month period (11 November 2015 – 11 January 2017), carcasses of 24 ungulates (15 red deer and 9 roe deer) were found entangled in the razor-wired fence, giving a mortality rate of 0.13 ungulates/km of fence. Also, even earlier along the border between Hungary and Croatia a razor-wired and fixed fence were set. A systematic and continuous monitoring between Slovenia and Croatia has been established by Hunters Association of Slovenia, while between Hungary and Croatia we still do not have similar program, and data are deficient. Although the direct impact of the fence on wildlife mortality is of relatively low importance, over the long-term, the fence may pose a serious threat to wildlife via its barrier effect, resulting in fragmentation of habitats and disconnection of populations. Therefore, systematic studies are urgently required to determine the implications of the fence on spatial behaviour, movements and gene flow of key species in the border zone. Also, joint wildlife/game management plans must adapt and establish coordinated and common conservation strategies for all countries since it is not known how long the fence will be maintained.

Figure 1: *Dead animals caused by the fence (photo: Tine Lindič).*

***Table 1:** Registered ungulate mortality due to the Slovenia-Croatia border fence, period 11 November 2015 – 31 January 2017 [1, adopted from 2]*

Hunting Management District	Hunting ground	ID	Sex	Age* (years)	Date	Location	Quadrant	No.
				Roe deer				
Ptujsko-Ormoško	Velika Nedelja	2/2016	F	4	7 Feb 2016	Otok	V3K9	C1
		75/2016	F	1	9 Oct 2016	Otok	V3K9	C2
	Središče	14/2016	M	1	25 Apr 2016	Banat	W9K8	C3
		35/2016	M	1	19 May 2016	Belo Trnje	W9K8	C4
Savinjsko-Kozjansko	Podčetrtek	36/2016	F	2+	8 July 2016	Imensko polje	R7H8	C5
Posavsko	Bizeljsko	84/2015	F	2	26 Nov 2015	Stara vas	S4G3	C6
		89/2015	F	1	18 Dec 2015	Lapor	S5G9	C7
		xy/2016	M	2+	Mar 2016	?	?	C8
	Kapele	xy/2015	F	2+	Nov 2015	?	?	C9
				Red deer				
Posavsko	Mokrice	80/2015	F	1	23 Nov 2015	Slovenska vas	S1E7	E1
Kočevsko-Belokranjsko	Vinica	165/2015	F	6	8 Dec 2015	Učakovci	O8A2	E2
	Sinji vrh	104/2015	F	2	6 Dec 2015	Strelišče	N8A6	E3
		113/2015	F	3	12 Dec 2015	Dečina	N7A7	E4
		114/2015	M	3	14 Dec 2015	Dečina	N7A7	E5
	Predgrad	233/2015	F	13	6 Dec 2015	Sodevci	N6A7	E6
	Banja Loka – Kostel	3/2016	F	3	12 Jan 2016	Kuželj	L5A6	E7
		6/2016	F	4	18 Jan 2016	Vas	M0A6	E8
		7/2016	F	5	24 Jan 2016	Grivac	L8A5	E9
		9/2016	F	3	8 Feb 2016	Fara	M1A6	E10
		59/2016	F	1	19 Jun 2016	Pirče	L9A5	E11
		72/2016	F	2	18 July 2016	Vas	M0A6	E12
		152/2016	F	2	18 Oct 2016	Fara	M1A6	E13
		199/2016	F	7	14 Dec 2016	Slavski laz	M3A7	E14
Primorsko	Kojnik – Podgorje	26/2016	F	0	18 Apr 2016	Rakitovec	E9A4	E15

** Age is assessed on the basis of teeth eruption and wear; 0 means calf, 2+ means adult but precise age is unknown.*

References

[1] **Lisjak** (2017). Slovene Hunting Information System. http://www.lovska-zveza.si/lzs/lisjak. Accessed 13 February 2017

[2] **Pokorny, B., K. Flajšman, L. Centore, S.F. Krope & N. Šprem** (2017). Border fence: a new ecological obstacle for wildlife in Southeast Europe. *Eur. J. Wildl. Res.,* **63:** 1-6, doi: 10.1007/s10344-016-1074-1.

Keywords: border fence, habitat fragmentation, wildlife mortality, Slovenia-Croatia border, Hungary-Croatia border

(poster #63)

The red-legged Partridge *Alectoris rufa* network : A tool for conservation and research

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The unfavorable evolution of its preferred habitats, following an important agricultural abandonment, as well as an unsuitable hunting management in presence of the releases of reared birds made fear a decline in the numbers of Red-legged Partridge *Alectoris Rufa* in France, then confirmed the work of [1]. Since 2003 it has become clear that the publication of the works describing the causes of this rarefaction and proposing solutions was not enough to alter this trend. So, it was decided to develop the Red-legged partridge network with the aim of popularizing and then implementing sustainable management of the partridges and its habitats for the conservation of the species. At that time, we could propose tools for monitoring and managing populations [2] and knowledge to improve habitats [3].

Managed by the ONCFS Red-legged Partridge team, the network relies on interlocutors who act as a relay in the organization of the network: departmental federations of hunters, reserves, national and regional parks, institutions managing territories, hunting groups. As threats to the species are partly the problematic evolution of habitats, which also impacts biodiversity in general, monitoring of the species had to go beyond the only sites managed by the hunters and to extend to all actors involved in the management of habitat. The strategy then adopted was to develop a network of sites based on volunteering and gathering various managers.

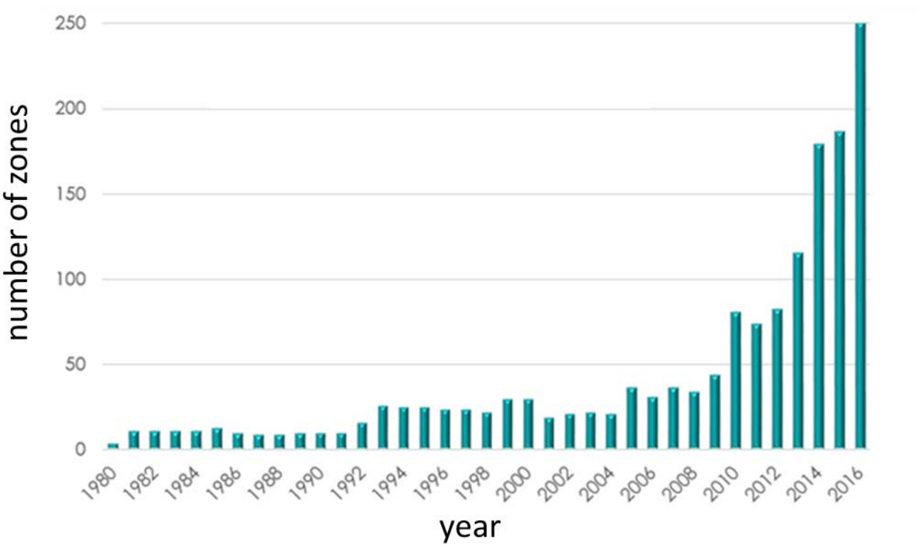
The network consists of sites of a minimum size of 0.8 km² representing a hunting management unit and above all with people (volunteers or professionals) undertaking to carry out monitoring operations.

In each territory of the network, are carried out, at the minimum, annual density estimation of red-legged partridges in the spring, preferentially using the method of call counts with song playback [4]. An estimate of the breeding success is also recommended in summer, which is essential for calculating the annual allowable harvest. It is also requested to collect as much information as possible on the hunting management of the game (including releases) and the habitat managements made. The network becomes here a research tool to advance in the knowledge of the functioning of the populations in relation to many parameters.

In exchange, partners are provided with advices on sustainable hunting management of red partridges and their habitats, useful documents and tools (USB key), and field training on their use. Also available are documents (videos, booklets, ...), training courses (video, information days from 2017), website address, annual letter plus warning letters (cf. summer 2014), annual meeting.

In 2004, the first annual letter was published. First confined to a few experimental sites, in an initial phase of testing and validation of the proposed solutions, it has really been extending since 2006. The number of sectors has recently grown exponentially, both in number of sectors belonging to the Network (Figure 1) and in terms of geographical distribution. Mainly active in its early years in the French Mediterranean region, the network is slowly spreading to other regions further north and abroad (Italy, Portugal).

***Figure 1:** Evolution of the number of sectors being monitored in the framework of the Red-legged Partridge network.*



References

[1] **Roux D., F. Dej, G. Body & C. Eraud** (2016). Suivi des populations nicheuses (1996-2016) et hivernantes (2000-2016). *Réseau national d'observation « Oiseaux de passage »*, ONCFS-FNC-FDC. Rapport interne ONCFS, novembre 2016, 28p.

[2] **Ponce-Boutin F., T. Le Brun, J.F. Mathon & J.C. Ricci** (2006). Propositions pour une gestion durable des populations de perdrix rouge. Quelle place pour les lâchers. *Faune sauvage*, **274:** 48-55.

[3] **Ponce-Boutin F., J.F. Mathon, T. Le Brun, C. Moutarde, E. Corda & L. Kmiec** (2004). Aménagements des milieux et perdrix rouge en collines méditerranéennes françaises. *Faune sauvage*, **262:** 42-46.

[4] **Jakob C., F. Ponce-Boutin & A. Besnard** (2014). Coping with heterogeneity to detect species on a large scale: N-Mixture modeling applied to red-legged partridge abundance: partridge abundance estimate via N-Mixture Model. *Journal of Wildlife Management*, **78:** 540-549.

Keywords: *Alectoris rufa*, monitoring, network

(poster #64)

Annual diet of Red-legged Partridge in the French Mediterranean region

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It is necessary to know the requirements of a sedentary species with respect to its habitat in order to understand its distribution and the factors that may limit its presence. For the Red-legged Partridge *Alectoris rufa*, the latter must provide it adequate cover, that will enable his survival and allow it to reproduce successfully, but also adapted food (availability, quality, quantity) at all stages of his life. The objective of this study is to know the diet of the species, throughout the year and regardless of its reproductive status. The evolution of habitats following a strong agricultural decline is certainly one of the causes of the decline of the species. Knowing which foods are needed make possible to adapt environmental management interventions in favor of the species.

The study was carried out on two very different habitats of the French Mediterranean region: a hilly area (Forest of the Luberon, Vaucluse) covered with more or less closed garrigues alternating with lawns and more wooded areas (pine forests, cedar trees) and a wine-growing zone strongly affected by the agricultural abandonment, where alternate vineyards and wasteland, heath and matorral (Vias, Hérault). The study is based on the analysis of feces harvested from these sites throughout the year. Harvesting of these droppings most often follows the direct observation of partridges beforehand captured and equipped with VHF transmitters in order to know the age (adult, juvenile) and the sex of the individual concerned, as well as its reproductive status.

The determination of galliforms diet by faecal analysis is based on the fact that the epidermis of the plants consumed by the bird is not degraded by digestion and allows the identification at the level of the genus, even the species, of the various organs ingested by comparison with a reference atlas (1) that had to be established at the start of the study (Figure 1). Also found are fragments of the arthropods consumed, mainly those covered with chitin but also larvae, allowing at least to determine the family. The tedious method of analysis is described by PONCE (2, 3). Correction factors are finally calculated to convert the number of fragments found in faeces to ingested biomass.

The results show that there are constant characteristics whatever the habitat on the type of food consumed. A significant proportion of Arthropods is present in the diet of young birds, which decreases rapidly as they grow. Comparatively, adults are much more vegetarian. A few plant families emerge such as Poaceae or Fabacae or Compositae. There is also a constant spatial seasonality concerning the organs consumed, in accordance with their availability.

Figure 1: *Fragment of a Leaf of Fabaceae, coloured by Red Congo (Photo M. LEPLEY).*

References

[1] **Ponce-Boutin, F.** (2000). Atlas d'aide à la détermination pour les études de régime alimentaire. *CDrom,* ONCFS, Réalisation APDI.

[2] **Ponce, F.** (1989). Etude du régime alimentaire du poussin de perdrix rouge Alectoris rufa en relation avec la gestion des milieux - Mise au point du protocole et prétest. *Rapport, convention ONCFS / EPHE, Montpellier,* 72p.

[3] **Ponce, F.** (1991). Impact de l'alimentation sur la dynamique des populations de Tétras lyre *Tetrao tetrix* dans les Alpes françaises : méthodologie, description, sélection, nutrition. *Thèse,* Univ. Montpellier II, 179p.

Keywords : *Alectoris rufa*, annual diet, faecal analysis, French Mediterranean region

(oral)

Evidences of sex-specific impacts of landscape on gene flows in a Mediterranean mouflon population.

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In natural populations, gene flows represent a key factor in determining and maintaining genetic diversity [1,2]. Any factors limiting animal movements such as anthropogenic and natural landscape structures are thus expected to impair population viability [3,4]. A recent challenge of landscape genetics was thus to better assess the relative contribution of landscape features to spatial genetic differentiation. It is usually done by contrasting IBD (Isolation By Distance) and IBR (Isolation By Resistance) models and allows to identify the resistance values associated with each landscape features [5-7]. Here, we applied this landscape genetic approach to investigate the effects of different landscape features on gene flows in a Mediterranean mouflon population from southern France (Caroux-Espinouse massif). The studied population has faced with a marked habitat closure largely related to changes in human activities since the 50's (agriculture abandonment and reforestation) that resulted in marked changes of habitat structure and detrimental phenotypical consequences for this grazer species [11]. These changes may also impact the spatial genetic structure of the population, providing a unique occasion to identify the factors constraining gene flows in this species.

We assessed the relative contribution of IBD and IBR model by using a causal modelling framework [5,6] on genetic data (16 microsatellites) collected from 236 adult individuals. In the IBD model, we calculated the Euclidean geographic distance on the ground (accounting for changes in elevation along the strait line separating two individuals). In the IBR model, we calculated the least cost distance (minimizing the sum of the costs of the different landscape elements along the path separating two individuals). We tested for the effects of 7 habitats types (deciduous and coniferous forests, rocky areas with slope > 30° or < 30°, grass- rich areas on plateaus (elevation > 900m) or not, and broom moorlands) distributed along a food/cover gradient which may generate varying degrees of resistance to gene flows (see [12]). We also accounted for all natural (ridges, talwegs and forests edges) and anthropogenic (hiking trails, tracks and roads) linear landscape features known to act as behavioural barriers impeding individuals movements in this population [12]. Three resistance values (1, 50, 100) were alternately assigned to the 9 landscape elements leading to 19 683 different scenarii. The reliability of each scenario was assessed with the partial Mantel correlation *r* between least cost and genetic distances after "partialling out" the Euclidean distance between individuals (following [7]).

Firstly, given the sex-specific differences in habitat selection and movement patterns previously reported in this population during the rutting period [11,14,15], we expected sex-specific impacts of landscape on gene flow. Moreover, landscape was expected to have a stronger impact on female movements than on male ones because of female philopatry and a more pronounced trade-off providing food and cover compared to males (see [11,12]). Accordingly, IBR was identified as the principal driver of genetic structure for females but not for males. Habitats preferentially selected by females during the rutting period (deciduous forests perceived as safe and supplying abundant resources, see [12]) opposed only a moderately low resistance to gene flows. In contrast, habitat types avoided by females during autumn were found to oppose a moderately high resistance to gene flows (coniferous forests, grass-rich areas of high altitude and broom moorlands, see [12]). Additionally, given the repulsive effects of linear landscape features on individual movements [11], we expected these features to be nearly impassable, at least among the most resistant habitat features. We indeed observed an optimal resistance value at its maximum of 100 for linear landscape features in the female analysis. In males, none of the landscape elements tested here nor the Euclidean geographic distance was found to impacts gene flows among males. These results suggest that, although males have habitat preferences during rutting period [11,12,15], landscape structure is not an obstacle during males reproductive excursions (see [15]).

References

[1] **Frankham, R.** (2005). Genetics and extinction. *Biological Conservation*, **126:** 131–140.
[2] **Říčanová, Š., J. Bryja, J.F. Cosson *et al.*** (2011). Depleted genetic variation of the European ground squirrel in Central Europe in both microsatellites and the major histocompatibility complex gene: Implications for conservation, *Conservation Genetics*, **12:** 1115–1129.
[3] **Reed, D.H. & R. Frankham** (2003). Correlation between fitness and genetic diversity. *Conservation Biology*, **17:** 230–237.
[4] **Frankham, R., J.D. Ballou & D.A. Briscoe** (2004). A Primer of Conservation Genetics. Cambridge University Press, p220.
[5] **Cushman, S.A., K.S. McKelvey, J. Hayden & M.K. Schwartz** (2006). Gene flow in complex landscapes: testing multiple hypotheses with causal modeling. *American Naturalist,* **168:** 486–499.
[6] **Cushman, S.A., T. Wasserman, E. Landguth & A. Shirk** (2013). Reevaluating causal modeling with mantel tests in landscape genetics. *Diversity,* **5:** 51–72.
[7] **Shirk, A.J., D.O. Wallin, S.A. Cushman *et al.*** (2010). Inferring landscape effects on gene flow: a new model selection framework. *Molecular Ecology*, **19:** 3603–3619.
[8] **Cazau, M., M. Garel & D. Maillard** (2011). Responses of heather moorland and Mediterranean mouflon foraging to prescribed-burning and cutting. *Journal of Wildlife Management*, **75:** 967–972.
[9] **Marchand, P., C. Redjadj, M. Garel *et al.*** (2013). Are mouflon *Ovis gmelini musimon* really grazers? A review of variation in diet composition. *Mammal Review*, **43:** 275–291.
[10] **Garel, M., J.M. Cugnasse, D. Maillard *et al.*** (2007). Selective harvesting and habitat loss produce long-term life history changes in a mouflon population. *Ecological Applications*, **17:** 1607–1618.
[11] **Marchand, P., M. Garel, G. Bourgoin *et al.*** (2017). Combining familiarity and landscape features helps break down the barriers between movements and home ranges in a non-territorial large herbivore. *Journal of Animal Ecology,* **86:** 371–383.
[12] **Marchand, P., M. Garel, G. Bourgoin *et al.*** (2015). Coupling scale-specific habitat selection and activity reveals sex-specific food/cover trade-offs in a large herbivore. *Animal Behaviour*, **102:** 169–187.
[13] **Dubois, M., K. Khazraïe, C. Guilhem *et al.*** (1996). Philopatry in mouflon rams during the rutting season: Psycho-ethological determinism and functional consequences. *Behavioural Processes*, **35:** 93–100.
[14] **Dupuis, J., J. Badia, M.L. Maublanc & R. Bon** (2002). Survival and spatial fidelity of mouflon (Ovis gmelini): A Bayesian analysis of an age-dependent capture-recapture model. *Biological and Environmental Statistics*, **7:** 277–298.
[15] **Portanier, E., M. Garel, S. Devillard *et al.*** (In prep). (Past) Introduction history overpasts social factors in explaining genetic structure in females of Mediterranean mouflon.
[16] **Vitousek, P.M., H.A. Mooney, J. Lubchenco & J.M. Melillo** (1997). Human domination of Earth's ecosystems, *Science*, **277:** 494-499
[17] **Marchand, P., M. Garel, G. Bourgoin *et al.*** (2015). Sex-specific adjustments in habitat selection contribute to buffer mouflon against summer conditions, *Behavioral Ecology*, **26:** 472–482.

Keywords: Landscape genetics, Mediterranean mouflon, isolation by resistance

(oral)

Game bird harvest on private lands in the USA: should we manage pheasants like fish?

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Hunters of upland game bird hunters on public and private lands in the USA are regulated by daily harvest and possession limits. Unlike our colleagues who manage fisheries, wildlife managers rarely design spatially-explicit regulations or quotas for individual units of land. The philosophy has been that local over-harvest would be compensated with dispersal of birds from nearby patches of habitat. However, hunting pressure on local patches of land has increased with an increase in fee and guided hunting in the USA, as well as incentive payments by states to a small number of private landowners to obtain Open Access rights for public use. Both of these trends have occurred at a time when fragmentation of game bird habitats has increased to the point that dispersal of animals could be affected. My goal was to assess the need for new methods of regulation to prevent over-harvest. I used spatial simulations to show how animals such as ring-necked pheasants can be legally over-harvested when multiple parties hunt the same parcel of land. During scenarios based on observed rates of use on Open Access-type lands in Nebraska, less than 20% of male pheasants were predicted to survive the 3-month hunting season if a habitat patch was searched by at least 100 hunting parties. Female pheasants cannot be legally taken, but if hunting parties had a 1% error rate for mistaking females for males, over 50% of female pheasants could be illegally harvested. The spatial model that assigned 5 birds per patch demonstrated that high rates of movement from more than 30 surrounding "refuge" (no harvest) patches were necessary to replace birds lost to over-harvest in a local patch. Thus, common levels of bird dispersal and landscape fragmentation in eastern Nebraska do not allow the dispersal of pheasants to repopulate the depleted land areas. I suggest that shorter hunting seasons and state-supported monitoring should be implemented on Open Access lands that have high use potential. And, states should work with landowners who engage in fee hunting to monitor their lands to establish suggested harvest levels or quotas to protect the public resource.

Keywords: conservation, dispersal, harvest regulations, over-harvest, population models

(poster #65)

The Structural Complexity Index: a nonparametric descriptor of habitat heterogeneity for game bird research and management

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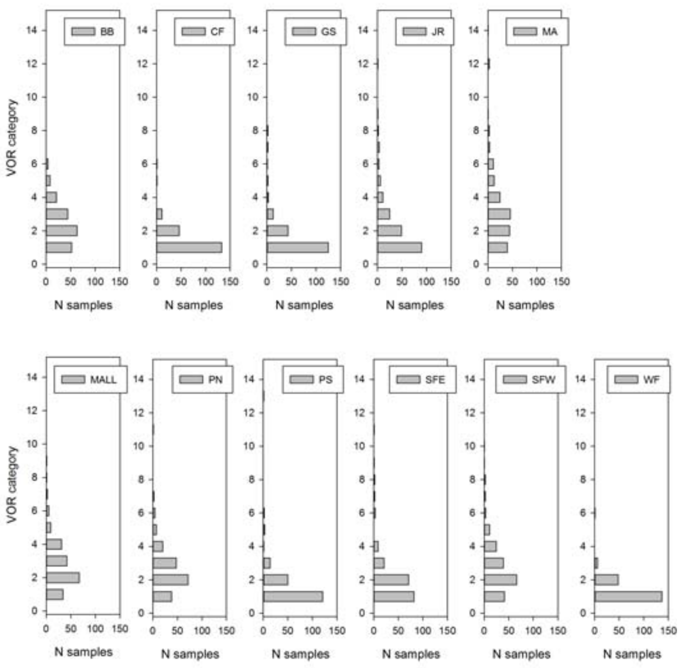
Habitat heterogeneity is considered to be the basis for biodiversity, and grassland ecologists have promoted various mechanisms to influence levels of structural heterogeneity at local, patch, and landscape scales. However, our ability to measure and represent habitat heterogeneity as a metric has not been satisfactory. Research biologists typically report the standard deviation (SD) or coefficient of variation (CV) for a sample of measures to quantify heterogeneity, but these measures of variation assume a normal distribution of measures and are not easily interpreted, especially by the public. More critically, it is possible that SD and CV do not represent the biological aspects of heterogeneity that are important to wildlife. We present a new metric to be used to depict structural heterogeneity: the Structural Complexity Index (SCI). We borrow the structure of the metric from acoustic scientists who use a similar metric to depict the acoustic complexity of a sound recording. We assessed the efficacy of the SCI with the use of visual obstruction reading (VOR) measures from 11 ranches during May 2014 in the Nebraska Sandhills, a large region with contiguous grasslands. Our objectives were to compare levels of pasture-level heterogeneity among ranches, and to compare the SCI with other potential metrics of structural heterogeneity. To calculate the SCI for a habitat unit, we binned of sample of VOR measures into 14 3-cm groups (0-3, 3.1-6, 6.1-9, …, 39.1-42 cm). Heterogeneity was measured as the sum of the absolute differences of the number of samples (n_i) between neighboring bins ($n_2 - n_1$, $n_3 - n_2$, …, $n_{14} - n_{13}$), divided by the total number of samples. Mean VOR at each ranch ranged from 2.1 to 8.5 cm, and SCI scores for each ranch ranged from 0.31 to 0.72. The graphic depiction of the binned data was immediately useful to visually compare central tendencies and variation of VOR among the ranches (Figure 1). The SCI and the SD of measures for each ranch were negatively correlated (Pearson's R = -0.706, P = 0.02), indicating that the SCI provided similar, yet unique, information to the SD. Neither SD nor SCI were correlated with CV. We suggest that the nonparametric SCI is a direct measure of variability of habitat structure while also offering an advantage to visualization of patterns of heterogeneity at study sites.

Figure 1: *Binned data from visual obstruction readings (VOR) from 11 ranches in Nebraska, USA during 2014 used to calculate the Structural Complexity Index as a measure of heterogeneity. VOR categories represent 3-cm groupings of data (0-3, 3.1-6, 6.1-9, …, 39.1-42 cm). Thus, both the central tendency and relative variation in structure can be inferred between the 11 ranches depicted in separate panes.*



Keywords: mensuration, statistic, vegetation

(oral)

Habitat change and population decline in breeding wigeon *Anas penelope*

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Habitat change is recognized as one of the main drivers of population declines of species worldwide. In extreme cases, habitat loss and fragmentation may result in population extinctions. On the other hand, habitat suitability may decrease more gradually, in which case species responses may manifest by decreased demographic rates and population density. Boreal wetlands are important breeding habitats for waterfowl in Europe and elsewhere [1]. While loss of wetlands per se is a major threat to waterfowl in many parts of the world [2, 3], gradual degradation of different habitat types within wetlands may also have significant negative impacts on populations. To assess the importance of such habitat changes to waterfowl and to predict their impact on population trajectories, we need a deeper understanding of habitat requirements of individual species and how habitat change affects their fitness.

Breeding numbers of Eurasian wigeon (*Anas penelope*) have declined dramatically in Finland since the early 1990s [4, 5]. In line with the alarming trends in Finland, the EU population status of wigeon has been assessed as vulnerable in 2015 [6]. We explored whether the recent population decline of Eurasian wigeon may be linked to long-term vegetation changes in their boreal breeding wetlands by using long-term data sets from six study regions in Finland and Sweden (gradient from Scania (55°N) to Lapland (66°N)). First, we assessed the importance of stands of the emergent water plants *Equisetum*, *Phragmites* and *Carex* in lake selection by pairs and in foraging habitat selection by broods. Second, in 2013-2014 we re-visited 58 lakes studied in 1990-1991, to examine if there had been any long-term change in the abundance of habitat types preferred by wigeon. Finally, using over 20 years long continuous data on breeding numbers of wigeon in 18 of the lakes studied in 1990-1991 (regions Häme and Karjala in Finland), we examined if wigeon numbers had changed at lakes where the habitat also had changed.

We found that, among the predictors considered, *Equisetum* was the best single predictor of lake occupation by wigeon (Table 1); lake occupation of nesting wigeon was positively associated with the extent of *Equisetum* stands. Similarly, *Equisetum* habitat was used more than expected by wigeon broods. When analysing the presence and abundance of this preferred habitat, we found a dramatic decline from 1990-1991 to 2013-2014 in the lakes from which the presence-absence data of wigeon emanate (Fig. 1). We also found a long-term declining trend of breeding numbers of wigeon in lakes where *Equisetum* has decreased. Our results imply that the recent population decline of wigeon in Europe may be linked to decreasing *Equisetum* habitat. However, it still remains to be resolved whether both declines reflect an overall degradation of the ecological conditions in aquatic ecosystems.

Figure 1: *Change in the extent of Equisetum habitat (length, m, of Equisetum-dominated shoreline) in 29 Finnish and Swedish lakes from 1990–1991 to 2013–2014. Lakes ranked according to extent of Equisetum habitat in 1990–1991. Figure according to Pöysä et al. 2016 in Hydrobiologia* [7].

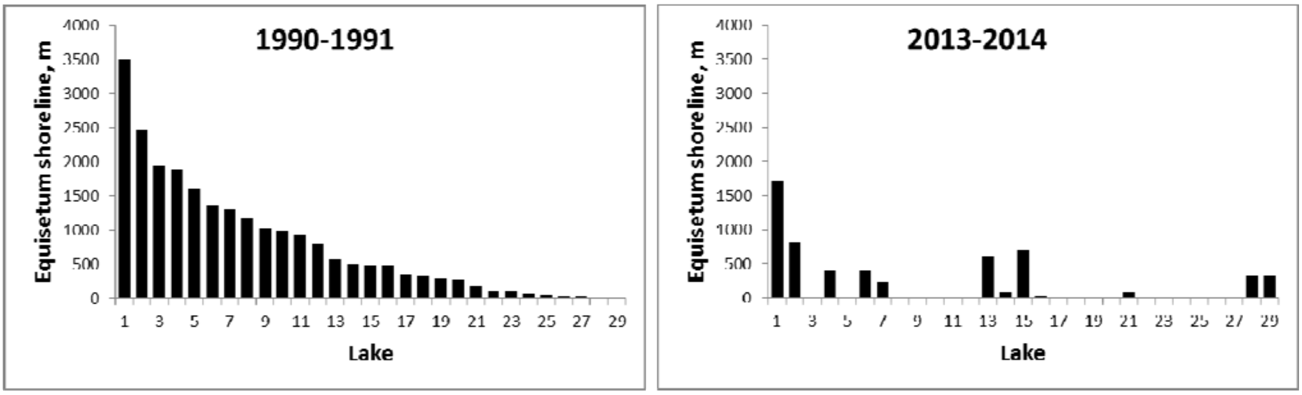

Table 1: *A priori candidate models estimating the probability of lake occupation by breeding wigeon. Table according to Pöysä et al. 2016 in Hydrobiologia* [7].

Model	AIC_c*	ΔAIC_{ci}†	w_i‡
1 *Equisetum* + Area	56.644	0	0.279
2 *Equisetum* + *Phragmites* + Area	57.205	0.561	0.211
3 *Equisetum*	57.635	0.991	0.170
4 *Equisetum* + *Phragmites*	58.693	2.049	0.100
5 *Equisetum* + *Carex* + Area	58.998	2.354	0.086
6 *Equisetum* + *Carex*	59.871	3.227	0.056
7 *Equisetum* + *Phragmites* + *Carex*	60.845	4.201	0.034
8 *Equisetum* + *Phragmites* + *Carex* + Area	61.049	4.405	0.031
9 *Phragmites* + Area	62.186	5.542	0.017
10 Area	63.902	7.258	0.007
11 *Phragmites* + *Carex* + Area	64.553	7.909	0.005
12 *Carex* + Area	65.891	9.247	0.003
13 *Phragmites*	68.115	11.471	0.001
14 *Carex*	69.920	13.276	0.000
15 *Phragmites* + *Carex*	70.406	13.762	0.000

*Second-order Akaike's information criterion.
†Difference between the current model and the minimum AICc.
‡Model weight.

References

[1] **Holopainen S., C. Arzel, L. Dessborn, J. Elmberg, G. Gunnarsson, P. Nummi, H. Pöysä & K. Sjöberg** (2015). Habitat use in ducks breeding in boreal freshwater wetlands: a review. *European Journal of Wildlife Research*, **61:** 339–363.
[2] **Bethke, R.W. & T.D. Nudds** (1995). Effects of climate change and land use on duck abundance in Canadian prairie-parklands. *Ecological Applications*, **5:** 588–600.
[3] **Roach, J.K. & B. Griffith** (2015). Climate-induced lake drying causes heterogeneous reductions in waterfowl species richness. *Landscape Ecology*, **30:** 1005–1022.
[4] **Pöysä H., J. Rintala, A. Lehikoinen & R.A. Väisänen** (2013). The importance of hunting pressure, habitat preference and life history for population trends of breeding waterbirds in Finland. *European Journal of Wildlife Research*, **59:** 245–256.
[5] **Lehikoinen A., J. Rintala, E. Lammi & H. Pöysä** (2016). Habitat-specific population trajectories in boreal waterbirds: alarming trends and bioindicators for wetlands. *Animal Conservation*, **19:** 88–95.
[6] **BirdLife International** (2015). *Mareca penelope*. The IUCN Red List of Threatened Species 2015: e.T22680157A59958709.
[7] **Pöysä H., J. Elmberg, G. Gunnarsson, S. Holopainen, P. Nummi & K. Sjöberg** (2016). Habitat associations and habitat change: seeking explanation for population decline in breeding wigeon *Anas penelope*. *Hydrobiologia*, **785:** 207–217.

Keywords: *Equisetum fluviatile*, Eurasian wigeon, herbivory, water horsetail

(oral)

Population trends of the Common quail (*Coturnix coturnix*) in France and Spain: conflicting data or controversial census methodologies?

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The Common quail (*Coturnix coturnix*) is a migratory Galliformes species whose current conservation status is classified as Least Concern (LC) with a decreasing population trend [1]. Due to its condition of huntable species in some Mediterranean countries (Greece, Italy, France, Spain…), its status and conservation is frequently a source of controversy between hunters, conservationists and wildlife managers.

For trying to clarify the population trends of the species, in this study we present two different census data collected with two different census methods in France and Spain:

a) The first census data set was collected during the period 2006-2016 in four breeding sites of France (Montbel, La Cavalerie, Sault and L'Ariège) and during the period 1998-2016 in two breeding sites of Catalonia, northeast Spain (Figuerola del Camp and Alp). The census method (hereafter "active census") was specifically designed for the Common quail and consisted in counting, once a week throughout the breeding season, the number of calling males responding to a digital female decoy in ten count points chosen in suitable Common quail habitats and separated by around 700 m.

b) The second census data set was collected during the period 1996-2016 in the whole France as a part of a large-scale survey (ACT survey). In this case, a more general census method (hereafter "passive method") was applied, in which 17 breeding species where monitored by using, one day from mid-May to mid-June, the count points methods without stimulating Common quail males with a digital decoy. The full coverage of France is based on about 28x20 Km grid cells (1/50000 IGN maps); each grid cell includes a randomly selected route (4 km), with 5 point counts spaced by 1 km. As in this species the detection rate of singing males was suspected to decline markedly from early morning, counts performed outside a presumed window of availability for detection by observers (from 1 hour before local sunrise to 3 hours after) were discarded to reduce bias. Given the range in longitude covered by the ACT survey, the counting (civil) hour filled by the observers was standardized in minutes relative to local sunrise. Finally, routes where Common quail was never detected since 1996 were discarded.

For the first data set, Generalised Additive Models (GAM), provided by the R-package mgcv [2] were carried out. The "Number of detected males" in each sampling day was considered the response variable in the model, and we assumed a quasi-Poisson error distribution and a log link function. Two factors, "Date" and "Site"), were considered as independent variables; "Year" variable was included as a covariate and also as a random factor. The degrees of freedom were restricted (k=3). Moreover, annual indices of population trends were estimated by using the poptrend R-Package.

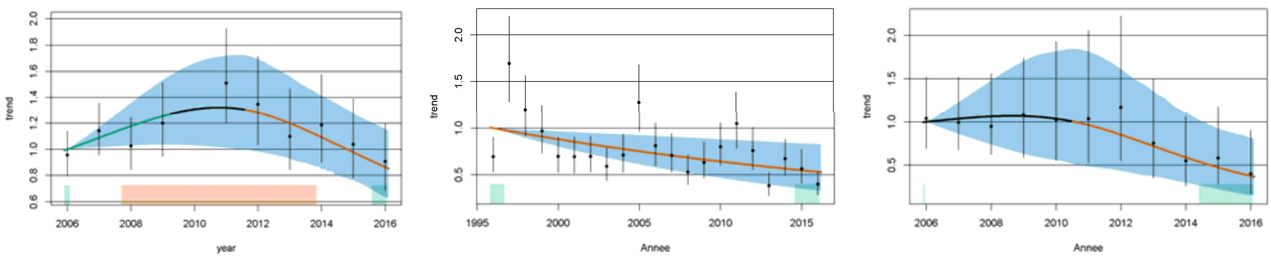
For the second data set, the same R-packages were used. The "Number of detected males" was modelled as a function of "Year", "Date" and "Counting hour" as covariates and, being "Site" and "Year" random factors. The model used a negative binomial distribution. The degrees of freedom were restricted (k=7). In order to compare the results of this model to that of the first data set, analysis has been carried out with data from 2006 to 2016.

In order to compare both census methods, we have also carried out the same analyses for the data obtained with the passive method in an area of France which included the four French sites of the first data set (from 1º and 6.31º longitude East range and from the South of 44º North latitude, third data set).

The results obtained do not show a clear decreasing trend of French populations of the first data set, in spite of a significant increase during 2006 to 2009 and a significant decrease during the period 2012-2016 (Figure 1a). GAM shows that “Year” as a covariate is significant (F=3.47, P=0.024) and that “Date” and “Year” as a random factor are highly significant (F= 1.56, P<<0.01 and F=22.28, P<<0.01), thus indicating that population estimates varies throughout the years and the days of the breeding season. The estimated percent trend change from year 2006 to 2016 is -14% (-35%, 15%). With regard to the Spanish populations, no trends have been observed for the period 1998-2016 [3], pers. obs.).

On the other hand, analyses of the second data set show that, for the whole France, the number of detected males follow a clear decreasing trend (Figure1b). In this case, “Year” as a covariate is significant (Chi-square=7.11, 1.0002 e.d.f., P=0.008), as well as “Date” (Chi-square=61.61, 1.560 e.d.f., P<<0.01) and “Counting hours” (Chi-square=30.95, 1.391 e.d.f., P<<0.01), together with “Year” as random factor (Chi-square=359.63, 17.933 e.d.f., P<<0.01) and “Site” (Chi-square=3890.49, 543.610 e.d.f., P<<0.01), thus indicating that population estimates varies throughout the years, the days of the breeding season and the hours, in the different sampled sites. The estimated percent change from 1996 to 2016 is -47% (-67%, -17%) (see [4] for a larger data series).

***Figure 1:** a) Population trends of* the four French sites in which active method was used *(first data set); b) population trends of France by applying the passive method (second data set); c) population trends of a part of France which includes the four French sites of a), by using passive method (third data set).*



a) ***b)*** ***c)***

Last but not least, in the third data set results are rather similar to those found in the first data set, the number of detected males follow a clear decreasing trend since 2010 (Figure1c). In this case, “Year” as a covariate is significant (Chi-square=4.92, 1.709 e.d.f., P=0.04) and “Site” is also significant (Chi-square=103.64, 29.554 e.d.f., P<<0.01), thus indicating that population estimates varies throughout the years in the different sampled sites. In this case, the estimated percent change from 2006 to 2016 is -62% (-84%, -19%).

All in all, results obtained with the active method (very intensive but applied in a reduced geographic scale) seem to indicate that it is more sensitive to population increases than the passive method (less intensive but applied at a large scale), and that more methodological studies should be conducted.

References

[1] **BirdLife International** (2017). Species factsheet: *Coturnix coturnix*. Downloaded from **http://www.birdlife.org** on 22/02/2017.

[2] **Knape, J.** (2016). Decomposing trends in Swedish bird populations using generalized additive mixed models. *J. Appl. Ecol.,* **53 (6)** : 1852-1861.

[3] **Puigcerver, M., F. Sardà-Palomera & J.D. Rodríguez-Teijeiro** (2012). Determining population trends and conservation status of the Common quail (*Coturnix coturnix*) in Western Europe. *Anim. Biod. and Cons.*, **35 (2):** 343-352.

[4] **Roux, D., F. Dej, G. Body & C. Eraud** (2016). Suivi des populations nicheuses (1996-2016) et hivernants (2000-2016). Réseau national d’observation « Oiseaux de passage » *ONCFS-FNC-FDC. Rapport interne ONCFS*, 28 p.

Keywords: population trends, census methods migratory bird, Galliform, ACT survey

(oral)

The golden jackal (*Canis aureus*) in Europe: predicting habitat suitability of a rapidly establishing carnivore

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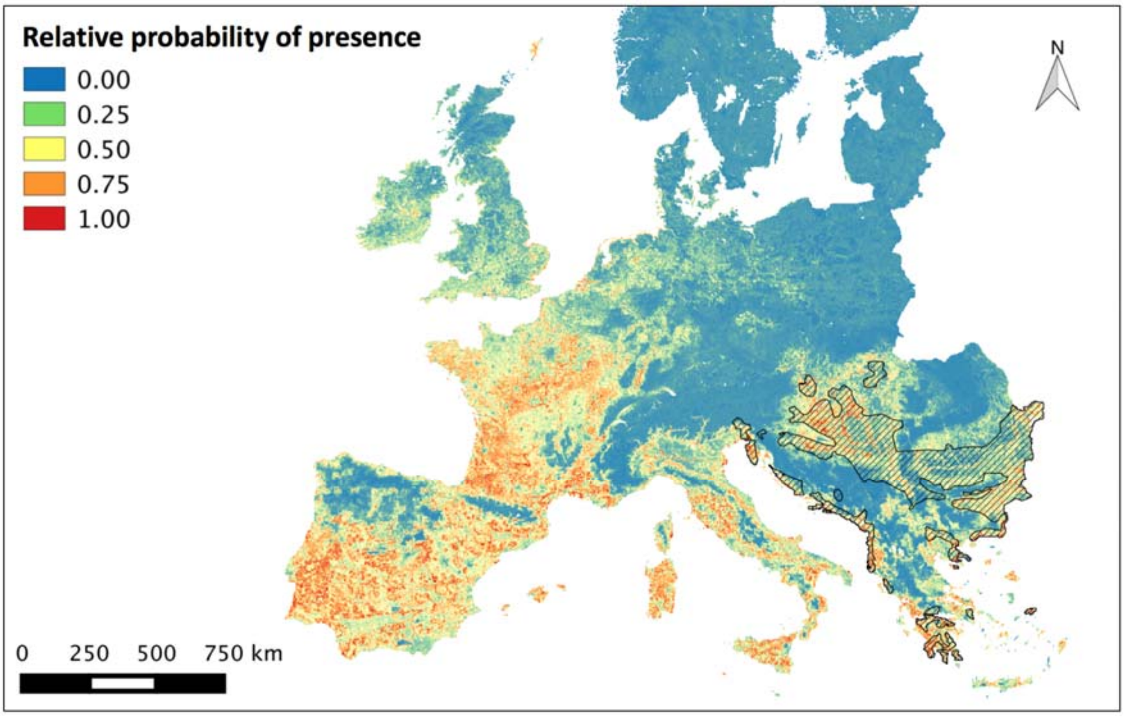
The golden jackal's *Canis aureus* range in Europe is expanding rapidly and populations are increasing. Historically restricted to the Mediterranean and Black sea coastal regions [1], jackals are now reproducing in most of Southeastern European and some Central European countries [2-4]. Current population trends suggest that population expansion is far from complete. The hypothesis according to which the species expansion may be the result of a mesopredator release mediated by grey wolves *Canis lupus* [5] is gaining support. Indeed, local evidence suggest that golden jackals avoid or have disappeared from core areas recolonized by wolves, and continental distribution patterns of both species show a marked negative correlation [1]. In turn, the colonization of this new carnivore could have profound impacts on existing animal communities [6], and trigger a large-scale trophic cascade – as reported in North America for an analogous wolf-coyote system [7,8,9]. From an applied perspective, the presence of this new carnivore has been found to be a source of ecosystem services [10] and is already receiving high interest among wildlife managers and policy makers [3]. In this study, we aimed at characterizing the golden jackal realized niche, and identifying areas of high habitat suitability, which are likely to be colonized in the future.

Since jackals are highly mobile and opportunist animals, dispersers can temporarily occupy nearly all types of habitats, far from population sources [11]. To prevent overestimation of the species' environmental niche, we focused on the sampling of established territorial jackal groups by means of a strict bioacoustic stimulation protocol [12]. We characterized the jackal environmental niche using snow cover duration [13] and ten land-cover variables extracted from Corine Land Cover, as well as grey wolf presence [14], treated as a trophic dependency covariate [15]. We modeled jackal probability of occurrence by fitting both a generalized linear model (GLM) and a generalized additive model (GAM) to our acoustic stimulation dataset. We evaluated the model predictive performance by means of a repeated split plot. The final model was achieved through an ensemble model procedure [16] and projected across the continent at a 4km resolution, coherent with both jackal territory size and error associated with howling surveys [13].

We performed acoustic stimulations at a total of 7,832 locations in twelve countries across the European range of the species. Among these, we recorded the presence of established jackal groups at 1,734 localities. For both model types, snow cover duration accounted for the highest variable contribution (mean = 37.2%), followed by wolf presence (mean = 20.8%). Proportion of forest and agricultural land cover, as well as distance from settlements and hydrological features were also selected in the best models. Jackal habitat probability of occurrence was highest in areas with short snow cover duration, heterogeneous land cover and outside the core of the wolf range. Average jackal probability of presence ranged from 0.21 in areas of permanent wolf presence to 0.73 in areas of wolf absence. Although snow cover duration was the most influential variable to predict jackal distribution, the model predictive ability was significantly improved by including the wolf presence covariate. Both model types performed very well (AUC_{GLM} = 0.87 and AUC_{GAM} = 0.89).

Besides the clear avoidance of snowy areas, our findings imply that the species favors mosaic landscapes and avoid areas with permanent grey wolf presence, which are coherent with recent findings [1,17]. Furthermore, our modelling results suggest that large parts of Western and Southern Europe, especially in France and in the Iberian and Apennine peninsulas, may be suitable for golden jackals (Figure 1). Although our modelling framework did not explicitly account for heterogeneous availability of anthropogenic food source – a factor known to affect distribution and densities of golden jackals – we can expect further expansion of this species in the future. Altogether, these results provide managers with relevant information to prepare for the jackal's future colonization of areas where the expansion is most likely.

Figure 1: *Ensemble model predictions of golden jackal's relative probability of presence in Europe. The current range of the species is pictured in the black polygons (source: Trouwborst et al. 2015).*



References

[1] **Krofel, M., G. Giannatos, D. Ćirović, S. Stoyanov & T.M. Newsome** (2016). Golden jackal expansion in Europe: a case of mesopredator release triggered by continent-wide wolf persecution? *Hystrix*, In press.

[2] **Arnold, J., A. Humer, M. Heltai, D. Murariu, N. Spassov & K. Hackländer** (2012). Current status and distribution of golden jackals *Canis aureus* in Europe. *Mammal Review* **42:** 1-11.

[3] **Trouwborst, A., M. Krofel & J.D.C. Linnell** (2015). Legal implications of range expansions in a terrestrial carnivore: the case of the golden jackal (*Canis aureus*) in Europe. *Biodiversity and Conservation,* **24:** 2593-2610.

[4] **Szabó, L., M. Heltai, E. Szűcs, J. Lanszki & R. Lehoczki** (2009). Expansion range of the golden jackal in Hungary between 1997 and 2006. *Mammalia,* **73:** 307-311.

[5] **Ritchie, E.G. & C.N. Johnson** (2009). Predator interactions, mesopredator release and biodiversity conservation. *Ecology Letters,* **12:** 982-998.

[6] **Lanszki, J., M. Heltai & L. Szabó** (2006). Feeding habits and trophic niche overlap between sympatric

golden jackal (*Canis aureus*) and red fox (*Vulpes vulpes*) in the Pannonian ecoregion (Hungary). *Canadian Journal of Zoology*, **84:** 1647-1656.

[7] **Berger, K.M., E.M. Geese & J. Berger** (2008). Indirect effects and traditional trophic cascades: a test involving wolves, coyotes and pronghorn. *Ecology,* **89:** 818-828.

[8] **Levi, T. & C.C. Wilmers** (2012). Wolves-coyotes-foxes: a cascade among carnivores. *Ecology,* **93:** 921-929.

[9] **Newsome, T.M. & W.J. Ripple** (2015). A continental scale trophic cascade from wolves through coyote to foxes. *Journal of Animal Ecology,* **84:** 49-59.

[10] **Ćirović, D., A Penezić & M. Krofel** (2016). Jackals as cleaners: Ecosystem services provided by a mesocarnivore in human-dominated landscapes. *Biological Conservation*, **199:** 51-55.

[11] **Rutkowski, R., M. Krofel, G. Giannatos, D. Ćirović et al.** (2015). A European concern? Genetic structure and expansion of golden jackals (*Canis aureus*) in Europe and the Caucasus. *Plos ONE,* **10:** e0141236.

[12] **Giannatos, G., Y. Marinos, P. Maragou & G. Catsadorakis** (2005). The status of the golden jackal (*Canis aureus* L.) in Greece. *Belgian Journal of Zoology*, **135:** 145-149.

[13] **Dietz, A.J., C. Wohner & C. Kuenzer** (2012). European snow cover characteristics between 2000 and 2011 derived from improved MODIS daily snow cover products. *Remote Sensing*, **4:** 2432-2454.

[14] **Kaczensky, P., G. Chapron, M. von Arx, D. Huber, H. Andrén & J. Linnell** (2012). *Status, management and distribution of large carnivores – bear, lynx, wolf and wolverine – in Europe, part 2.* LCIE report.

[15] **Trainor, A.M. & A.J. Schmitz** (2014). Infusing considerations of trophic dependencies into species distribution modelling. *Ecology Letters,* **17:** 1507-1517.

[16] **Araújo, M. & M. New** (2007). Ensemble forecasting of species distributions. *Trends in Ecology and Evolution,* **22:** 42-47.

[17] **Šálek, M., J. Červinka, O.C. Banea, M. Krofel, D. Ćirović, I. Selanec, A. Penezić, S. Grill & J. Riegert** (2013). Population densities and habitat use of the golden jackal (*Canis aureus*) in farmlands across the Balkan Peninsula. *European Journal of Wildlife Research*, **60:** 193-200.

Keywords: golden jackal, environmental niche modelling, range expansion, grey wolf, mesopredator release

(poster #66)

Assessing the functionality of wildlife corridors in an urban landscape with Red deer space use

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Habitat loss and habitat fragmentation are considered as the greatest threats to wildlife survival. Consequences of urban space expansion and growing development of transport infrastructures (roads, highway, railway), this loss of natural habitats renders andiminution of land surface but also a decrease in ecological functionality [1]. Indeed, habitat fragmentation splits the landscape in small discontinuous patches. Thus links between wildlife reservoirs and resources wildlife needs to complete its biological cycle disappear [2]. This lead to more and more human/wildlife conflicts as roads accidents (direct) or by the diminution of available habitats and resources (indirect).

In the specific context of the "*Grand Genève*" (an urban cluster including Geneva, Vaud county and french neighbouring region), wildlife corridors tends to become more and more fragile [3]. Hence there is a need to assess whether the corridors previously defined in 2012 are still functional or not. Red deer which requires surfaces and structures with an important size and quality has been chosen as a model for this study because of its umbrella species status. Moreover this species moves a lot, use different types of habitats from grasslands to forests and is emblematic for communication tools to reach public. Since 2009, Red deer population in this region have been studied with GPS monitoring. We analysed data from 18 individuals in comparison with the existing potential corridors. We also determine corridors use by several GIS analysis and GIS-based permeability treatments. Maps of connectivity and permeability as well as method to assess the functionality of corridors and their priority regarding fragmentation will be appraised and expected to be integrate in future urban plans.

References

[1] Beninde, J., M. Veith & A. Hochkirck (2015). Biodiversity in cities needs space: a meta-analysis of factors determining intra-urban biodiversity variation. *Ecology Letters,* **18:** 581-592. Doi: 10.1111/ele.12427.

[2] Vasudev, D., R.J. Fletcher, V.R. Goswami & M. Krishnadas (2015). From dispersal constraints to landscape connectivity: lessons from species distribution modelling. *Ecography,* **38:** 1-12. Doi:10.1111/ecog.01306.

[3] Société Suisse de Biologie de la Faune (Ed.) (1995). Faune, construction de routes et trafic. 53 pages

Keywords: Connectivity, corridors, habitat fragmentation, urban Ecology, conservation priorities, conflict mitigation

(oral)

The South African Game Ranching Industry: Quo Vadis

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Since the 1960's the South African game ranching industry has grown into a force to be reckoned with making a very significant contribution to the South African economy. This private sector initiative has burgeoned on the back of private ownership of wildlife and has been supported by a very active trade in wildlife species. The industry has also been underpinned by growing ecotourism and both foreign and local hunting industries. The growth has led to inevitable diversification with commensurate national debate on the pros and cons of directions taken by landowners and the ultimate contribution to South Africa's conservation estate. Socio-political pressures have also made themselves felt in the industry as have illegal trade in wildlife products.

This paper will track the game ranching industry through recent history to its current status and discuss all the diversifications that have manifested in recent times. These will be further discussed against their potential impacts on the South African conservation effort and risk assessment to the industry as a whole. Finally an attempt will be made to track the future of the industry and directions and potential decisions that will enhance the further growth of the industry as a significant partner in the conservation of South Africa's national resource.

Keywords: South Africa, game ranching, private ownership, wildlife, risk

(poster #67)

Carnivorous birds and small mammals depend on invertebrates that are threatened by human activities in southern Africa

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The dependence of larger wild animals on invertebrates is often overlooked when considering their conservation. Invertebrate biodiversity and their activities in the environment render various ecosystem services such as decomposition and mineralization of organic matter, pollination of plants as well as being an important source of food for African wildlife such as mammals (aardwolf, aardvark, bat-eared fox), reptiles, fish and many birds. These functions are important in both natural and agricultural environments where they also control populations of fungi and bacteria, but they are threatened or detrimentally affected by anthropogenic and natural changes. Agricultural areas in southern Africa are being stressed by chemical and other management practices because this sector relies heavily on the use of biocides to protect crops. Natural areas are decreasing and plans to expand coal mining and fracking for oil in pristine areas are on the table. Loss of invertebrate biodiversity is inevitable but will it have a direct impact on game animals and other wildlife in general? Here we pose the questions: how dependent are wild animals in southern Africa on invertebrates; can we identify the different manmade and other factors threatening the abundance and diversity of important invertebrate species; what impact might a loss of such species have on selected mammals in the region when considering their food preferences. A review of available data showed how dependent several carnivorous birds and mammals are on invertebrates as a food source. Contents of aardwolf faeces in summer and winter consisted mainly of termites belonging to various species. Also some *Formicidae*, *Coleoptera*, *Diptera* pupae, other *Insecta* and *Myriapoda* [1]. Content of the hadeda ibis (*Bostrychia hagedash*) stomach of one individual in spring contained 80% earthworms and the remainder was mostly insects but it also eats weevils, flies, butterfly pupae and beetle larvae, as well as crustaceans, millipedes, centipedes, spiders, and snails, depending on seasons and availability. Aardvark (*Orycteropus aferr*) and the bat-eared fox (*Otocyon megalotis*) feed mainly on termites and ants. Local shrews are generalist insectivores that take earthworms, Araneida, Chilopoda, Isoptera and insect larvae as prey We also identified the main drivers of change which are affecting invertebrates biodiversity and abundance in southern Africa which include land use, fire, mining activities and waste disposal apart from climate change. We report on our experimental and field studies on the effects of oil sludge [2] and pesticides [2,3,4] on invertebrates. These studies on the impact of agricultural management and waste disposal practices revealed detrimental impacts on the growth and population densities of selected invertebrates such as earthworms, springtails and mites and potentially also their activities as ecosystem "service providers." But little is known of the role of termites in this respect in spite of the fact that they play a dominant role in many African soils. We conclude that conservation management and planning for the protection of larger animals should follow a holistic approach to assess and include the role of these lowly but important creatures even although it is difficult to quantify and express their importance in economic terms. They form part of the bigger web of life.

References

[1] **Cooper, J.D**. (1979). Importance of termites in the diet of the aardwolf *Proteles cristatus* in South Africa. *African Zoology,* **14(1):** 5-8.

[2] **Reinecke, A.J., M. Van Wyk & S.A. Reinecke** (2016). The influence of soil characteristics on the toxicity of oil refinery waste for the springtail *Folsomia candida* (*Collembola*). *Bulletin of Environmental Contamination and Toxicology,* **96:** 804–809.

[3] **Reinecke, A.J., M. Van Wyk & S.A. Reinecke** (2016). Toxicity to Earthworms and Chemical Composition of Oil Refinery Sludge Destined for Landfarming. *Soil and Sediment Contamination: An International Journal,* **25(8):** 868-881.

[4] **Reinecke, A.J., S.A. Reinecke & M. Van Wyk** (2016). The suitability of potworms (*Enchytraeidae*) and plants to test the toxicity of oil refinery sludge. *Suid-Afrikaanse Tydskrif vir Natuurwetenskap en Tegnologie,* **35(1):** 1-13.

[5] **Eijsackers, H., A. Reinecke, S. Reinecke & M. Maboeta** (2017). Threatened southern African soils: A need for appropriate ecotoxicological risk assessment. *Environmental Impact Assess. Rev.,* **63:** 128-135.

Keywords: invertebrates, birds, small mammals, human threats

(poster #68)

Recent changes in grey partridge *Perdix perdix* demography in central northern France

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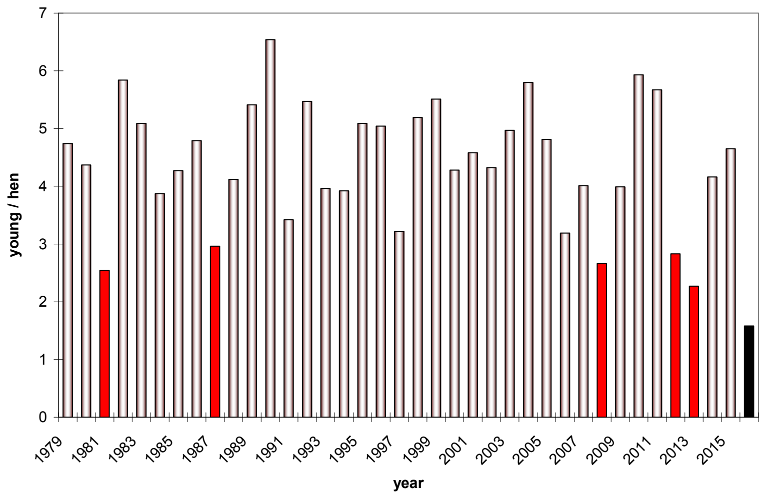
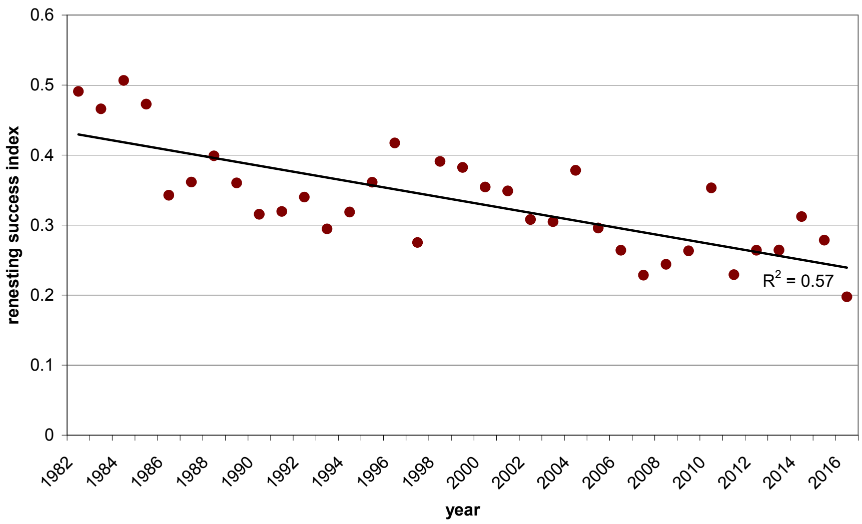
Wild grey partridge populations have been monitored in central northern France for more than 30 years. Data collection, essentially by technicians of departmental hunting associations, concerns spring density, brood composition at the end of summer and hunting bags for a great number of hunting estates spread over the core of the distribution area of the species. In the 1990's, we detected an important increase in adult mortality rates [1]. More recently, data analysis pointed out two other new tendencies that could be at risk for partridge populations: first the reproductive success index (RSI), calculated as the number of young per hen seen in late summer, seems to be more and more variable over time with a sequence of low RSI in the most recent years. Four of the six worst RSI recorded since 1979 were observed during the last ten years (figure 1). However, high RSI were recorded in 2010 and 2011. The coefficient of variation of RSI for a ten consecutive year period has never been so high before the period 2003-2012 and has still increased since that date. The consequence is an increase in fluctuations of the population abundance, which highly depends on the reproductive success [2], and finally in the risk of local extinction. The second tendency is an increase in the proportion of hens seen without young or as extra hens accompanying broods ($R^2=0.18$, $p<0.01$). It has never been so high than in 2013 (62%) and 2016 (70%). A more detailed analysis shows that this is essentially the consequence of a sharp decrease in broods issued from replacement clutches that should have hatched after June. A renesting index (RNI)[1] of only 20% was recorded. The trend of RNI from 1982 to 2016 ($R^2=0.57$, $p<0.001$) corresponds to a quite linear absolute decrease of 20% in 35 years (figure 2). Reasons of this decrease are unknown but strong hypotheses are changes in crops and harvest date (increase in surfaces of crops with early summer harvest) and increase in field size with fewer margins offering a suitable permanent cover for safe renesting.
Due to these trends, wild grey partridge populations in some regions of France, known in a recent past as the most abundant of Europe (several tens of pairs / km²) [3], are now at their lowest level and have locally almost disappeared (eg less than 1 pair/km² in some areas of Beauce region). As a consequence, hunting has been forbidden on most hunting estates these last years. A strong demand emerges today to release hand-reared birds for shooting, which ultimately raises the question of the conservation of wild populations of this high value species.

Figure 1: *variations of the reproductive success index (RSI) of the grey partridge as young to adult hen ratio in end summer observations. In red, < 3 young/hen, in black, < 2 young/hen. From 35 to 750 observation areas per year and from 5 500 to more than 150 000 partridges identified.*



[1] The renesting index (RNI) is the ratio of the number of hens seen at the end of the summer accompanied by young born after June to the total number of hens that were not accompanied by young born in May or June. It has been estimated since 1982 by means of determining the age of the young surviving till the observation period.

Figure 2: *Trend of the renesting success index (RNI) between 1982 and 2016.*



References

[1] **Reitz, F.** (2000). The status of partridges in North-Central France. *In* proceedings of Perdix VIII Symposium, Sopron, Hungary, Oct 1998, S. Farago ed. *Hungarian Small Game Bull*., **5:** 151-163.

[2] **Bro, E., H. Santin-Janin & F. Reitz** (2015). L'évolution récente des populations gérées de perdrix grise (Perdix perdix) de plaine reflète surtout les variations du succès de la reproduction. *Alauda*, **83(4):** 241-246.

[3] **Bro, E., F. Reitz & P. Landry** (2005). Grey partridge *Perdix perdix* population status in central northern France: spatial variability in density and 1994-2004 trend. *Wildlife Biology*, **11:** 287-298.

Keywords: *Perdix perdix*, reproductive success, variability, re-nesting, central-northern France

(poster #69)

Hunting and Scientific National Observatory Citizen: participatory science or just how hunting can be of use?

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In 2010 a website (http://observatoirenationalmigrateurs.net) was created in the aim of involving hunters in participating in forwarding the sightings of some migratory birds each year during post-nuptial migration, wintering and pre-nuptial migration in France (September to April). The first idea was to collect observations from hunters who are above all bird-watchers, present everywhere,frequently at the same time but hundreds of kilometres apart. Observers should collect data in accordance with a data collection protocol noting particularly: date, commune, start and finish time (duration of observation in hours), habitats, hunting method and number of each species observed. The main species of migratory birds concerned in the National Observatory are: thrushes (*Turdus* sp : *merula*, *philomelos*, *iliacus*, *pilaris* and *viscivorus*) ; wood pigeon (*Columba palumbus*); skylark (*Alauda arvensis*) ; starling (*Sturnus vulgaris*) ; lapwing (*Vanellus vanellus*). "Hunter-bird watchers' may enter observations on line or transcribe them onto a standard observation form, or more recently a smartphone application (Naturapass) permits the entering of observations. All collected data is extremely useful to establish a database as an Excel sheet. Each observation entered on our website is stored in an Excel file and each observer has his own data without access to others data. Each year since 2011/2012, the total duration of observations is between 5100 and 6400 hours throughout the national territory among over half of all French departments (Regions). The total number of birds observed is between 315 000 and 880 000 from year to year. The proposed hunter watcher effort may vary each year from one department (Region) to another but for any particular year since 2011 is greater in southern France.

Among the notable results could be highlighted : spatial distribution of species according to decades from September to April (data is provided with a specially developed graphic shells : GIS-type mapping), relative abundance index of observation (RAIO = total number of observed birds / total number of hours of observation) from 2011/2012 till 2015/2016 (the respective Min. and Max. measured value) : blackbird (0.9 - 2.0) ; song thrush (5.4 - 6.9); redwing (0.9 - 3.4) ; fieldfare (1.1 - 3.8) ; mistle thrush (0.7 - 1.5) ; wood pigeon (24.3 - 69.1) ; skylark (1.3 - 3.9) ; starling (12.3 - 58.7) ; lapwing (1.0 - 4.5) ; temporal and spatial variations of the RAIO of each species are also studied.

This website is based on the spirit of volunteerism to involve hunters in monitoring some migratory birds and does not pretend to be a scientific research program but rather a complement to other databases. Opening up participation in the network to "hunter-bird watchers" from other countries of the Western Palearctic will help provide a better understanding of movements and spatial distribution of migratory birds during migration and wintering over a broader area. We sincerely thank all the « hunter-bird watchers », wildlife technicians and hunting federations for their participation every year since 2011.

(poster #70)

Influence of large-scale conservation grazing projects on time-space-behaviour of Red Deer (*Cervus elaphus*) – first results from the Oranienbaumer Heide (DBU Naturerbeflächen)

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Large-scale grazing projects are suspected to influence the time-space-behaviour of wild animals. In three study areas the influence of grazing animals and/or meadow fences on wild animals was determined, with the analysis of red deer behavioural patterns (*Cervus elaphus*).
The study spaces are located on former military training areas in Saxony-Anhalt (*Glücksburger Heide* and *Oranienbaumer Heide*) and Mecklenburg-West Pomerania (*Ueckermünder Heide*).
The project's aim is to generate data based on the influences of large-scale grazing projects on time-space-behaviour of red deer as a basis for future project modelling.
In order to analyse the problem, two before-after-studies in the Glücksburger Heide and Ückermünder Heide were performed, as well as one current-state-study with established grazing in the Oranienbaumer Heide. Various methods were implemented in order to carry out the study: GPS-Telemetry, interaction analysis between grazing animals and red deer using Proximity-Sensors, camera trapping, fecal pellet counts as well as vegetation mapping.
Since 2014 overall 38 red deer were fitted with collar-transmitters in the three areas, in addition to two Konik-Horses and three Heck-Cattle in the area of the Oranienbaumer Heide. The collars are GPS-telemetry-collars manufactured by *Vectronic Aerospace GmbH*. The analysis of the data was performed using the software *ArcMap 10.1 (2012*) from *ESRI* and *Ranges 9 (2016)* from *Anatrack Ltd*. Up until now, the home range sizes show substantial differences between the study areas: for female red deer the average home range size (MCP 95) is about 2500 ha in Glücksburger Heide, 850 ha in Oranienbaumer Heide and only 350 ha in Ückermünder Heide. Male deer show similar tendencies: 5700 ha in Glücksburger Heide, 2600 ha in Oranienbaumer Heide and 850 ha in Ückermünder Heide.
The Oranienbaumer Heide is Germany's largest extensive year-around-pasture with Konik-Horses and Heck-Cattle located on approx. 800 ha since 2008. In order to investigate the spatial use and interaction behaviour between the grazing animals and red deer, the GPS-data over a time frame of one year was analysed. This investigation showed that the cattle used larger home ranges, however smaller 50%-core-range than the horses. Otherwise, the animals behaved individually in reference to their intra- and interspecific interactions. The 50%-core-range of the cattle showed strong intraspecific intersection in contrast to a lack of intersection for the horses. However, only a small interspecific intersection between cattle and horses was determined. These results indicate that the horses show a strong intraspecific as well as interspecific competition in contrast to the cattle. Interestingly, GPS-telemetry analysis of red deer prove the occasional usage of the meadow. Until now, there is evidence that the fences have barrier effects at least in winter. Fecal pellet counts and camera trapping support this assumption.
This study could prove useful to support the design of future large-scale grazing conservation projects.

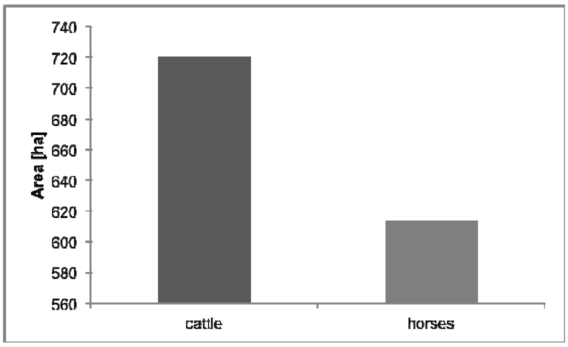

Figure 1: average area of home range of cattle and horses in the Oranienbaumer Heide.

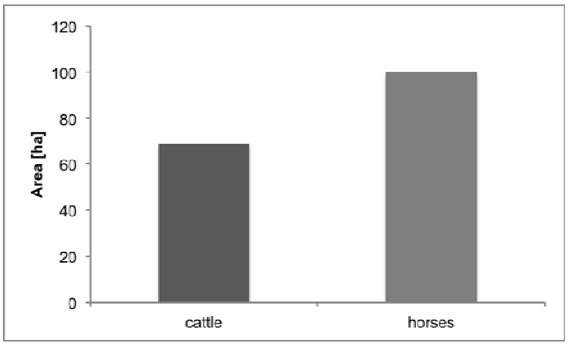

Figure 2: average area of 50%-core-range of cattle and horses in the Oranienbaumer Heide.

***Table 1:** interspecific as well as intraspecific intersection of the 50%-core-ranges of cattle and horses in the Oranienbaumer Heide.*

	cattle	horses
cattle	24,69%	0,56%
horses	0,56%	1,50%

Keywords: Red Deer, *Cervus elavus*, time-space-behaviour, Heck-Cattle, Konik-Horse, fence barrier

HNE Eberswalde
University of Applied Sciences
DBU Naturerbe
Gesellschaft der Deutschen Bundesstiftung Umwelt zur Sicherung des Nationalen Naturerbes mbH

(poster #91)

Causes of grey partridge (*Perdix perdix*) decline in northern Germany**

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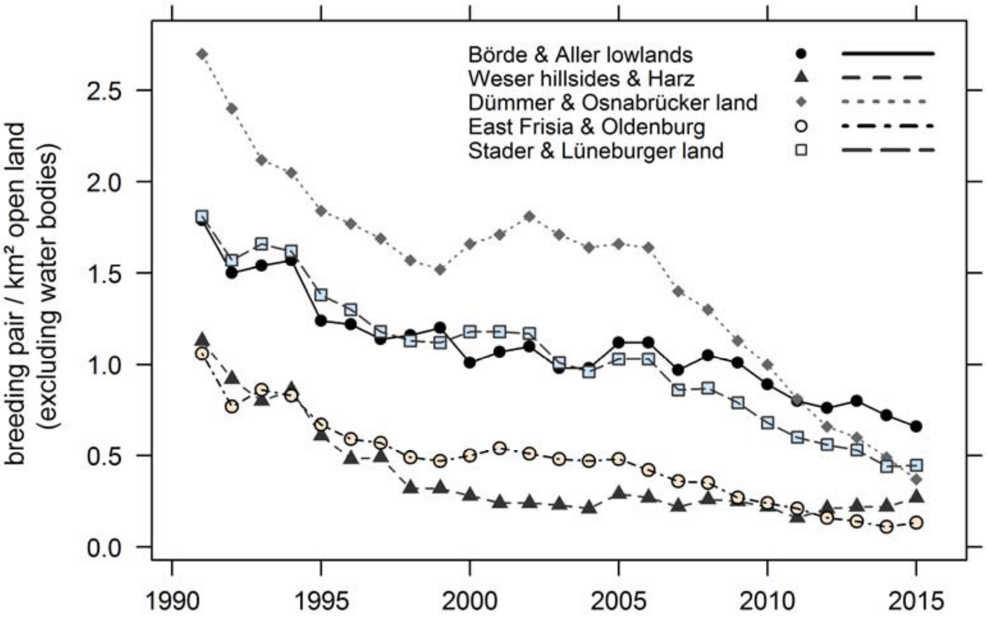
** funding provided by "Jagdabgabemittel des Landes Niedersachsen".

Farmland birds are experiencing a dramatic population decline and the grey partridge (*Perdix perdix*) is one indicator species showing this severe development in Central Europe. The causes for the decline in the middle of the 20th century have been studied extensively and were mostly attributed to adverse effects of agricultural industrialization. Whereas the grey partridge was traditionally hunted, the levels decreased with the reduction in population densities and were completely halted in 2012 in Lower Saxony. Nonetheless the decline continued. Over the last decade the population collapse in parts of Germany was suspected to be caused by increasing proportions of maize cultivation, or a reduction in set-aside fields. However, these relationships are not yet verified.
A citizen science program, the wildlife survey (WTE) of Lower Saxony [1], monitors grey partridge spring densities since 1991 annually. Over 7,000 hunting district holders estimate wildlife species in a range of 3.7 Mio ha which constitutes a unique dataset on wildlife trends. Hunters estimates of grey partridge densities were validated through a thorough comparison to ornithological assessments and found reliable [2]. Grey partridges have decreased markedly and especially in the west (i.e. Dümmer and Osnabrücker land), which has traditionally been the area of highest abundance in Lower Saxony (Fig 1). In contrast to that, the population in the Southeast of Lower Saxony (Weser hillsides and Harz) has been more or less stable over the last 15 years, but on a low level of population densities.

***Figure 1:** Population trends (1991-2015) of grey partridge in Lower Saxony (Germany). Developments were aggregated to 5 regions characterised by similar main landscape traits.*



In a recent study general habitat preferences of the grey partridge were modelled over the entire range of Lower Saxony (Germany) aggregated to the municipality level [3]. In addition to the large spatial scale data for 10 years (2005-2014) were available. As explanatory variables landscape groups and functional groups of agricultural crops (compiled by the Integrated Administration and Control System) were tested in a GAMM (generalized additive mixed model).

The model showed avoidance of municipalities with a high proportion of woodland and areas with a higher proportion of open water, but a preference for areas with a high proportion of winter grains and high crop diversity. Maize did not explain habitat use of grey partridges and data on set-aside were insufficient to evaluate this effect.
In addition to the habitat use, ten years population trends calculated as rho correlation coefficients of densities were adopted as dependent variable for all municipalities. Rho correlation coefficients of agricultural crops were integrated as predictors in a GAM (generalized additive model).
The trend model confirmed the importance of crop diversity per municipality with a linear positive effect.
Spatial scale may influence statistical relationships and thus results of the large scale study will be compared to data on a smaller spatial scale for 2015. Here the hunting district scale is used as sampling unit.

All models support the importance of diverse crop cultivation. Thus even if maize was not the primary cause of decline, large monocultures of maize are certainly a disadvantage for the grey partridge, which is true for most crops. Many EU-incentives, but also the globalized marked; favor the cultivation of specific crops, which results in large areas of monocultures. In order to find alternatives to maize as energy crop, wildflower mixtures were evaluated as habitat for wildlife species. Camera traps were installed to capture wildlife use in comparison to conventional agricultural crops. Although the grey partridge was intended as target species <10 pictures were taken, all of which in the wildflower fields. Thus, although the results are non-conclusive due to lack of samples they may support the importance of diverse habitats.

References

[1] **Strauß, E., K. Ronnenberg, I. Klages & R. Gräber** (2016). Wildlife survey in Lower Saxony 1991-2016 - a base tool for description of biodiversity of our cultural landscape. Pages 363-364. *150 years of ecology [lessons for the future]* - 46th annual meeting of the Ecological Society of Germany, Austria and Switzerland. Verhandlungen der Gesellschaft für Ökologie e.V. (GFÖ), Marburg, Germany.

[2] **Tillmann, J.E., M. Beyerbach & E. Strauß** (2012). Do hunters tell the truth? Evaluation of hunters' spring pair density estimates of the grey partridge *Perdix perdix*. *Wildlife Biology,* **18(2):** 113-120

[3] **Ronnenberg, K., E. Strauß & U. Siebert** (2016). Crop diversity loss as primary cause of grey partridge and common pheasant decline in Lower Saxony, Germany. *BMC Ecology*, **16:** 39: DOI 10.1186/s12898-016-0093-9.

Keywords: Habitat model, trend analysis, grey partridge, citizen science, crop diversity, maize cultivation

(poster #71)

Monitoring of reintroduced population of roe deer (*Capreolus capreolus*) reintroduced in central Portugal

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In the last decades, roe deer (*Capreolus capreolus*) has increased in abundance and range throughout Europe, and Portugal is no exception. However, most of the populations in central Portugal, particularly those in Serra da Lousã, are the results of a series of reintroduction programs during the 90's. The main aims of such programs were to increase the biodiversity of these mountains. Twenty years after the reintroductions, it is timely to evaluate roe deer densities and abundance. With this aim, field work began in December 2016. It consisted of 1km long and 2m wide transects, randomly distributed in the Serra of Lousã. To estimate the density, we used indirect methods, pellet group counted, coupled with Distance sampling. The estimated roe deer density using a uniform detection function was 2,72 ind. per 100ha (95% confidence interval: 1.5-4.8). However, it is important to stress that this is an ongoing study. The obtained densities so far show that this reintroduction program can be considered a case of success; however, future monitoring programs should continue to be developed.

Keywords: ungulates, monitoring, reintroduction, Distance Sampling, Portugal

(poster #72)

Diversionary feeding does not reduce home ranges of European wild rabbits: implications to minimise damage in agricultural landscapes

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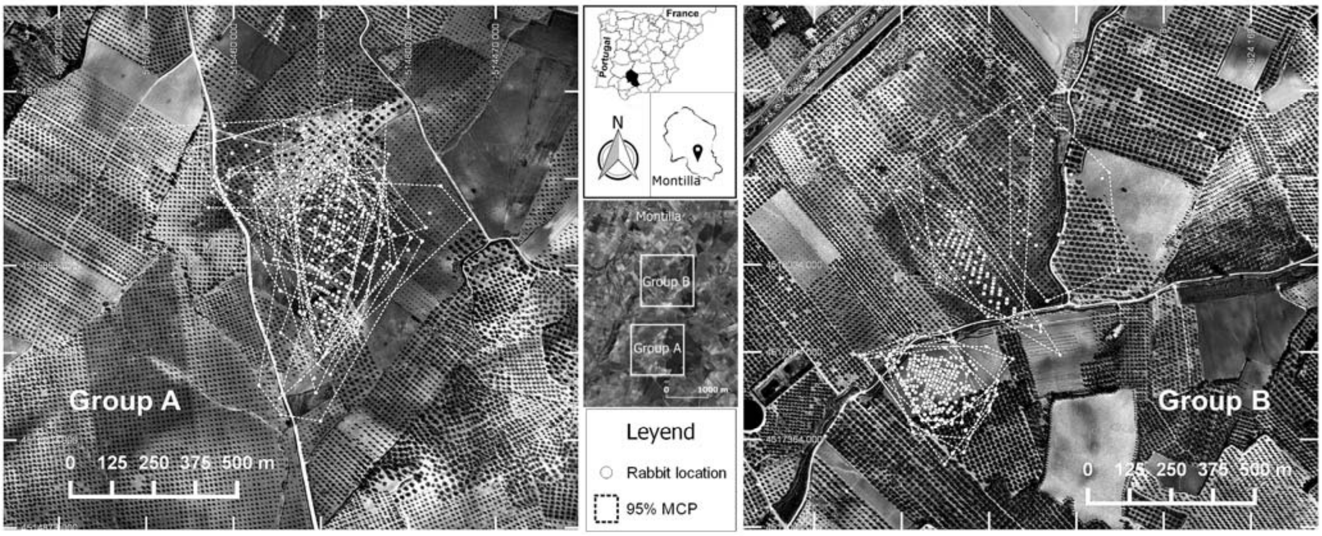
Understanding space use in free ranging populations that cause damage to agriculture can help in the design of measures aimed at reducing their impact. Food availability is known to determine space use in terrestrial vertebrates and, providing alternative food sources during a specific time period may help the management of vertebrate pests by reducing their ranging behaviour [1]. We investigate the use of space by a crop damaging species, the European wild rabbit, in an intensively-managed agricultural landscape within its native range and evaluate the potential of food availability to restrict areas of rabbit activity. We determined diurnal home range (95% minimum convex polygon, MCP) and core area (50% MCP) sizes of rabbits before and after providing diversionary feeding to one rabbit population, while an unsupplemented population served as a control. Rabbits in the study area had large home ranges in comparison with those previously reported in the literature, probably linked to the heterogeneous and unpredictable distribution of resources of intensively-managed semiarid Mediterranean agro-ecosystems. We found no indication that diversionary feeding restricted rabbits' use of space. However, the studied rabbit populations had different strategies in their use of space, probably linked to local conditions. The wide-ranging behaviour of rabbits documented in the present study might explain why even moderate rabbit densities can cause widespread damage to crops. Other factors that promote enlarged home ranges, such as human disturbance, might be more relevant than food availability to the design of management tools in agricultural areas where rabbits are considered an agricultural pest.

Figure 1: *Aerial ortho-rectified photograph of the two study sites (A and B). White circles show point locations of rabbits and dot line represents rabbits home ranges estimated using the 95% minimum convex polygon method (95% MCP).*



References

[1] **Saïd, S., J.M. Gaillard, O. Widmer et al.** (2009). What shapes intra-specific variation in home range size? A case study of female roe deer. *Oikos,* **118:** 1299-1306.

Keywords: food availability, space used, lagomorph, management, vertebrate pest, wildlife damage

(oral)

Just follow the road to find European rabbit causing damage to agriculture in southern Iberian Peninsula

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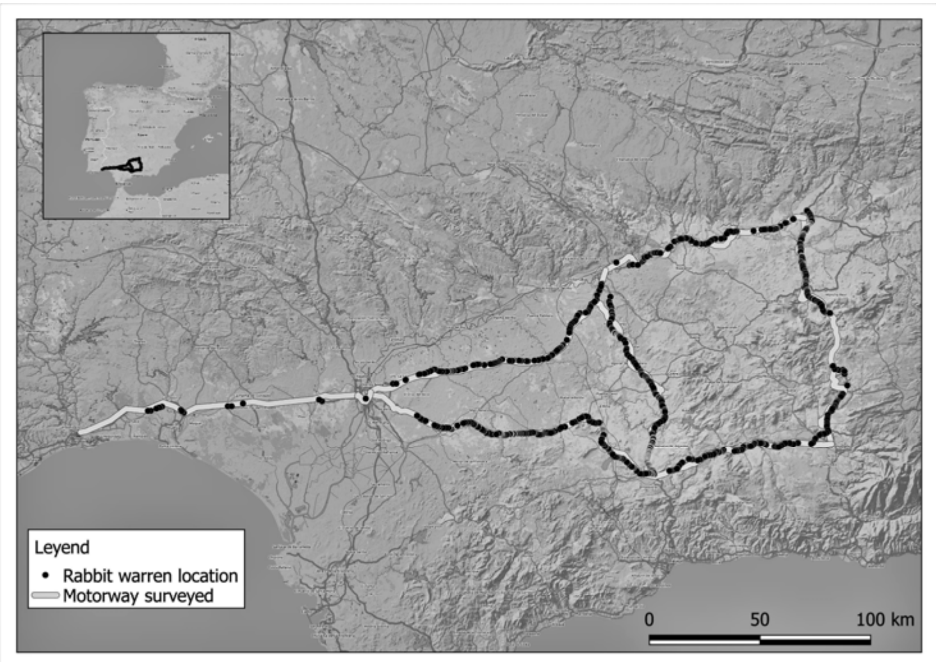
The spread of introduced invasive species causes significant ecological, social and economic impacts [1]. Control programs can target specific landscape features if those are used by invasive to disperse. It is widely known that roads or railways are often used by invasive, harmful species as dispersal corridors [2]. However, little is known about the role of these human infrastructures on the species dispersal when it is a native agricultural pest. This scenario becomes even more complex if the native pest species in question plays key-roles in ecological systems; this is the case of the European rabbit (*Oryctolagus cuniculus*) in the Iberian Peninsula (IP). We study the distribution of rabbit warrens in the verges of 1 500 km of motorway in South IP. We collected the locations of rabbit warrens along the motorways verges using CyberTraker 3.0 installed in a pad; surveys were conducted by car, driving at constant speed (80Km/h). In addition, we used a favourability function to assess the extent of which conditions (e.g. environmental, anthropogenic, agriculture) determine the presence of rabbits in motorway verges. Our preliminary results revealed that rabbit warrens distribution was widespread along the verges (Figure 1). A total of 1 693 warrens were located along the motorway verges and its presence seemed to correlate with near distance to intersections between roads, likely due to an increase of verges area availability in such sites. Effect of environmental, anthropogenic and agriculture conditions are discussed.

Figure 1: *Distribution of the location of European rabbit warrens in the verges along 1 500 kilometres of motorways surveyed in southern Iberian Peninsula.*



References

[1] **Mack, R.N., D. Simberloff, W.M. Lonsdale, H. Evans, M. Clout & F.A. Bazzaz** (2000). Biotic invasions: causes, epidemiology, global consequences, and control. *Ecological Applications,* **10:** 689–710.

[2] **van der Ree, R., J.A. Jaeger, E.A. van der Grift & A.P. Clevenger** (2011). Effects of roads and traffic on wildlife populations and landscape function: road ecology is moving toward larger scales. *Ecology and Society,* **16:** 48–48.

Keywords: CyberTraker, favourability, motorway verges, *Oryctolagus cuniculus*

(oral)

Dynamics and viability of a reintroduced population after 24 years of release: the case of the cinereous vulture *Aegypius monachus* in France.

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Reintroduction programs provide opportunities for real-scale hypothetico-deductive experiments in ecology [1]. Long-term monitoring is necessary to investigate the dynamics and the viability of reintroduced populations and to help managers and policy-makers, and to assess the effectiveness of reintroduction operations [1,2]. The theoretical dynamics of a reintroduced population is define according to three successive phases: (i) installation that depends on the strategy of release, (ii) growth that depends on the reproduction of wild born individuals, and (iii) regulation which corresponds to the population reaching the carrying capacity [3]. Recently, [4] proposed to assess the success of the restored populations by projecting their viability once they enter into the regulation phase (criterion E; [5]). However, it remains unclear whether and how these criteria could be applied within a metapopulation context.

The three reintroduction programs of cinereous vultures (*Aegypius monachus*) conducted in France during the last two decades represent an opportunity to study the viability components and success criteria of reintroduced species along the three phases. The first program was initiated from 53 individuals released in the Grands Causses between 1992 and 2004, the second program from 46 individuals released in the Baronnies since 2004 and the third program from 28 individuals released in the Verdon since 2005. Since the first successful breeding in the wild in 1996 in the Grands Causses, the population has increased to 20 pairs in 2016, 10 pairs in the Baronnies and 1 pair in the Verdon. For 5 years, the number of breeding pairs remained stable in the Grands Causses suggesting that the population entered the regulation phase, whereas previous study estimated that the breeding habitat would host bigger breeding population [6]. Besides, a metapopulation system seems to be happening between these three populations since exchanges of individuals have been detected.

The present study provides a demographic assessment of the reintroduced populations of cinereous vultures in France from 1992 to 2016 in order to figure out whether a metapopulation dynamic acts within these reintroduced populations and how it could affect its long-term viability. The specifics aims of this work is to estimate the demographic parameters of the three populations of cinereous vulture and of the French (meta)population to understand the processes of the population dynamics. Survival and dispersal will be conducted by multi-event and multi-site Capture-Mark-Recapture analysis from 279 life histories of ringed individuals. Also, we will quantify fecundity rates from breeding parameters using generalized linear model.

Our results model will provide essential information to optimize decision-making in the priorities for the conservation of the species. This study will be the first step in assessing the viability of the (meta)population of cinereous vultures reintroduced in France.

References

[1] **Sarrazin, F. & R. Barbault** (1996). Reintroduction: challenges and lessons for basic ecology. *Trends in Ecology & Evolution*, **11:** 474–478.
[2] **Sutherland, W.J., D. Armstrong, S.H.M. Butchart, J.M. Earnhardt, J. Ewen, I. Jamieson, C.G. Jones, R. Lee, P. Newbery, J.D. Nichols, K.A. Parker, F. Sarrazin, P.J. Seddon, N. Shah & V. Tatayah** (2010). Standards for documenting and monitoring bird reintroduction projects. *Conservation Letters*, **3:** 229–235.
[3] **Sarrasin, F.** (2007) Introductory remarks—a demographic frame for reintroductions. *Ecoscience,* **14:** IV–V.
[4] **Robert, A., B. Colas, I. Guigon, C. Kerbiriou, J.B. Mihoub, M. Saint-Jalme & F. Sarrazin** (2015). Defining reintroduction success using IUCN criteria for threatened species: a demographic assessment. *Animal Conservation*, **18:** 397–406.
[5] **International Union for Conservation of Nature and Natural Resources & Species Survival Commission** (2013). *Guidelines for reintroductions and other conservation translocations.*

[6] **Mihoub, J.-B., F. Jiguet, P. Lécuyer, B. Eliotout & F. Sarrazin** (2014). Modelling nesting site suitability in a population of reintroduced Eurasian black vultures *Aegypius monachus* in the Grands Causses, France. *Oryx*, **48:** 116–124.

Keywords: Conservation, population dynamic, reintroduction, vultures, Capture-Mark-Recapture.

(oral)

Using an Unmanned Aerial Vehicle (UAV) and Object Based Image Analysis (OBIA) to map agricultural damage by wild boars in Flanders, Belgium

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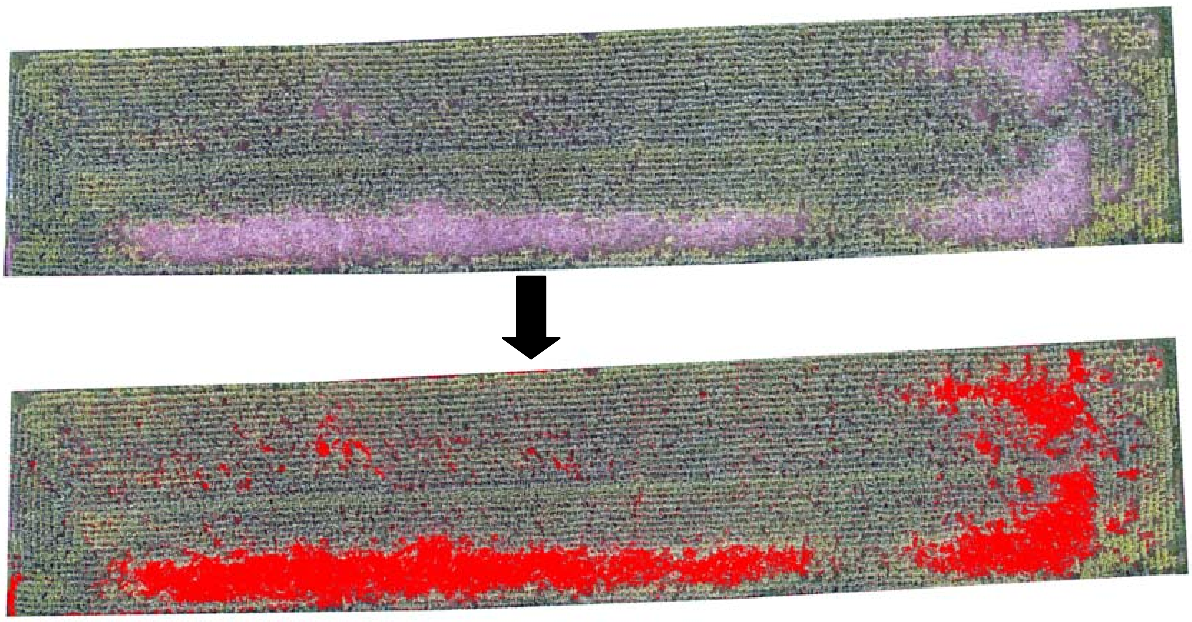
Wild boars returned to Flanders (Belgium) since 2006 after almost half a century of absence. During their absence, the landscape has changed dramatically due to transport infrastructure, urbanisation and agricultural intensification. The current Flemish landscape is severely fragmented and is one of the most densely populated areas in the world (462 persons per square kilometre). This fragmented landscape with an intense interweaving between the urbanised, natural and agricultural landscape is causing frequent contacts between wild boar and human activities. Especially, complaints about agricultural damage are increasing which often leads to conflicts because of the associated economic losses. At present, the extent of crop damage in Flanders is however unknown, there is no standardised method to collect the number of damage cases and to measure the yield losses associated with this agricultural damage by wild boars in Flanders.
Damage assessments are often performed by ground visits which are time consuming, subjective and damage spots can be overseen in large areas.
With the fast developing technology of unmanned aerial vehicles (UAV), better known as drones, we used drones to develop a novel method to collect damage information in an objective and standardised manner.
In 2015 and 2016 all reported agricultural damage cases by wild boars (N=189, maize, cereals, grasslands) in two study areas (121 and 136 km²) in Flanders were photographed with a drone. By photographing damaged parcels in numerous photographs of which each are taken with a 80-85% overlap, photogrammetric processing of these pictures resulted in clear orthophotographs of each damaged field (figure 1).
Next, Object Based Image Analysis (OBIA) provides a detailed technique to classify the orthophotographs into damaged and undamaged areas. The surface of the damaged area of a parcel can thus be easily calculated which makes an objective and accurate measurement of the yield losses possible (figure 1). By the use of this method, it will be possible to process all photographed fields to get a first insight in the economic impact of wild boar damage for the agricultural sector in Flanders.

***Figure 1: Above** - Orthophotograph of a damaged field by wild boars.*
***Below** - Classified photo using Object Based Image Analysis (OBIA).*



Keywords: Drone, wild boar, agricultural damage, Object Based Image Analysis

(keynote)

From wildlife management to Planetary Health: a multidisciplinary challenge

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In numerous civilizations for many centuries, wild animals have been essential sources of proteins and raw materials. In earlier times, there were fewer humans and their impact was low compared to that of climate, diseases, predation and food shortage. Domestication, growing human population, globalization, a number of ecological perturbations including climate change, and human activities in general have dramatically accelerated the rate of species extinction and caused a cascade of events leading to the emergence of an increasing number of infectious diseases in animals and humans, and to an exponential overexploitation of natural resources threatening human's survival in the long term. Therefore, it has been proposed to call "Anthropocene" the epoch dating from the commencement of significant human impact on the Earth's geology and ecosystems. As the human impact on the planet has accelerated, the awareness for the fact that natural resources are limited has begun to grow. The concept of Planetary Health was born from the recognition that the health of human civilization relies on the health of the natural systems on which it depends [1]. Here, we argue that wildlife, and in particular wildlife management (i.e. the process which recognizes, analyzes and proposes solutions for tasks and problems when dealing with wild animals and their habitats) and wildlife population health (i.e. the discipline dealing with the health of wild animals, with a focus on ecosystem and population health) should play a key role in the efforts towards Planetary Health.

Health is the capacity of an organism or a population to adapt and self-manage under changing environmental conditions. It is a delicate balance between a host, population or ecosystem, and the stressors it is exposed to. Until relatively recently, health concerns have been largely focused on humans and their domestic animals, these being mostly relevant as a source of food as well as a potential source of disease agents for humans. During the past decades, several initiatives were taken towards more integrated health approaches, such as One Health, Conservation Medicine and EcoHealth. Planetary Health is a new discipline proposed in 2015. It recognizes that it is vital that we protect the environment in which we live and on which we depend, and that we develop sustainable systems to support human health. Planetary Health warns that while human health has progressed, the depletion of our natural systems threatens our ability to maintain these improvements (www.thelancet.com/infographics/what-is-planetary-health). However, despite these initiatives, up to now collaborations between health disciplines, nature conservation and wildlife management have been insufficient.

The relationship between wildlife disease and wildlife management is often seen as causal, with diseases impacting wildlife populations in such a way that their exploitation may be limited or their conservation threatened. Yet, this causality link is also valid in the other direction. Microorganisms with pathogenic potential are an integral part of ecosystems and co-evolutive mechanisms have promoted individuals and populations able to cope with infectious and non-infectious stressors through natural selection. Thus, disease and associated mortality are not necessarily a threat to species survival but certainly important drivers of natural selection. By contrast, where habitats and wildlife populations are strongly disturbed by humans (intensive management towards increased production for people's benefit, introduction of new microorganisms through human travel and encroachment in wildlife habitats), the systems' plasticity is strongly affected, new diseases emerge, pathogens relevant to humans and their domestic animals become maintained in the wild, and diseases can turn into a serious threat to wildlife, domestic animals and humans [2].

Wildlife disease investigations include surveillance and research with the aim to develop prevention measures in two main areas: 1) Risk of transmission of pathogens of wildlife origin to humans and domestic animals, including diseases with potential global spread through animal migration and trade (e.g. avian influenza, African swine fever, bovine tuberculosis); 2) diseases as a threat to species conservation, locally and globally (e.g. white nose syndrome in bats, chytridiomycosis in amphibians). In both areas, it is now recognized that wildlife management is a considerable disease risk factor. For example, management practices fostering unnaturally high game densities and aggregation, such as supplemental feeding and fencing, contribute to the maintenance of *Mycobacterium bovis* and *M. caprae* (the agents of bovine tuberculosis) in the wild, creating infection sources for domestic livestock and humans [3]. Population isolation (fencing, habitat fragmentation) leading to a loss of genetic diversity increases disease risk, including the maintenance of livestock pathogens such as the agents of bovine tuberculosis in wild ungulates [3] and species conservation threats such as the facial tumor disease in Tasmanian devils [4]. Wildlife translocations are associated with a high risk of disease introduction with potentially disastrous impacts on indigenous populations [2,5].

Consequently, sound wildlife management has the potential to bring a major contribution to health in four ways: 1) Protection of functioning ecosystems: ensuring the existence of habitats in which the natural plasticity of species is not overloaded, i.e. where the full ecological potential of species and biocenosis are not exploited up to exhaustion; 2) Respectful exploitation of natural resources: ensuring the utilization of wildlife populations without disturbing or destroying the structures that arose from evolution as concerns their social structure, ethology and ecology; 3) Contribution to ecosystem recoveries: restoration and tolerance for restoration of ecosystems (e.g. reintroduction or immigration of predator species), implementation of measures to reconnect and revalue habitats to prevent genetic isolation and foster biodiversity, decrease of disease risk through increase of genetic diversity (e.g. reducing cryptorchidism occurrence in Florida panther *Puma concolor coryi* [6]), inclusion of veterinary supervision in translocation programs [5] (e.g. planning the restoration of lynx populations *Lynx* spp. in Europe [8]), and reduction of host densities and feeding bans (e.g. bovine tuberculosis in white-tailed deer *Odocoileus virginianus* in Michigan [8]); 4) Development of tools for wildlife health investigations: collection of population data in a harmonized way to better assess wildlife health, to understand the underlying causes of threatening disease situations, and to take measures towards solutions [9].

Planetary Health recognizes the essential value of ecosystems services, and that nature conservation (including an exploitation respectful of natural equilibriums, i.e. "wise use") is no less than a health insurance. This concept was first proposed nearly 80 years ago by the American forester and founder of the wildlife management concept, Aldo Leopold [10], but has been largely ignored so far. Up to now, biocentric wildlife management (i.e. aiming primarily at species conservation with the view that living organisms have an intrinsic value) and anthropocentric wildlife management (i.e. aiming at a maximal possible exploitation of wildlife resources such as venison and trophies) have been largely opposed and dependent on people's own values or ethics. Planetary Health warns that in the long run, human survival and the sustainable exploitation of natural resources upon which we depend is only possible if nature conservation and restoration is placed at the top of our agendas. Applied to global health, Leopold's vision means that the health of each of us is linked to the health of all the rest [11]. In other words, independently of people's ethical principles, we need to recognize that everything is interconnected and that ecosystem conservation is indispensable to human survival.

Consequently, we have to ask ourselves whether current management systems are in agreement with the Planetary Health concept, and whether scientific knowledge is being used for the benefit of the planet's health or mostly for production purposes. Wildlife management is a powerful tool on the way to Planetary Health, but to achieve this goal, ecological criteria should be prioritized. Almost a century after Aldo Leopold's ideas, the Planetary Health approach requires and offers the chance to bring scientists with similar goals and complementary skills together, to demonstrate evidence and take action for the long-term benefit of humans, animals, and of the planet as a whole.

References

[1] **Horton, R. & S. Lo** (2015). Planetary health: a new science for exceptional action. *Lancet*, **386:** 1921-1922.

[2] **Ryser-Degiorgis, M.-P., M. Pewsner & C. Angst** (2015). Joining the dots – understanding the complex interplay between the values we place on wildlife, biodiversity conservation, human and animal health: A review. *Schweizer Archiv für Tierheilkunde,***157:** 243-253.

[3] **Schöning, J.M., N. Cerny, S. Prohaska, M.M. Wittenbrink, N.H. Smith, G. Bloemberg, M. Pewsner, I. Schiller, F.C. Origgi, & M.-P. Ryser-Degiorgis** (2013). Surveillance of bovine tuberculosis and risk estimation of a future reservoir formation in wildlife in Switzerland and Liechtenstein. *PLoS One*, **8:** e54253.

[4] **Mc Callum, H.** (2008). Tasmanian devil facial tumour disease: lessons for conservation biology. *TREE*, **23:** 631-637.

[5] **Kock, R.A., M.H. Woodford & P.B. Rossiter** (2010). Disease risks associated with the translocation of wildlife. *Revue Scientifique et Technique (OIE)*, **29:** 329-350.

[6] **Mansfield, K.G. & E.D. Land** (2002). Cryptorchidism in Florida panthers: prevalence, features, and influence of genetic restoration. *Journal of Wildlife Diseases*, **38:** 693-698.

[7] **Ryser-Degiorgis, M.-P.** (2009). Planning of veterinary supervision for translocation programmes of wild felids. *In*: Vargas A., C. Breitenmoser & U. Breitenmoser (eds.): Iberian lynx *ex situ* conservation: an interdisciplinary approach, Fundación Biodiversidad & IUCN Cat Specialist Group, Madrid, p. 489-498.

[8] **Carstensen M. & M.W. DonCarlos** (2011). Preventing the establishment of a wildlife disease reservoir: a case study of bovine tuberculosis in wild deer in Minnesota, USA. *Veterinary Medicine International*, **2011:** 413240.

[9] **Sonnenburg J., M.-P. Ryser-Degiorgis, T. Kuiken, E. Ferroglio, R.G. Ulrich, F.J. Conraths, C. Gortázar & APHAEA project partners** (2017). Harmonizing methods for wildlife abundance estimation

and pathogen detection in Europe – a questionnaire survey on three selected host-pathogen combinations. *BMC Veterinary Research,* **13:** 53.
[10] **Leopold, A.** (1949). The land ethic. In: Leopold, A. (ed.), A sand country almanac and sketches here and there. Oxford University Press, New York, p. 201-226.
[11] **Goldberg T.L. & J.A. Patz** (2015). The need for a global health ethic. *Lancet*, **386:** e37-e39.

Keywords: ecosystem services, disease risk, tool, health, management, wildlife

(oral)

Population Quality of Free – Ranging European Bison in Lithuania

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European bison (*Bison bonasus* Linnaeus, 1758) is the largest herbivore in Europe. Historically it was distributed throughout Western, Central and South-Eastern parts of Europe. By the end of XIX century, there were two isolated populations of European bison left in the wild: in Białowieża Forest (*B. b. bonasus*) and in the West-Caucasus Mountains (*B. b. caucasicus*)[4]. During the period of World War I and the Revolution of 1917, civil war episodes and heavy poaching became directly responsible for the complete extirpation of European bison in the West-Caucasus region before 1927 [1,2,4]. Last free-ranging female was shot in Bialowieza forest in 1919.

The concept of restoring the European bison using animals kept in zoos originated in several countries and was publicly presented for the first time by Polish zoologist J. Sztolcman at the 1st International Congress of Nature Protection in Paris, 1923. Restoration of free ranging European bison population in Europe started with very few founders, collected from different zoos of the world. Lowland line (Bialowieza line) originates from only 7 founders (4 males, 3 females) and includes pure animals of *B. b. bonasus* subspecies, Caucasian line (LC), (*B. b. bonasus X B. b. caucasicus*) originate from all 12 founders (5 males, 7 females) including the bull of Caucasian subspecies.

Lithuania was one of the countries where European bison reintroduced. Enclosure for bison's was built in central part of the country and first bison's released there in 1969, from Russian breeding centre in Moscow region. After inhabiting the bison started breeding successfully. The first young individuals born in enclosure were released to the neighbouring wild forest in 1971. The herd of free ranging bison formed gradually. Currently the population of European Bison is 182 individuals in Lithuania. Thus, we may confirm that European bison reintroduction in Lithuania was successful. However, it was inconsistent and not properly planned process. Current herd is sufficient to maintain a vital population, but it causes the conflicts with local farmers. Bison herds are very sedentary and they mainly inhabiting the area of 57 thousand ha, of the most fertile and productive forest and agriculture land of the country. Thus, bison density in their current home range is rather high 3.2 ind./1000 ha. The compensation paid to farmers by Ministry of Environment reached 98 thou € during 2016. However, farmers are still unsatisfied with the insufficient adequacy of damage estimation methodology.

European Bison Protection Plan was prepared and confirmed in 2015 [3]. The main idea was to split and translocate bison herds to better places with more suitable environment for bison. Two areas were suggested for bison translocation. One is forested area in (a) North-West part of the country, in Telsiai state forest enterprise, other is (b) a low productivity forested area in South of the country, Dzukijos National park. In a first place (a) new enclosure for bison was built with a modern biotechnical construction. According to the European Bison Protection Plan, the young (2 – 3 yrs. old) free ranging bison individuals had to be captured and placed in enclosure for quarantine and later, translocated, after adaptation to local environment conditions, they had to be released. Unfortunately, any bison in freedom was captured so far, due to lack of experience, lack of funding and even contrary legislation acts. Enclosure in South part of Lithuania (b) was not even started to build so far, due to funding delay for juridical reasons. Even more, the increase of free ranging European bison population caused a danger of vehicle collision on roads. The area occupied by bison is crossed by Trans European transport corridor Via Baltica E67 with one of the highest traffic intensity in the region. Recently (on 25 11 2016) 3 bison's were killed trying to cross the road early morning on traffic pick hours.

In beginning of March 2016, one female bison was captured and GPS collared in order to investigate the size of bison herd home range and habitat selection. The collared female was living in very small semi isolated (by highway, railway and urban territory) area with a herd of 33 individuals until late autumn. Later herd split, 25 individuals moved to South-Eastern direction, while collared female stayed in the same area with other 8 individuals.

The home range of collared female was largest in March (762.7 ha). The bison herd spent as much time in open areas as in the forest habitats. Later the home range decreased and in summer months the bison spent most of their time in forested area. Since September, home range size started to increase again. This could be due to (a) decreased disturbance of agricultural machinery in fields and (b) with a need to find more nutrient food before winter.

The analysis of habitat selection showed that bison prefer coniferous forest rather than broadleaves; they prefer young, middle age and pre-mature forest, while they avoid clear cutting and over mature forest. In open agrarian landscape they preferred grains and corns, while avoided leguminous, rape, grassland, pastures, and other lands.
For improving damage estimation methodology, we have tried to estimate damaged area in a grain field using aero photography, captured by unmanned aircraft (drone). Using Arc Map software, we were able to distinguish and estimate the area damaged by bison, while eliminating damage caused by wild boar and abiotic factors (wind and rain). This is very useful possibility for specific damage estimation, however it requires suitable weather conditions and good time selection for capturing (just before harvest time). However, more studies must be dedicated to improve the precision of damage estimation.

References

[1] **Bashkirov, I.** (1940). Kavkazskii zubr. Monograficheskii ocherk Pp. 7 – 72 in: Kavkazskii zubr. (ed. N.K. Kulagin). Glavnoe Upravlenie po zapovednikam, zooparkam I zoosadam. Moscow, USSR.
[2] **Heptner, V.G., A.A. Nasimovic & A.G. Bannikov** (1966). Die Saugetiere der Sovietunion. 1. Paarhufer und Unpaarhufer. G. Fischer Verl. Jena, Germnay. Pp. 1-939.
[3] **Pėtelis, K., G. Brazaitis, J. Baranauskaitė & G. Narauskaitė** (2015). European Bison (*Bison bonasus* L.) protection plan. Ratified on 21-09-2015 by Minister of LR Ministry of Environment No. D1-675 [in Lithianian]
[4] **Pucek, Z.** (2004). Status Survey and Conservation Action Plan European Bison. The World Conservation Union.

Keywords: bison herd, damage, unmanned aircraft, aero photography, vehicle collision

(poster #74)

Behavioural, survival and breeding success of parent-reared grey partridges *Perdix perdix* in English lowland farmland

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It is known that populations of grey partridge (*Perdix perdix*) in Europe have declined dramatically since the mid-20th century [1] and in the United Kingdom its breeding abundance has declined by 92% between 1970 and 2013 [2]. In Britain, targeted management to increase numbers of grey partridges has proven to work [3], though in many areas partridges have now gone extinct or their densities are too low to recover through targeted management. Hence, in some cases the release of birds is necessary.

Several techniques for re-introducing grey partridges are available [4]. Different types of rearing and releasing have been investigated extensively, and best survival results have been achieved with bantam-reared and artificially-reared fostered young birds [5]. A rearing technique which has not been studied yet is parent-rearing, which consists on birds hatched and reared by their own parents. In other gamebirds such as the red-legged partridge (*Alectoris rufa*), parent-reared birds have shown higher survival and breeding success compared to commercially-reared ones [6]. We studied the behavioural patterns, survival rates and breeding success of parent-reared grey partridges released in lowland England, and compared with wild counterparts and results from previous studies.

We conducted a re-introduction project at a lowland farm in southern England where gamebird management was in place: habitat enhancements, predator removal and supplementary feeding. Coveys were released in January of 2012 'year 1' (2 coveys, 27 birds) and November of 2012 'year 2' (5 coveys, 68 birds). All birds were colour-ringed and 3-4 juvenile females were radio-tagged in each covey. In total, 10 birds were radio-tagged in year 1 and 19 in year 2.

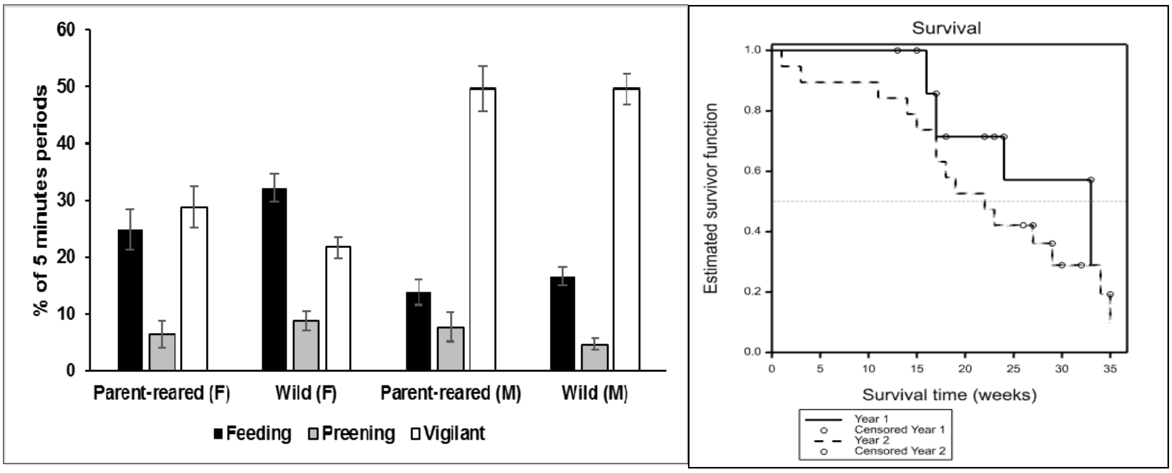
We radio-tracked coveys and pairs at least once a week to estimate survival rates and possible causes of death, conducting one hour observations of pairs from a vehicle using binoculars between 8:00 and 19:00 hours. We recorded the behaviour of the hen and the cock separately every 5 minutes, and the behaviours were categorized as: *vigilant, feeding, preening-resting* and *other behaviours*. We conducted 38 observations of parent-reared birds from 17 different pairs, and 81 observations from 39 wild pairs at two different lowland farms in southern England.

In parent-reared birds, the proportion of 5 minute periods in which the male and the female were vigilant was 49.6% and 28.7% respectively, while the proportion of periods in which females were feeding (24.7%) was approximately double of that spent by males (13.8%). When looking at wild pairs, males also spent more time vigilant (49.5%) compared to females (21.7%), the latter also spending more time feeding (32.2%) (Fig. 1a). Although no statistical comparison was conducted owing to possible site effects, the time budget of parent-reared birds was similar to the observed in wild birds, and agreed with existing literature: females mainly feed and preen-rest to increase their body condition and males remain vigilant to avoid predators [7]. We recorded eight disturbances to parent-reared birds while being observed, six caused by raptors, with five responses been flushing and one crouching (lasting for 60 seconds).

In year 1, two partridges were known to reach the nesting period (May-June) and only one bird was known to be alive six months after release (10%). In four birds the possible cause of death was mammalian predation (fox *Vulpes vulpes* or cat *Felis catus*), and the signal was lost in four radio-tagged birds. In year 2, seven birds were alive and reached the nesting period six months after release (beginning of May, 37%). In this year, the possible cause of death was predation from sparrowhawk (*Accipiter nisus*) (n = 6) fox (n = 3), disease (n = 3) and human causes (n = 2). For both years, a significant proportion of birds died or went missing (60-70%) during the pairing period (from mid-February to mid-April) (Fig. 1b). All radio-tagged birds reaching the breeding season paired successfully. In year 1, one hen was known to lay a clutch, but this bird was predated while nesting, and other non-radio-tagged but coloured ring bird was seen with chicks (2012 had the wettest spring-summer recorded in Britain for a century). In year 2, two birds nested and one hatched its own chicks.

Overall, the survival of parent-reared was better than the one recorded in commercially-reared grey partridges, which often suffer high rates of predation during the first weeks after release [8,9]. Although birds were able to pair-up, the number of hens hatching their own brood successfully was low, which agrees with the limited breeding output observed in commercially-reared grey partridges [8,9] and parent-reared red-legged partridges [6].

Figure 1: *(a, left) comparison of behaviour categories proportions between sexes in parent-reared and wild pairs of grey partridges (mean ± SE) and, (b, right) Kaplan-Meier survival function for parent-reared partridges.*



Our results suggest that parent-reared may be a viable option to consider owing to their improved behaviour and survival compared with commercially-reared ones [8,9], but further research needs to be conducted to understand why birds struggle to hatch their own chicks.

References

[1] **Birdlife International** (2004). *Birds in Europe: Population Estimates, Trends and Conservation Status*. Birdlife International.

[2] **Hayhow, D., A.L. Bond, M. Eaton, P.V. Grive, C. Hall, J. Hall, S.J. Harris, R.D. Hearn, C.A. Holt, D.G. Noble, D.A. Stroud & S. Wotton** (2015). *The state of the UK's birds 2015*. RSPB, BTO, WWT, JNCC, NE, NIEA, NRW and SNH, Sandy, Bedfordshire.

[3] **Sotherton, N.W., N.J. Aebischer & J.A. Ewald** (2013). Research into action: grey partridge conservation as a case study. *J. Appl. Ecol.,* **51:** 1–5.

[4] **Browne, S.J., F. Buner & N.J. Aebischer** (2009). A review of gray Partridge Restocking in the UK and its Implications for the UK Biodiversity Action Plan. in *Gamebird 2006* (eds. Cederbaum, S., Faircloth, B., Terhune, T., Tompshon, J. & Carroll, J.) 380–390 (Warnell School of Forestry and Natural Resources).

[5] **Buner, F.D., S.J. Browne & N.J. Aebischer** (2011). Experimental assessment of release methods for the re-establishment of a red-listed galliform, the grey partridge (*Perdix perdix*). *Biol. Conserv.,* **144:** 593–601.

[6] **Pérez, J.A., C. Sánchez-García, C. Díez, D.J. Bartolomé, M.E. Alonso & V.R. Gaudioso** (2015). Are parent-reared red-legged partridges (*Alectoris rufa*) better candidates for re-establishment purposes ? *Poult. Sci.,* **94:** 2330–2338.

[7] **Dahlgren, J.** (1990). Females choose vigilant males: an experiment with the monogamous grey partridge, *Perdix perdix*. *Anim. Behav.,* **39:** 646–651.

[8] **Parish, D.M.B. & N.W. Sotherton** (2007). The fate of released captive-reared grey partridges Perdix perdix: implications for reintroduction programmes. *Wildlife Biol.,* **13:** 140–149.

[9] **Rymešová, D., O. Tomášek & M. Šálek** (2013). Differences in mortality rates, dispersal distances and breeding success of commercially reared and wild grey partridges in the Czech agricultural landscape. *Eur. J. Wildl. Res.,* **59:** 147–158.

Keywords: behaviour, parent-rearing, *Perdix perdix*, predation, re-introduction

(oral)

Characteristics of fallow deer reproduction and time of conception

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We investigated the reproduction of fallow deer in a lowland forest-cropland habitat. In the course of our eight-year-long investigation we have analysed the uterus of 261 culled females during individual hunts from December to February.
Our research was conducted in the DALERD South Plains Forestry Share Holding Company's Gyula Forestry Area, on an 8,250 hectare hunting ground. The study site is located on the Great Hungarian Plain, East of Békés County, at the Hungarian-Romanian border, with the following coordinates: N latitude 46° 38' 42.79" and 21° 16' 49.63" E longitude.
We investigated the relation between the age of the female and the twin conception and the birth rate of the population. We calculated the sex ratio at birth and monitored the survival. The investigation was performed for 8 years.
Estimation of embryonic ratio: we collected the uterus of females culled during the hunting season (X.01-I.31) and counted the number of embryos.
Estimation of the embryonic sex ratio: we detected the sex of the embryos in all cases when it was possible by visual perception.
Estimation of age: was done based on the lower jaw, in case of young animals teeth eruption and teeth change were considered, whilst in case of older animals the number of cement layers of the first molar was counted.
Estimation of the recruitment: we counted the number of the females and that of the offspring in the groups using video technology and photos. We gained support from the professional hunter staff of the territory and thus the monitoring was continuous during the whole research period We calculated the summertime fawn losses from the offspring estimation done in September. The winter survival was calculated in end of February, taking into account the number of fawn culled during the hunts. The number of offspring raised till the next fawning was estimated in the end of April. The average number of observed females during one year was 646 (min. 507 and max 1126).
During the observations we distinguished the yearlings and females older than two years. The observations were performed in each month during the year. The conception rate was 0.989 (n=261) and we experienced twin-gestation two times (this was 0.77 % of the total sample). There was no significant difference between the conception rate of does (99%, n=182) and yearlings (96%, n=51). The conception rate of females older than 10 years was 87,5 % (n=24) but the difference compared to the younger ones was not significant. In the samples (n=163) where we were able to define the sex of the foetus, there were 98 males and 91 females during the 8 years.
The rate of conception of yearlings didn't differ significantly from that of youngs and old ones, but differed significantly from that of middle aged. The conception rate of young females didn't differ significantly from the middle aged ones, but differed significantly from the old ones. The conception rate of middle aged and old females differed significantly as well (**Table 1**).

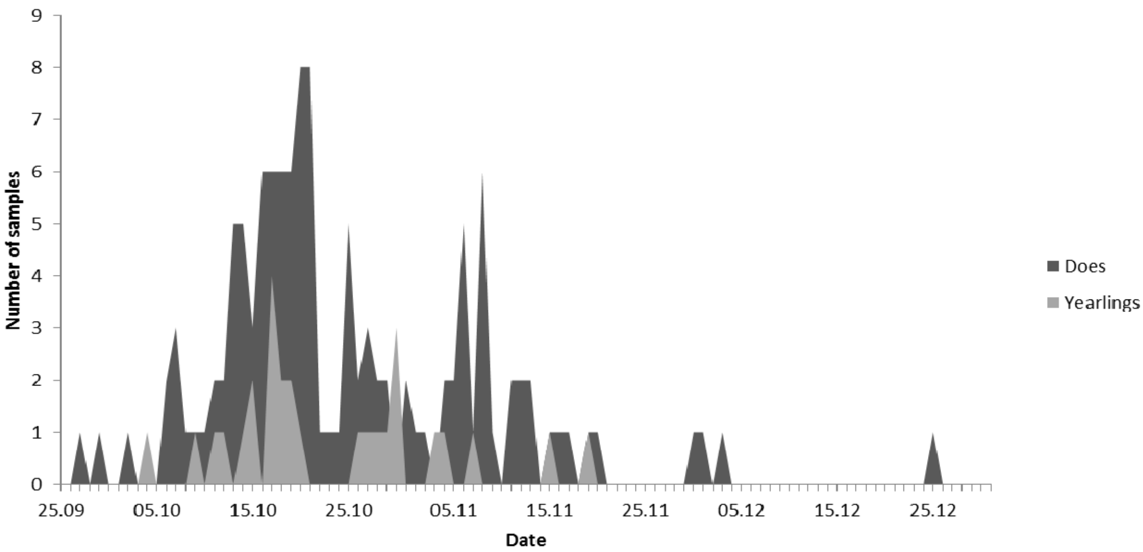
	Yearling	Young (2-3 y)	Middle aged (4-9 y)	Old (10 y-)
Yearling (n=51)				
Young (n=47)	p=0,173620			
Middle aged (n=111)	p*=0,0313987	p=0,357562		
Aged (n=23)	p=0,152000	p*=0,010923	p*=0,000677	

***Table 1**. Student's t-test regarding the measure of conception of age cohorts*

The sex ratio (1.08:1) of the embryos did not differ significantly from 1:1, however there were differences between certain years. We determined the time of conception based on the established functions.

In order to determine the time of conception of different individuals, we examined the sex and body weight of embryos present in the uterus of dissected does and yearlings, killed during one year's hunting season on the latest possible dates. The first sample was taken on December 1, the last on February 18 (Table 1). Sample collection closer to fawning time ensured that we were able to analyze data with greater accuracy and certainty. We analyzed a total of 149 samples (120 does and 29 yearlings). We removed the reproductive organs (uterus and ovaries) from the sampled fallow deer females. We dissected the uterus and removed the embryo or embryos for analysis. We measured the body weight to within 0.1 gram for each embryo, after separation from the embryonic sac and water, and we recorded the sex of the embryos.
We determined conception times based on the established functions (**Figure 1**). Based on the 149 samples and the parameters measured (body weight and sex of embryos), the following results were obtained: most conceptions (72.5%) occurred in October, 24.2% occurred in November, 2% in December and only 1.3% occurred in September.

***Figure 1**. Calculated fertilization dates of does (n=120) and yearlings (n=29)*



While the typical conception period of fallow deer in Europe is October, which is also supported by our observations, we also noted, similarly to other data, that conception can often occur as late as November. During the mating season the presence of mature, high ranking, older bucks can induce fertility in females; whereas, the absence of such males or even the larger representation of younger bucks can prolong the fertility period of females.
There were no significant differences found between mean fertilization dates of adult does and yearlings (t= -0.72 p=0.47). The mean fertilization date of does (with a gestation period of 231.5 days) was October 25th (SD=13.82; n=120); whereas, for yearlings this date was October 24th (SD=12.97; n=29). Taking into consideration the outlying values (226-237 days) of some reported gestationals, we calculated the mean fertilization date for does to be between October 23 (SD=14.25, n=120) and 26 (SD=13.41, n=120), while for yearlings it was calculated to be between October 23 (SD=13.72, n=29) and 27 (SD=12.96, n=29).
The mortality after fawning up to June was nearly 20 %. The winter mortality together with harvest by hunting also caused significant losses (28 % of the remained fawns). Till the beginning of the next fawning period the recruitment was 0.38, but among the certain years there were significant differences.

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Keywords: fallow deer, time of conception, reproduction, age estimation, sex ratio at birth

(oral)

Information requirements and data availability to support adaptive harvest management in Europe

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The need to promote and implement sustainable harvest frameworks is a fundamental part of ensuring sustainable use in line with national and international laws. Lack of adequate data is often quoted as one of the main obstacles to apply adaptive harvest management in Europe. We review the availability and quality of population size, trend and harvest data for waterbird populations listed on Annex II of the EU Birds Directive. We also present some on-going efforts to further improve the situation. The paper concludes by proposing a set of recommendations to better support international waterbird monitoring and harvest data collection. In doing so, it stresses the need build on existing case-specific successes of adaptive harvest management approaches in Europe and to develop new international projects to achieve desired goals.

Keywords: adaptive harvest management, monitoring, harvest data

(poster #75)

Comparing two different approaches for assessing red deer distribution: direct aerial survey and faecal pellet counts

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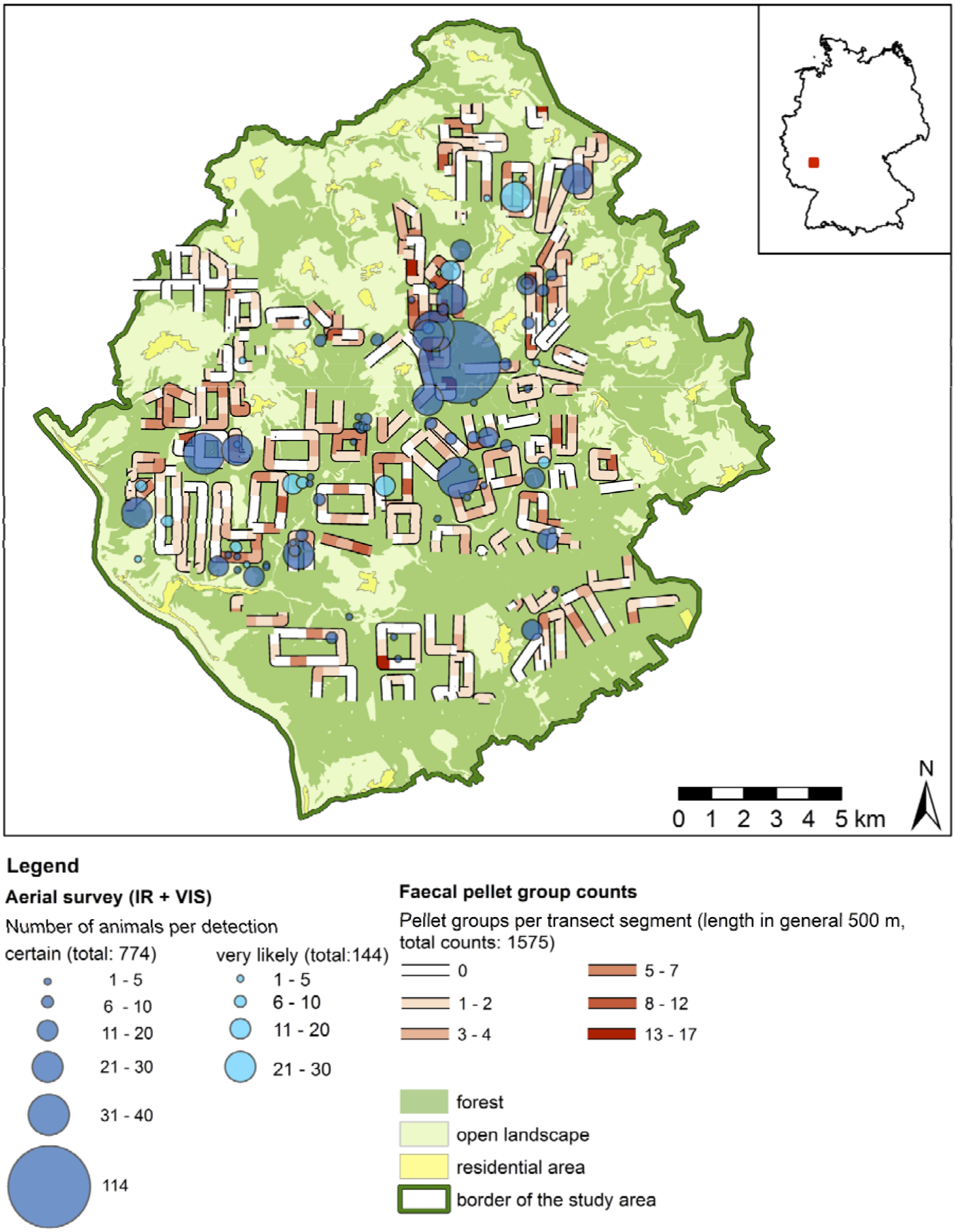
The Taunus mountain range is a red deer (*Cervus elaphus*) distribution hot spot in Western Germany.
In spring 2016 population density has been assessed via aerial survey, using a combination of thermal and high-resolution visual imagery. Additionally, the sex ratio in the sampled population has been estimated via genetical analysis of faecal pellet groups collected along transects in the study area.
The aim of this study is to compare the results of the direct and indirect survey approaches concerning the distribution of red deer in the 32,490 hectares large study area.
A comparison of both approaches is possible since for both methods spatial data - the coordinates of red deer detections by aerial survey as well as the locations of pellet groups - have been collected. In total 918 red deer and 1575 pellet groups have been detected during both surveys.
In order to visually identify faecal pellet distribution hot spots I splitted the transect lines in segments of in general 500 metres length and counted the number of pellet groups corresponding to each segment.
In Figure 1 these transect segments as well as the locations of the directly detected animals are displayed only for the parts of the study areas where both surveys have been conducted.
In general the main hot and cold spots of the red deer distribution coincide for both approaches: the main hot spot is located north of the centre, cold spots are located in the North-West and South of the study area.
This accordance is remarkable: on the one hand the relevant time scale differs strongly for both approaches considering that the pellet group distribution reflects the nocturnal and diurnal distribution of red deer over several months while the direct detection of animals provides a snap-shot of the distribution during daytime. Furthermore the ways in which the data are collected differ completely between the two methods.
Together with knowledge about population density and sex ratio the information about spatial distribution of the animals can support decision making in local red deer management.

Figure 1: *Comparison of the red deer spatial distribution patterns derived from pellet group counts and aerial survey data.*



In the south-western part of the Taunus mountain range red deer pellet groups have been searched along line transects in April 2016. One month before red deer have been detected directly via aerial survey using a combination of thermal and high resolution visual imagery. The pellet group counts have been conducted by volunteers, the aerial survey by Ulrich Franke (Wildlifemonitoring by Aerosense). Very likely red deer detections have been classified as red deer via thermal imagery, but could not be confirmed by visual imagery. Where both methods have been conducted, a comparison of the results regarding the distribution of red deer is possible. It is assumed that the distribution of pellet groups reflects the distribution of the animals.

Keywords: red deer distribution, aerial survey, faecal pellet counts

(oral)

The grey partridge (*Perdix perdix*) in Vienna: population trends and habitat preferences

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The agricultural landscape is home to many common farmland birds. Semi-natural habitats, which provide habitats for different bird species are highly influenced by agricultural measures or get lost due to sealing and land consumption. Moreover, rearrangement of parcels has negatively affected the availability of complex habitat structures, e.g. hedgerows, within farmland areas. The Pan-European Common Bird Monitoring Scheme [1] produces a set of European wild bird indicators, which gives information about population trends within the period between 1980 and 2013. These data indicate that populations of many common farmland birds show a significant negative trend across Europe [2] and in Austria [3]. The grey partridge (*Perdix perdix*) is one of the 22 indicator species, representing the manifold types of agricultural land use in Austria [4]. The number of breeding pairs of this species has declined by over 75% since 1998 in Austria and in some provinces the grey partridge already became extinct [5]. Therefore, it is on the Austrian Red List of endangered species [6].

In Vienna, small and large scale habitat structures have changed over time. In addition, according to population forecasts, Vienna is fast moving towards the two-million-inhabitant mark. Thus, suitable habitats for the grey partridge might directly get lost, or indirectly through the impact of human frequentation by sports and dog walking activities especially in suburban areas. The combination of both factors affect habitat quality, firstly, habitat parameters and land use characteristics and secondly, human disturbance.

Two countings of grey partridges in previous years indicated a drastic decline. Additional countings in winter and spring were performed in the year 2017 to investigate the population trend of Viennese grey partridge. Moreover, we analysed the impact of small and large scale habitat parameters, gained from aerial photographs and field mapping, on the occurrence of grey partridge.

References

[1] **Pan-European Common Bird Monitoring Scheme** (2016). http://www.ebcc.info/pecbm.html, Czech Republic.

[2] **Bauer, H-G & P. Berthold** (1996). Die Brutvögel Mitteleuropas - Bestand und Gefährdung. *Aula-Verlag*, Wiesbaden.

[3] **Teufelbauer, N.** (2015). Farmland Bird Index: Aktuelle Entwicklung und der Konnex zu Landschaftselementen. *Ländlicher Raum - Online-Fachzeitschrift des Bundesministeriums für Land- und* Forstwirtschaft, *Umwelt und Wasserwirtschaft,* **03:** 1-11.

[4] **Teufelbauer, N.** (2009). Bereitstellung des Farmland Bird Index für Österreich: Datenerhebung und -aufbereitung 2008. *Report - BirdLife Österreich; im Auftrag des Lebensministeriums*, Wien.

[5] **Uhl, H, C. Kuhn & B. Klöpzig** (2015). Vögel und Landwirtschaft - Wie schützen Landwirte seltene Vogelarten in Österreich? *Report - BirdLife Österreich*, Gesellschaft für Vogelkunde, Wien.

[6] **Zulka, K.P.** (2005). Rote Listen gefährdeter Tiere Österreichs. Ruth Maria Wallner und Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft, Wien.

Keywords: farmland bird, habitat characteristics, human disturbance

(oral)

Influences of climate oscillations on population dynamics of nesting ducks in the south of Western Siberia

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The south of Western Siberia is an important region for production of waterfowl and other waterbirds because of the abundance of shallow wetlands. The study was carried out at Krotovo Lake (53.72 N; 77.88 E) continuously from 1970 until 2016. Complete searches for duck nests were conducted from early May to late July. The most common duck species found nesting in the area were Mallard (*Anas platyrhynchos*) – 2230 nests, Gadwall (*A. strepera*) – 324, Pochard (*Aythya ferina*) – 1825, and Tufted Duck (*Ay. fuligula*) – 2153 nests. We used information about weather conditions from the nearest meteorological station to the study area (Karasuk, Novosibirsk Region). Local spring temperatures explained some of the variation in the timing of breeding, clutch size, nest (egg) survival, and numbers of nesting ducks in the following year. The numbers of ducks breeding increased in the years that followed a good season and fell in those following a bad [1,2].
The North Atlantic Oscillation (NAO) is the global climatic process that impacts local environmental conditions at northern latitudes [3]. A significant correlation between the NAO and the temperature in Western Siberia was observed [4]. Available evidence suggests that the NAO influences dynamics in marine, terrestrial and limnic ecosystems, and its effects may be seen in variation at the individual and population levels [5,6].
Our objective was to analyze data on size of duck breeding population in relation to NAO indices. NAO data were obtained from https://climatedataguide.ucar.edu/climate-data/hurrell-north-atlantic-oscillation-nao-index-station-based. Correlation analyses were used as the favoured method for the identification of NAO-ecology links. We examined all monthly and seasonal NAO indices.
Seasonal (December to March) NAO indices ($NAOI_{DJFM}$) are correlated positively with the sum of minimal 10-day temperatures on the soil in April in the study area ($r = 0.38$, $P < 0.05$), and negatively with the total annual precipitation ($r = -0.33$, $P < 0.05$). Thus high NAO values are associated with warm-dry, and low NAO values with cool-wet conditions. There are significant correlations between winter NAO indices and clutch initiation date of all four species (table). Earlier egg laying onset is significantly connected with higher values of indices. Correlations are higher for Mallard, a species that nests earlier than others in the breeding season. Population dynamics respond to the effects of the NAO with a lag of one year (table).

Table: *Pearson correlation coefficients between monthly (February) and seasonal (December to March) North Atlantic Oscillation indices ($NAOI_F$ and $NAOI_{DJFM}$) and averaged annual (1970–2016) nest initiation date, and next year nest number of ducks on Krotovo Lake. Statistically significant correlations are shown with asterisks (*P < 0.05, **P < 0.01).*

	Mean laying date in each year			
	Mallard	*Pochard*	*Tufted Duck*	*Gadwall*
$NAOI_F$	-0,41**	-0,40*	-0,36*	-0,36*
$NAOI_{DJFM}$	-0,47**	-0,31*	-0,21	-
	Nest number in the following year			
	Mallard	*Pochard*	*Tufted Duck*	*Gadwall*
$NAOI_F$	0,23	0,26	0,39*	0,32*
$NAOI_{DJFM}$	0,33*	0,38*	0,43**	0,33*

Our findings indicate that the population size of duck is significantly influenced by the varying weather conditions on the breeding grounds, and driven by global climatic events. The use of NAO indices allows prediction of reproductive success in the current year and trends in duck abundance the following year. It is important for wildlife management planning. The study was supported by the RFBR grant N 15-29-02479-ofi - m.

References

[1] **Mikhantyev, A. & M. Selivanova** (2006). Long-term population dynamics of nesting ducks in the south forest steppe zone of the Novosibirsk region, Russia. *Journal of Ornithology*, **147(Suppl 1):** 211.

[2] **Mikhantyev, A.I. & M.A. Selivanova** (2009). Ecological bases for the prediction of the productivity and abundance of breeding ducks. *Casarca*, **12(1):** 47–67.

[3] **Hurrell, J.W., Y. Kushnir & M. Visbeck** (2001). The North Atlantic Oscillation. *Science*, **291(5504):** 603–605.

[4] **Ippolitov, I. I., M.V. Kabanov & S.V. Loginov** (2007). Spatiotemporal scales of warming observed in Siberia. *Doklary Earth Science*, **413(2):** 248–251.

[5] **Ottersen, G., B. Planque, A. Belgrano, E. Post, Ph.C. Reid & N.C. Stenseth** (2001). Ecological effects of the North Atlantic Oscillation. *Oecologia*, **128:** 1–14.

[6] **Stenseth, N.Chr., G. Ottersen, J.W. Hurrell, A. Mysterud, M. Lima, K.S. Chan, N.G. Yoccoz & B. Ådlandsvik** (2003). Studying climate effects on ecology through the use of climate indices: the North Atlantic Oscillation, El Niño Southern Oscillation and beyond. *Proceedings of the Royal Society of London B*, **270(1529):** 2087–2096.

Keywords: ducks, population dynamic, North Atlantic Oscillation, weather conditions, Western Siberia

(poster #77)

History of hunting and current state of roe deer population in Amur region

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In the second half of XIX century roe deer population in Amur region numbered in hundreds of thousands. Herds of a thousand animals were met occasionally and peasants, in order to avoid gun powder waste, sometimes were just beating them with wooden sticks after surrounding the herd on saddled horses and driving the animals on a lake's ice [1]. According to A. Kirillov [2], 150 thousand roe deers were hunted in Amur region in 1888. To hunt 100-150 animals for a single rifle during one hunting season was not considered an outstanding event at the beginning of XX century. Even in 1920-1930s herds of 100-200 animals were seen. Up to 1934 no limitations for roe deer hunt ever existed and it was conducted to the exhaustion. Due to this fact, the animal's population was steadily decreasing. In 1940-1950s this process was especially fast. The introduction of license system was (and still is) a formal act, because poacher hunts exceeded officially set limits by 6-8 times. Reduction of these limits later did not stop roe deer population decrease. According to K.A. Morozov's materials [3] actual roe deer hunt statistics exceeded the official data by 5-6 times in 1970s in Amur region.

Until 1972 the tendency for roe deer population decrease was gradually stable. A disastrously fast drop occurred during unusually snow abundant winter of 1972-1973. By the end of October 1972 up to one meter of snow and in some places – up to 1,5 meters already fell on the ground, while considerable part of roe deer herds did not yet come to their wintering areas. Due to early and abundant snowfall, local streams did not cover with ice and turned into traps for the animals. At crossing spots, they were coming to covered with pudgy thick snow streams, sinking though the snow and dying. By spring of 1973, according to some reference calculations, roe deer population grew short by 2-3 times in many areas.

The overall roe deer population in the region at the beginning of 1970s figured 100,000 species [3], by 1973 it shortened about to 40-50 thousand, at the end of 1970s Game and Nature Management Department of Amur region evaluated it about in 42,000 and by 1981 it shortened down to 33,800 species.

Analyzing species' population dynamics from 1981 we saw a significant growth until 1991-1992. In this period, commercial interest to roe deer was reduced to zero, infinitesimal became its game (amateur) significance. For 1981-1982 game season, only 150 animals were allowed for the hunt and 125 permits out of this limit were officially used. We believe the main reason for such a drastic drop in roe deer population at that period was poaching, in the first hand. Unofficial hunting went on practically all year round using motor boats, cars, off-road vehicles and even helicopters [1]. At present time as it also was in that period, poachers are especially active at the end of summer and during fall using vehicle's headlamp lights to blind the ungulates for illegal shooting.

Nevertheless, measures taken to protect and increase roe deer population were bringing their effect. Certain signs of stability and the following fast population recovery became evident. Besides intensifying protective efforts other measures, such as game season cuts and, for some areas (especially focused on agriculture), total prohibition of hunting for several years were taken. At the same time, a gradual hunting limit increase was observed alongside roe deer population growth. Thus, during 1984-1985 hunting season 300 permits were issued.

As a result, at the beginning of 1990s roe deer population size reached its maximum for the last half century. Species' population in Amur region reached 135000 animals with an average density of 11,79 species per 1000 hectors. But protective measures for preserving the animals remained sufficiently strict. Hunting seasons were shortened up to 1,5 months - from November 1st to December 16th (in 1981 - from November 1st to December 31st). However, in 1992 a decline by 7% in population to 124980 species was recorded. Adverse conditions in spring (abundant snowfalls and snow ice) aggravated the state of migrating populations and prompted a decrease in their reproductive level and number, which was expected to happen next year. And that's what really happened when the population was reduced to 118250 species. Regardless of the fact that roe deer population was still at the maximum of its half century cycle, specialists reopened a serious discussion about its

population decrease, since the state of this species began arousing some fears. In March of 1995, according to air counting data, roe deer population decreased only by 2000 and counted 116390 species. At the same time the average density rose from 8,7 up to 9,2 species per 1000 hectors [4], which happened due to geographic range narrowing and thicker concentration of migrants in wintering zone. The density reached 60 to 100 roe deers per 1000 hectors within this concentration zone.
Until 2002 we observed a stable tendency for yearly reduction of roe deer population by 5-7 thousand species. In 2002 winter route counting resulted in data, showing species population size at the level of 53936 animals. At the same time its population during previous season was at the level of 84700 animals. These numbers raise a question of counting work quality and possible drastic reduction of population size.
Conclusion: In any case, starting with 2005 up until present time we are observing a small but stable tendency for roe deer population growth in Amur region. In fact, there are some seasons when it slightly reduces due to weather conditions and, accordingly, an undercount (especially during years with little snow, when most part of population stays in hard-to-reach taiga areas). However, these fluctuations are overcome further on. Sudden changes of population in 2014-2015-2016, to our opinion, can be attributed to variability of counting methods that were used. Though the main principle of species population counting remained unchanged, the territories of observation (geographical districts at first, then game territories, and geographical districts again) changed. Volumes of length rages stored for the routes changed as well, which in turn led to confusion among game area users doing field work, and in field work data processing and computing.

References

[1] **Кучеренко, С.П.** (1982). Кадастр охотничьих животных Амурской области. Отчет о научно-исследовательской работе. ВНИИОЗ, Хабаровск, стр.155-181.
[2] **Кириллов, А.** (1894). Географическо-статистический словарь Амурской и Приморской областей. Благовещенск, с. 29.
[3] **Морозов, К.А.** (1975). Численность популяции косули Верхнего Приамурья. В сб.: "Копытные Фауны СССР". М., "Наука", стр. 56-58.
[4] (1995). Отчет по учету копытных животных Амурской области в 1995 году. Благовещенск.

Keywords: hunting, deer, elk, red deer, animal population

(poster #78)

Brown bear as a source of conflict situations with wild ungulates and humans

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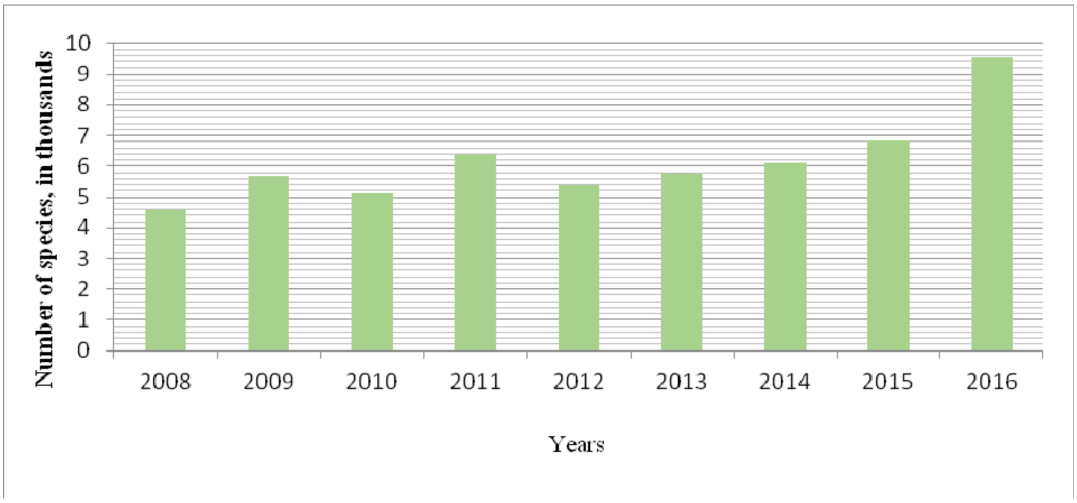
Currently one of the pressing problems in Amur region is the increase of brown bear population. Forest fires have direct impact on animals' population in the area since they destroy animals' food supply and safety bases making them migrate. Incidents with men encountering bears became more frequent in Amur region during last few years, while the animals started showing up on uncommon grounds. For many territories in the past where a brown bear was seen very rarely, or never appeared at all, its' appearance today is not an unusual case anymore. For instance, during summer and autumn of 2016 eleven human encounters with bears were officially registered, that is as many permits were issued by an authorized Russian Federation's regional body for predator's population control. Citizens' property as well as safety were harmed. Even cases of human lethal outcome were recorded. What is the reason of such abrupt aggression of the predator? The main subspecies in Amur region is Amurskiy brown bear (*Ursus arctos lasiotus* Gray, 1867). In our region, brown bears start hibernation by the end of November and wake up at the end of March – the beginning of April. This timing may vary due to weather (atmospheric temperature, precipitation) and food supply situation. Occasionally rogue bears are seen. Brown bears are widely spread in taiga zone, and in steppe areas are rarely seen. The most typical areas of brown bear habitation in Amur region are taiga and mixed forest subzone. They often walk out the forested areas to moss moors. Thus, we deal with a very-well adapted to external conditions predator. Since it's fertile, omnivorous and has no natural enemies, it can recover quickly after any negative influence upon its population.

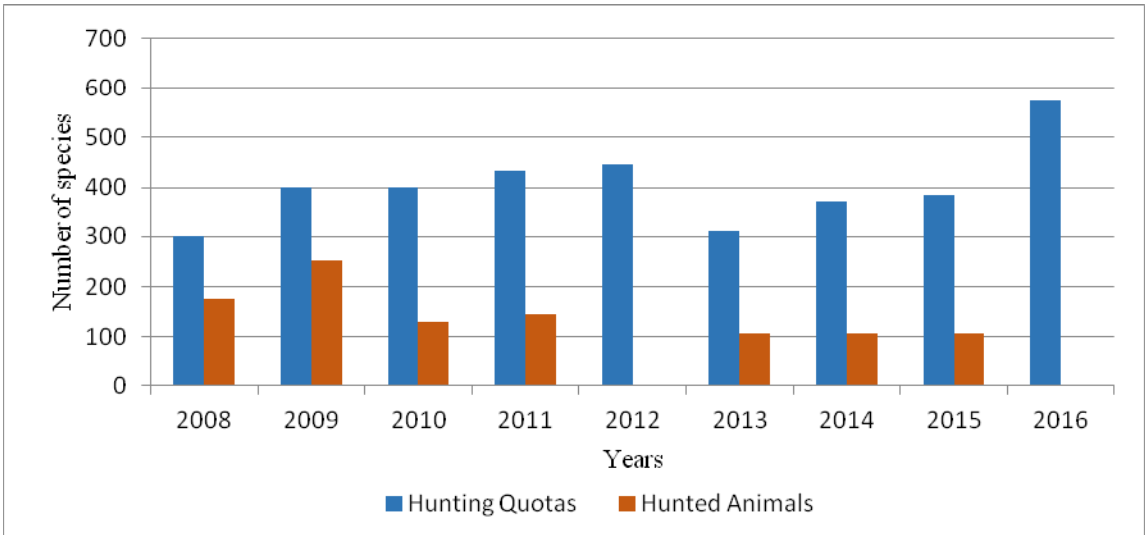
Figure 1. *Brown bear population in Amur region*



Regardless of the fact, that a bear's teeth are more intended for vegetable food, it is omnivorous. One of the top choices in its nutrition intake is the food of animal origin – European elk (*Alces alces*), red deer (*Cervus elaphus*), roe deer (*Capreolus capreolus*), wild boar (*Sus scrofa*). It is especially significant in spring and summer. During this period the share of animal protein food in a bear's ration may reach up to 70%. Population of wild ungulates, particularly young animals, pregnant and springing female animals suffer in the first place. While conducting biotechnical activities for wild ungulates in summer months (June-July) from 2010 to 2016, hunting brown bear in spring and autumn on the territory of Skovorodinskiy game management area, analyzing different literature sources focusing on bear behavior it is determined that bears are very inventive in how they hunt for ungulates. They use many ways of hunting with the three ones to be distinguished as the most commonly used. The first one is that during early spring period while deep snow has thin crust of ice over it bears drive ungulates into the deep snow and kill them there. The animals which usually fall prey to this way of bear hunt are springing females and weakened after winter animals [2]. The second method of hunting which bears use is the following. At the end of spring – the beginning of summer bears come out of dens and can hardly find vegetable food. It is especially acute in the northern areas of Amur region with the vegetative period

starting later in the year. During this period the easiest feedstuff for a bear is newly born ungulates, pregnant and springing females. Bears are aware where calving may take place or pregnant ungulate species stay. Usually it is river and spring bottomlands. Thus, examining bottomlands of Guraniy and Doroznaya Tipara springs in the upstream, as well as some parts of Urka, Urusha, Oldoy rivers bears' life activity signs – excrements, paw prints, scratches were detected many times. The third hunting method bears exploit is staying in wait for wild ungulates on forest trails, near watering places and saline soil spots. [2] This hunting method is used all year round. According to our observations and the data from Wild Life Protection Service workers up to 60 % of calves die as a result of bear influence upon moose population, 30 % of them – within first two weeks. In general, 85% of all calves die from natural causes during the first month. And that irrespective to the presence or absence of wolves. We also revealed that with high bear population the ungulates' offspring may be exterminated almost totally, which is what is happening in some areas in Amur region. During winter counting of wild ungulates on the territory of Skovorodinskiy game management area (589 thousand square hectors) we found that in 2014 29% of moose in detected groups with tracks' crossings were young animals; in 2016 – 14%; Manchurian deer in 2014 – 27%, and in 2016 – 22%; roe deer in 2014 – 29%, and in 2016 – 21%. According to preliminary data in 2017 the quantity of young moose animals' crossings will amount 4%, Manchurian deer – 16%, roe deer – 13%. Considering the results of conducted wild ungulates' counting the following conclusions can be made: first – wild ungulates' population is in the direct correlation with brown bear population; second – the ungulates population decrease drives bears to search for new feeding sources and consequently approach human inhabited areas.
Besides wild ungulates' population decrease the quality of vegetable feeding base is being deteriorated. The main reason for this is yearly spring and fall forest fires that destroy berry bush grounds, dwarf pines, Siberian (stone) pines and Mongolian oaks. These species are essential for bears' fattening during autumn.
To improve the present situation, it is necessary to manage brow bear population efficiently. What is it that we currently have?

Figure 2. *Brown bear hunting quotas compared to hunted species in Amur region*



As we can see, brown bear hunting quotas in Amur region are being drawn by less than 50 per cent. At present time, according to Hunting Regulations the bear hunting season in Russian Federation falls into 2 periods: from August 1st to November 30d; and from April 1st to May 31st. Comparing bear population with its game hunting rates and taking into account hunting season periods it is logical to ask the following question: why are hunters buying bear hunting permits?
If in the nearest possible time the bears' population is not taken under control, the damage to human safety, public and private property will seriously increase. In our opinion, certain steps must be taken for efficient regulation of animal population. First, it is necessary to introduce control over correct use of brown bear hunting permits. With the current state of its population and density it will not be a problem for hunters, specializing in bear hunting, to wrap up their work within 1 or 2 weeks.
Second, to increase the interest to this type of game hunt it is necessary on the federal level to work out some motivational measures for hunters who are successfully dealing with bear hunting. For the same purpose, it would be appropriate to cut the price of the hunting permit or even make it free of charge, like it was done for wolves' hunting.
Third, to stimulate hunters' interest in this type of hunting it is necessary to create possibilities for selling the game results. It means that for any hunter this type of game hunting must be economically rational to cover all costs and risks.

Fourth, for the efficient regulation of bear population the its game hunting must be open all year round and the list of game hunting methods be extended. Humanism towards this predator must not exceed our consideration for human safety. [2]

References:

[1] **Шевченко Б.П.** (2003). Анатомия бурого медведя. - Оренбург, с 454.

[2] **Аслаев А.** (2016). Не допустить появления проблемных медведей. - Охота и охотничье хозяйство № 11, г. с. 48;

[3] В Архаре медведь пришёл в школу. - Амурская правда;

[4] В двойном ДТП в Свободненском районе погиб медведь. Амурская правда, 5.10.2016 г;

[5] Фадеева Н. В Ромненском районе мужчина отбился от медведя берёзой. Амурская правда, 20.09.2016 г;

[6] Фадеева Н. Медведь оставил амурского охотника без глаз. - Амурская правда, 17.11.2016 г.

[7] Павлов А.М. Ареал, численность и хозяйственное использование бурого медведя в Амурской области.

[8] Павлов А.М. Охота на бурого медведя в Амурской области.

[9] Павлов А.М. Определение возраста бурого медведя

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[11] Ведомственная документация Управления по охране, контролю и регулированию использования объектов животного мира и среды их обитания.

(poster #79)

One year life of red deer (*Cervus elaphus* L.) stag

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The main aim of the study was to analyse migration range of red deer stag in forested areas of the Regional Directory of State Forest in Szczecin, Poland. Positioning of the stag was done at one hour intervals using GPS telemetry collars. Daily, night, monthly and seasonal activities of the animal were described using Kernel method on the background of biotope features and weather conditions. Very detailed description of forest sites (based on forest inventory data) and stands with following changes during the year makes this research very unique. Thus biotope selectivity was calculated as a main result of the research.

Keywords: red deer, GPS collar, migration, biotope selectivity, Kernel method

(poster #80)

The attempt to use the empirical data for red deer (*Cervus elaphus* L.) population management

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In the winter 2012 the large-scale inventory of big game was done in the North-Western part of Poland on the territory of Regional Directory of State Forest (RDSF) in Szczecin. During 5 weeks the area over 600 thousands hectares of forests were covered by almost 400 experimental plots (60-120 ha) with surface over 30 thousands of hectares inclusively, on which the game was counted with driving sense method. For the experiment all forest complexes over 50 ha were taken into considerence. All the experimental plots were chosen by random. The driving sense method used in the experiment was under strict control of scientists from our team, who participated as static observers and as moving observers also. In the situation of appearance more numerous group of animals, we used video cameras to archiving this data and we analyzed the video from the cameras during laboratory works. During summer time 2012 two days observations of red deer was conducted with average one observer per 1000 hectares. The main aim was to count the sex ratio of the species and how many calves were born in relation to the hinds.
In the winter 2016 red deer population was counted with driving sense method also, and in the summer 2015 two days red deer observations was repeated also. Taking into account hunting bag of red deer in the years 2012-2016 we proved that the number of red deer counted with driving sense method is quite close to real.

Keywords: red deer, driving sense method, sex ratio, population management

(poster #81)

Status and possible restoration of North Caucasian Pheasant in Russia

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North Caucasian Pheasant (*Phasianus colchicus septentrionalis* Lorenz, 1883), the only native sub-species of Common Pheasant in Europe, occurred in north-eastern Black Sea region, northern and north-western Caspian Sea region and along the rivers of Trans-Caucasia [1]. Wild populations were nearly destroyed at many areas by late 1950th due to uncontrolled hunting. Since early of 1960th tens of thousands of pheasants from a number of local farms have been released in the North Caucasus and Lower Volga. The farms reared mostly Ring-necked ("hunting") Pheasants imported from Eastern Europe while native pheasants were never been captive-bred. Hunting demand for pheasants is very high presently which promotes further producing and introduction of Ring-necked Pheasants and loss of local sub-species genotype due to cross-breeding.

Protection of native Pheasant is only possible through development of artificial breeding of this sub-species for meeting of the hunter's needs and gradual replace of Ring-necked Pheasants [2]. It is necessary to find "pure" populations which could exist in the areas where no introduction occurred. Then, based on experience of our work with other native Pheasant sub-species [3,4] we can start the experimental captive breeding of North Caucasian Pheasant.

In 2016 we undertook the literature review and questionnaire survey to find out the scale of pheasant release in the range of native sub-species. Additionally, field research was conducted in April for clarification of the pheasant status at some suitable sites in Kabardino-Balkaria and North Ossetia-Alania republics of the North Caucasus. Our investigations revealed that during last 50 years the "hunting" pheasants have been released at the plenty of sites within the historical distribution of a native sub-species, especially in western and central parts of Trans-Caucasia. Therefore no "genetically pure" North Caucasian Pheasants can be found at most part of former range of a native sub-species. However, some information suggests that local populations of native Pheasant could survive in the central part of the Volga Delta and in lower Terek valley where likely no release occurred. Further investigations will be conducted during 2017 for clarification of the pheasant status at these areas.

References

[1] **Potapov R.L.** (1987). Genus *Phasianus* Linnaeus, 1758. Pheasant. In: Birds of USSR. *Galliformes, Gruiformes*. Leningrad. P. 119-135 (in Russian).

[2] **Solokha A.V., Y.E. Komarov & A.V. Yakimov** (2016). On the distribution and number of Pheasant in the south of central Trans-Caucasia // Proceedings of the XVIII International Sci. Conf. "Biological diversity of the Caucasus and Southern Russia" (Groznyi, Nov. 4-5 2016). Part II. Groznyi. P. 319-322 (in Russian).

[3] **Solokha A.V.** (1987). Captive breeding of Khiva Pheasant. In: Breeding of valuable and rare animals. Collection book of the Central Laboratory of Hunting Management of the Hunting Dept. of the RSFSR. Moscow. P. 14-24 (in Russian).

[4] **Solokha A.V.** (1989). Biological peculiarities of some Central Asian sub-species of the Pheasant during captive breeding. In: Zooculture of valuable and rare birds and mammals. Collection book of the Central Laboratory of Hunting Management of the Hunting Dept. of the RSFSR. Moscow. P. 69-82 (in Russian).

Keywords: North Caucasian pheasant, release, captive breeding

(oral)

Estimating waterbird harvest in Russia

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According to national hunting legislation, nearly 80 species of waterbirds are game species in Russia. They mostly belong to the groups of geese, ducks, waders, rails and crakes. Sport hunting of waterbirds is widespread and popular activity in Russia which covers long autumn season (including late summer and early winter) and, in some regions, short spring season for shooting of duck drakes and geese. By official data for 2011-2013, the total hunting bag size of geese, ducks and Coot in Russia was around 3.1-3.5 million birds [1].

Waterbird bag data collection has been introduced in Russia since early 2000th and is still under further development and improvement. Currently this program consists of three separate surveys including 1) compiling of hunter's bag reports; 2) questionnaire and 3) species identification by photographs. First survey is an officially endorsed procedure while two others are research projects yet.

National Hunting Rules request that hunters report their waterbird bag sizes to the local authorities which in turn are responsible for compiling of rough data. Since many hunters cannot recognize reliably all waterbird species, this information is integrated at the level of the groups, such as “geese”, “ducks” and “waders”. Additionally, information from hunters is not always full and accurate because some people do not care about timely and proper reporting their bags. The State Center of Game Animals and Habitats (SCGAH) receives summarized data from local authorities for verification and compiling national estimates. We also correct this information with according to missing hunter's reports. However these results remain very general estimates and therefore require further clarification in terms of bag size and species composition. Two additional surveys are being developed by SCGAH since 2013 to meet these requirements.

Questionnaire of hunters covers spring hunting season and still includes only one species, Mallard. It is a special request to hunters about reports of numbers of shot Mallard males (drakes). Being voluntary this survey provides quite reliable information. During 2013-2016 we collected more than 5,000 reports from hunters from about 60 administrative regions of Russia where spring hunting of drakes was available. Based on hunting success of these voluntary respondents in relation to Mallard, the most frequently shot species, we are exploring opportunities to correct official statistics for spring hunting in Russia.

A new method of species differentiation of bagged waterbirds by photographs includes collection, examination and analysis of the digital pictures of hunted birds [2]. By the request, local game managers and hunters take pictures of shot waterbirds and pass them to the SCGAH. These photos are then being checked and examined in the office for identification of waterbird species. Sex and age determination is mostly carried out on ducks hunted in autumn. When abundant materials are available, it is possible to evaluate proportions of different species in the hunting bag.

Over the spring and autumn hunting seasons in 2013-2015, we collected above 3,300 photographs with waterbird hunting bag from nearly 60 administrative regions across Russia. Materials of 2016 are still being collected. Totally, 8,768 waterbirds were identified by species, including 1,870 specimens from spring seasons (duck males and geese) and 6,897 specimens from autumn season. The list of harvested waterbirds included one species of swans (Mute Swan), 4 species of geese, 22 species of ducks, 4 species of rails and crakes, and 8 species of waders. Spring bag consisted of 21 species, from which the Mallard, Greater White-fronted Goose and Garganey were the most harvested species. Autumn hunting bag included 35 waterbird species with highest numbers of the Mallard, Common Teal and Goldeneye. Among waders, Ruff was the most hunted species.

The sex was identified in 2,728 ducks shot in autumn, and the male/female ratio was as follows: 1,455 males (53.3%) and 1,273 females (46.7%). Among 1,368 autumn hunted ducks, at least 632 birds (46.2%) were young.

As quite simple and feasible procedure, collection of digital pictures with shot waterbirds is being integrated into hunting management across the country. Conducting of three surveys altogether can help to improve the estimation of waterbird harvest in Russia and hunting impact on populations.

References

[1] **Solokha A.** (2016). Assessment of waterfowl resources and hunting use in Russia, *Herald of Russian State Agrarian Correspondence University*, **vol 20 (25)** (in press.). (in Russian)
[2] **Solokha A. & K. Gorokhovsy** (2015). Survey of duck hunting bag in Russia by photographs // 4th Pan-European Duck Symposium. 7—11 April 2015. Hanko, Finland. P. 37.

Keywords: waterbirds, hunting bag, questionnaire, photography, management

(oral)

Waterbirds hunting harvest in Italy: results from the seasons 2003-2012

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Harvest data are important source of information in bird management, both for assessing sustainability of hunting, and for other information as population trends, spatial distribution, and seasonal phenology. Data collected for a significant number of years could be used together with other monitoring projects to understand population trends, as the hunting harvest could be an index of presence of migratory transient populations, while winter counts only regards wintering populations, and breeding surveys the reproductive ones. Previous works on this subject are of 1999 [1] with quantitative estimate, and of 2011, without national estimates [2]. This study is the result of a data collection and elaboration obtained from 2003 to 2012 from Italian Regions, and from a sample of hunters that cooperate to an independent research by ACMA-FIDC. The great parts of data come from the official reports that every hunter must have for hunting, and in which all birds shot must be filled, for every day of shooting. Unfortunately, at the moment of the study do not exist in Italy an official national survey on migratory bird harvest, but just the single regional collection of reports. And only in some cases hunting departments, which made the analysis of regional reports, provided data. ACMA and FIDC Migratory Bird Office collect all harvest data, because of the request from European Union and for their utility in population management. Species object of this study are the huntables waterbirds in Italy, namely: *Anas plathyrhynchos*, *Anas crecca*, *Mareca penelope*, *Anas acuta*, *Mareca strepera*, *Spatula clypeata*, *Spatula querquedula*, *Aythya ferina*, *Aythya fuligula*, *Fulica atra*, *Gallinula chloropus*, *Rallus aquaticus*, *Gallinago gallinago*, *Lymnocryptes minimus*, *Vanellus vanellus*, *Calidris pugnax*. Good data series were received from 9 regions in which are the most important areas for waterbirds presence and hunting. Other data from important macro areas was collected by an independent research of ACMA-FIDC. Where the series of data were sufficiently long, trends in harvest of species were calculated, using software TRIM 3.53 [3], through inter face open-source BirdSTATs tool 2.01 (http://www.ebcc.info/trim.html). Model 3 was used (effect for every year of study) without covariates. TRIM software allows analysing trends taking into account missing values and standard errors. For national estimates, correction factors were used to estimate non declared shot birds and unretrieved ones. Due to missing values from a lot of regions, and differences in temporal series, it was not possible to calculate trends at national level, but for some regions or district. Such trends are compared with the ones of the International Waterbird Census in the same area. Results of national estimates are discussed in relation to the ones presented in 2005, regarding the period 1996-2001 [4]. Changes in bag estimates for some species agree with changes in population detected by IWC, both at national [5] and international level [6], as decrease in *Aythya ferina*, and increase in *Mareca strepera*. Among ducks, *Anas plathyrhynchos* is the most hunted species, followed by *Anas crecca* and *Mareca penelope*. *Anas plathyrhynchos* is also the most hunted species among waterbirds, and *Gallinago gallinago* is the most important in waders and rails. *Aythya fuligula* and *Spatula querquedula* are the less hunted ducks and *Calidris pugnax* the less hunted wader. Composition in species of total harvested sample is presented, and distribution for hunting months of different specie is given for some areas. We analysed also the harvest composition in macro regional areas, coastal, inland and North-Center-South Italy, compared with the results of a previous survey in 2011.

Table 1 : *Estimates of annual harvest of huntables waterbirds in Italy.*

Species	Confidence intervals of annual harvest estimates Reference period 2003-2012	
Anas platyrhynchos	241000	295000
Anas crecca	165000	202000
Spatula clypeata	26100	31900
Anas acuta	19300	23500
Mareca penelope	54000	66000
Mareca strepera	16400	20000
Spatula querquedula	6600	8000
Aythya ferina	14800	18000
Aythya fuligula	6500	8000
Gallinago gallinago	94600	115600
Lymnocryptes minimus	5700	7000
Fulica atra	49200	60200
Rallus aquaticus	5800	7100
Gallinula chloropus	43200	52800
Vanellus vanellus	46000	56300
Calidris pugnax	2500	3100

References

[1] **Sorrenti, M., G. Fasoli & A. Concialini** (1999). Waterfowl Harvest In Italy. In: Thomaides C, Kypridemos N (eds.). *Proceedings International Union Of Game Biologists XXIV Congress* Thessaloniki, Greece, pp. 104-118.

[2] **Sorrenti, M., G. Fasoli & A. Lenzoni** (2011). Il Prelievo di anatidi in Italia. In Tinarelli R., Andreotti A., Baccetti N., Melega L., Roscelli F., Serra L., Zenatello M., (a cura di). Atti XVI Convegno Italiano di Ornitologia. Cervia (RA). 22-25 Settembre 2011. Scritti, studi e ricerche di Storia Naturale della Repubblica di San Marino. 445-449.

[3] **Pannekoek, J. & A. Van Strien** (2005.) *TRIM 3 Manual. Trends and indices for monitoring data. Research paper 0102. Voorburg,* The Netherlands (http://www.ebcc.info/index.php?ID=13).

[4] **Mooij J. H.** (2005). Protection and use of waterbirds in the European Union. *Beiträge zur Jagd- und Wildforschung,* **30:** 49-76

[5] **Zenatello, M., N. Baccetti & F. Borghesi** (2014). *Risultati dei censimenti degli uccelli acquatici svernanti in Italia. Distribuzione, stima e trend delle popolazioni nel 2001-2010.* ISPRA, Serie Rapporti, 206/2014.

[6] **Nagy, S., S. Flink & T. Langendoen** (2014). *Waterbird trends 1988-2012 Results of trend analyses of data from the International Waterbird Census in the African-Eurasian Flyway.* Wetlands International Ede, the Netherlands

(poster #82)

Estimate of Turtle dove *Streptopelia turtur* harvest in Italy

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This research aims to estimate hunting bag of turtle doves (*Streptopelia turtur*) which every year are shot in Italy during the hunting season. Migration of turtle dove take place in Italy mostly in August [1] and early September, except for south Italy, where passage is consistent also in September. FIdC Migratory Bird Office asked or found official regional bag data reports, and archived them in Excel files. Participating in this data collection has been good in many cases. Unfortunately, the data are not uniform for all seasons for each region. Therefore, the estimate was made using the best available data, and giving an estimate range, which could include the season with a good presence and the year with a low number of species.

Data of declared harvest were corrected by a factor that estimates not declared birds shot and by another factor that estimates the wounded or not recovered birds. The correction factor is different between regions due to different degree of reliability of reports. Difference depends on availability of studies on reliability of official reports and also depends on opinion of authors. For regions where no data were available the estimates was done using mean bag/hunter of nearby regions, extended to the number of hunters in that region. For some region the trend of turtle doves harvest is presented.

Official reports on hunting bags are available from analysis of "Tesserino venatorio", which is a mandatory document that every hunter obtains from district administration. Regions are now progressing with optical reading of such documents, so the collection of data is not complete for every region for every season. The reliability of data of birds hunted is different from region to region. In Toscana region a study demonstrated that 1 bird on 3 is not declared [2], and a comparison between official data and independent hunters research in Po delta in Veneto region shown that the real bag is double than the declared one [3].

These data made it possible to evaluate the differences of turtle doves harvested between northern, central and southern Italy. It was possible determine the estimate of turtle dove harvest in regions with available official data, which is 200.205 birds shot as a mean per season (Tab.1). Moreover It was possible determine the total estimate for Italy, which is 305.590 turtle doves shot as a mean per season.

***Table 1:** estimate of turtle dove harvest in region with available official data.*

REGION WITH DATA	TOTAL SUM OF STUDY PERIOD	MEAN BAG/SEASON	CORRECTION FACTOR %	CORRECTED ESTIMATE	WOUNDED/ NOT RECOVERED 12%	REGIONAL ESTIMATE	TOTAL	NOTE
FRIULI	2688	244	200%	489	59	547	200205	Season from 2004 to 2014
VENETO	1749	1749	200%	3498	420	3918		Season 2014
LOMBARDIA	44708	4471	200%	8942	1073	10015		Season from 2002 to 2012
EMILIA ROMAGNA	11720	11720	150%	17580	2110	19690		Season 2011
LIGURIA	4687	1562	150%	2344	281	2625		Season from 2010 to 2012
TOSCANA	277706	30856	150%	46284	5554	51838		Season from 2004 to 2013
LAZIO	735	735	600%	4410	529	4939		Data one district only. Season 2009
MARCHE	25309	25309	150%	37964	4556	42519		Season 2012
UMBRIA	34639	11546	150%	17320	2078	19398		Season from 2009 to 2011
ABRUZZO	7209	1202	200%	2403	288	2691		Season from 2007 to 2012
PUGLIA	2255	2255	300%	6765	812	7577		Season 2014
SICILIA	156624	26104	200%	52208	6265	58473		Season from 2004 to 2008

References.

[1] **Spina F. & S. Volponi** (2008). *Atlante della Migrazione degli Uccelli in Italia.1. Non Passeriformi.* Ministero dell'Ambiente e della Tutela del Territorio e del Mare, Istituto Superiore per la protezione e la Ricerca Ambientale (ISPRA). Tipografia SCR-Roma. 800 pp.

[2] **Mazzarone V. & A. Poli** (2012). *Piano Faunistico Venatorio Provincia di Pisa, 2012- 2015.* Provincia di Pisa. (http://www.provincia.pisa.it/uploads/PianoFaunisticoVenatorioProvinciale.pdf

[3] **Sorrenti, M., L. Carnacina, D. Radice & A. Costato** (2006). In: Boere GC, Galbraith CA, Stroud DA (EDS). *Waterbirds around the world.* EDS. The Stationery Office, Edinburgh, UK. 864-865 pp

(oral)

Investigating survival of wild and hand-reared red-legged partridges in Southern France

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Restocking actions, release of captive-reared individuals into wild populations, are widely used to manage wildlife population of harvested species either to enhance future harvest or to make current harvest sustainable for the target population [1,2]. However, such actions can have adverse effect on wild populations [3-5]. In France, such releases are common for small game species and especially the red-legged partridge (~3M individuals are released annually). Nonetheless, investigating relevance of restocking action received little attention despite numbers of birds released and cost associated. It is thus critical to evaluate demographical consequence of such action by (i) estimating survival of wild and released individuals, (ii) assessing impact at the population levels.

Here, we took advantage of a telemetry experiment conducted in Southern France with ~200 birds surveyed to estimate monthly survival of both wild and released red-legged partridges in a common site (Pailhès), and to compare those estimates to survival of wild individuals on two other sites (Luberon area and Porquerolles Island), allowing us to investigate site-specific performance.

Our result showed that released red-legged partridges had a very high hunting mortality (0.60-0.80) the months following their release compared to hunting mortality of wild young of the year (~0.40). Natural mortality was fairly constant across the year for both wild and released individuals of same age, with wild individuals showing lower mortality rate (0.15 vs 0.20). Adult mortality of wild bird in Pailhès was much lower for hunting and natural mortality (0.15 and 0.05, respectively). In Luberon, we found similar adult natural mortality rate outside the breeding season (0.05), but 3-fold higher during the breeding season only (0.15). Adult natural mortality in Porquerolles Island was very low (~0.03) and constant over year.

Survival rate from late August to the next breeding season in Pailhès were derived from monthly estimates and showed the poor survival performance of released individual (< 0.03) compared to those of young wild individual (0.1-0.2). Annual survival rate of adults was higher (0.2-0.3) in Pailhès. Annual survival rate, irrespective of age, was also slightly higher in Luberon (0.3) and much higher in Porquerolles (0.7).

Our result illustrated high spatial heterogeneity for survival, with very high and constant survival rate in Porquerolles, a Mediterranean island with few predators, medium survival rate in Luberon, an area located among reserve and Natural Park and lower survival rate in Pailhès, an agricultural landscape with hunting.

Our study illustrated the poor survival performance of released red-legged partridge in Southern France. In Pailhès, ca. 300 individuals were released annually during last decades. These numbers combined with survival estimations from release to breeding season suggest that up to 10 hand-reared birds can be present during breeding season. Given the estimated breeding density in this site (ca. 15-25 breeding pairs/km²), number of survivors from hand-reared releases in the breeding population may be quite significant.

References

[1] **Champagnon, J., J. Elmberg, M. Guillemain, M., Gauthier-Clerc & J.D. Lebreton** (2012). Conspecifics can be aliens too: A review of effects of restocking practices in vertebrates.*Journal for Nature Conservation,* **20:** 231-241.

[2] **Piorno, V., R. Villafuerte, M. Branco, M., Carneiro, N. Ferrand & P.C. Alves** (2015). Low persistence in nature of captive reared rabbits after restocking operations. *European Journal of Wildlife Research,* **61:** 591-599.

[3] **Caro, J., M. Delibes-Mateos, J. Vicente & B. Arroyo** (2014). A quantitative assessment of the release of farm-reared red-legged partridges (Alectoris rufa) for shooting in central Spain. *European Journal of Wildlife Research,* **60:** 919-926.

[4] **Ponce-Boutin, F., J.C Brun, J.F. Mathon & J.C. Ricci** (2006). Propositions pour une gestion durable des populations de perdrix rouge. Quelle place pour les lâchers? *Faune Sauvage,* **274:** 48-55 [in French]
[5] **Casas, F., B. Arroyo, J. Viñuela, J.L. Guzmán & F. Mougeot** (2016). Are farm-reared red-legged partridge releases increasing hunting pressure on wild breeding partridges in central Spain? *European Journal of Wildlife Research,* **62:** 79-84.

Keywords: red-legged partridge, survival, hunting, releases, radiotracking, population dynamics

(poster #83)

Where are the Wolves and how many are out there?

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Globally researches have unanimously declared that calculating the abundance of wolves is a rather difficult. A huge attention is paid to detailed investigations of the state on wolves' population in many European countries. For this purpose, rather large expert teams are employed that work all year round on these issues only.

The entirety of methodologies both classic and based on advanced techniques is used for investigation of wolves. Scientists often advise that a combination of several methods should form the basis of population and variation estimations [1]. Surprisingly, in all countries it is accentuated that investigations should be performed when there is snow cover [2,3]. In fact, it is recommended to use high technologies as possible, i.e. DNA research that improves results of currently used investigation systems [4-6]. Nevertheless, although genetic investigation is a highly valued method, it certainly has vulnerabilities. Before undertaking this method, it is necessary to carefully consider organization of outdoor work (collection of samples) and lab research (protocols). Without paying respect to these aspects, the population may be established erroneously. Furthermore, investigations using snow tracking are considered to be essential method that helps to collect material for a genetic research (wolves' scats are most often used) as well as to interpret results obtained during the genetic research correctly [5,7,8].

Reviewing experience of other countries, it is obvious that snow cover tracking is the basic method used to estimate wolf abundance. Surprisingly, a usual way of tracking on the snow is used in many countries including European and Northern America. For instance, it is generally accepted that, the methodologies and technologies for wolves' investigation and monitoring used in Scandinavia, are most advanced ones if compared among the European states. However, in this region, tracking on the snow is used alongside with genotype determination using scats. Using a combination of these methods, the numbers of packs, pairs, and single wolves can be established.

Investigating wolf abundance and tracking in Southern Europe where there is no snow cover is much more time consuming and complicated compared to obtaining the same information in countries with snow. For instance, packs of wolves in Spain and Portugal are being calculated in summer by searching wolf dens with pups and rendezvous sites [5,9-11]. Registration of howling wolves' through stimulation is also often used to locate and calculate how many individuals there are in a pack. Unfortunately, this method has not proved successful in all locations. Many researchers have come to the conclusion that success of this method (response of wolves) is generally low [12,13]. On the other hand, the howl simulation method is recommended and used in some cases. Recent research has shown that analysing recordings of wolves' howls, individuals may be identified by unique voice, i.e., the number of wolves in packs [14].

Currently the evaluation of wolf abundance and distribution using genetic research is becoming used more frequently and on a wider scale. For this purpose, scats are being collected, analysed using DNA research, and as a result wolves are being identified to single individuals. This research might have the most ideal outcome; however, much investment is required to collect and conduct genetic research using scats.

Another method which is getting more popular is the registration of wolves by camera traps. This method has been proven successful during wolf investigations [15]. Namely, with the help of this method, most cases of wolf cub were registered in Germany, and Western Poland. Furthermore, camera traps assist in collecting data to understand pack dynamics and size, separating neighbouring packs, or finding out about distribution and state of the species.

Tracking of marked wolves with the help of radio antennas or satellite is used as a secondary method, but provides significant information on the size of pack's territory, traveling distances, activity, etc [16,17]. For example, often it would be difficult to distinguish between neighbouring packs or pairs without having information about the average area used by the pack. Radio telemetric research (especially combined with other kinds of research) gives the most precise data; however, it is suitable in smaller-sized territories and only for several individuals [16]. A significant disadvantage of the method is that the data are collected from several individuals, and the territory used by single individuals may differ [18]; therefore, many cases must be investigated to make the right general view.

Most countries use more or less different methods for wolves' research and monitoring. But it is obvious that boundaries of countries made by people do not exist for wolves. Thus, scientists of Europe pursue for creating methods with the help of which it would be possible to investigate wolves "without boundaries" [6,19]. That means, the results of the researches in different countries might be analysed in a common sense. Currently, wolves that live in Germany and Poland, Sweden and Norway, as well as the region of the Alps are being investigated jointly [20,22]. The accumulated experience shows that joint activity must expand itself in the name of the right attitude to this respectable animal.

References

[1] **Duchamp, Ch., J. Boyer, P.E. Briaudet, Y. Leonard, P. Moris, A. Bataille, Th. Dahier, G. Delacour, G. Millisher, Ch. Miquel, C. Poillot & E. Marboutin** (2012). A dual frame survey to assess time– and space–related changes of the colonizing wolf population in France. *Italian Journal of Mammalogy,* **23(1):** 14-28.

[2] **Rigg, R., T. Skrbinšek & J. Linnell** (2014). A pilot study of wolves in Slovakia using noninvasive genetic sampling, 38 p.

[3] **Wabakken, P., H. Sand, O. Liberg & A. Bjärvall** (2001). The recovery, distribution and population dynamics of wolves on the Scandinavian Peninsula, 1978-1998. *Can. Journal of Zoology,* **79:** 710–725.

[4] **Marucco, F. & L. Boitani** (2012). Wolf population monitoring and livestock depredation preventive measures in Europe. *Hystrix, the Italian Journal of Mammalogy,* **23(1):** 1-4.

[5] **Blanco, J.C. & Y. Cortes** (2012). Surveying wolves without snow: a critical review of the methods used in Spain. *Italian Journal of Mammalogy,* **23(1):** 35-48.

[6] **Reinhardt I., G. Kluth, S. Nowak & R.W. Mysłajek** (2015). Standards for the monitoring of the Central European wolf population in Germany and Poland. 46 p.

[7] **Lucchini, V., E. Fabbri, F. Marucco, S. Ricci, L. Boitani & E. Randi** (2002). Noninvasive molecular tracking of colonizing wolves (*Canis lupus*) packs in the Western Italian Alps. *Mol. Ecology,* **11:** 857-868.

[8] **Marucco, F., D.H. Pletscher, L. Boitani, M.K. Schwartz, K.L. Pilgrim & J.D. Lebreton** (2009). Wolf survival and population trend using non-invasive capture-recapture techniques in the Western Alps. *Journal of Applied Ecology,* **46:** 1003–1010.

[9] **Blanco, J.C., S. Reig & L. Cuesta** (1992). Distribution, status and conservation problems of the wolf *Canis lupus* in Spain. *Biological Conservation,* **60:** 73–80.

[10] **Llaneza L. & J.C. Blanco** (2005). Situación del lobo (*Canis lupus* L.) en Castilla y León en 2001. Evolución de sus poblaciones. *Galemys (n.e.),* **17:** 15–18.

[11] **Pimenta, V., I. Barroso, F. Álvares, J. Correia, G. Ferrao da Costa, L. Moreira, J. Nascimento, F. Petrucci-Fonseca, S. Roque & G. Santos** (2005). Situaçao populacional do lobo em Portugal: resultados do censo nacional 2002/2003. Relatório Técnico. Instit. da Conservaçao da Natureza/Grupo Lobo. Lisboa.

[12] **Fuller, T.K. & B.A. Sampson** (1988). Evaluation of a simulated howling survey for wolves. *Journal of Wildlife Management,* **52:** 60–63.

[13] **Nowak, S., W. Jędrzejewski, K. Schmidt, J. Theuerkauf, R.W. Mysłajek & B. Jędrzejewska** (2007). Howling activity of free ‐ ranging wolves (*Canis lupus*) in the Białowieża Primeval Forest and the Western Beskidy Mountains (Poland). *Journal of Ethology,* **3:** 231–237.

[14] **Root-Gutteridge, H., M. Bencsik, M. Chebli, L.K. Gentle, C. Terrell-Nield, A. Bourit & R.W. Yarnell** (2013). Identifying individual wild Eastern grey wolves (Canis lupus lycaon) using fundamental frequency and amplitude of howls. *Bioacoustics,* http://dx.doi.org/10.1080/09524622.2013.817317

[15] **Galaverini, M., D. Palumbo, E. Fabbri, R. Caniglia, C. Greco & E. Randi** (2012). Monitoring wolves (*Canis lupus*) by non-invasive genetics and camera trapping: a small-scale pilot study. *Eur J Wildl Res,* **58:** 47-58.

[16] **Breitenmoser, U., Ch. Breitenmoser ‐ Würsten, M. von Arx, F. Zimmermann, A. Ryser, Ch. Angst, A. Molinari-Jobin, P. Molinari, J. Linnell, A. Siegenthaler & J.M.** (2006). Guidelines for the Monitoring of Lynx. KORA Bericht Nr. 33 e.

[17] **Jedrzejewski, W., K. Schmidt, J. Theuerkauf, B. Jedrzejewska & H. Okarma** (2001). Daily movements and territory use by radio-collared wolves (*Canis lupus*) in Bialowieza Primeval Forest in Poland. *Canadian Journal of Zooogy,* **79:** 1993–2004.

[18] **Reinhardt, I. & G. Kluth** (2011). Pilotstudie zur Abwanderung und zur Ausbreitung von Wölfen in Deutschland. Final Report, F+E Vorhaben (FKZ 806 86 080)

[19] **Linnell, J., V. Salvatori & L. Boitani** (2008). Guidlines for population level management plans for large carnivores in Europe. A Large Carnivore Initiative for Europe report prepared to the European Commission (contract 070501/2005/434162/MAR/B2), 84 pp.

[20] **Fabbri, E., C. Miquel, V. Lucchini, A. Santini, R. Caniglia, C. Duchamp, J.M. Weber, B. Lequette, F. Marucco, L. Boitani, L. Fumagali, P. Taberlet & E. Randi** (2007). From the Apennines to the Alps: colonization genetics of the naturally expanding Italian wolf population. *Molecular Ecology,* **16:** 1661-1671.

[21] **Liberg, O., A. Aronson, H. Sand, P. Wabakken, E. Maartmann, L. Svensson & M. Åkesson** (2012). Monitoring of wolves in Scandinavia. *Italian Journal of Mammalogy,* **23(1):** 29-34.

[22] **Reinhardt, I., G. Kluth, S. Nowak & R.W. Mysłajek** (2012). A review of wolf management in Poland and Germany with recommendations for future transboundary management. Final report for the German Federal Ministry of Environment, Nature Conservation and Nuclear safety (BMU) (N I 3 – 45031 POL/0).

Keywords: wolf *Canis lupus* L., method, scat, DNA, telemetry, howling

(oral)

Trophic interactions in Sweden's diverse ungulate communities

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The introduction of non-native species, shifts in land-use practices and range expansions of native species have strongly changed Sweden's ungulate communities resulting in species assemblages and abundances that have not been witnessed before. These include novel trophic interactions which are one of the strongest drivers through which ungulate species influence each other's performance, e.g. via competition or facilitation. Such interactions might cause shifts in the species-realized niches and thereby alter the functioning, structure and performance of ungulate populations and communities.

For my PhD research I investigate trophic interactions, potential niche shifts and population performance in Sweden's diverse ungulate communities, primarily focusing on moose, red deer, roe deer and fallow deer. Using DNA metabarcoding I aim to quantify how patterns of resource sharing and partitioning vary at multiple foraging scales across the seasonal cycle, along gradients of ungulate diversity, productivity and human land use. Understanding ungulate diets and their impacts on the landscape has direct implications for the development of sustainable management practices for multi-species communities. In the talk I will present the results of a meta-analysis of ungulate diets across Europe and then narrow the focus on specific findings from Sweden.

Keywords: ungulates, trophic interactions, DNA metabarcoding

(poster #84)

ConFoBi - Conservation of Forest Biodiversity in Multiple-use Landscapes of Central Europe: an interdisciplinary research training programme

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The DFG-funded Research Training Group ConFoBi *Conservation of Forest Biodiversity in Multiple-use Landscapes of Central Europe* is a major research and qualification programme of Freiburg University. ConFoBi combines multi-scale ecological studies on forest biodiversity with social and economic studies of biodiversity conservation. In addition to this interdisciplinary approach, ConFoBi is maintaining a lively exchange of expertise between scientific research and the demands of forestry and conservation practice throughout all stages of the project. Twelve PhD students supervised by researchers of Freiburg University, as well as the Forest Research Institute Freiburg (FVA), focus on the effectiveness of structural retention measures, namely habitat trees and dead wood, for the conservation of biodiversity in managed forests. ConFoBi focusses explicitly on multi-functional forests of Central Europe, using the mixed mountain forests of the Black Forest as a model system. ConFoBi formulates two lead questions: 1) What is the contribution of the landscape context to the effectiveness of retention for conserving biodiversity in multi-functional forests? 2) What is the role of the socio-economic context for the integration of such measures in forest management? The research programme comprises 5 Modules (Figure 1): A will provide tools for Multi-Scale Assessment of Structures ranging from trees to landscapes; B focussed on linkages between Structures and Forest Biodiversity by studying components of biodiversity (mainly epiphytes, vascular plants, insects, bats, and birds) along gradients of forest structure and connectivity; C uses social science and economic approaches to assess Human Dimensions of Forest Biodiversity such as opportunity costs and stakeholder perceptions; D focusses on the interface between science and society in order to study and foster Integration and Translation between ConFoBi and forest management; E is responsible for the Coordination of ConFoBi. To maximize synergies, ConFoBi adopted an “all-measurements-on-all-plots” approach (Figure 2). All 12 research projects of ConFoBi work on the same 135 study plots, which were selected along two gradients: 1) forest structure, as indicated by the number of standing dead trees at the plot scale (1 ha), and 2) landscape connectivity, as measured by the proportion of forest with the 25km² surroundings of study plots (Table 1).

Figure 1: *The ConFoBi concept, illustrating the study system (above) and its representation (grey arrows) in the research system (below). The research system comprises 5 Modules: A will provide tools for Multi-Scale Assessment of Structures ranging from trees to landscapes; B will focus on linkages between Structures and Forest Biodiversity by studying components of biodiversity from genes to communities along gradients of forest structure and connectivity; C will use social science and economic approaches to assess Human Dimensions of Forest Biodiversity ; D will focus on the interface between science and society in order to study and foster Integration and Translation between ConFoBi and forest management; E will be responsible for the Coordination of ConFoBi.*

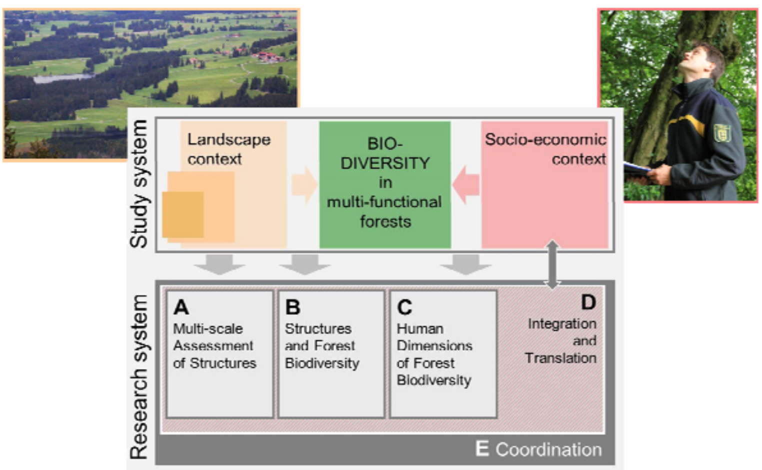

*__Figure 2:__ A cartoon of ConFoBi's inter- and transdisciplinary approach with its "all measurements on all plots" study design. Red letters and numerals indicate individual projects of Research Modules A-D. All projects share the same study system but focus on different predictors, components and drivers of forest biodiversity in a typical multiple-use landscape of Central Europe. Major linkages among projects are illustrated above. (Illustration: Katrin Seidelmann)*__.__

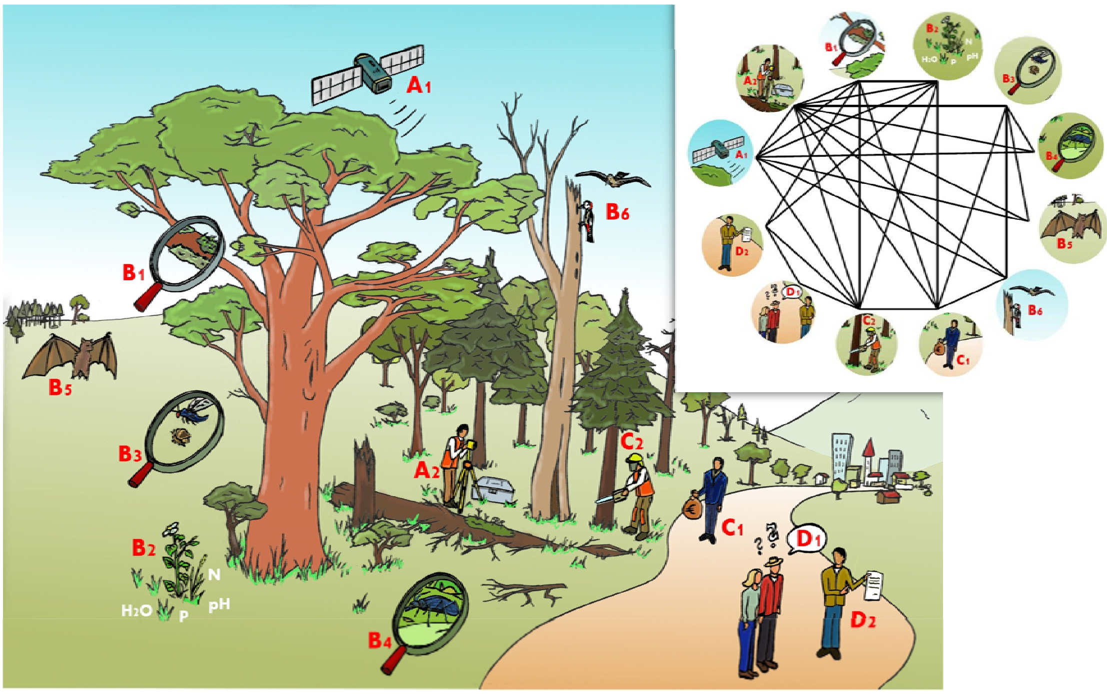

***Table 1:** ConFoBi study plots (1 ha) are placed along two gradients: landscape-scale forest connectivity (proportion of forest in the surrounding 25 km²) and plot-scale forest structure (richness in habitat trees and dead wood per ha).*

N ConFoBi study plots *Black Forest, >500 m a.s.l.*		**Forest Connectivity** *% forest in landscape (25 km²)*		
		<50	50-75	>75
Forest Structure *N habitat trees in plot (1 ha)*	0-5	**15**	**15**	**15**
	5-20	15	15	15
	>20	**15**	**15**	**15**

References

http://confobi.uni-freiburg.de/

Keywords: forest biodiversity, management, landscape pattern, human dimensions

(oral)

Dispersal of wolves and lynx and their perceived effects on roe deer in the hunting districts of Lower Saxony, North Germany**

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Wolf and lynx populations have been recolonising the federal state Lower Saxony, North Germany continuously. In 2011, the first wolf was found to be resident, in November 2016, minimum 56 wolves live in Lower Saxony [1]. Between 2000 and 2006, 24 Lynxes were released in the Harz mountains, the population is currently estimated to be about 46-84 juvenile and adult lynxes in the Harz mountains and its surroundings [2]. The spreading has been monitored by a wildlife survey performed by hunters and the Harz National Park. The return of the wolf and lynx has mainly been accepted by the hunters in Lower Saxony. Important reasons for this are the hunters’ involvement in the monitoring of the natural wolf repopulation and the reintroduction of the lynx in the Harz. However, the potential influence of predators on the ungulates and resulting disadvantages for the hunters are controversial as there is a lack of information about the effects of carnivores on the cultural landscape.

In this study the opinions, moods and the observations of the hunters on the roe deer are to be analyzed in the areas with and without wolf and / or lynx occurrences. Furthermore, the hunting bags in these areas are compared.

The citizen science program, the wildlife survey of Lower Saxony (WTE), has been continuously monitoring several game species since 1991 [3]. The holders of the hunting districts have provided estimates of wildlife, the hunting bag and the occurrence in their hunting ground (mean: 474 ha) for a number of species. Furthermore, the hunters were questioned about diseases, road kills and other topics, as well as on the human dimension, e.g. hunters' opinions and attitudes. The participation of hunting district holders was high throughout the years 1991–2015 and ranged between 80 and 90 % of hunting districts (6,151–8,300). More than 90 % of the huntable area of Lower Saxony was recorded (43,000 km^2).

In spring 2015, the wolf was reported present in 1785 districts, mainly in the northeast German Plains of Lower Saxony (Fig.1). The lynx was present in 604 districts, primarily in southern Lower Saxony in the Harz and Weser-Leine hillsides (Fig.2). (*The current data from 2016 are presented in the oral presentation*). In addition to the occurrence of the two predators, the opinion of the hunter on the effects of wolf and lynx on roe deer in the WTE was polled. In recent years, there was a much lower visibility of roe deer in the hunting districts where the wolf or lynx permanently or frequently occurred (Fig.3). For this analysis, only the main distribution areas of the wolf (Lueneburg Heath) and lynx (Weser-Leine hillsides) (1223 and 537 hunting districts) were considered. In the hunting areas with lynx occurrences, 44% of the hunters believe to observe fewer roe deer (categories "a lot" and "complete", Fig; 3), compared to 16% without lynx. In the wolf areas, the opinions are comparable (49% with wolf, 10% without wolf).

Whether these observations are actually attributable to the presence of wolves, or can be attributed to other factors (diseases, misjudgments, etc.), will continue to be open to discussions.

For the years 2009–2014, the preliminary statistical analysis in R (mixed models with hunting district as random factor) of the roe deer hunting index in areas with and without wolf or lynx occurrences show partly significant decreases in the hunting bags. In the Lueneburg Heath region in hunting districts with regular wolf occurrences, the hunting bag decreases more than in areas without wolf. The hunting bag of roe deer decrease from about 3.5 to 2.2 killed roe deer/100 ha.

Figure 1: *Rare and regular occurrences of wolves in the municipalities of Lower Saxony, (North Germany) 2015. (Proportions of hunting districts per municipality with occurrences).*

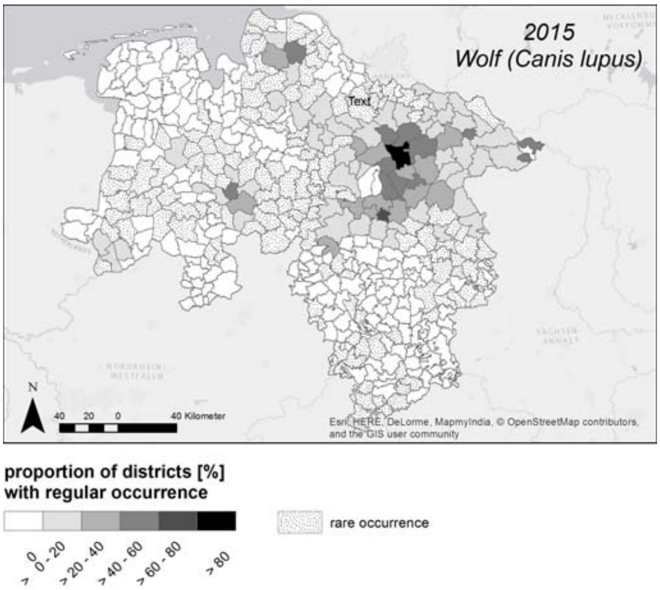


Figure 2: *Rare and regular occurrences of lynxes in the municipalities of Lower Saxony, (North Germany) 2015. (Proportions of hunting districts per municipality with occurrences)*

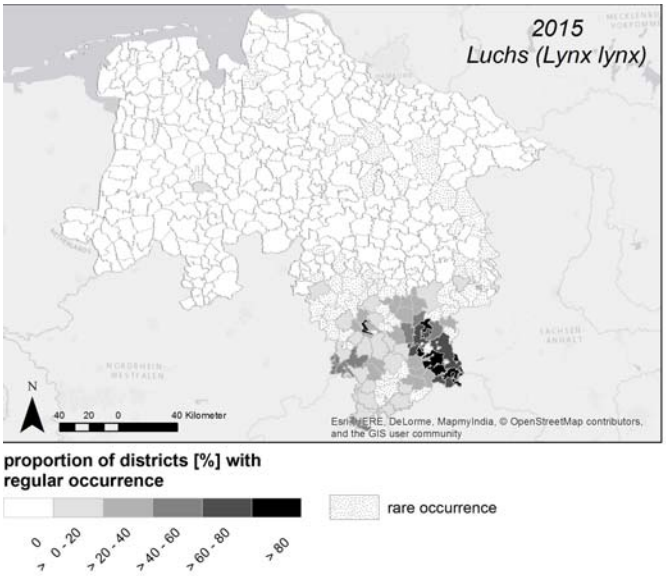
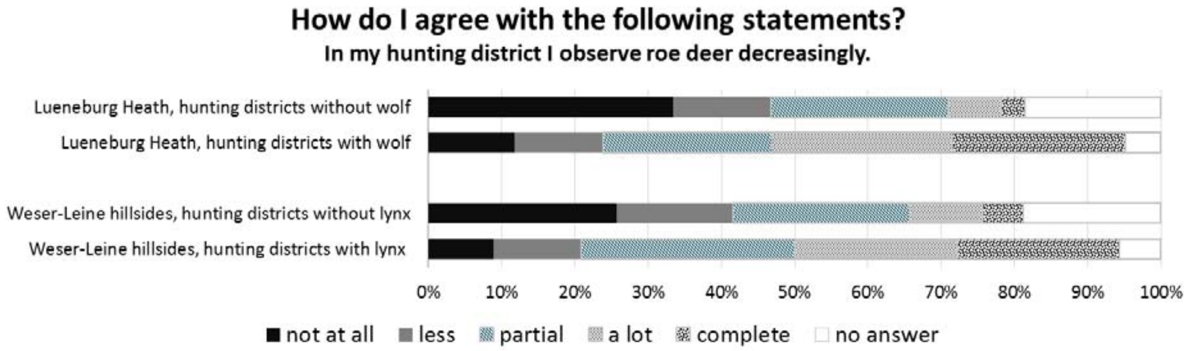


Figure 3: *Opinion poll among hunters to the visibility of roe deer in their hunting districts in the nature regions Lueneburg Heath (n = 1223 hunting districts) and Weser-Leine hillsides (n = 537 hunting districts) with and without wolf or lynx occurrences in 2015.*



In the Weser-Leine hillsides, the differences in the hunting bag in hunting districts with and without lynx are only marginal and, dependent on the forest proportion. In this region, the roe deer hunting bag decreased from about 3 to 2.5 killed roe deer/100 ha.

Because wolves and lynx are increasingly found in the hunting districts, opinion polls are especially valuable for monitoring the connection between hunting statistics and population data. Using this data, it can be assessed which effects occur over large areas, and which are in fact due to the presence of predators, as well as what influences the "perceived" effects have. Both are crucial for the acceptance of carnivores among rural actors.

References:

[1] http://www.wildtiermanagement.com/wildtiere/haarwild/wolf/wolfsnachweise_in_niedersachsen/

[2] **Anders, O. & L.T. Middelhoff** (2016): Abundance and density of the lynx *(Lynx lynx)* in the western part of the Harz mountains. Säugetierkundliche Informationen, *Jena,* **10, H.51:** 213-224

[3] **Strauß, E., K. Ronnenberg, I. Klages & R. Gräber** (2016). Wildlife survey in Lower Saxony 1991-2016 - a base tool for description of biodiversity of our cultural landscape, 363-364. *150 years of ecology [lessons for the future]* - 46th annual meeting of the Ecological Society of Germany, Austria and Switzerland. Verhandlungen der Gesellschaft für Ökologie e.V. (GFÖ), Marburg, Germany.

Keywords: monitoring, hunting bag, management, human dimension

(oral)

Long-term population trends on Brown Hare in intensively used agricultural landscape**

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In Germany, the Brown hare typically inhabits agricultural land but population densities differ between regions. In mosaics of intensively used agricultural land and grassland, hares reach relatively high population densities [1,2]. In recent decades decreasing hare populations have resulted in a widespread voluntary abandonment of hare hunting. Thus, hunting bags are no longer a reliable index for both the population dynamics and actual densities [3].
Within the citizen science program, wildlife survey of Lower Saxony (WTE – WildTierErfassung), the Brown hare, among several other game species, has been continuously monitored since 1991 [4]. Each year the holders of the hunting districts provide wildlife estimates, the hunting bag and the occurrence in their hunting ground (mean: 474 ha) for a number of species. Furthermore, the hunters were questioned about diseases, road kills and other topics, as well as on the human dimension, e.g. hunters' opinions and attitudes. The participation of hunting district holders was high throughout the years 1991–2015 and ranged between 80 and 90 % of hunting districts (6,151–8,300). More than 90 % (43,000 km²) of the huntable area of Lower Saxony was recorded yearly. For calculating population densities, the hunting grounds are aggregated to 455 municipalities and population trends are compared between six nature regions in Lower Saxony.
The population densities in Lower Saxony differ significantly on regional and local scales. The densities in the hunting grounds range from less than one hare/km² to more than 100 hares/km² and municipality level between 3 and 60 hares/km² resp.. The highest densities are in the intensively farmed arable areas in “Börde”, “Ems-Hunte Geest” and “Dümmer Geest-Niederung” as well as in the grassland areas of “Fluss- und Seemarschen” at the North Sea coastline.
In Lower Saxony, the average population densities have increased from 11.0 to 16.9 hares/km² between 1993 and 2005. Since 2006, the hare population has decreased drastically and reached numbers of 11.3 hares/km² again in 2015.
In the western and northern parts of Lower Saxony, which were traditionally the areas of highest population densities, a strong population increase was recorded up to 2007 after which a sharp decline was observed again (Fig. 1). The hare population densities further decreased in the following years and became stable at a low level in recent years. In contrast, the populations in the southern and eastern parts at low population levels have mostly remained constant over the same period. In spring 2015, the mean population density in the different regions in Lower Saxony ranged from 8.1 to 13.5 hares/km² and 11.5 to 26.7 hares/km² in 2005 resp..
In the hunting season 2014, approx. 50 % of the hunting grounds were used to hunt. Only in 29 % of the hunting grounds more than 10 hares were killed.
Since 1994, in addition to the WTE, hare populations have been assessed continuously by spotlight counts in several hunting grounds (N=6-12). 40 hunting grounds more have been included since 2002. Spotlight counting is performed as strip transect method, 2-3 repeated counts by the same experienced people in spring (March–April) and autumn (Oct–Nov) using standardized procedures.
The results of the spotlight counting in five selected hunting grounds show significant regional differences. The highest population densities were counted in intensively used agricultural landscapes on the coast, in the Börde (study area 1 and 3) and in grassland areas (study area 2) (Fig. 2). For a while, the lowest population densities of hares were detected in richly structured agricultural landscapes with 30 % of organic farming and adjacent woodland (study area 5). Large fluctuations in the discontinuous and asynchronous population developments were especially striking. These changes are unlikely caused by ongoing transformations of the landscape.
The causes for these negative developments are still unknown, but it is presumed, that regional epidemics by EBHS (European Brown Hare Syndrome) become important. Further studies are needed to show to what extent the changes in agricultural land use due to increased maize production for bioenergy or different causes may regulate the development [e.g. 5].

***Figure 1:** Estimated population densities of Brown hare by hunters in the natural regions of Lower Saxony 1991-2015 (hunting grounds 6,000-8,000)*

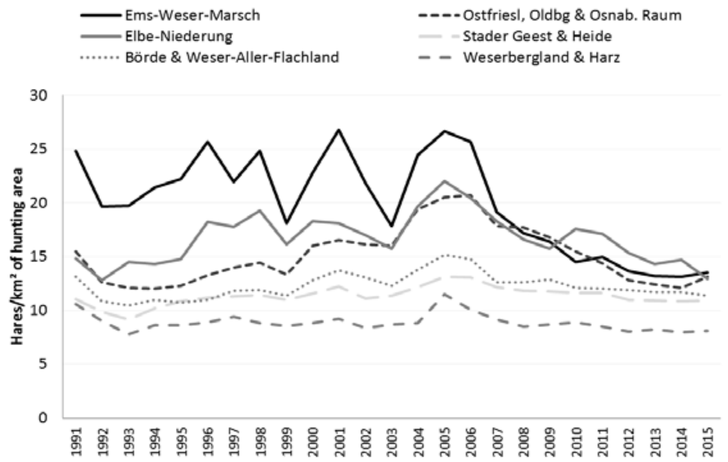
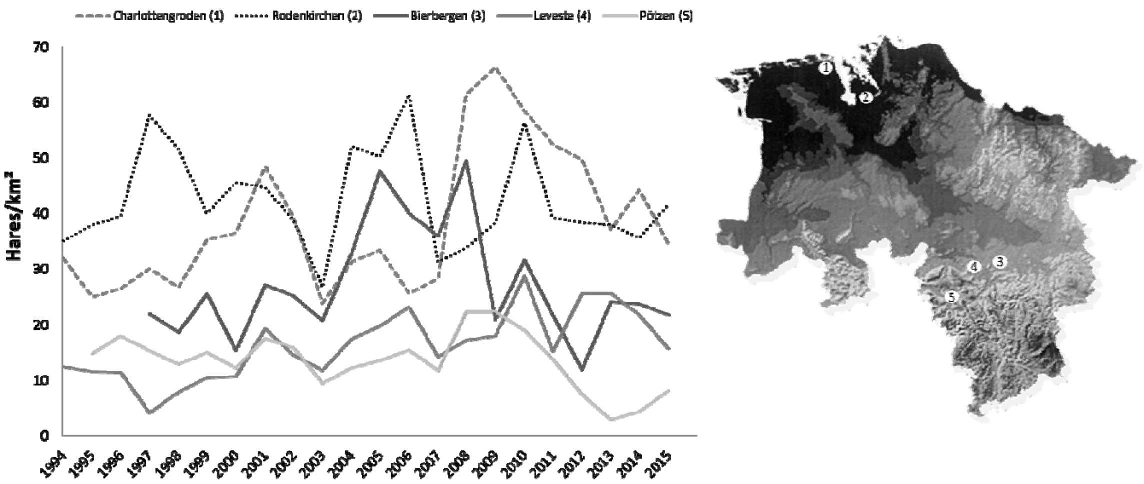


***Figure 2:** Population densities of spotlight counts in 5 selected hunting grounds in spring 1994-2015.*



References

[1] **Strauß, E.** (2016). Niederwild – Hase, 35-38. In: Gräber R, Strauß E, Johanshon S (Hrsg.). Wild und Jagd - Landesjagdbericht 2015/2016. Hannover, Niedersächsisches Ministerium für Ernährung, Landwirtschaft und Verbraucherschutz. ISSN 2197-9839.

[2] **Arnold, J.M., G. Greiser, O. Keuling, I. Martin & E. Strauß** (2013). Status und Entwicklung ausgewählter Wildtierarten in Deutschland. Jahresbericht 2012. Wildtier-Informationssystem der Länder Deutschlands (WILD). Deutscher Jagdschutzverband. Berlin.

[3] **Strauß, E. & K. Pohlmeyer** (2001). Population density of European hares (*Lepus europaeus* Pallas, 1778) and hunting activity in Lower Saxony. *Zeitschrift für Jagdwissenschaft,* **47(1):** 43-62.

[4] **Strauß, E., K. Ronnenberg, I. Klages & R. Gräber** (2016): Wildlife survey in Lower Saxony 1991-2016 - a base tool for description of biodiversity of our cultural landscape. 150 years of ecology [lessons for the future] - 46th annual meeting of the Ecological Society of Germany, Austria and Switzerland; Marburg, Germany: Verh. der Gesellschaft für Ökologie e.V. (GFÖ), 363-364.

[5] **Ronnenberg, K., E. Strauß & U. Siebert** (2016). Crop diversity loss as primary cause of grey partridge and common pheasant decline in Lower Saxony, Germany. *BMC Ecology,* **16:** 39. doi:10.1186/s12898-016-0093-9

Keywords: spotlight counting, monitoring, hunting, citizen science

(oral)

Effective strategies for wild pig management in the southeastern U.S.

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Wild pigs have become one of the most important invasive pests in the southeastern U.S. as many states have documented damage costs of $50 to 100 million, annually. Although wild pigs exist on public lands managed by the state or federal government, most of the land area in the southeastern U.S. is private. As such, we have designed educational outreach programs for landowners to teach and demonstrate the most efficient and effective techniques for management of wild pigs. Contrary to popular belief, we explain that sport hunting is not an effective technique for management. Instead, we teach strategies for trapping that results in far greater success on private properties. Additionally, we demonstrate the latest technologies that enable greater trapping efficiency as well as mobile applications that can be used to spatially document damage on their property that will guide future management efforts.

(poster #85)

Steps to reveal a general pattern in species diversity along gradients of urbanization across continents

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Growing rate of urbanization increases global concerns for urban biodiversity, though urbanization is a challenge as well as an opportunity to manage species and ecosystem diversity. Because, high spatial habitat heterogeneity and diverse land use intensities in cities can result high level of species diversity. Since decades, many studies have assessed diverse effects of urbanization on patterns and drivers of biodiversity. Thus, our theoretical understanding and hypotheses of urban biodiversity are also considered as well established. However, most of these research studies as well as our conceptual understanding of urban biodiversity are biased as majority of these research are conducted in temperate zone, focusing on North America and Europe [1,2], and there is still a missing link in the knowledge on urban biodiversity in other climatic zone. Such an example is tropical zone of South Asia which is rich in biodiversity but will face largest future urban consequences in near future [3]. Patterns and drivers of urban biodiversity are likely to vary around the globe at regional and local scales because of the different levels of urbanization within countries and regions, resulting from diverse pressures of human population growth on balancing the ecosystem's sustainability [4,6]. Here, my proposed poster will highlight most commonly used urban biodiversity hypotheses and the importance of a comparative study for their validation across continents to reveal a general pattern in urban biodiversity. I shall also share my designed doctoral research plan on patterns and drivers of biodiversity in multiple cities from different geographic areas and climatic zones of Southern Asia and Western Europe which is aimed at validation of intermediate disturbance hypothesis and green infrastructure concept.

References

[1] **Faeth, S.H., C. Bang & S. Saari** (2011). Urban biodiversity: patterns and mechanisms. *Annals of the New York Academy of Sciences*, **1223:** 69–81.

[2] **Grimm, N.B. *et al.*** (2008). Global change and the ecology of cities. *Science*, **319(5864):** 756-760.

[3] **United Nations** (2015). 'Population, Consumption and the Environment 2015'. Economic and Social Affairs, United Nations, New York. United Nation. <http://www.un.org/en/development/desa/population/publications/pdf/environment/PopulationConsumptionEnvironment2015.pdf>

[4] **Blair, R.B.** (1996). Land use and avian species diversity along an urban gradient. *Ecol. Appl*. **6:** 506–519.

[5] **McKinney, M.L.** (2002). Urbanization, biodiversity, and conservation. *BioSci*, **52:** 883–890.

[6] Ricketts, T. & M. Imhoff (2003). Biodiversity, urban areas, and agriculture: locating priority ecoregions for conservation. *Conservation Ecology*, **8(2):** 1.

Keywords: Urbanization, biodiversity, tropical zone, Southern Asia, Western Europe

(poster #86)

Wildlife - vehicle collisions in urban area in Lublin

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Wildlife-vehicle collisions (WVC) are a considerable problem in the transport route ecology due to their serious consequences for human life; they can result in economic losses and have a profound impact on many animal species [1,2,5,6]. Therefore, prevention of the analysed incidents should be the major factor in designing and constructing roads and traffic management [14]. This is usually accomplished through enforcement of national and international regulations for prevention of damage and for design of proactive actions in the most problematic sectors [9]. In this context, it is worth assessing the geographic distribution of WVC, determining the most problematic animal-human conflict areas, and strengthening preventive measures [3,7,11,12,14].
Road collisions involving animals are among the most dangerous road incidents. In Poland, many collisions are not reported and only fragmentary information about this type of incidents has been gathered by various institutions, e.g. national parks, forestry offices, and hunter associations. The police and institutions that arrive directly to the scene of a collision possess the most complete data.
The study analyzed the number of road accidents involving wild animals in the city of Lublin in 2016, taking into account the seasons and day. The information about wildlife-vehicle collisions was obtained from the documentation held by the shelter for homeless animals in Lublin and veterinary services which have been equipped with GPS transmitter and were listed during each trip to the reported events throughout the year 2016. Completed and have been verified by the data obtained from the documentation of police in Lublin. In addition, we analyzed the average traffic volume occurred in places where most of road accidents involving wild animals.
The aim of the research was to develop a map of road accidents involving wild animals in the city Lublin.
The data are presented in a spreadsheet containing the following fields: street name, animal species, number of incidents, and date of the incident. Further analysis was performed in the GIS (ArcGIS 10.1) environment. Based on the ESRI Base Map-BING MAP HYBRYD, a vector database of streets where the incidents had taken place was compiled. According to the number-of-incidents attribute, the streets were categorised in the form of a map. Characteristic points marked the place where occurred the most collisions involving wild animals.
There is a need for verification of the existing migration corridors in terms of their importance for the spatial and genetic permanence of populations and real long-term protection. The localisation of the corridors should be based on data of sites where animals cross public roads and spots of wildlife-vehicle collisions in urban areas, particularly in sites where the land along the roads will be transformed.
Animal populations have to adapt to the natural environment transformed by man. This is possible and effective in the case of some species (e.g. insects, rodents, predators), whereas other species such as large ungulates are not able to cope with the barriers created in the course of human development. From this point of view, the most important problem, i.e. degradation, loss, and fragmentation of habitats, it is not impossible to be solved, particularly in Poland, where the natural environment is relatively well preserved, in comparison with Western European countries. Therefore, the experience of other countries should be taken into account in the economic development in order to avoid the same mistakes and not to forget about the natural environment [8,10].
Fencing the roads integrated with animal migration routes seems to be the most effective way to prevent this type of accidents; however, this method is relatively seldom used in Poland, as only 0,64% of all roads are fenced. A commonly used method, although little effective, is installation of warning signs (A-18b “wild animals”), which allow road administrators to avoid liability for the consequences of accidents [13]. It is therefore necessary to undertake mitigation measures during construction of new roads or modernisation of existing ones. An important element in reduction of the number of wildlife-vehicle collisions is appropriate education and awareness-raising actions. Adequate information about animals’ behaviour on the roads provided to drivers may contribute to reduction of the number of such traffic incidents. This practice has become a standard in many countries [4,11].

References

[1] **Coffin, A.W.** (2007). From roadkill to road ecology: a review of the ecological effects of roads. *J. Transp. Geogr.,* **15:** 396–406.

[2] **Conover, M.R., W.C. Pitt, K.K. Kessler, T.J. DuBow & W.A. Sanborn** (1995). Review of human injuries, illnesses, and economic losses caused by wildlife in the United States. *Wildl. Soc. Bull.,* **23:** 407–414.

[3] **Farell M.C. & P.A. Tappe** (2007). County-level factors contributing to deer– vehicle collisions in Arkansas. *J. Wildl. Manag.,* **71(8):** 2727–2731.

[4] **Ford, A.T., A.P. Clevenger, M.P. Huijser & A. Dibb** (2011). Planning and prioritization strategies for phased highway mitigation using wildlife-vehicle collision data. *Wildl. Biol.,* **17:** 253-265.

[5] **Forman, R.T.T. & L.E. Alexander** (1998). Roads and their major ecological effects. *Annu. Rev. Ecol. Syst.,* **29:** 207–231.

[6] **Groot-Bruinderink, G.W. & E. Hazebroek** (1996). Ungulate traffic collisions in Europe. *Conserv. Biol.,* **10:** 1059–1067.

[7] **Gunson, K.E., G. Mountrakis & L.J. Quackenbush** (2010). Spatial wildlife–vehicle collision models: a review of current work and its application to transportation mitigation projects. *J. Environ. Manag.,* **92:** 1074–1082.

[8] **Indykiewicz P., K. Napieraj & J. Kowalski** (2013). Urbanizacja-synatropizacja-synurbizacja, czyli o różnorodności i adaptacjach zwierząt w środowisku zurbanizowanym Część I. Potencjał ekologiczny obszarów metropolitarnych w Polsce [Urbanization - synantropization- synurbization, that the diversity and adaptations of animals in urbanized environment, Part I. The potential ecological metropolitan areas in Poland] Wydawca NICE, Bydgoszcz

[9] **Iuell, B., H. Bekker, R. Cuperus, J. Dufek, G. Fry, C. Hicks, V. Hlavác, V. Keller, C. Rosell, T. Sangwine, N. Tørsløv, B. & W.B. le Maire** (2003). COST 341: Habitat fragmentation due to transportation infrastructure: wildlife and traffic; a European handbook for identifying conflicts and designing solutions. KNNV Publishers.

[10] **Klimaszewski K.** (2011). Szlaki komunikacyjne i inne bariery antropogeniczne a funkcjonowanie populacji zwierząt [Routes and other anthropogenic barriers and the functioning of animal populations]. *Annals of Warsaw University of Life Sciences SGGW Anim. Sci.,* **50:** 19–28.

[11] **Malo, J.E., F. Suárez & A. Díez** (2004). Can we mitigate animal-vehicle accidents using predictive models? *J. Appl. Ecol.,* **41:** 701–710.

[12] **Rosell, C., M. Fernández-Bou, F. Camps, C. Boronat, F. Navàs, M. Martínez & A. Sorolla** (2013). Animal-vehicle collisions: a new cooperative strategy is needed to reduce the conflict. Proceedings ICOET 2013 International Conference on Ecology and Transportation. Scottsdale, Arizona, USA, 23-27th June 2013

[13] Szczęsny, P. & G. Orlicz-Szczęsna (2014). Identification of road accidents involving animals on Polish territory. - *Logistics - the science* **6,** 10289-10298

[14] **Zuberogoitia, I., J. del Real, J.J. Torres, L. Rodriguez, M. Alonso & J. Zabala** (2014). Ungulate vehicle collisions in a peri-urban environment: consequences of transportation infrastructures planned assuming the absence of ungulates. *PLoS ONE,* **9(9):** e107713.

Keywords: urban roads, vehicle collisions, wild animals, GIS, GPS

(oral)

Conflicts between large predators and farmers in Estonia: value of different conservation tools

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Large predators (wolf, brown bear and lynx) are common throughout Estonia. Damage caused to livestock (mainly on sheep, occasionally on dogs, goats, cattle and horses), other agricultural products and apiaries is the primary reason of the human – large predator conflict. To reduce the conflict and build tolerance, Estonia developed a depredation and damage prevention measures compensation program.
Area of the country is >45 000 km2 with population 1,29 million people (population density 28 ind/km2), and fast urbanisation (1/3 inhabitants live in capital). 50 % of the country is covered with forests. Viable populations of common large predators (ca 200 wolfs, 400 lynxes, 600 bears) are present. In the country there are ca 90 000 sheeps and ca 40 000 beehives available as depredation target. Predator natural prey (roe deer, wild boar, moose, red deer) is abundant in nature. In Estonia 600-900 sheeps/year are depredated by wolves (plus some cattle, dogs, goats, horses) and 100-300 beehives/year depredated by bears (plus some sheeps, cattle and silages). Ca 0,5…1 % of available sheeps are killed by wolves. There are trends of changes in wolf behaviour and agricultural practice (no more shepherds, distant pastures, large herds etc). Conflicts between different groups (carnivores↔hunters, carnivores↔farmers, sheep farmers↔crop farmers, carnivore conservation↔agricultural subsidies) present in country.
To reduce conflict and build tolerance, damage compensation and mitigation subsidies were introduced in Estonia in 2008. All the reported damage cases inspected by trained experts, 100 % of the market value are compensated to more than 200 farmers/year, ca 100 000 €/year of wolf and 50 000 €/year of brown bear depredation damages compensated.
In the management of large predators-human conflict, different damage prevention measures are introduced. Main priorities are to improve husbandry practices, to (re)introduce different prevention measures, to improve farmers' responsibility and training, to inform and educate general community. In the program, different effective measures (substantially improved electric fences, night enclosures, livestock guarding dogs etc) are compensated by the state to the extent of 50 %.
In large predators-human conflict coexistence, management priority focus should be on the improvement of husbandry practices, different damage prevention measures, farmers responsibility and training, general community education and information.

Keywords: large predator-human conflict, compensation program, damage prevention measures

(oral)

Reasons of the synurbanization of wild boar in the region of Lake Balaton

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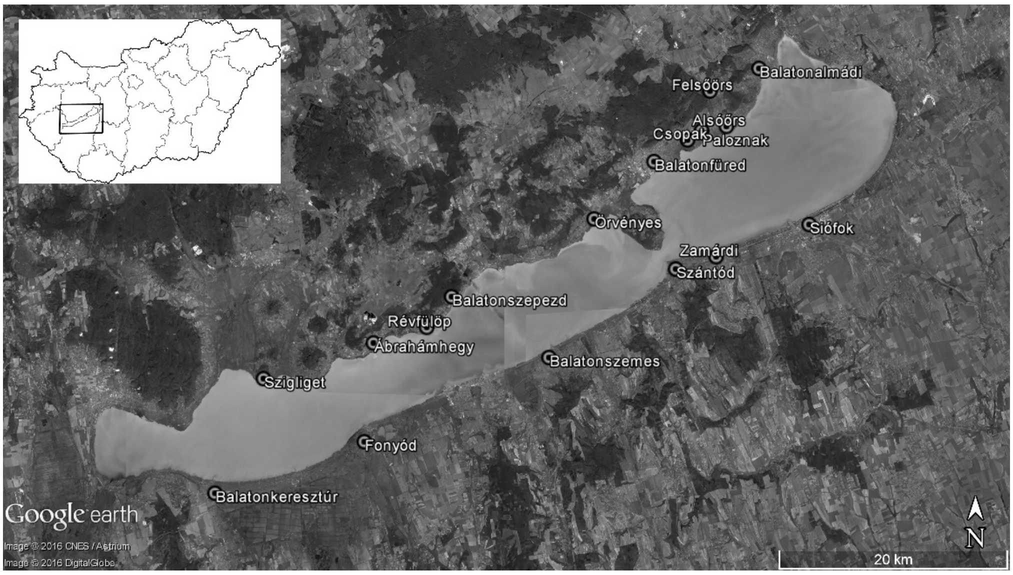
The habituation of the wild boar to urban areas became a growing problem in Hungary. One of the most affected regions is the surroundings of the Lake Balaton, a heavily affected resort area. Being a resort area the human disturbance is low during the winter and spring. The area is surrounded by reed on the lake shore on one side, and by forest and agriculture fields on the other. Wild boar use both of these habitats, and from time to time cause damages in urban areas situated between the two habitats. In order to work out mitigation measures to reduce the negative effects caused by wild boar, we investigated the reasons of the phenomenon.

During our research we used two methods. First we applied keyword search method on different web platforms. We used the Google search with keywords „wild boar" and the name of the settlements which are located on the shore of the lake. We analysed the online national- and local news websites, and the Database of the National News Agency as well. We selected down the search results based on the topic of the article connected to the wild boar appearance in urban areas. We recorded the date of the article, the name of the location, the type of the topic (e.g. direct observation or signs of the damage) and the supposed reason of the appearance. We have found 163 articles or documents which were connected to wild boar problems in urban areas. 20 of them have been connected to the region of lake Balaton, the first result was from 2000. Overall 17 settlements were affected with the problem (**Fig. 1**). The region of the lake was the second mostly affected by wild boar area after Budapest.

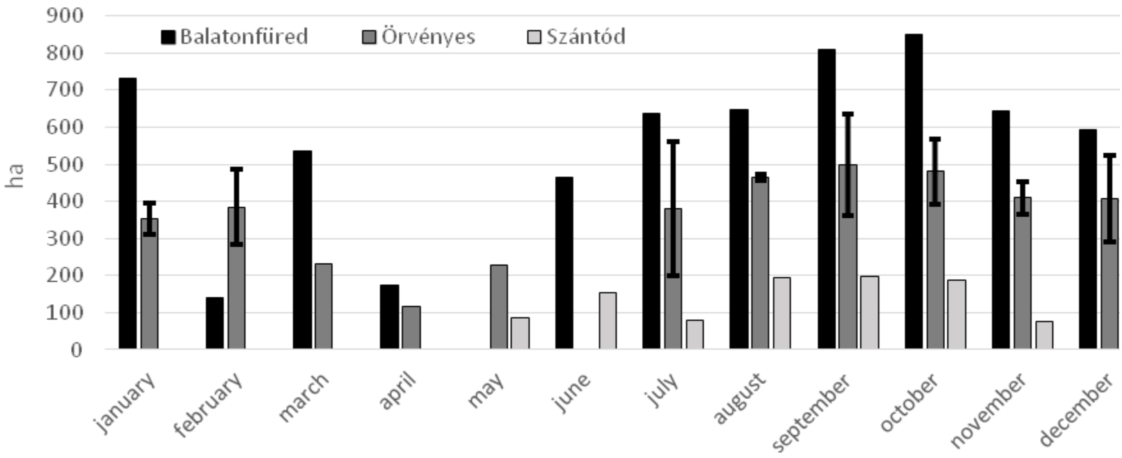
Figure.1. *Map of the Balaton with the affected settlements*



The most frequent reason mentioned in the articles were the artificial food supply on public domains and gardens, and the abandoned real estates and orchards which offered suitable hideaways. They were referred in 65% percent of cases. The population overabundance, the incomplete/damaged fences, the illegal feeding and weather conditions were mentioned in 25% percent of cases.

As a second method we applied GPS-telemetry. We trapped 4 wild boar females in the shrubland habitat on the edge of the reed and equipped them with GPS collars. The 4 animals were trapped nearby settlements with different characteristics. One of them was a bigger town (Balatonfüred) between forest and reed, the second one was a small settlement (Örvényes)(2 animals), connected to agriculture areas and reed, and the third was a middle sized settlement (Szántód) surrounded by reed. We investigated the seasonal change of the home ranges, the activity patterns, and the habitat preference. Habitat use was determined by direct GPS position tracking in the field. The yearly home ranges of the selected animals have evolved in different ways. Measured by minimum convex polygon, the animal from Balatonfüred moved on 1215 ha, while the individuals from Örvényes used 935 ha and 803 ha respectively. The wild boar from 1Szántód had a 209 ha home range. There were also differences between the seasonal home ranges sizes in the three areas (**Fig. 2**).

Figure 2. *Sesonal home range size (MCP) of wild boar in three diferent habitat*



In Balatonfüred and Örvényes the changes between the seasons followed the same trend: the end of the summer and early autumn have the highest values. In case of the wild boar from Balatonfüred which lived close to large vineyards, an autumn habitat shift has been observed. The animals from Balatonfüred and Örvényes used intensively the forest in winter time. The boar from Szántód used only the reed each month. There were no differences between the individuals regarding their daily activities. In both cases an elongated diurnal resting period has been observed, fact which was related to human activity especially characteristic in the tourist season. There was difference between the animlas regarding their habitat use as well, which was due to the different habitat availability. The daytime hideaways (reeds and forests) were straightly connected to the urban areas in more than 90% of the cases. The wild boar from Balatonfüred and that from Szántód visited the urban area for food supply mainly at nighttime. They used abandoned and cultivated gardens, orchards and damaged them by rooting. They often damaged the fences of the gardens as well. The animals from Örvényes visited for food supply mainly the croplands situated between the inhabited agricultural areas. Their appearance and damaging in the gardens was negligible.

As a conclusion we can state that the habituation of wild boar to urban areas is a complex problem because each settlement has a special characteristic. However, regardless the area three parties should manage the problem: the hunters/wildlife managers, the city council via legislation and last but not least the citizens The problem could be solved only by the cooperation of the three parties.

Acknowledgments: Supported by „VKSZ_12-2013-0034" – Agrárklíma2 Project

Keywords: wild boar, synurbanization, damage, GPS-telemetry, keyword-search method

(oral)

Novel Methods for Estimating Neonate Survival of Northern Bobwhite

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Neonate survival is an important but poorly understood component of northern bobwhite (*Colinus virginianus*) population dynamics. We used a combination of thermal imagery (forward-looking infrared [FLIR]) and radio-telemetry to estimate survival from time of hatch to fall recruitment. During 2013 – 2015, we tracked bobwhites and captured broods at ~11 days of age using the corral technique. In addition to patagial tagging each neonate captured, we sutured radio-tags (0.76 g) on a subset of neonates (n = 56), and located them 3-4 times daily using radio-telemetry to determine fate and cause of mortality. We used the Dail-Madsen model in R (package unmarked) to estimate survival from data collected with FLIR and program MARK (known-fates model) to estimate survival of radio-tagged birds. We observed a curvilinear relationship ($ß$ = 0.047, SE = 0.014) between age and survival such that daily survival rates gradually increased up to 10 weeks of age at which time survival reached an asymptote. The average daily survival rate for bobwhite neonates during the first 2 weeks of age was 0.9458, 0.9814 (SE = 0.0049) for weeks 3 to 10, and 0.9979 (SE = 0.0017) after 10 weeks of age. Linking daily survival estimates from FLIR (0-11 days) with radio-tagged (≥12-days) survival, we surmise that only small portion (~18.5%) of chicks hatching during the peak nesting period (June-July) survive to fall recruitment. Despite the lack of information on neonate survival, to date, numerous population models incorporate estimates of chick survival at 45-50% to fall recruitment. However, our results suggest that those estimates are egregiously high and may report spurious results due to inaccurate parameter inputs for neonates. We further suspect that hatch timing (June vs Sep) and weather likely influence daily survival rates of neonates and may substantially impact overall fall recruitment.

Keywords: *Colinus virginianus*, chick, neonate, *northern bobwhite,* survival

(oral)

Status of the implementation of the AEWA International Single Species Action Plan for the Taiga Bean Goose

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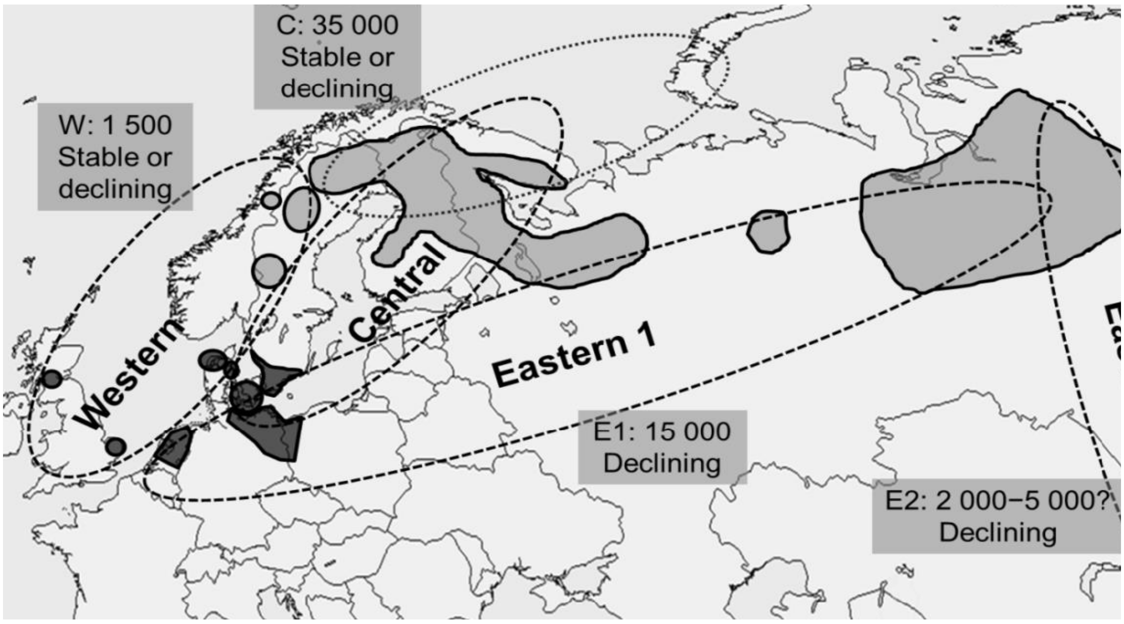
Taiga Bean Geese *Anser fabalis fabalis* breed in the boreal forest and sub-tundra regions from west Siberia to Fennoscandia and winter in northwest Europe and Central Asia. Numbers are believed to have fallen from *c.* 100,000 in the mid 1902 to *c.* 45,000 by 2015. The African-Eurasian Migratory Waterbird Agreement (AEWA) International Single Species Action Plan developed for the population in 2015 [1] is the first for a declining taxa subject to hunting. In this presentation, we review progress since the inauguration of the Plan, providing additional evidence from stable isotope and gps telemetry to confirm the existence of three functional flyway sub-populations, each of which face different conservation challenges. The Western sub-population (W) breeds in Sweden and Norway, wintering in northern Denmark, southeast England and Scotland; the Central sub-population (C) breeds in northern Sweden and Norway, northern and central Finland and adjacent northwest Russia, wintering mostly in southern Sweden, as well as northeast and southeast Denmark and to an minor extent in Germany and the Eastern sub-population (E1) which breeds in the upper Pechora and west Siberian lowlands of Russia and winters in northeast Germany and northwest Poland (Fig. 1). The Eastern sub-population (E2) which breeds in eastern parts of the west Siberian lowlands and winters in Central Asia, is not a subject of the Action Plan. The long term goals are to restore W to 5,000-10,000 individuals, C to 60,000-80,000 and E1 to 100,000 with stable or increasing trends through increasing survival and reproductive rates and the cessation (and restoration) of habitat loss and fragmentation. To reach this, we outline 12 key mechanisms to achieve these objects and outline progress towards these goals, in particular, the immediate priority has been to better understand population sizes and flyway definitions, survival and reproductive rates and hunting bags to support the development of predictive models, effective management actions and iterative learning. We also report briefly on implementation of the plans and remaining challenges to its successful application to restoring all three populations.

Figure 1. *Geographical representation of the provisional flyway units delineated for the Taiga Bean Goose population, identified to support the establishment of management units for the purpose of the Plan. The numbers refer to estimated current population sizes accompanied by indicative trends, and the broken lines link breeding areas (light grey) with specific winter quarters (dark grey) (from Marjakangas et al. 2015).*



Reference

[1] **Marjakangas, A., M. Alhainen, A.D. Fox, T. Heinicke, J. Madsen, L. Nilsson & S. Rozenfeld** (Compilers) (2015). International Single Species Action Plan for the Conservation of the Taiga Bean Goose (*Anser fabalis fabalis)*. AEWA Technical Series No. 56. Bonn, Germany.

Keywords: Taiga Bean Goose, flyway sub-populations, AEWA International Single Species Action Plan, conservation

(oral)

Ecosystem services provided by beavers (*Castor* spp.)

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Beavers (Castor spp.) are ecosystem engineers, raising floodwaters into surrounding forests. This causes tree mortality, dead wood accumulation [1], and releasing of organic material into riparian systems and lakes. Through the biogeochemical and hydrological changes they exact on wetlands [2], beavers also provide a multitude of ecosystem services to humans in the form of necessary benefits and economic gain. Ecosystem services can be used to appraise both the economic and ecological value of ecosystems, an important tool for political and societal decision-making. Beavers provide ecosystem services that can globally be valued in the tens of billions of USD per annum. Beavers mitigate flood peaks by retaining rainwater and drought conditions by slowly releasing water and raising groundwater levels [e.g. 3]. In monetary terms flood and drought mitigation by beaver-created wetlands is the single most valuable service. Its importance will additionally most likely increase in the future due to climate change. Carbon storage is significant in beaver meadows, although especially new flowages also emit greenhouse gases, and the landscape-level effect of beaver on carbon dynamics is not well known [4]. Water quality and wastewater management are improved by the beaver's filtration service, as impurities (e.g. pollutants, disease-causing agents) are removed from waterways through sedimentation and increased evapotranspiration in the buffer zones created through damming. These processes also potentially improve soil quality upstream of beaver dams. Beavers can also aid in the biological control of invasive species, potentially accumulating substantial economic savings to societies. They generate habitats suitable for recreation and relaxation, providing e.g. hunting, fishing, hiking, and canoeing possibilities. Local communities can benefit from beavers by offering nature tourism possibilities. Beaver engineering creates new wetlands in large quantities. Beaver wetlands are therefore important hot spots for species diversity [5], upholding biodiversity [6] and ecosystem functionality, and also benefiting societies implementing wetland restoration schemes. Lastly, beavers provide several types of raw materials, e.g. pelts and castoreum, which are directly utilizable by humans. However, beavers also cause several disservices, e.g. by damming culverts, flooding roads or agricultural areas, or by potentially elevating methylmercury concentrations in waterways. These disservices can locally cause economically significant damage. As beaver populations are increasing in both Europe and North America, the species is likely to influence larger areas in the future, especially near dense human populations. Acknowledging the positive ways in which beavers can influence societies and both natural and human-influenced ecosystems is crucial for future management efforts and decision-making affecting e.g wetland conservation or mitigating structural damages caused by the species.

References

[1] **Thompson, S., M. Vehkaoja, & P. Nummi** (2016). Beaver-created deadwood dynamics in the boreal forest. *Forest Ecology and Management,* **360:** 1-8.

[2] **Vehkaoja, M., P. Nummi, M. Rask, T. Tulonen & A. Arvola** (2015). Spatiotemporal dynamics of boreal landscapes with ecosystem engineers: beavers influence the biogeochemistry of small lakes. *Biogeochemistry,* **124:** 405-415.

[3] **Rosell, F., O. Bozsér, P. Collen & H. Parker** (2005). Ecological impacts of beavers *Castor fiber* and *Castor canadensis* and their ability to modify ecosystems. *Mammallian Review,* **35:** 248-276.

[4] **Nummi, P., J. Pumpanen, M. Vehkaoja & A. Ojala** (2017). Beaver and carbon biogeochemistry: short-term and long-term processes. Submitted.

[5] **Nummi, P. & S. Holopainen** (2014). Whole-community facilitation by beaver: ecosystem engineer increases waterbird diversity. *Aquatic Conservation: Marine and Freshwater Ecosystems,* **24:** 623-633.

[6] **Stringer, A.P. & M.J. Gaywood** (2016). The impacts of beavers *Castor* spp. on biodiversity and the ecological basis for their reintroduction to Scotland, UK. *Mammal Review,* **46:** 270-283.

Keywords: beavers, ecosystem services, flood mitigation, drought mitigation, carbon storage, biodiversity

(oral)

Climate change and biodemographic performance in a mountain ungulate: warm temperatures are bad for Alpine ibex (*Capra ibex*)

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Climate warming is particularly marked in polar and alpine regions, with the spectacular melting of the ice caps. In such ecosystems, increasing temperatures could be expected to have positive effects on large herbivores, by decreasing the duration of winter, when ungulates are faced with a severe food shortage. Indeed, warm spring temperatures promote an early start of vegetation growth as well as plant productivity. By shortening the period of food shortage and enhancing food resource abundance they should thus improve herbivores performance. However, during warm springs plant growth is accelerated at any elevation, and the period during which herbivores have access to high-quality forage, which is tightly linked to plant phenology, is shortened. High summer temperatures have a direct negative impact on ungulates through thermoregulation or adaptive behaviours against heat, and they also accelerate the senescence of plants and hence decrease the quantity of resources available during late summer and autumn.

Studies on the impact of climate warming on mountain ungulates performance provided contrasted results, some showing a benefit ([1] on ibex horns, [2] on chamois and isard horns) while others found clear evidence for negative effects ([3] on juvenile survival in ibex, mountain goat and bighorn sheep, [4] on juvenile body mass in chamois). Such opposite results highlight that the response to high temperatures is site-, species-, and trait-dependent, and emphasize that further studies are necessary to gain insight into the relationship between climate and life history variation and to be able to predict what will be the effects of climate warming.

Based on the monitoring over 30 years of captured and individually marked Alpine ibex, we investigated the impact of spring and summer temperatures on different traits related to biodemographic performance: male horn length, female reproductive success, and adult survival in both sexes.
Our study took place in the Belledonne massif, intern French Alps, where a marked climate warming was measured, with spring temperatures having increased by 1,8°C in 30 years, corresponding to a shift of nearly 2 weeks in the timing of the peak of vegetation productivity. The increase of summer temperature was even more pronounced, with 2°C in 20 years.

We found that males born during warm springs exhibit shorter horns throughout their life than males born during cooler springs. This may be linked to the quality of food available during the first spring and summer. Cool spring temperatures promote slow vegetation growth, and thus a prolonged access to high-quality forage both for the mother during lactation, with the production of high quality milk, and for the young when it begins to graze during summer. Our results show that the food conditions encountered during the first spring/summer of life have long-lasting effects on ibex male horn length.
Female reproductive success decreased in years following hot summers, suggesting that under such conditions females were not able to accumulate sufficient reserves before winter to deal with next gestation.
Female survival was decreased after warm springs, while male survival was decreased after hot summers. Because of the strong sexual size dimorphism exhibited by ibex, both sexes have different energy requirements, with males needing a high quantity of forage throughout spring and summer while females rely more on forage quality. These differences may explain why the survival of females depend on spring temperatures (which determine the duration of the period with high-quality forage), whereas males survival is more related to summer temperatures (which determine the quantity of resources available during late summer and autumn).

Overall, we found negative effects of warm spring or summer temperatures on the biodemographic performance of ibex. In our population, ibex occupy the whole existing altitudinal range, and have no possibility to modify their home range towards higher elevations to follow the shift in their suitable niche. This situation is common to the majority of the French ibex populations, and our results raise the question of the future of ibex populations: will the species be able to adapt to the modification of its habitat generated by the ongoing climate warming, or are we going towards a global decline of ibex populations?

References

[1] **Büntgen, U., A. Liebhold, H. Jenny, A. Mysterud, S. Egli, D. Nievergelt, N.C. Stenseth & K. Bollmann** (2014). European springtime temperature synchronises ibex horn growth across the eastern Swiss Alps. *Ecology Letters,* **17:** 303-313.

[2] **Richard, Q., M. Garel, P. Menaut, J.M. Jullien, K. Foulché, D. Maillard, A. Loison & C. Toïgo** (2013). Spring warming increases horn length in females of Pyrenean and Alpine chamois. 2è Rupicapra symposium, Bellver de Cerdanya.

[3] **Pettorelli, N., F. Pelletier, A. Von Hardenberg, M. FestaBianchet & S.D. Côté** (2007). Early onset of vegetation growth vs. rapid green-up: impacts on juvenile mountain ungulates. *Ecology,* **88:** 381-390.

[4] **Mason, T., M. Apollonio, R. Chirichella, S.G. Willis & P.A. Stephens** (2014). Environmental change and long-term body mass declines in an alpine mammal. *Frontiers in Zoology,* **11:** 69-81.

Keywords: Climate change, Mountain ungulate, *Capra ibex*, Survival, Reproductive success, Horn length

(poster #87)

Behind wolf predation on wild ungulates: environmental factors influencing the distribution of kill sites in Northern Italy

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Predation is a hierarchical process whereby predators are constrained to kill prey within the area they select while hunting. Therefore kill sites are not randomly distributed, rather where kill sites occur is a function of prey distribution and predictability and environmental factors that influence prey detection, access, or the success of an attack [1]. Wolves (*Canis lupus*) are considered generalist apex predators, preying mainly on wild ungulates. Being socially organized in packs, usually consisting of the breeding pair and their offspring, wolves roam within their exclusive territory and cooperate during the hunt. Wolves are well adapted for cursorial predation with chases ranging from 100 m to more than 5 km [2].
The aim of this research is to identify the main environmental factors influencing the distribution of wolf kill sites, so at the same time determine which factors influenced the vulnerability of prey once the hunt began.
The study was carried out in Liguria (5343 km^2 region in Northern Italy; Fig. 1) The wild ungulate community includes the wild boar (*Sus scrofa*) and the roe deer (*Capreolus capreolus*), widely distributed with high densities, the fallow deer (*Dama dama*) and the chamois (*Rupicapra rupicapra*) more localized. Moreover, the red deer (*Cervus elaphus*) has a sporadic presence along the boundaries of the region. Wolves reached the Ligurian Apennines in the late 1980s (the first illegally killed wolf was found in 1990) and the Ligurian Alps in the late 1990s (the first illegally killed wolf was found in 1997). The most recent research estimated the presence of minimum five wolf packs by non-invasive genetic sampling [3].
Using data collected through a monitoring project carried out between 2007-2014 [3], we delineated wolf range using the sampled wolf genotypes by a fixed kernel estimator. We considered all claimed and verified cases of wolf predation upon wild ungulates recorded during 2007-2016, reporting the preyed species and possibly some related information (sex, age, proportion of consumption). Around each kill site we defined a buffer corresponding to the potential hunting area of wolves. We used a width of 13 km, corresponding to the average travel distance of wolves during the night to go from dens or resting sites to hunting sites in Italy [4]. We compared the plots where kill sites were recorded and an equal number of random plots within the estimated wolf range. We formulated a habitat suitability model following an approach presence vs. availability by binary logistic regression analysis (BLRA, forward stepwise method); we tested the hypothesis that wolf choice of kill sites is influenced by the morphology and the land use of the area. In each plot, we measured from the Corine Land Cover III level and the Digital Elevation Models (DEM) the environmental variables used as covariates: four slope classes (range between 0° and >60°), road density, path density, forests (broad-leaved, coniferous, and mixed forests), urban and cultivated areas, scrublands, open areas (pastures and grasslands), and bare ground (rocks and areas with little or no vegetation cover). We considered even two-way interactions between covariates. We tested the model performance by the percentage of correct classifications of original cases, Nagelkerke's R^2, and receiver operating characteristic (ROC) curve analysis.
We identified 74 distinct wolf genotypes, corresponding to 189 non-invasive DNA samples (98% faeces, 1% urines and 1% hairs), collected in the study area from 2007 to 2014. Wolf range had a total extent of 5068 km^2.
We mapped and digitized 62 wolf kill sites; among the preyed wild ungulates, we identified 23 roe deer, 18 fallow deer, 16 wild boars, and 5 chamois (Fig. 1). BLRA showed a negative effect of the road density, the urban areas, the mixed forests, and the medium slopes (20-40°), a positive effect of steep slopes (>60°), open areas, and bare ground, the latter without statistical significance (Tab. 1). The logistic model explained 56.4% of the variance of the response variable and correctly classified 78.2% of original cases, 82.3% of kill sites and 74.2% of control ones. The area under the ROC curve was significantly greater than that of a model that randomly classifies the cases (AUC=0.883±0.029; P<0.001).
Wolves kill sites in Liguria were steep, open habitats (pastures and grasslands) far from roads and urban areas. Wolves tend to avoid areas with high road and human settlement densities, as they may be barriers to wolf movements and a cause of direct mortality both from vehicle collisions and illegal killing. Moreover, human disturbance associated with roads and urban areas may deter or interfere with wolves when attempting to kill prey, or afterward during carcass consumption. Wolves seemed to select steep slopes, probably because they may find a suitable habitat in terms of advantage during hunting activities. We found that hiding-cover levels were lower at kill sites than at random sites. Indeed, dense cover can affect the prey capacity to exploit refuges, thus enhance its chances of escaping an attack, and can increase the chance of detection the predator,

because of its noisier approach. From the predator point of view, in open habitats prey were easier to locate and catch. Wild ungulates mainly use open habitats during the night as feeding areas, because of the higher quality resources, and more closed habitats during the day, with less forage but a higher degree of shelter. Wild ungulates have to face a constant trade-off between the choice of better food patches and predation risk. This trade-off is mediated by the vigilance behaviour, which requires exclusive visual attention to scan the environment, thereby interrupting or slowing down foraging activity. Wolves usually take advantage of this wavering behaviour to start the rush. Moreover, wolves are mainly active from dawn to dusk and this is probably closely related to their hunting pattern, which matches with the activity patterns of wild ungulates.
Overall, the environmental factors of the kill sites identified in this study are consistent with the cursorial hunting strategy of wolves.

Figure 1: *On the left: Liguria region and wolf distribution in Italy (data from 3rd National Report Italy ex-art. 17 Habitat Directive (92/43/EC), 2013). On the right: wolf range and wolf kill sites in Liguria.*

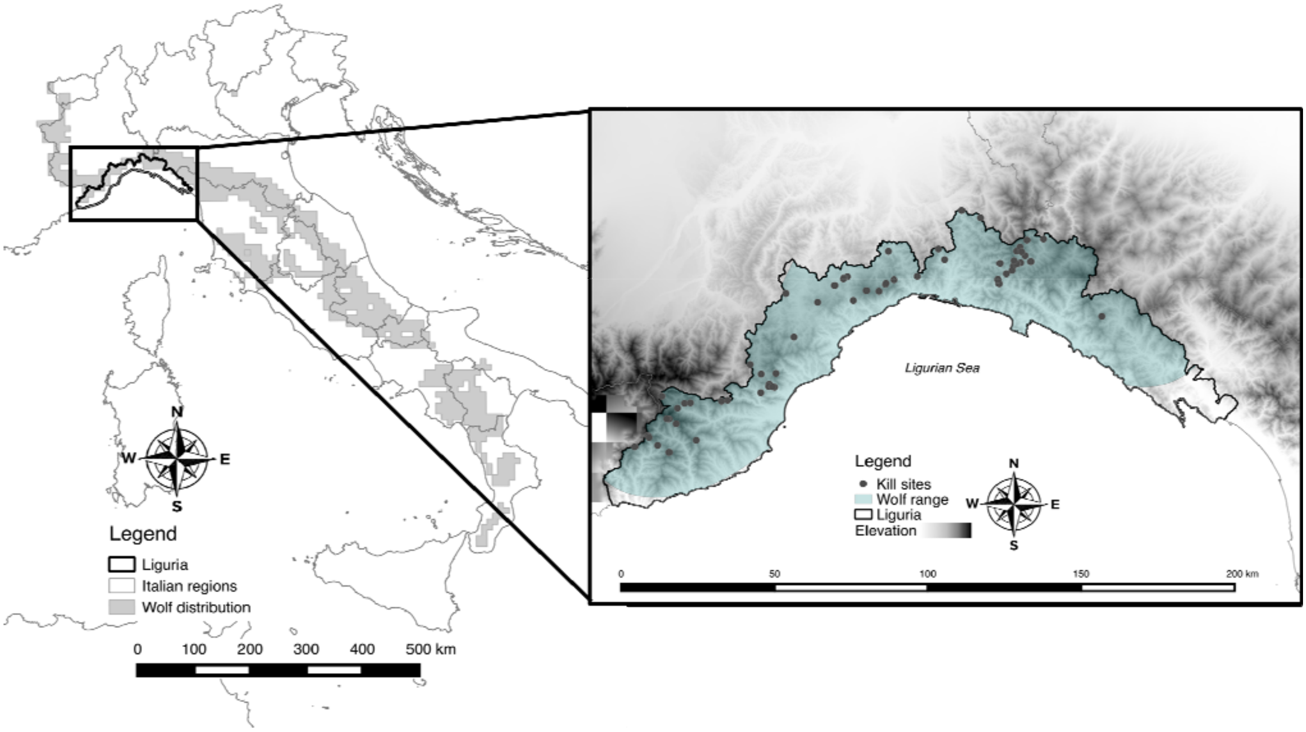

Table 1: *Results of logistic regression analysis between kill sites plots (n=62) and random ones (n=62).*

Variables	B	S.E.	*P*
open areas	13.01	5.38	0.016
bare ground	57.19	31.19	0.067
slopes >60° * open areas	84066.98	30276.27	0.005
road density * urban areas	-21881.13	7009.79	0.002
slopes 20°-40° * mixed woods	-34.26	10.34	0.001
(constant)	0.89	0.47	0.058
-2 Loglikelihood	103.64		
Nagelkerke's R^2	0.564		

References

[1] **McPhee, H.M., N.F. Webb & E.H. Merrill** (2012). Hierarchical predation: wolf (*Canis lupus*) selection along hunt paths and at kill sites. *Canadian Journal of Zoology*, **90:** 555-563.
[2] **Mech L.D. & L. Boitani** (2003). *Wolves: Behavior, Ecology, and Conservation*. University of Chicago Press, Chicago.
[3] **Imbert, C., R. Caniglia, E. Fabbri, P. Milanesi, E. Randi, M. Serafini, E. Torretta & A. Meriggi** (2016). Why do wolves eat livestock? Factors influencing wolf diet in northern Italy. *Biological Conservation*, **195:** 156-168.
[4] **Ciucci, P., L. Boitani, F. Francisi & G. Andreoli** (1997). Home-range, activity and movements of a wolf pack in central Italy. *Journal of Zoology*, **243:** 803-819.

Keywords: predator-prey interaction, *Canis lupus*, habitat selection, wolf hunting habits

(poster #88)

Distance Sampling: Population estimations of roe deer in a heterogeneous forest

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Density estimates of ungulates in woodlands could be crucial for effective and sustainable managing and / or understanding predator – prey dynamics [1,2]. This 3-year study of a roe deer population is located in the Palatinate Forest, a 1790 km² large heterogeneous forest in the south-western part of Germany. It runs parallel to reintroduction of the lynx (*Lynx lynx*), a roe deer specialised hunter [3,4,5]. The aim of the study is to estimate temporal changes of the roe deer population on a large scale and the possible effect of the natural predator onto the prey population. A remarkable feature of this study is that it includes a before-and after comparison, i.e. roe deer estimations without and with the presence of lynx.
Roe deer population was estimated with Distance Sampling during summer (August-September) and spring (February- March). Distance sampling was performed with thermal imagers on approx. 500 km forest paths per run during dawn and night times. 10 transects spread across the study area were randomly chosen in respect to the forest road network (**Fig. 1**.). Preliminary results of the first 7 out of 14 planed runs (before lynx introduction and with lynx presence) will be presented (**Tab.1**). In this presentation we will focus on methodological problems, e.g. comparisons between two seasons, random transect design on forest paths - a special habitat and responsive movement.

Figure 1: The study area and location of the 10 randomly chosen transects in the Palatinate Forest.

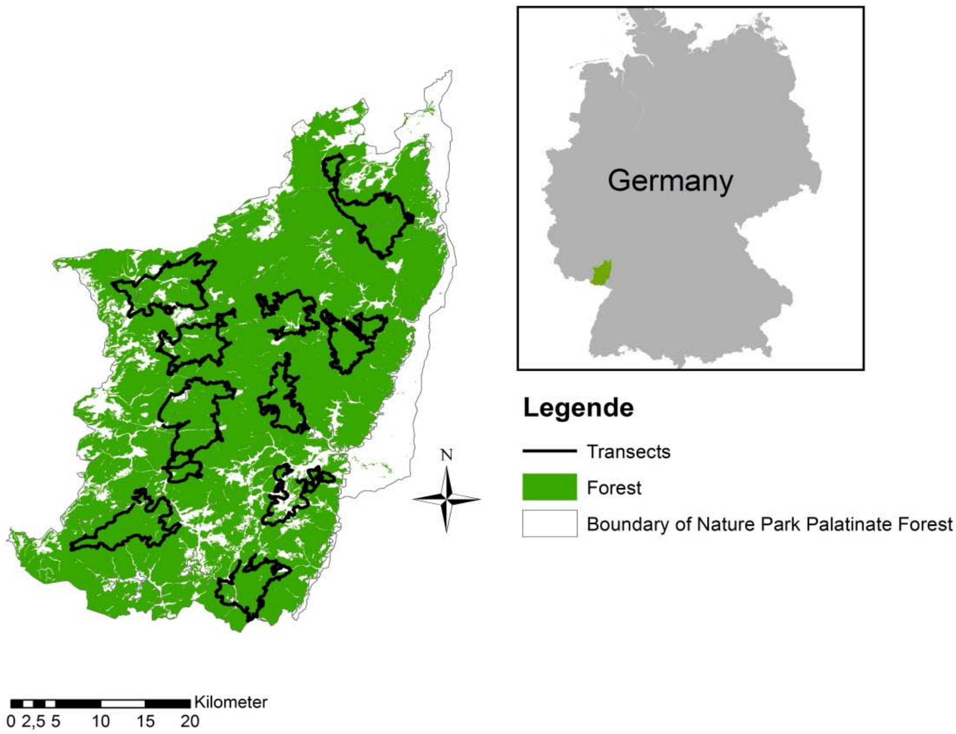

Table 1: *Roe deer detections and number of roe deer individuals observed of 7 runs without and with the first lynx releases in the Palatinate Forest. Detections were made on approx. 3500 km transect length. 3 lynx were introduced in the Palatinate Forest in July 2016.*

Season	No. of runs	Transect length	Detections	No. of roe deer	lynx presence
Summer 2015	2 runs	~ 1000 km	433	652	No
Spring 2016	3 runs	~ 1500 km	670	1152	No
Summer 2016	2 runs	~ 1000km	415	558	Yes (3 Individuals)
Total	7 runs	~ 3500 km	1518	2362	

References

[1] **Wäber, K. & P.M. Dolman** (2015). Deer abundance estimation at landscape-scales in heterogeneous forests. *Basic and Applied Ecology,* **16(7):** 610-620.
[2] **Morelle, K., et al.** (2012). Game species monitoring using road–based distance sampling in association with thermal imagers: a covariate analysis. *Animal Biodiversity and Conservation,* **35(2):** 253-265.
[3] **Heurich, M., et al.** (2012). Survival and causes of death of European Roe Deer before and after Eurasian Lynx reintroduction in the Bavarian Forest National Park. *European Journal of Wildlife Research*, **58:** 567-578.
[4] **Breitenmoser, U. & A. Haller** (1987). Zur Nahrungsökologie des Luchses Lynx lynx in den schweizerischen Nordalpen. *Zeitschrift für Säugetierkunde,* **52(3):** 168-191.
[5] **Okarma, H., et al.** (1997). Predation of Eurasian lynx on roe deer and red deer in Bialowieza Primeral Forest, Poland. *Acta Theriologica,* **42(2):** 203-224.

Keywords: population estimation, distance sampling, thermal imager, roe deer, lynx introduction, forest

(oral)

Waterbird conservation and sustainable use under AEWA

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The Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA) is an intergovernmental treaty dedicated to the conservation of migratory waterbirds and their habitats across Africa, Europe, the Middle East, Central Asia, Greenland and the Canadian Archipelago. Administered by the United Nations Environment Programme (UN Environment), AEWA brings together countries and the wider international conservation community in an effort to establish coordinated conservation and management of migratory waterbirds throughout their entire migratory range. AEWA covers 254 species of birds ecologically dependent on wetlands for at least part of their annual cycle. Currently 75 countries and the European Union (EU) have become Contracting Parties to AEWA. The Agreement provides for coordinated and concerted action to be taken by the Range States throughout the migration system of waterbirds to which it applies.

AEWA currently covers the majority of migratory waterbirds which occur in the Agreement area: from globally threatened species to abundant populations. For those species listed under the Agreement, which are open for harvest, Parties are obliged to “ensure that any use of migratory waterbirds is based on an assessment of the best available knowledge of their ecology and is sustainable for the species as well as for the ecological system that support them”.

First steps towards establishing a process for adaptive harvest management within the AEWA region, were laid out in the 2009-2018 AEWA Strategic Plan which calls for adaptive harvest management of quarry populations to be ensured at international level (target 2.5). To this end, the Strategic Plan foresees the development and implementation of international harvest management plans for at least two quarry populations.

AEWA Secretariat convenes for this purpose working groups (government representatives, experts and observers) to draft management plans which have to be adopted by the Meeting of the Parties, becoming then a legally-binding document. For the success of the process, clear management objectives are established and the governance should be transparent not only during the drafting of the plan but also during its implementation. This process led by the Parties concerned with the support of the Secretariat and scientists from the WHSG implies a great involvement of the national representatives and their experts.

The basis of adaptive management set up global objectives for the population using two sets of data (population level and harvest level) and the modelling of the dynamic of the population. Once the objectives adopted, the countries involved in the process should adapt their own regulation to implement the collective and binding decisions.

Subsequently, the AEWA International Single Species Management Plan for the Pink-footed Goose (Svalbard population) was adopted at the 5th Session of the Meeting of the AEWA parties in May 2012 following lengthy negotiations and its implementation, including the development and adoption of an adaptive management plan, commenced in 2013. For this increasing species, the objective is to stabilise its population at ca. 60 000 individuals, implying optimisation of the harvest. For the Taiga Bean Goose, on the other hand, an International Single Species Action Plan was adopted at the following Session of the Meeting of the AEWA Parties (MOP6) in 2015. As the Taiga Bean Goose is declining, the appropriate tool is a recovery plan, the implementation of which has begun in 2017, with range states implementing actions to reduce or close the harvest in the different management units to allow recovery.

At the same Meeting of the Parties in 2015, the parties decided to launch a European Goose Management Platform to serve as the overarching framework for the international conservation and management of huntable goose populations under AEWA. The inter-governmental AEWA European Goose Management International Working Group has since been convened by the AEWA Secretariat, and functions as the main coordinating and decision-making body of the Platform. The two species already mentioned above as well as the Barnacle Goose and the North-West European population of the Greylag Goose are currently included within the remit of the Platform. Processes to develop AEWA International Single Species Management Plans for both the Barnacle as well as the Greylag Goose are ongoing, with a management planning workshop for the Greylag Goose scheduled to take place in October 2017.

(oral)

Bird flu in France since 2015: a disease of wild birds or livestock ?

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Regularly, bird flu outbreaks come through continents, and connection is made with migratory birds.
Each outbreak raises questions about wild fowls implication, and each time, drastic measures are carried out to protect poultry farms.

During winter 2015-2016, a particularly serious outbreak was observed in fat duck farms from South West of France, due to H5N1, H5N2 and H5N9 influenza virus. All the farms from 15 departements were emptied of their ducks, and during one month, an area of 100 000 km2 was maintained depopulated of ducks.
During this outbreak, these virus strains were never found on wild birds, despite some meticulous protocols to find them:

- a permanent network has collected and analysed the dead wild birds since the H5N1 world outbreak, known in France in 2006. This network, called SAGIR, mobilizes agents from ONCFS and from hunting federations. Each result was negative
- while the duck farms were empty, a lot of virology analyses were carried out on captive wild ducks used as decoy for hunting. All the results were negative.
- with the support of the MNHN (French National Museum of Natural History), 600 wild birds living in close proximity to the positive farms were captured after ducks slaughter by net and swabbed to virology analyses (April-May 2016) : All the results were negative

The results from the ANSES national reference laboratory have shown that the virus has been present in the duck farms for several months, first as a low pathogenic strain and then became highly pathogenic after some recombination. The outbreak was considered over in July 2016, and new ducks have been raised in the farms. At the beginning of November, most of them were full of ducks, for the festive season.

In September 2016, a first alert was sent by the FAO who reported a new flu outbreak in Tuva republic, this time concerning H5N8 and affecting wild ducks and some other wild birds, and threatening Western Europe along bird migratory corridors. In October, first European countries reported their first cases, and in November, a lot of cases were concentrated in Germany and Switzerland, some of them just near French border. The first implicated species was the tufted duck (*Aythya fuligula*). On November 17, the first decoy ducks were found dead in the North of France, and the analyses were positive for H5N8. Then, 2 gulls were confirmed positive near the Lac Leman and the Switzerland cases. And at the end of November, the first fat duck farm from the South West was affected in the Tarn departement, in the same duck industry as the previous spring, despite the eradication success in summer. There is no link between both of the outbreaks. Quickly, the virus has spread through farms, requiring prescribed measures, including local hunting restrictions, more or less accepted.

The origin of the virus arrival in the farms is not known. There are 2 hypothesis: either a contaminated wild bird has died in one of the farms, or a commercial importation has introduced the virus, maybe from an Eastern European country. During this time, some cases were found from time to time in wild birds:

- the SAGIR monitoring network is strengthened, as the national risk level was considered ‘high’ : the officers are mobilized, each waterfowl found dead is analyzed, as well as the other species, as soon as 3 birds are found dead.

  - Between November 1 2016 and February 21 2017, 629 wild birds have been collected, which is 20 times more than during the same period one year before
  - 67 wild birds were positive in 40 different cases. After the frost in January, the first implicated species were the mute swan (*Cygnus olor*), in France and in Europe.

- As the number of dead animals was smaller in France than in neighbouring countries, especially Germany and Switzerland, we have organized a protocol to identify wether some dead animals could have been missed. This protocol is called ‘active monitoring’
    - 10 areas have been selected based on Wetland international results from January 2015: 7 for their number of tufted duck (*Aythya fuligula*), and 3 for their total number of migratory waterfowl.
    - A coordinator was appointed for each area. He or she has to mobilize the observers who can do a regular monitoring of dead wild birds, and send the results to the ONCFS, including if possible the number of live birds observed.
    - As at January 30, 2017, 74 days of monitoring have been done in this 10 areas, and more than 400 000 living birds have been counted. Only 20 dead birds have been found, and 4 have been analyzed, and were negative. (the other were not analyzable)
    - This number is very low, which means that regular monitoring of dead birds is better than specific operations to find the bodies. If the SAGIR network does not find more dead birds, it is not because of carelessness, but because there is no excessive death rate

In conclusion, France has had to support 2 big flu outbreaks for two years: one in 2015-2016 affecting only the duck farms, and no neighbouring country; and one totally different in 2016-2017 which came to Eastern Europe by wild migratory birds, reached a growing number of countries and wild bird species as well as, depending of the country, a larger or smaller number of poultry farms, either gallinacean or palmiped.

Other outbreaks are expected, and are a big threat for our farms, and the role of wild bird is perceived very differently depending on who is speaking. Important biosecurity measures will have to be taken in livestock management, to limit contact between bird farms and migratory wild birds. Some coexistence has to be expected.

Keywords: bird migration, hunting, poultry, breeding, flu

(oral)

Old roe deer females avoid mating with old males

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Long-lived iteroparous vertebrate species often display age-related variations in female reproductive strategies that may be explained by 2 non-mutually exclusive hypotheses. The terminal investment hypothesis predicts increased female reproductive effort toward the end of the life span, as residual reproductive value decreases with age, whereas the senescence hypothesis predicts decreased female reproductive performance toward the end of the life span due to the progressive loss of physiological function with age. Ungulates are well suited for testing these hypotheses, as they are long-lived, they reproduce once a year at the same time and their offspring depend heavily on maternal investment. However, while empirical evidence of reproductive senescence is now well established in female ungulates thanks to the increasing availability of longitudinal studies based on known-aged individuals monitored from birth to death, empirical evidence of terminal investment remains scarce and confusing. Indeed, experimentally estimating reproductive effort in wild ungulate populations is almost impossible, and so a test of terminal investment hypothesis must rely on indirect measures, such as the number and growth of offspring, which assess the energetic costs of breeding rather than the actual reproductive costs in terms of individual's future survival and breeding potential. Among these indirect measures of female reproductive effort, female mating patterns have been overlooked, which in part is a result of the difficulty to obtain pedigrees from known-age individuals in wild long-term monitored ungulate populations. And yet, mate sampling is highly costly for female ungulates, due to the time and energy required to search mates, predation risk, male aggression and inter-female aggressive behavior. Under the terminal investment hypothesis, we should therefore expect an increased allocation in mate sampling and greater choosiness towards high quality males in older females. In this study, we examined how female age influences the age of their mates in two contrasted long-term monitored populations of European roe deer, *Capreolus capreolus*, an ungulate species in which females play an active role in mate choice, although males are strongly territorial during rut. We found that old females (over 7 years of age) avoided mating with old males (over 7 years of age), whereas no age-related pattern was detectable for younger females. Old females thus appear to be more directional in their mate choice than younger females. This greater choosiness in older females may be related to an increased allocation in mate sampling (as predicted by the terminal investment hypothesis), greater experience at discriminating between males of differing quality, or greater experience at avoiding mating with poor quality males. Females probably avoid old mates, based on cues such as antler size or territorial status which decline after 7-8 years of age in males. By avoiding mating with old males, old females may avoid mates with lower reproductive potential and lower phenotypic and genetic qualities. Further studies are required to fully understand the fitness consequences of these age-dependent matting patterns in roe deer.

Keywords: *Capreolus capreolus*, age, mate selection, terminal investment hypothesis, life history

(poster #89)

Preliminary study about seasonal spatial behaviour of reared Italian hares (*Lepus corsicanus* de Winton, 1898) and reintroduced on Elba Island

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The Italian hare (*Lepus corsicanus* de Winton*, 1898)* is an Italian endemic species, genetically and morphologically distinct from the European hare (*Lepus europaeus* Pallas 1778) [1,3,4].
The Italian National Action Plan for the Conservation of *Lepus corsicanus* [7] foresees the reintroduction in nature of reared subjects of Italian hare. The reintroduction project, aimed to create a wild population on the Isle of Elba, within the territory of the National Park of the Tuscan Archipelago, where the species was historically endemic.
A total of 20 sub-adult hares, equipped with VHF tracking collars, were reintroduced in spring 2016 on Monte Perone, in the south west of the isle. All the animals came from national breeding center.
Monitoring activity was carried out trough daily radio-tracking for the first 30 days, then weekly. The Project started in April 2016 and ended in December 2016. At the end of the project 7 hares were still alive [5,6,8].
The aim of the present work is to evaluate the seasonal spatial behaviour of the released subjects. For this we used two different types of analysis. The Spring period goes from the release data, 04/04/2016, to 21/06/2016; Summer period goes from 22/06/2016 to 21/09/2016 and Autumn period goes from the 22/09/2016 to 19/12/2016.
The first analysis compares the change of dimension of the home ranges and of the core areas in the three periods considered. The comparison evaluates the home range of the 17 subjects that survived at least 30 days (3 of the released hares died within 14 days after release). The home ranges were estimated using the Kernel areas with 95% of the fixes, the core areas were estimated using the Kernel areas with 50% of the fixes. See Table 1 for the resulting medians and averages. Seasonal areas were compared using the Mann Whitney U test.
The comparison between the Spring and the Summer home range is not statistically significant like Summer vs Autumn; the comparison between the Spring and the Autumn home range is statistically significant (U test = 26, $p < 0,05$). The average of the surface covered by the animals in Autumn is about 50% less than Spring. The core areas median size, instead, remained unchanged and there aren't significant differences between the three season. The reduction of the extent of the home range (fix 95%) would seem to indicate a reduction in the need for large displacements probably due to a greater adaptation to the environment.
The second analysis evaluates the percentage of overlapping of the home range and core area (calculated as previous analysis) of every single alive hare in the three periods.
We considered 14 subjects for the Spring vs Summer comparison and 7 subjects for the Summer vs Autumn comparison. The overlaps percentages in the seasonal home ranges and core areas were evaluate using a modified Minta Index [2] (See Table 2 for the results).
This analysis seems to confirm the previous one as concerns the increased sedentary life of the subjects in the transition from Summer to Autumn. In Autumn, there is a greater overlap of ranges as opposed to the great change that is the case between the Spring and Summer. This may be due in part to the post placing adaptation as well as to a distribution area bedding addition to the possible influence of the reproductive period.
The comparison between Spring and Summer highlights that a large number of animals (7 of 14) substantially did not settle into a defined core area. Between Summer and Autumn, 4 of same 7 animals die, and the remaining 3 are stabilized in a consistent manner to other surviving hares.
In conclusion, the seasonal home ranges of the Summer and Autumn period were more constant and the animals were more bound to the chosen territory.
The data of this study are currently being analysed (the project is still in progress), further study will highlight links between home range and rates of mortality than the influence of farming methods.

Table 1: Median and average areas (ha) for the seasonal Home ranges (Kernel 95%) and Core areas (Kernel 50%). S.D. = Standard Deviation.

	Spring Home range ***N=17*** ***S.D. ±15,44***	***Spring Core area*** ***N=17*** ***S.D. ±3,37***	***Summer Home range*** ***N=14*** ***S.D. ±12,66***	***Summer core area*** ***N=14*** ***S.D. ±3,42***	***Autumn Home range*** ***N=7*** ***S.D. ±3,36***	***Autumn Core area*** ***N=7*** ***S.D. ±0,48***
Median	12,46	2,96	10,60	2,38	7,12	1,58
Average	18,85	4,13	14,48	3,51	6,44	1,75

Table 2: Overlaps (%) for seasonal Home ranges and Core area, calculated with a modified Minta Index [2].

ID_LEPRE	**HR Spring Summer**	**CA Spring Summer**	**HR Summer Autumn**	**CA Summer Autumn**
12	38,94%	0,00% **	\	\
13	55,71%	0,00% **	68,10%	58,74%
18	36,09%	0,00% **	66,25%	67,72%
16	56,48%	1,86% **	\	\
7	43,02%	2,13% **	82,50%	48,98%
17	33,17%	2,31% **	\	\
11	67,30%	2,90% **	\	\
1	50,91%	22,64%	\	\
3	71,49%	33,21%	\	\
6	71,36%	46,66%	68,00%	72,35%
9	74,99%	48,32%	\	\
15	56,96%	57,10%	70,85%	60,12%
5	65,09%	61,64%	62,23%	64,70%
14	63,95%	64,13%	70,26%	61,59%

**** hares with overlapping percentage below 5%**

References

[1] **Pierpaoli, M., F. Riga, V. Trocchi & E. Randi** (1999). Species distinction and evolutionary relationships of the Italian hare (*Lepus corsicanus*) as described by mitochondrial DNA sequencing. *Molecular Ecology,* **8 (2):** 1805-1817.

[2] **Ponzetta, M.P., V. Becciolini, C. Trunfio, F. Cervasio, A. Bocci & L. Conti** (2013). Monitoraggio a distanza di ungulati selvatici e domestici in ambiente appenninico. In: *L'edilizia rurale tra sviluppo tecnologico e tutela del territorio. Convegno della II Sezione AIIA Firenze, 20-22 settembre 2012* (Barbari M., Sorbetti Guerri F., Eds). Firenze University Press, Firenze: 103-135.

[3] **Randi, E., C. Mengoni & N. Mucci** (2007). Genetica di *Lepus Corsicanus*: evoluzione, speciazione ed assenza di ibridazione interspecifica. In: *Conservazione di Lepus Corsicanus (De Winton, 1898) e stato delle conoscenze* (De Filippo G., De Riso L., Riga F., Trocchi V., Troisi S.R., Eds). IGF Publishing, Napoli. 37-43.

[4] **Riga F., V. Trocchi, E. Randi & S. Toso** (2001). Morphometric differentiation between the Italian hare (Lepus corsicanus De Winton, 1898) and the European brown hare (*Lepus europaeus* Pallas, 1778). *Journal of Zoology (London),* **253:** 241-252.

[5] **Scarselli D., G. Vecchio, F. Oliviero, A. Riccetti, R. Petrini, M. Gasperini, C. Mencarelli, F. Giannini & F. Riga** (2016). Coming home: reintroduction of Italian hares (*Lepus corsicanus*) in the Isle of Elba 90th Annual Meeting of the German Society for Mammalian Biology (Deutsche Gesellschaft für Säugetierkunde e.V.) Berlin 2016.

[6] **Scarselli D., G. Vecchio, M. Gasperini, F. Oliviero, A. Riccetti, R. Petrini, C. Mencarelli, F. Giannini & F. Riga** (2016). Home range analysis and survival of two groups of Italian hare (*Lepus corsicanus*), released in a reintroduction project on Elba Island. International Congress "22 years of Italian Hare. National Park of Cilento 13/12/2016

[7] **Trocchi V. & F. Riga** (2001). Piano d'azione nazionale per la Lepre italica (*Lepus corsicanus*). *Quad. Cons. Natura*. Min. Ambiente – *Ist. Naz. Fauna Selvatica.* **9:** 1-104.

[8] **Vecchio G., D. Scarselli, M. Gasperini, F. Oliviero, A. Riccetti, R. Petrini, C. Mencarelli, F. Giannini & F. Riga** (2016). Reintroduction of the Italic Hare (*Lepus corsicanus*) to the Island of Elba. III National Congress Problematic Wildlife, oral comunication, Cesena 24 -26 November 2016

Keywords: *Lepus corsicanus*, reintroduction, Elba Island, radiotracking, home range, seasonal behaviour

(oral)

Modeling the spread of avian influenza viruses in aquatic reservoirs: a novel hydrodynamical approach applied to the Rhône delta (southern France)

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Avian influenza viruses (AIV) are part of the emerging pathogens that raised the awareness of the close links existing between the health of humans, domestic animals and wildlife. Indeed wild aquatic birds represent a natural AIV reservoir from which viruses can spread to poultry. AIV epizooties were associated with huge economic impacts during the last decades and are still of major concern. Within aquatic bird populations AIV are transmitted either by direct contact or through the ingestion of water that has been contaminated by infected individuals, mainly through fecal excretion. This second route involving environmental transmission is of upmost importance in the ecological and evolutionary dynamics of AIV.

Our objective here was to combine a hydrodynamic model with data on mallard abundance as well as AIV prevalence within the population throughout a wintering season to characterize virus dissemination within a complex wetland network. We chose the Camargue hydrosystem, situated in the Rhône delta in Southern France, as a wetland model. Indeed, this area is a major wintering site for a large diversity of aquatic birds, including AIV hosts. More specifically we aimed to identify the environmental parameters that drive AIV dynamics within this system and the spatio-temporal pattern of dispersion and persistence in two hypothetical cases: i) the punctual arrival of an AIV strain, a situation corresponding to a highly pathogenic AIV outbreak, and ii) the frequent and regular introduction of AIV into the system throughout a wintering season, a situation more similar to the circulation of a low pathogenic AIV within the duck population.

Our results show that in a complex hydrosystem we can expect an important heterogeneity in the AIV risk among wetlands according to the host density as well as to various environmental parameters including water volume and connection to the rest of the hydrological system. This heterogeneity is observed both at the geographical and the temporal scales. Our simulations underline how a simple "blue box" approach could in the case of deltaic ecosystems minimize the expected risk by diluting it in the whole system, whereas high viral concentration areas are expected to occur when considering more finely the characteristics of the network. Moreover this undermining of the risk perception could affect the risk duration prevision since high concentration areas will maintain important viral loads longer than a uniformly low concentrated pond.

We thus present a new approach to identify hotspots of virus concentrations within deltaic areas that could make advantage of the duck count data, AIV surveys and hydrological models that may already be available in several important duck wintering areas constituted by complex hydrosystems, such as the major European deltas (e. g. Guadalquivir delta, Danube delta, Elbe estuary etc.). Indeed those areas are potential hotspots for AIV transmission. Thus we plead that our method could be of particular interest to optimize surveillance strategies in the current context of highly pathogenic AIV diffusion within wild bird populations.

Keywords: Avian influenza viruses, Wild birds, Hydrodynamic model, Mallards, Wetlands

(oral)

Here, there and everywhere: Spatial ecology of the red fox (A project overview)

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Human land use changes can exert great influence on ecological systems, altering species distributions, animal behaviors, movements and survival at individual and population levels [1, 2]. These land use changes are likely to further intensify in synergy with climate warming, expanding increasingly northward into boreal and arctic ecosystems [3]. The plasticity of the red fox *Vulpes vulpes*, and its ability to benefit from anthropogenic landscape changes [4, 5], as well as changes in landscape productivity, has enabled it to exploit increasingly northern latitudes, directly impacting northern ecosystems [6]. As such, there is increasing concern the red fox is becoming a driving species affecting the food webs of boreal forests, agricultural landscapes and even urban areas [7, 8, 9]. Thus, it is increasingly relevant to understand how highly adaptable species, like the red fox, are likely to expand and shift space use through preferential habitat selection along a gradient of environmental productivity and human influence. In response, the red fox project began in 2012, capturing and outfitting red foxes with GPS/GSM collars in order to improve understanding of red fox spatial ecology. To date, we have detailed movement data from 92 collared foxes from four study areas along a landscape gradient from hemi-boreal mid-Sweden to boreal forest and tundra landscapes to the north in Norway. Preliminary project results indicate changes in environmental productivity at both regional (latitude) and local scales (elevation) and increased landscape modification influence the distribution and space use of red foxes. Foxes residing in more productive landscapes (those in more southern vegetation zones), have home ranges approximately four times smaller than the home ranges of foxes in the northern boreal vegetation zone. Our use of GPS technology also highlights that resident foxes use much larger areas than previously presumed, and indicate that excursions may be more common among red foxes than previously thought. Excursions were commonly observed in all four study areas, lasting for 1-3 days and were typically less than 10 km, but could sometimes be longer than 20 km (Fig. 1). Additionally, preliminary results indicate that dispersal distances of foxes vary along a latitude gradient, with observed distances of 25-50 km in southern areas, while those in northern areas have reached 295 km (Fig. 2). These spatial patterns demonstrate the ability of GPS collars to enhance our knowledge of red fox movements and behaviors across landscapes, and highlight the variability of red foxes in their space use. They further illustrate that red foxes can cover large areas in short time periods, and that the extent of such movements may have previously been underestimated. This opens the door for future research into broader ecosystem consequences of the space use and movement patterns of red foxes. Developing appropriate management will involve improving our understanding of how changing land use, hunting pressure, foraging ecology, and dispersal patterns alter the spatial structure of red fox populations and facilitates red fox population increases and northern range expansions.

***Figure 1.** Excursions made by a male red fox, ranging 5- >50 km from its home range, during a 4-month period (Oct. – Feb.).*

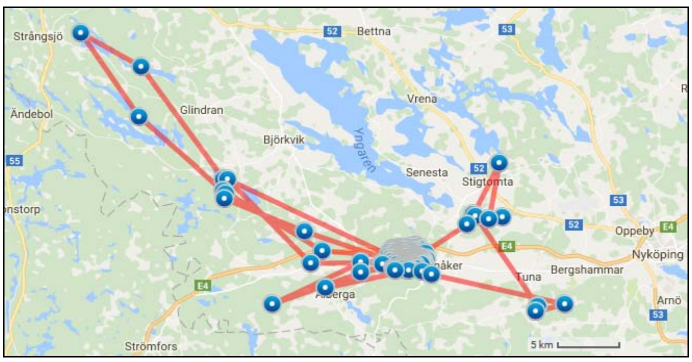
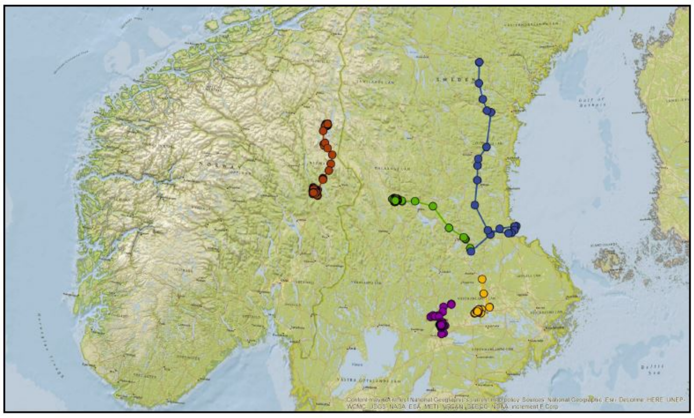


__Figure 2.__ Long distance dispersal of five red foxes (4 males and 1 female) from the three northern study areas in Sweden and Norway. The young male in blue moved approximately 450 km (295km straight line distance) within a three week period in March.



References:

[1] **Gehrt, S.D.** (2007). Ecology of Coyotes in urban landscapes. In: Nolte DL, Arjo WM, Stalman DH (eds) Proceedings of the 12th Wildlife Damage Management Conference, vol. Paper 63.

[2] **Šálek, M., L. Drahníková & E. Tkadlec** (2014). Changes in home range sizes and population densities of carnivore species along the natural to urban habitat gradient. *Mammal Review,* **45:**1-14. doi: 10.1111/mam.12027

[3] **Elmhagen, B., J. Kindberg, P. Hellstrom & A. Angerbjorn** (2015). A boreal invasion in response to climate change? Range shifts and community effects in the borderland between forest and tundra. *Ambio,* **44 Suppl 1:** S39-50. doi: 10.1007/s13280-014-0606-8

[4] **Contesse, P., D. Hegglin, S. Gloor, F. Bontadina & P. Deplazes** (2004). The diet of urban foxes (*Vulpes vulpes*) and the availability of anthropogenic food in the city of Zurich, Switzerland. *Mammalian Biology - Zeitschrift für Säugetierkunde,* **69:** 81-95. doi: 10.1078/1616-5047-00123

[5] **Prugh, L.R. et al.** (2009). The Rise of the Mesopredator. *BioScience,* **59:** 779-791. doi: 10.1525/bio.2009.59.9.9

[6] **Elmhagen, B., G. Ludwig, S.P. Rushton, P. Helle & H. Linden** (2010). Top predators, mesopredators and their prey: interference ecosystems along bioclimatic productivity gradients. *J Anim Ecol,* **79:** 785-794. doi: 10.1111/j.1365-2656.2010.01678.x

[7] **Goszczyñski, J.** (2002). Home ranges in red fox: territoriality diminishes with increasing area. *Acta Theriologica,* **47:** 103–114

[8] **Kujawa, K. & R. Łęcki** (2008). Does Red Fox Vulpes vulpes Affect Bird Species Richness and Abundance in an Agricultural Landscape? Acta Ornithologica 43:167-178. doi: 10.3161/000164508X395289

[9] **Marcström, V., L.B. Keith, E. Engren & J.R. Cary** (1989). Demographic responses of arctic hares (*Lepus timidus*) to experimental reductions of red foxes (*Vulpes vulpes*) and martens (*Martes martes*). *Canadian Journal of Zoology,* **67:** 658-668. doi: 10.1139/z89-095

Keywords: canid, Scandinavia, mesopredator, movement, intraspecific variation, boreal forest

(oral)

Reactions of red deer (*Cervus elaphus*) to recreational and hunting activities

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Human off-road recreational activity is increasing and represents additional sources of disturbances for wild ungulates. Human-caused disturbances by recreational activities or by hunting can have influences on wild ungulates in various ways. Beside ultimate flight reactions, disturbances may also have subsequent effects. For example, wild ungulates may react with altered spatial behaviour in combination with physiological adjustments after disturbance events, which in turn may have consequences on individual fitness. However, reactions of wild ungulates to disturbances are expected to depend on the type of disturbance.
To investigate ultimate and subsequent reactions, we were particularly interested if and how patterns of red deer (*Cervus elaphus*) space use differ before, during and after the disturbance event. Further we aimed at quantifying if the patterns differ between varying types of disturbance events (hunting vs. mushroom pickers).

We equipped a total of 46 free-ranging red deer with GPS-GSM collars in Eastern Switzerland. Subsamples of collared red deer were used to analyse red deer reactions upon human hunting or mushroom pickers.
From 2014 to 2016 we collected temporally fine-resolved (5 min) GPS-data of 21 red deer during driven hunts in autumn. In summer 2016, we collected temporally fine-resolved (10 min) GPS-data of 22 red deer when being approached by two persons in their daytime habitat in order to simulate mushroom pickers. In both cases, the beaters and the simulated mushroom pickers were equipped with GPS-loggers (5 s resolution) to record red deer and human movements simultaneously.

Preliminary results reveal that mean two-hourly distances covered by red deer at daytime are higher for the day of the disturbance event (driven hunts: mean = 367.7 m, max = 2368.0 m, mushroom pickers: mean = 190.7 m, max = 2121.9 m) compared to the preceding (driven hunts: mean = 135.6 m, max = 1001.0 m, mushroom pickers: mean = 152.6 m, max = 1066.4 m) and the following day (driven hunts: mean = 125.8 m, max = 1923.8 m, mushroom pickers: mean = 118.2 m, max = 1527.3 m). Comparing the preceding and the following day of the disturbance there are only slight differences. It also shows that mean two-hourly distance covered by red deer during driven hunts are almost twice as high as when disturbed by mushroom pickers.
Final analyses will result in implications for managing recreational activities in natural habitats, planning wildlife refuges and optimizing hunting strategies.

Keywords: Red deer, disturbance, GPS-GSM collar, hunting, recreational activity, wildlife refuges

(plenary)

Monitoring, modelling and managing natural resources in the face of uncertainty and environmental fluctuations – a synthesis view

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There is a continuing need to recognize and account for scientific uncertainty in natural resources management. In particular, conservation can benefits from bidirectional linkages between science and management, whereby science contributes understanding to inform management and management helps to focus scientific investigation. Through these linkages uncertainty can be reduced, and both resources understanding and decision making can be improved. Resource management faces a number of uncertainties about resources and the influence of decisions on them. I focus in this talk on 2 factors that are prevalent, namely partial observability and process or structural uncertainty. Partial observability is associated with resource monitoring, where the resource is only partially observed and parameters of interest must be estimated with data. Structural uncertainty refers to a limited understanding of resource dynamics and the processes influencing dynamics. Both sources of uncertainty impose limitations on the value of decision making. I present a framework for decision making in terms of stochastic resource transitions and valuation based on accumulations of rewards from decisions. I discuss the extent and frequency of monitoring and the timing of decisions, as well as the linkage of uncertainty and the value of information under optimal decision making. Finally, I identify some outstanding technical and institutional challenges in learning-based resources management.

(oral)

Managing geese and the influence of different hunter typologies: hunting behaviour and motivations of Danish goose hunters

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As many goose populations across Europe continue to rise the role of recreational hunters to manage these populations is increasingly being considered and formalised. In Denmark and Norway goose hunters have actively been engaged in the adaptive harvest management to regulate the population of one goose species, the Svalbard Pink-footed Goose (Anser brachyrhynchus). Within the framework of an AEWA International Species Management Plan hunting in these countries has been employed to initially reduce the population to an agreed target, whilst recognising the need to ensure hunting is sustainable in the long term [1]. However, detailed knowledge was lacking about current goose hunting behaviour and motivations of recreational hunters and the implications for regulating goose hunting, in terms of both increasing and dampening harvest pressure. Using data from the Danish hunting bag statistics and survey responses from 962 Danish goose hunters we have been able to identify different segments of the goose hunter population in Denmark. In a novel approach we combined these data sets to enable us to assess their behavioural as well as motivational differences. Our results show that there is a core group of hunters who have the desire, expertise and opportunities to be specialist and effective goose hunters. However, the majority of hunters who shoot geese in Denmark tend only to shoot a couple of geese and not every year. Most hunters shooting geese in Denmark also have broad hunting interests, targeting a variety of huntable species. Securing access to goose hunting areas (renting hunting rights on privately owned land) and a hunter's willingness to invest time and resources e.g. purchasing specialist goose hunting equipment are determining factors that can set 'specialist' goose hunters apart. The dynamics of hunter behaviour and their motivations are complex. Only by better understanding hunter traits can hunting regulations be effectively tailored and adjusted to take account of different hunter typologies and the breadth of their hunting interests, whether regulating through hunting seasons, annual quotas or daily bag limits.

Reference

[1] **Madsen, J. & J.H. Williams** (2012). International Species Management Plan for the Svalbard Population of the Pink-footed Goose *Anser brachyrhynchus*. AEWA Technical Series No. 48. Bonn, Germany.

Keywords: Hunter typologies, bag statistics, goose management, adaptive harvest management, hunting regulation

(oral)

Who is outside the door? Wolf movement in relation to human settlements

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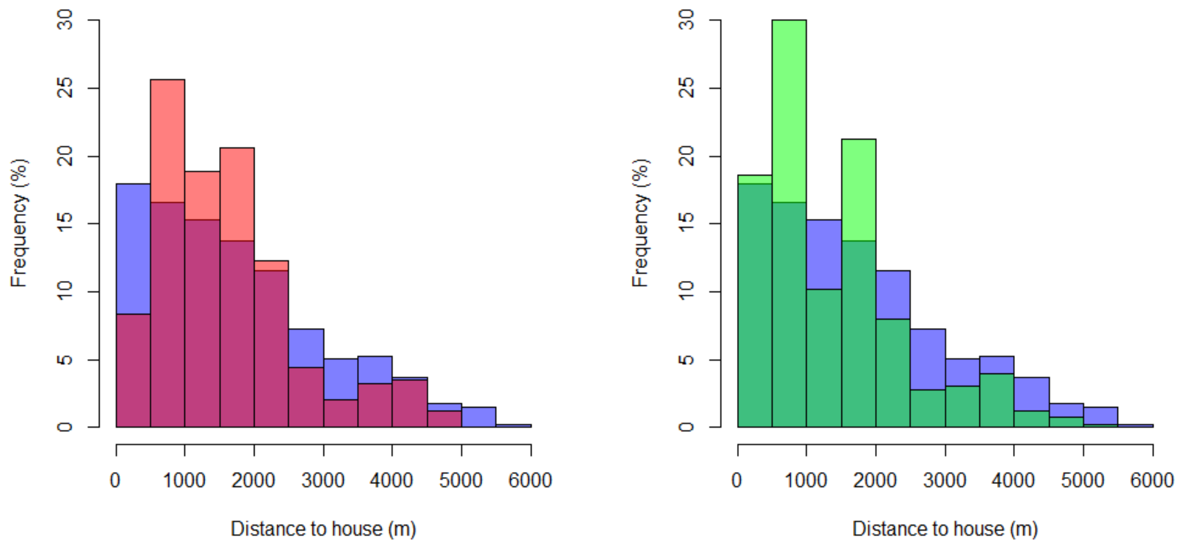
Upon large carnivore recovery in Scandinavia, no other species has caused a comparable magnitude of conflict as the wolf (*Canis lupus*) currently does. Common to all large carnivore species are conflicts concerning livestock depredation. Wolves additionally cause conflicts related to perceived competition for moose by hunters, wolves killing hunting dogs, and people being afraid of wolves. Locals living in wolf territories can perceive wolves as a personal threat when they register wolf presence close to their house by means of direct sightings and tracks in the snow. A better understanding of how wolves move through the landscape and why they use certain areas of their territories more than others may help to relieve fear [1]. The Scandinavian Wolf Research Project SKANDULV is currently analyzing more than 250.000 GPS-positions collected from GPS-collared wolves of more than 50 wolf territories in relation to human settlements. We hypothesize that the distance of wolves to inhabited houses is strongly influenced by daylight conditions, with closer distances during night than daylight hours. At a larger temporal scale, we hypothesize that wolves move closer to houses during the second part of the winter, when snow has accumulated at higher altitudes. This is the time of the year when moose (*Alces alces*) migrate to lower altitudes and congregate in browsing areas at the valley bottom [2]. These areas coincide usually with the more productive areas often used for human settlements in an else marginal landscape of the boreal forest zone. Since moose is the main prey of wolves in Scandinavia [3], we hypothesize that wolves use these productive areas of their territory more than the snow-rich parts of higher altitudes during winter. In addition, we hypothesize that roads may direct wolf movement to pass close to houses, because wolves prefer to use roads when travelling within their territory [4]. A preliminary resource selection model of an intensively monitored wolf pack (one adult and four pups) from mid-January to end of February 2017 [5] indicates that the wolves preferred distances of 500 – 2000 m from inhabited houses, and that they avoided the closest 500m during day time, but used these areas as expected from their availability at night (Fig. 1, GLMM with used and random points as response and the quadratic effect of distance to house as predictor). Field check of clusters of hourly positions revealed that wolf activity related to human sources of food (bait, slaughter remains) were situated closer to houses (mean ± SE = 673 ± 259 m) than moose kill sites (1434 ± 825 m) and bed sites (1401 ± 141 m) ($F_{3,70}$ = 3.741, P = 0.015). Corresponding analyses of existing GPS-data across 50 wolf territories throughout the year will allow us to describe average or "typical" behavior and its variation. We will also be able to test for potential habituation of wolves to human settlement over time.

Figure 1. *Frequency distribution of distance to inhabited houses during daylight (red) and night (green) for the GPS-collared wolves in the Slettås pack in the time period 20 January to 23 February 2017, compared with the general distribution of distances to inhabited houses in the wolf territory (blue). Distance classes with red or green bars exceeding the underlying blue bar are used more than expected by wolves and vice versa.*



References

[1] **Johansson, M., I.A. Ferreira, O.G. Støen, J. Frank & A. Flykt** (2016). Targeting human fear of large carnivores—Many ideas but few known effects. *Biological Conservation,* **201:** 261-269.

[2] **Ball, J.P., C. Nordengren & K. Wallin** (2001). Partial migration by large ungulates: characteristics of seasonal moose Alces alces ranges in northern Sweden. *Wildlife Biology,* **7:** 39-47.

[3] **Sand, H. et al.** (2008). Summer kill rates and predation pattern in a wolf-moose system: can we rely on winter estimates? *Oecologia,* **156:** 53-64.

[4] **Zimmermann, B., L. Nelson, P. Wabakken, H. Sand & O. Liberg** (2014). Behavioral responses of wolves to roads: scale-dependent ambivalence. *Behavioral Ecology,* **25:** 1353-1364.

[5] **Zimmermann, B. et al.** (2017). Behavioural studies of wolves in the territories Slettås and Osdalen: preliminary results from the field period January to February 2017. *Oppdragsrapport* **2017/1** Inland Norway University of Applied Sciences: 1-20.

Keywords: fear, wolf, human settlements, moose migration, movement, Scandinavia