



8th International

WOODPECKER CONFERENCE

March 16-20, 2019 - Białowieża, Poland

ORGANIZING



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**8th International
Woodpecker Conference:
Conservation & Ecology of Woodpeckers
March 16 - 20, 2019
Białowieża, Poland**

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Welcome to the 8th International Woodpecker Conference

Białowieża Forest – hosting the last remnants of European primeval lowland forest – welcomes participants to the 8th International Woodpecker Conference to Białowieża – the main village in this unique place. As previous international woodpecker conferences since 1989, the current one aims to bring together woodpecker researchers from across the globe and to provide an international forum for discussion on how woodpecker research may improve our understanding of behavior, ecology and conservation sciences. The title of the conference „Conservation & Ecology of Woodpeckers” was chosen to underline that woodpeckers, as a group, are specialized birds that need protection of their habitats – even more so today with the ongoing, and in parts of the worlds intensifying, use and destruction of forests. Accordingly, we are very happy about the interest that this conference has raised among researchers and conservationists interested in woodpeckers and forests. As a consequence, we will be able to enjoy a fantastic array of talks and posters on diverse topics, so that each of c. 110 participants representing 20 countries is expected to benefit from this conference.

The conference follows the path of previous scientific meetings on woodpeckers organized by the Special Interest Group Woodpeckers <https://www.fachgruppe-spechte.de/> of the German Ornithologists’ Society (Deutsche Ornithologen-Gesellschaft - DO-G <http://www.do-g.de/>), which launched the initiative also for this meeting. The conference has mainly been organized by Siedlce University of Natural Sciences and Humanities, the Museum and Institute of Zoology, Polish Academy of Science and the Special Interest Group Woodpeckers of the German Ornithologists’ Society. These three organizations have worked in partnership to generate a pleasant atmosphere that hopefully leads to fruitful exchange of information on this fascinating avian group. The Białowieża National Park and the German Ornithologists’ Society DO-G are organizations supporting the conference.

The Białowieża Forest is the best preserved lowland forest of the

temperate zone in the northern hemisphere. Protected for centuries as royal hunting grounds, it survived almost unchanged until World War I, when its exploitation started and many fragments of the Forest lost their natural character. Nevertheless, one can still admire primeval stands in the Białowieża National Park and in nature reserves, as well as many natural fragments of old-growth stands outside these protected areas. The diverse fauna of the Białowieża Forest consists of intermediate faunal elements from Central, Northern and Eastern Europe, including the European Bison. At the turn from winter to spring, these mammals often feed on meadows near the village. Białowieża is also known as paradise for birdwatchers. So far, c. 250 species of birds were recorded, including all European woodpeckers, 11 species of owls and over a dozen other birds of prey. Although in March it will not be possible to see the majority of bird migrants, there is a good chance to observe most woodpecker species. Mid-March is a time of significant activity of the White-backed Woodpecker.

Many people have helped to organize this conference, and we thank everyone for their support. We are also very grateful for the financial support provided by the German Ornithologists' Society DO-G and for organizational help of the Białowieża National Park. Without all this help and support, we would not have met in Białowieża. Last, but not least, we thank Altafilm GmbH allowing us to enjoy one of their wonderful movies.

We warmly welcome you at the 8th International Woodpecker Conference; enjoy the visit in the Białowieża Forest and its beauty.

Dorota Czeszczewik & Gilberto Pasinelli

COMMITTEES

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Special Interest Group Woodpeckers of German Ornithologists' Society, Deutsche Ornithologen-Gesellschaft - DO-G
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Supporting institutions:

Białowieża National Park, Poland
German Ornithologists' Society (DO-G)
Altay Film

PROGRAM

Saturday, March 16

17:00 – 21:00 Registration and reception at the conference venue (Hotel Białowieski <https://www.hotel.bialowieza.pl/en>)

Sunday, March 17

08:15 – 09:00 Registration and reception at the conference venue Hotel Białowieski

09:00 – 09:15 Opening ceremony

Session 1: Conservation. Chair: Martjan Lammertink

09:15 – 10:05 Tomasz Wesołowski (plenary talk): **Woodpecker studies in the Białowieża Forest**

10:05 – 10:30 *Coffee break*

10:30 – 10:50 Philippe Cadieux, Pierre Drapeau, Alain Leduc, Marianne Cheveau, Antoine Nappi: **The Pileated Woodpecker (*Dryocopus pileatus*): an umbrella species for cavity nesters in boreal forests**

10:50 – 11:10 Carsten Kost, Ola Olsson: **Modelling past and present habitat suitability for the lesser spotted woodpecker in Sweden**

11:10 – 11:30 Marco Basile, Thomas Asbeck, Cesare Pacioni, Grzegorz Mikusiński: **Tree relative size, not its absolute, supports woodpecker cavities' establishment**

11:30 – 11:50 Leif Lithander: **Will there be room for Woodpeckers in the Anthropocene?**

12:00 – 13:30 *Lunch at Hotel Białowieski*

Session 2: Habitat use. Chair: Karen Wiebe

13:30 – 13:50 Pierre Drapeau, Philippe Cadieux, Louis Imbeau, Antoine Nappi, Alain Leduc, Réjean Deschênes: **Linkages between decaying trees and woodpeckers in eastern boreal forests of Canada: when keystone attributes interact with keystone species**

13:50 – 14:10 Raman Kumar, Ghazala Shahabuddin, Ajith Kumar: **Foraging niche differentiation among sympatric**

**woodpecker species in dipterocarp forests of northwest
India**

14:10 – 14:30 Arkadiusz Fröhlich, Michał Ciach: **Woodpeckers in an urban ecosystem: searching for a high quality refuges in a matrix of habitats**

14:30 – 14:50 *Coffee break*

Session 3: Cavity ecology. Chair: Victoria Saab

14:50 – 15:40 Kristina L. Cockle, Kathy Martin (plenary talk):
Woodpeckers, wood decay, and the resilience of nest web communities

15:40 – 16:00 Kathy Martin, Kristina Cockle: **Woodpecker Legacies: The resource value of fresh and older tree cavities to support complex cavity nesting communities**

16:00 – 16:20 Wiesław Walankiewicz, Dorota Czeszczewik, Grzegorz Bednarczyk, Tomasz Stański, Anna Kapusta: **Does Collared Flycatcher benefit from nesting in woodpecker-made cavities under the conditions of the primeval forest?**

16:20 – 16:40 Joshua M. Diamond, Michael S. Ross: **Palm snags are a critical nesting resource for woodpeckers in an urbanized tropical region**

16:40 – 17:00 Camille Puverel, Anick Abourachid, Christine Bohmer, Baptiste Kerfiden, Jean-Michel Leban, Yoan Paillet: **This is my spot: characteristics of trees bearing Black Woodpecker cavities**

17:00 – 19:00 Poster session

19:00 – 20:30 *Dinner at Hotel Białowieski*

20:30 Movie time...

Monday, March 18

08:00 – 14:00 Guided excursion to the strictly protected area of Białowieża National Park

14:00 – 15:30 *Lunch at Hotel Białowieski*

16:00 – 18:30 Utku Perktas: Workshop on environmental niche modelling and phylogeography

19:00 – 20:30 *Dinner at Hotel Białowieski*

20:30 – 21:30 Roundtable with Bogdan Jaroszewicz et al.: threats to the Białowieża Forest. Chair: Wiesław Walankiewicz

Tuesday, March 19

Session 4: Evolutionary ecology and population biology.

Chair: Utku Perktas

- 09:00 – 09:50 Jérôme Fuchs (plenary talk): **Diversification and speciation in woodpeckers**
- 09:50 – 10:10 Łukasz Kajtoch, Tomasz Figarski, Jerzy Michalczyk, Artur Gurgul: **Phenotypic and genotypic traits of hybridization between Syrian and Great spotted woodpeckers**
- 10:10 – 10:30 Sayaka Mori, Kaori Kuno, Saori Tsuyama, Shokuro Tamura, Satoru Chiba, Hiroe Izumi, Isao Nishiumi: **Genetic structure analysis for the conservation of critically endangered insular endemic Okinawa Woodpeckers (*Dendrocopos noguchii*)**
- 10:30 – 10:50 *Coffee break*
- 10:50 – 11:10 Gerardo Soto: **Effects of forest degradation on local populations of Magellanic woodpeckers: from territory allocation to population viability under climate change scenarios**
- 11:10 – 11:30 Eric L. Walters, Walt Koenig: **Drivers of seasonal decline in reproduction in the cooperatively breeding acorn woodpecker**
- 11:30 – 11:50 Ken W. Smith, Linda Smith: **The impact of the abundance and timing of defoliating caterpillars on the breeding success of Great Spotted Woodpecker (*Dendrocopos major*) in oak (*Quercus woodland*) in southern UK over a 16-year period**
- 11:50 – 12:10 Gilberto Pasinelli, Peter Knaus, Nicolas Strebel, Thomas Sattler: **Population trends and changes in distribution of woodpeckers over 20 years in Switzerland**

12:15 – 13:30 *Lunch at Hotel Białowieski*

Session 5: Climate and weather effects. Chair: Eric Walters

- 13:30 – 14:20 Victoria Saab, William Block, Jonathan Dudley (plenary talk): **Disturbances and woodpeckers: making sense of**

fires, bark beetles, logging and woodpeckers of western North American forests

- 14:20 – 14:40 Jacopo G. Cecere, Andrea Marcon, Simona Imperio, Rosita Mantovani, Pierfrancesco Micheloni, Ezio Orfelini, Dario Piacentini, Lorenzo Serra, Fernando Spina: **Long-term changes in migration timing of Wryneck**
- 14:40 – 15:00 Jeffrey Walters, Stephanie DeMay: **Geographic variation in effects of changing climate on productivity of an endangered woodpecker in the southeastern United States**
- 15:00 – 15:20 Ziemowit Kosiński, Łukasz Walczak: **Different factors affect breeding populations of middle spotted woodpecker *Dendrocoptes medius* in strictly protected and managed forests in western Poland**

15:20 – 15:40 *Coffee break*

Session 6. Space use and movement ecology. Chair: Ken Smith

- 15:40 – 16:00 Natasha D.G. Hagemeyer, Sahas Barve, Russell E. Winter, Samuel D. Chamberlain, Walter D. Koenig, David W. Winkler, Eric L. Walters: **Status, sex, and group size drive extra-territorial forays in cooperatively breeding acorn woodpeckers**
- 16:00 – 16:20 Karen L. Wiebe: **Local recruitment and natal dispersal in the Northern Flicker, a migratory woodpecker**
- 16:20 – 16:40 Hugo Robles, Carlos Ciudad, Zeno Porro, Julien Fattebert, Gilberto Pasinelli, Matthias Tschumi, Marta Vila, Martin Gruebler: **Natal dispersal of middle spotted woodpeckers under habitat fragmentation scenarios**

16:40 – 17:00 *Coffee break*

- 17:00 – 17:20 Ola Olsson: **Movement ecology and habitat use of lesser spotted woodpeckers**
- 17:20 – 17:40 Antonia Ettwein, Michael Lanz, Gilberto Pasinelli: **Variation in home range size of the white-backed woodpecker**
- 17:40 – 18:00 David Champion, Diego Villanúa, Miguel Mari Elósegui: **First experiences with the use of GPS-tags in the Lilfordi woodpecker (*Dendrocopos leucotos lilfordi*)**
- 18:00 – 18:30 Closing ceremony

19:15 *Conference dinner at Hotel Białowieski*

Wednesday, March 20

Departure

8:30

Post-conference excursion to the Biebrza National Park

Out-of-the-program activities

Exhibition of woodpecker pictures of the world by Beatriz Cárcamo -
illustrator, sculptor and draftswoman.

PLENARY TALKS

Woodpeckers, wood decay, and the resilience of nest web communities

Kristina L. Cockle, Kathy Martin

Nearly 1900 bird species require tree cavities for nesting. Non-excavators (such as toucans, owls) are linked to the organisms that produce cavities (including woodpeckers, other avian excavators, and decay organisms) in complex ecological networks or nest webs. Conserving these networks in the face of global change requires an understanding of their structure and dynamics. Here, we draw on decades of research in North and South American forests to explore the roles of woodpeckers in the structure and function of nest web communities. Woodpeckers are the primary source of cavities throughout much of North America, but, at first glance, they appear to play only a minor role in producing cavities in forests outside North America (e.g., 0-20% of cavities in many forests of South America, Europe, and Oceania). In globally-endangered old-growth Atlantic forest of Argentina, woodpecker cavities persisted <3 years on average (vs. >10 years for non-excavated cavities), comprised 7% of nest sites used by non-excavators, and supported only 0.3 species of non-excavators, on average, across their lifetimes (vs. 1.5 for non-excavated cavities). With increasing human disturbance to the forest, however, cavity supply declined dramatically and woodpecker cavities took on an increasing role, comprising 57% of nest sites used by non-excavators in isolated trees on farms. In Interior British Columbia, Canada, woodpeckers were consistently important facilitators in the nest web; however, species' roles shifted in response to a bark beetle outbreak, and the Northern Flicker, a facultative excavator, dramatically increased cavity production following the destruction of cavities in wildfires. We conclude that healthy woodpecker populations may play a critical role in regulating cavity supply, while rich woodpecker assemblages can offer redundancy in cavity production. We propose that woodpeckers act as agents of resilience in nest webs, allowing non-excavators to survive in otherwise cavity-poor habitats, and increasing the ability of nest webs to respond dynamically to disturbance.

Diversification and speciation in woodpeckers

Jérôme Fuchs

With the advent of DNA sequencing, our understanding of the evolution of the Picidae has greatly changed during the last two decades, allowing us to refine previous hypotheses regarding their biogeography, diversification and speciation patterns, community composition as well as plumage convergence. We will summarize the current knowledge regarding the spatio-temporal evolution of woodpeckers as well as provide a set of evolutionary questions that recently developed methods allow us to tackle.

Forest disturbances and woodpeckers: making sense of fires, bark beetles, logging and woodpeckers of western North American forests

Victoria Saab, William Block, Jonathan Dudley and many others

Woodpeckers coevolved in western North American forests with wildfires and bark beetle outbreaks. Several woodpecker species directly benefit from the ephemeral habitat created by fire and bark beetles. Although fire and beetle outbreaks are part of the evolutionary history in western forests, alterations in disturbance regimes have occurred due to logging activities, grazing practices, fire suppression, and climate change. Increases in frequency of wildfires and beetle outbreaks are expected with climate change, allowing more opportunities for post-disturbance salvage logging. Removal of snags through salvage logging can be beneficial to local economies but detrimental to disturbance-associated woodpeckers. For the past 25 years, we studied woodpecker distributions and demographics in relation to large-scale disturbances in dry coniferous forests of the Interior Western U.S.A. The focal species of our work are Black-backed (*Picoides arcticus*), American three-toed (*P. dorsalis*), White-headed (*Dryobates albolarvatus*), Hairy (*D. villosus*) and Lewis's (*Melanerpes lewis*) woodpeckers. We examined changes in nesting densities, habitat suitability, and nesting survival as a result of recent wildfires, bark beetle outbreaks, and land management activities, including tree harvest and prescribed fire. While nest densities of all species increased in relation to recent fires and beetle outbreaks, salvage logging reduced densities and nest survival for some species. To inform post-disturbance forest management that minimizes negative consequences to woodpeckers, we developed a GIS-tool for mapping nesting habitat suitability. The tool is

being used to make informed decisions on locations for salvage logging that are compatible with the long-term persistence of disturbance-associated woodpeckers.

Woodpecker studies in the Białowieża Forest

Tomasz Wesołowski

Situated on the Polish/Belarussian border, the Białowieża Forest still contains fragments of the pristine forests that once covered the lowlands of temperate Europe. Such patches are protected within the Białowieża National Park (Polish part). There is no direct human intervention in the operation of abiotic and biotic processes shaping the forest, including patterns of tree decay and death, seed masting, insect outbreaks or predation threat. Studies of woodpeckers living in these conditions have taken place during the last 40+ years. Here I shall review some results of this work, introducing the woodpeckers' rich breeding assemblage (all but one European woodpecker species occur there), patterns of species' habitat distributions, densities and long-term numerical fluctuations. I shall then present their breeding phenology and the holes used for nesting (location, persistence, importance for secondary users). Finally, I shall discuss the evolutionary insights gained from studies in these conditions and stress the urgent need to preserve the last pieces of pristine forests as indispensable evolutionary and ecological laboratories.

ORAL PRESENTATIONS

Tree relative size, not its absolute, supports woodpecker cavities' establishment

Marco Basile, Thomas Asbeck, Cesare Pacioni, Grzegorz Mikusiński

The selection of retention trees to set aside from logging for the maintenance of tree-related biodiversity is an unsolved issue in retention forestry systems. Retention trees can be chosen among candidates that bear distinct structures as tree-related microhabitats (TreMs). TreMs provide shelter, rest, food or breeding sites for other organisms. One specific group of TreMs is woodpecker cavities, which constitutes the main breeding sites for primary cavity-nesters and one of the main breeding sites for secondary cavity-nesters. Therefore, understanding which trees woodpeckers select for cavities can inform forest management, as retaining the most suitable trees could support a great variety of organisms that depend on cavities. We used data from a full forest inventory, TreM inventory and woodpecker counts to investigate the characteristics of trees chosen by woodpeckers by building a resource selection probability function. Several predictors were tested for their influence on the probability of tree selection by woodpeckers including altitude, tree species, TreM richness and abundance, diameter at breast height (DBH) and deviation from the mean DBH per plot. The results show that the cavity size does not correlate with the individual tree diameter, and neither does the probability of choice by woodpeckers. Instead, the probability of choice by woodpeckers seems to be driven only by the deviation from the mean DBH per plot. We were able to identify a relative threshold for the selection of trees indicating that woodpeckers significantly prefer trees that are 20 cm larger than the mean DBH per plot. Though more data are still needed on this preliminary project about woodpecker's tree choice, these results deliver a clear improvement of the understanding for the selection of retention trees. Our findings might guide forest management decisions for the conservation of forest biodiversity.

The Pileated Woodpecker (*Dryocopus pileatus*): an umbrella species for cavity nesters in boreal forests

Philippe Cadieux, Pierre Drapeau, Alain Leduc, Marianne Cheveau, Antoine Nappi

Several researchers and wildlife managers qualify the Pileated Woodpecker (*Dryocopus pileatus*) as an umbrella species or indicator species. The conservation of its habitat would also benefit multiple other co-occurring species. However, there are few empirical studies on the subject. We evaluated if the presence of a Pileated Woodpecker cavity tree can be used as an indicator of habitat quality for the reproduction of cavity nesters in boreal forests. We used data from a long-term study (2003-2014) which covers a vast territory (12 000 km²) and overlaps two bioclimatic domains: the balsam fir white birch and the black spruce moss in eastern Canada. Data on the reproduction of cavity nesters were collected in 106 plots. Contrary to other indicator species studies that generally use occurrence data, we used nesting trees, which more directly reflects the limiting resource for this functional group of species. We compared the efficiency of using the Pileated Woodpecker over other cavity excavators for predicting cavity nesters species richness. Our results show that the Pileated Woodpecker strongly selects stands with that are also selected by the majority of cavity nesters: old growth forests with trembling aspen. The Pileated Woodpecker is also the species for which the presence of its cavities at a site was the most susceptible to predict the presence of other species' nesting cavities. Moreover, its habitat selection model was the most efficient for prioritizing sites for the conservation of this group of species. The Pileated Woodpecker can thus be considered an efficient umbrella species for the quality of breeding habitat for cavity nesters associated with boreal mixedwoods, a key component of biodiversity in boreal forest ecosystems.

First experiences with the use of GPS-tags in the Lilfordi woodpecker (*Dendrocopos leucotos lilfordi*)

David Campion, Diego Villanúa, Miguel Mari Elósegi

The White-backed woodpecker (*Dendrocopos leucotos*) – WBW - is considered the rarest woodpecker in Europe. Moreover, its irregular distribution, together with the strong isolation of the populations, make the species especially vulnerable. The population present in the

Iberian Peninsula would be one of these specially endangered ones, with only 78-95 pairs which are located in the global south-west limit distribution area. So far, the WBW habitat requirements have been poorly studied with radio-tracking works, due to the small size of this bird and the steepness of its habitat. Recently, new small GPS-tags which can accumulate a largenumber of locations have been developed. Also, the location data can be remotely downloaded with no need of animal recapture. Using this material, we started a WBW study in Navarra inside the HABIOS project, aimed to obtain information about their habitat selection in order to adjust the beech forest management.

During the spring of 2017 and 2018 fifteen birds were captured and tagged (12 adults and 3 juveniles) which allowed us to obtain more than 500 exact locations and to characterize 7 territories. All tagged adults finished their reproduction period without any problem or changes in their behavior. In addition, one male that had been marked in 2017 and recaptured in 2018 didnot show any lesions associated with the GPS-tag.

Mean home range size was 245 ha, much bigger than estimated by direct observations or registered in scientific literature. WBW nests were situated in mature beech forests areas; however our tracking showed that other habitats like young forests, pollarding trees, forest borders or even grasslands, habitats not traditionally associated with the WBW, were included in their home range. These first results suggest that the use of these small GPS-tags can be a good option to study the habitat requirements in the White-backed woodpecker.

Long-term changes in migration timing of Wryneck

Jacopo G. Cecere, Andrea Marcon, Simona Imperio, Rosita Mantovani, Pierfrancesco Micheloni, Ezio Orfelini, Dario Piacentini, Lorenzo Serra, Fernando Spina

Climate warming affects timing of both pre- and post-nuptial migration in several species breeding in Europe. We investigated long-term changes in migration timing of Wryneck analyzing information stored at the Italian Ringing Centre (EPE dbase). For the spring migration we relied on 1,729 birds captured during 30 spring seasons of the Progetto Piccole Isole (1988-2017) at 11 ringing stations mainly located on small Tyrrhenian islands which are used as stopover sites by many species of small migrants. For the autumn migration we relied on 1,447 birds captured during 36 autumn seasons (1982-2017) at 62 ringing stations located along the Italian

Peninsula. Given the location of the ringing stations, spring sampling mainly regarded long-distance migrants, while autumn sampling could also involve short-distance migrants. The timing of spring migration showed long-term advance (c.a. 1 day/6 years) but, at the same time, it was affected by meteorological conditions at African non-breeding grounds: the higher the rainfall amount was in the Sahel during the non-breeding period, the earlier was the spring arrival date in Italy. The timing of autumn migration showed a rapid long-term delay (c.a. 1 day/4.7 years), with adults generally migrating earlier than first year individuals and with no effects of the North Atlantic Oscillation, which strongly influences climate variables in Europe. Higher rainfall conditions at the non-breeding grounds favour vegetation growth and likely prey abundance, which in turn may favour Wrynecks in storing their fat reserves, allowing birds to advance their spring migration. Long-term delay in autumn migration date might be explained by the lengthening of the warm season and the capacity of the species to produce a variable number of broods. Overall, the long-term changes in both spring and autumn migration timing may suggest a good adaptation of Wryneck to climate change.

Palm snags are a critical nesting resource for woodpeckers in an urbanized tropical region

Joshua M. Diamond, Michael S. Ross

Critical resources for birds nesting in cities can support populations in spite of the challenges imposed by urbanization, and the identification of such resources can shed light on how species are able to adapt to novel environments. In the case of woodpeckers, these resources also support the conservation of secondary cavity-nesters. Woodpecker nesting has been well-studied in temperate regions, including within urban areas, but in subtropical and tropical regions, less is known. Here we ask what types of trees and what habitats are used most by woodpeckers, and which species of woodpeckers create the most nest cavities. We recorded information from 967 woodpecker nest trees in the region surrounding Miami, Florida, USA, which contained a total of 1,864 nest cavities excavated by four woodpecker species. Palm trees were used more than all other tree categories, and royal palms (*Roystonea regia*) were the most-used species overall. Palm snags were preferentially excavated in every habitat where they were available and three of the four woodpecker species used palms snags over all other categories of trees. Palm snag

nests were the most used by native and exotic secondary cavity-nesting birds. Red-bellied Woodpeckers (*Melanerpes carolinus*) were the most prolific cavity excavators, creating 78.1% of holes. Remnant patches of two native forest types contained the highest densities of woodpecker nest trees. We found a higher density of nest trees in moderately-developed suburban areas than either rural, agricultural areas or in the highly-developed urban core. We consider how these results can inform conservation efforts in the developing tropics, and especially within similar urbanizing environments in the nearby Caribbean.

Linkages between decaying trees and woodpeckers in eastern boreal forests of Canada: when keystone attributes interact with keystone species

Pierre Drapeau, Philippe Cadieux, Louis Imbeau, Antoine Nappi, Alain Leduc, Réjean Deschênes

In the eastern Canadian boreal forest, the northern expansion of timber harvesting in the last 35 years has shifted the age-class distribution from a matrix formerly dominated by old forest cover types to a matrix that is now dominated by young forests. This represents a major change for organisms that evolved and experienced high availability of keystone structures such as decaying and dead trees. These resources may thus become limited, which may affect woodpecker species foraging and nesting conditions. This in turn could likely have cascading effects on cavity-using vertebrates since woodpeckers are keystone agents in the provision of tree holes in the Canadian boreal forest. We quantified and compared nesting and foraging tree selection of six bark-foraging woodpeckers – downy woodpecker (*Picoides pubescens*), hairy woodpecker (*Picoides villosus*), American three-toed woodpecker (*Picoides dorsalis*), black-backed woodpecker (*Picoides arcticus*), yellow-bellied sapsucker (*Sphyrapicus varius*) and pileated woodpecker (*Dryocopus pileatus*) – that co-occur in different study sites that encompass Québec's boreal forest both in old and recently burned forests over the last 15 years. Our results show that decaying and dead trees represents an important foraging substrate for most bark foraging woodpeckers whereas most species rely on decayed trees (trees infected by wood-decaying polypores) or dead trees for nesting. We argue that providing foraging and nesting substrates for most woodpecker species not only requires maintaining dead trees but also the underlying dynamics of tree decay in boreal forest landscapes.

Variation in home range size of the white-backed woodpecker

Antonia Ettwein, Michael Lanz, Gilberto Pasinelli

Knowing a species' area requirements and the mechanisms affecting them is of great importance for developing effective conservation measures. The endangered white-backed woodpecker *Dendrocopos leucotos* typically occurs in forests with little or no forest management. Although this species is of high conservation concern and has already been used as a target species in conservation projects, knowledge gaps exist regarding its ecology, particularly in Central European forests, as well as its area requirements and space use patterns. We studied variation in home range size of white-backed woodpeckers occurring in managed forests in Western Austria, Eastern Switzerland and Liechtenstein in relation to sex, season and habitat. We also tested whether reproductive success (number of fledglings) was related to home range size during the breeding season. Fifty individuals were fitted with radio transmitters in 2017 and 2018, and data collected throughout each year. The nestlings of each tagged woodpecker were counted shortly before fledging. We used 95% fixed kernel density estimation to estimate home range sizes. Home range size significantly differed between the seasons and was 60 ± 19 ha ($n = 19$) during the pre-breeding season, 40 ± 14 ha ($n = 26$) during the breeding season and 95 ± 36 ha ($n = 31$) in summer. Two individuals tracked during winter had home range sizes of 94 and 178 ha, respectively. Home range size did not differ between the sexes, and reproductive success was not related to home range size. The relationships between home range size, habitat structure and forest management intensity and the implications for forest management will be discussed.

Woodpeckers in an urban ecosystem: searching for a high quality refuges in a matrix of habitats

Arkadiusz Fröhlich, Michał Ciach

Woodpeckers are relatively often recorded in an urban environment. However, their habitat preferences and habitat quality of territories located in an urban matrix are not studied in details. Urbanization potentially contribute to the limitation of dead wood resources, which are crucial for woodpeckers occurrence. However, an urban matrix may contain habitat patches that are suitable for this group of birds. The aim of

this study was to assess habitat preferences of woodpeckers in an urban matrix and select factors that influence habitat quality of an urban environments. In 2015-2018, the survey of woodpeckers was conducted in the city of Kraków on randomly selected sample plots. Habitat parameters, including quality and quantity of dead wood resources, were used to model species occurrence and richness. In total, eight woodpecker species were recorded. Two distinct groups of species were revealed – first contained species that preferred urban forests, while second group was more related with private gardens. Dead wood resources, which occurred mainly in the form of tree dead branches, were major driver of a community richness. Municipal greenery has most limited dead wood resources, thus this habitat type was avoided by woodpeckers. Moreover, we found that requirements of dead wood availability and canopy coverage correlated with species abundance. Dead wood resources in an urban environment were shaped by ownership and type of management of an urban green spaces and estate prices. Our study demonstrates that management of urban greenery is an important factor that has effect on the woodpeckers assemblage and less manicured urban green spaces are crucial for the woodpeckers occurrence. Our findings are important in the context of progressive urbanization of the landscape mosaic.

Status, sex, and group size drive extra-territorial forays in cooperatively breeding acorn woodpeckers

Natasha D.G. Hagemeyer, Sahas Barve, Russell E. Winter, Samuel D. Chamberlain, Walter D. Koenig, David W. Winkler, Eric L. Walters

Environmental constraints restrict dispersal in cooperatively breeding taxa, and extra-territorial forays to find breeding opportunities are a critical yet understudied behavior in cooperative breeders. The study of extra-territorial forays in birds has been constrained by the cryptic behavior of birds on foray, the resource-intensive methods of radio-telemetry requiring manual tracking of individuals, need for recapture to retrieve tags, and the short tracking periods feasible due to weight constraints on the radio-tags. We examined extra-territorial forays in cooperatively breeding acorn woodpeckers (*Melanerpes formicivorus*) by tracking 62 birds using lightweight solar-powered radio-tags and an automated array of receiver stations throughout an entire breeding season. This novel technology allowed us to track radio-tagged birds simultaneously and continuously throughout the study. Number of territories visited, mean

and maximum distance to each territory visited, and proportion of time spent on the home territory were determined for each bird for each day. We predicted that helpers would foray farther and more often than breeders, and that females would foray farther than males. The number of long-distance forays by birds were at a scale and frequency previously unknown among cooperatively breeding birds. We found no difference in the number of territories visited with regard to sex and breeding status. Unexpectedly, the mean and maximum distance to territories visited was significantly smaller for helper males than other sex-status classes. Also, birds from larger social groups spent less time on their territories. Our results demonstrate that extra-territorial forays are frequent and routine regardless of sex or social status. Individual foray strategies, however, are likely driven by a combination of sex, status and group size at the home territory.

Phenotypic and genotypic traits of hybridization between Syrian and Great spotted woodpeckers

Łukasz Kajtoch, Tomasz Figarski, Jerzy Michalczyk, Artur Gurgul

Syrian and Great spotted woodpeckers (*Dendrocopos syriacus* and *D. major*; SW and GW, respectively) are known to hybridize in nature. The extent of this phenomenon was poorly known due to difficulties in hybrid detection. The population structures, phenotypes, and genotypes of sympatric SW and GW were investigated in Poland. Field studies were undertaken in 2013-2015, whereas samples for genetics were collected in 2009-2017. Based on field studies it was estimated that only 2.1% of territories were formed by birds belonging to different species (5.3% if also considering pairs comprising at least one hybrid). These interspecific pairs in 92.8% comprised SW or hybrid females and GW males. In total 3.6% of observed individuals and 6.9% of dead birds were identified as hybrids. The sex ratio of hybrids was equal. 8 phenotypic characters were found to allow in combination for the identification of hybrids. Next, with use of 5 markers (1 mitochondrial and 4 nuclear introns) and a set of 6 microsatellite loci, genotypes of 12 SW, 12 GW, and 2 phenotypic hybrids was determined. The highest number of fixed nucleotide sites was found in the mtDNA and intron 5 of the transforming growth factor. Analyses of microsatellite data distinguished the two species, but all loci showed a large number of common alleles. According to the DNA sequence analyses, 2 out of 18 specimens within the sympatric range in Poland were identified

as hybrids, but microsatellites suggested more individuals with introgressed DNA. This was further supported by genotyping-by-sequencing of nearly 2.500 single nucleotide polymorphisms. These results suggest that in urban populations of these woodpeckers, part of phenotypic SWs harbor genotypes assigned as these known for GWs. These data suggest that hybridization between SWs and GWs is an underestimated phenomenon with important consequences for any ecological studies on sympatric populations of both species and for the conservation of the rare SW.

Different factors affect breeding populations of middle spotted woodpecker *Dendrocoptes medius* in strictly protected and managed forests in western Poland

Ziemowit Kosiński, Łukasz Walczak

We investigated the impact of weather conditions and forest management intensity on breeding populations of the middle spotted woodpecker between 2000 and 2018. Since climatic extremes can have major effects on birds due to low survival rate we assumed that weather conditions during winter could affect spring population from one year to another. Moreover, unfavourable weather conditions during reproduction in the previous year might negatively affect breeding performance and shape breeding population in the following breeding season. We also assumed that forest management intensity might negatively affect breeding population. We established a study sites in strictly protected riverine forest - "Czeszewski Las Reserve" (CLR; 223 ha), and in intensively managed oak forest "Łówkowiec" (L; 611 ha) in western Poland. Both sites are parts of two NATURA 2000 SPAs (Middle Warta River Valley and Krotoszyn Oak Forest), with the middle spotted woodpecker as one of the target species. The temporal trends in the abundance in both sites were not significant. In the case of CLR, the number of pairs increased with increasing mean temperature or wind chill in winter, and decreased with increase of mean temperature in May. In the case of L, number of pairs decreased with increasing number of days with snow. However, when the index of forest management intensity was included into the analysis, we have found that the number of pairs increased with increasing mean temperature or wind chill in winter and decreased with increasing forest management intensity. Our data suggests that winter severity might have a direct effect on winter survival of middle spotted woodpeckers. The negative effects of

temperature in previous May on number of pairs in CLR might be affected by disruption of the synchrony of oak phenology and herbivorous caterpillar activity, and mistiming of middle spotted woodpecker reproduction due to climate change. The effect of climate conditions may be altered by intensity of forest management.

Modelling past and present habitat suitability for the lesser spotted woodpecker in Sweden

Carsten Kost, Ola Olsson

Habitat suitability models provide important tools in conservation planning and research. During a large -scale project during 1985-1988, occurrence of lesser spotted woodpeckers (*Dryobates minor*) was surveyed in ca 170 areas across Sweden. Presence or absence of the woodpecker, as well as the forest composition was recorded. Additionally, the species and its habitat were studied in great detail in a smaller area of Sweden in the 1990-ies. We combined this information on forest composition and woodpecker presence from both studies with satellite data from the same period, which has recently been released in a usable format, to derive a habitat suitability model for the species. We then applied the same methodology to recent satellite data to obtain a habitat suitability map for the current state of the Swedish forest. We compare the model results with the population trends for lesser spotted woodpeckers according to the Swedish Breeding Bird Survey and test it against a large citizen science dataset. This model is also used to identify appropriate field-sites with different degrees of habitat suitability for a new national study that will begin in 2019 to follow up the project from the 1980-ies. The results from the new survey will be used to further test the validity of the habitat suitability model. Additionally, comparison of the habitat suitability models for the different decades can provide important insights into the changes in availability of suitable habitat on a nation-wide scale. The results can further be used to estimate future population developments in relation to land-use changes and therefore facilitate the planning and implementation of appropriate conservation measures. This project shows the potential for the application of new techniques to both old and new data and the direct application of the resulting insights.

Foraging niche differentiation among sympatric woodpecker species in dipterocarp forests of northwest India

Raman Kumar, Ghazala Shahabuddin, Ajith Kumar

Tropical/subtropical regions harbour a high picid diversity e.g. the sub-Himalayan dipterocarp forests in northwest India support 17 species of woodpecker. However, foraging ecology of woodpeckers in these regions has not been studied in great detail. From a conservation perspective it is necessary to assess the ecological requirements of woodpeckers in these biologically diverse landscapes, which are experiencing habitat modification and decline in some woodpeckers.

We studied the foraging niche differentiation among ten sympatric woodpeckers in the sub-Himalayan forests of northwest India. We examined the foraging site preferences of individual woodpecker species and explored the role of inter-specific differences in foraging behaviour as a possible mechanism for their coexistence.

Observations on foraging woodpeckers were taken vis-a-vis the following niche dimensions: DBH of the foraging tree, height of the foraging bird, part of tree on which it was observed foraging, vertical position with respect to canopy, condition of the forage tree and condition of the substrate.

Distinct preferences were evident among species in their foraging tree diameters, foraging heights, vertical positions, and choice of substrate type, while preference for dead substrates was not an important distinguishing factor. Species that overlapped in one dimension generally segregated along other dimensions. Niche segregation in forage tree diameter was associated with body weight.

Our study demonstrates that differentiation in foraging is an important mechanism for coexistence of sympatric woodpeckers in the sub-Himalayan region. Given that larger species prefer larger substrates, removal of mature trees could affect their abundance, and homogenisation of stand structure could lead to impoverishment of woodpecker diversity.

Will there be room for Woodpeckers in the Anthropocene?

Leif Lithander

The similarities between cancerous cells and civilization are apparent. Human population and economy grow at the expense of healthy ecosystems. Woodpeckers are among the the first bird species to lose

foothold in this devastating process. In Sweden, the Middle Spotted Woodpecker vanished and the White-backed Woodpecker is critically endangered as a consequence of large scale transformation of deciduous forests into coniferous plantations. On the other hand, the Swedish Parliament has signed and ratified the Convention on Biodiversity and opinion polls have shown that 70 % of the Swedish citizens consider "the species right to exist" to be the main reason to prevent extinction of the White-backed Woodpecker. This incongruity raises several important research questions regarding sociopolitical issues. Here, some results from a series of questionnaires conducted in Sweden 2013 - 2017 are presented. The most important one, and perhaps the most worrying, is that despite a rapidly growing concern for climate change and loss of biodiversity, the Swedish general public lacks the insight that human population growth is the root cause of accelerating detrimental impacts on the ecosystems, also in their own country. In particular, members of political parties consider growing numbers of citizens to be highly desirable. Moreover, although most respondents were able to recognize a woodpecker, very few could identify a White-backed Woodpecker. The awareness of the ongoing conservation efforts to restore the species' dwindling population in Sweden are poorly spread among the general public. An efficient conservation policy in a modern, democratic society requires understanding of how nature, social structure, the individual citizen and scientific knowledge interact and evolve over time. In other words, the issue here is to develop a theory on how the distance between science, politics and everyday praxis may be shortened.

Woodpecker Legacies: The resource value of fresh and older tree cavities to support complex cavity nesting communities

Kathy Martin, Kristina Cockle

Tree cavities are a critical reusable nesting resource for cavity-nesting birds and mammals globally, however, tree cavities may decline in occupancy and quality as they age. Although we know that trees and their cavities change as they age, with trees becoming softer and cavities becoming larger, we do not know how their value as nesting resources varies with age. In the context of wildlife and forest management, we investigated the relative value of generating a supply of fresh tree cavities—which are thought to be of high quality—versus protecting cavities as they age and expand in interior volume. For 21 years (1995–2016), we monitored the

formation and occupancy of tree cavities used by more than 30 species of birds and mammals in British Columbia, Canada. Cavity occupancy by secondary users was highest 1 year post-excavation (53%), declined to 40% after 2 years, remained at 33 % between 3 and 16 years of age, and increased to 50% use from 17–20 years post-excavation. Woodpeckers that reused cavities strongly selected 1 and 2 yr old cavities; large-bodied non-excavators (ducks, raptors, squirrels) selected mid-aged cavities; and mountain bluebirds (*Sialia currucoides*) and tree swallows (*Tachycineta bicolor*) selected most strongly for the oldest cavities. Cavities created in living aspen trees, especially those excavated by northern flickers (*Colaptes auratus*), maintained high occupancy by secondary users across cavity age. Altogether, our results show that a diverse woodpecker community is needed to generate a supply of fresh cavities in the ecosystem, and the retention of the mid-aged and older cavities helps support larger-bodied species. Understanding the value of old cavities which are available across many years, versus fresh cavities, which may provide high quality, preferred nest sites helps to inform better forest management for cavity-nesting vertebrate communities.

Genetic structure analysis for the conservation of critically endangered insular endemic Okinawa Woodpeckers (*Dendrocopos noguchii*)

Sayaka Mori, Kaori Kuno, Saori Tsuyama, Shokuro Tamura, Satoru Chiba, Hiroe Izumi, Isao Nishiumi

The Okinawa Woodpecker is distributed in the Yambaru forests of northern Okinawa Island, Japan (ca. 300km²). The population has decreased primarily due to deforestation events in the 1960-80s, and its numbers are estimated at 150-584 individuals. Recent increases in predators, such as the invasive mongoose (*Herpestes auro-punctatus*), also pose a threat. For conservation and management of these woodpeckers, their genetic structure should be considered. While microsatellite markers are a powerful tool for this purpose, few known markers were available for this species. We therefore developed new markers using NGS techniques. The resulting sequence included 2,250 microsatellite loci, and 146 primer sets were designed. We screened 55 potential primer sets with seven multiplex PCR systems. A pre-analysis of allele frequency revealed that 33 markers would be useful for the genetic structure analysis of the species. Of those, 17 markers were used in the genetic structure analysis of 322 woodpeckers

sampled from entire Yambaru region during 1999-2013. Isolation-by-distance was not detected, and kinship scores were always nearly zero. Although 6-10 genetic clusters among individuals were suggested by DAPC, its spatial distribution was ambiguous for now. Ancestry estimation revealed a single genetic origin of all individuals. However, two genetic clusters between north and south of the range were detected by landscape genetic analysis. This genetic differentiation may suggest a founder effect in the southern population, since this species has historically disappeared once in the south. We speculate that intensive removal efforts of mongooses could have enhanced the re-establishment of the Okinawa Woodpecker in southern Yambaru.

Movement ecology and habitat use of lesser spotted woodpeckers

Ola Olsson

The lesser spotted woodpecker (*Dryobates minor*) is a small species with the capacity to use an unusually large territory. Our previous studies have shown that a pair may defend areas ranging from 50 to over 150 ha, but within these there is always an area of high quality deciduous forest of between 30 and 45 ha. It is only these deciduous forest patches that are used for foraging in spring. The foraging habitat is thus fragmented by up to 75%, in territories where breeding may still be successful. During winter they use home-ranges with an average size of over 700 ha. Here, I will present previously unpublished movement, foraging, and habitat selection data of lesser spotted woodpeckers, which explain and illustrate the above patterns. During winter, habitat selection is very weak and habitats are used more or less in relation to availability, whereas during the territorial period in spring habitat selection is very strong with clear preference for deciduous forest stands and stands with much dead branches of preferred tree species. Additionally, in winter the movement pattern ranges from directional to diffusion, which leads to very large areas covered, and the likelihood of revisiting a patch being very low. By contrast, during spring the movement pattern is area focused, interrupted by short bouts of directional movements. This is related to concentrated use of high-quality patches, which can be separated by relative large distances of matrix habitat.

Population trends and changes in distribution of woodpeckers over 20 years in Switzerland

Gilberto Pasinelli, Peter Knaus, Nicolas Strebel, Thomas Sattler

Identifying potential causes of spatial and temporal variation in the size of animal populations is a cornerstone of ecology and continues to be a major challenge despite the long history of population biology. The increasing availability of data systematically collected over broad spatial scales allows addressing potential reasons underlying variation in population size in space and time. Here, we make use of two such systematic monitoring schemes to examine i) population trends of eight woodpecker species based on data from the common breeding bird survey conducted since 1999 across Switzerland and ii) changes in woodpecker distribution over 20 years based on data from the new atlas of the Swiss breeding birds (1993-1996 vs 2013-2016). One species, the grey-faced woodpecker (*Picus canus*), showed significant population declines and associated range contractions. Three species - three-toed woodpecker (*Picoides tridactylus*), middle spotted woodpecker (*Dendrocoptes medius*) and lesser spotted woodpecker (*Dryobates minor*) - have increased since the early 2000 after previous declines and have expanded their distribution. The remaining four species - green woodpecker (*Picus viridis*), black woodpecker (*Dryocopus martius*), great spotted woodpecker (*Dendrocopos major*) and white-backed woodpecker (*Dendrocopos leucotos*) - have steadily increased in population size and in distribution since the 1990s. Reasons possibly explaining the different population trajectories such as climatic factors, the ageing of forests and increases in dead wood volumes at the different spatial scales are presented. In addition, population trends and distribution changes observed in Swiss woodpeckers are compared to the situation in Europe.

This is my spot: characteristics of trees bearing Black Woodpecker cavities

Camille Puverel, Anick Abourachid, Christine Bohmer, Baptiste Kerfiden, Jean-Michel Leban, Yoan Paillet

The Black Woodpecker is considered both an ecosystem engineer and an umbrella species: it has the capacity to modify its environment through cavity excavation which in turn favors a large range of species that depend on cavities but are unable to dig them (secondary cavity nesters). However,

the factors that affect cavity excavation by Black woodpecker at the tree scale remain poorly known. We analyzed characteristics of trees bearing Black Woodpecker cavities to assess its local habitat preferences. We compared tree-traits between trees bearing Black Woodpecker cavity (n=60) and trees devoid of it (n=56) in two French lowland forests. We hypothesized that:

- i. Cavity-trees would have a lower wood density and display more conks of fungi than control-trees;
- ii. The local environment of cavity-trees would be less crowded than those of control trees. In particular, the first branch would be higher on, and their first tree neighbor tree further away from, cavity-trees than control-trees;
- iii. Cavity-trees would display more other woodpecker cavities and saproxylic microhabitat than control-trees.

We validated most of our hypotheses and showed that cavity-trees differed significantly from their control counterparts according to analyzed factors. Black Woodpeckers excavate softer trees with a higher first branch in a less crowded environment, and thus, at the same time, minimize both the energy dedicated to cavity excavation and the predation risk. Second, cavity-trees bear more microhabitats, supporting a more important engineer role than previously proposed. In terms of biodiversity-friendly management measures, it would be beneficial to favor large standing beech trees with a trunk free of low branches and locally apart from others, especially in stands dominated by other tree species.

Natal dispersal of middle spotted woodpeckers under habitat fragmentation scenarios

Hugo Robles, Carlos Ciudad, Zeno Porro, Julien Fattebert, Gilberto Pasinelli, Matthias Tschumi, Marta Vila, Martin Grüebler

Natal dispersal critically influences population dynamics, particularly in spatially structured systems resulting from habitat fragmentation. Ecological theory suggests that habitat fragmentation (habitat subdivision and isolation) may either increase or reduce the cost-benefit ratio of dispersal depending on the extinction risk associated with remaining within the small patches and the mortality risk during migration, but empirical data of detailed dispersal movements in fragmented landscapes are scarce. We investigated dispersal movements of middle spotted woodpeckers by radio-tracking juveniles under habitat fragmentation scenarios. Young birds

reared in small habitat patches and in high quality territories (high large oak densities) stayed longer in the natal range and initiated dispersal (through temporary forays or permanent emigration) at older ages, suggesting that, while habitat fragmentation may inhibit dispersal, habitat degradation may promote dispersal as a behavioural mechanism to escape adverse conditions. In addition, juveniles born in high density areas stayed shorter in their natal range and initiated dispersal at earlier ages, which may indicate a strong effect of competition on dispersal timing. Larger (chord length) fledglings stayed shorter in the natal range, were less likely to perform forays and initiated dispersal at earlier ages than smaller birds. Moreover, heavier juveniles stayed shorter in the first transfer stage after emigration. These results support the hypothesis that, under habitat fragmentation scenarios, individuals with large body sizes may benefit from dispersing earlier (increased access to vacant territories) and staying shorter (reduced exposure to predation/starvation) in the critical postfledging and transfer periods.

The impact of the abundance and timing of defoliating caterpillars on the breeding success of Great Spotted Woodpecker (*Dendrocopos major*) in oak (*Quercus woodland*) in southern UK over a 16-year period

Ken W. Smith, Linda Smith

In this paper we analyse the outcomes of over 800 breeding attempts by Great Spotted Woodpeckers (*Dendrocopos major*) in relation to the abundance and timing of defoliating caterpillars, a key prey in the breeding season. The study was conducted over a 16-year period from 2001-16 in four study woods in southern England. We developed video nest inspection cameras to monitor nest contents and outcomes. Caterpillar abundance and timing were monitored by means of frass trays and standard assessments of leaf damage to oak (*Quercus*) trees through the woods.

In the last decade, largely driven by concerns about climate change, there has been much attention given to the impacts on breeding success, survival and recruitment of the 'phenological mismatch' between breeding birds and their defoliating caterpillar prey. Such impacts are particularly marked for long-distance migrants but are also of concern for resident species.

Those studies have tended to focus on the impacts of the timing of the caterpillars whereas both abundance and timing are likely to be important in determining prey availability at key times during the breeding cycle. The

timing of the caterpillar peak is closely related to spring temperature whereas the abundance of the caterpillars is influenced by many factors and is subject to long-term cyclic fluctuations over periods of ten or more years. We use our 16-year long-term dataset to examine the relative importance of caterpillar timing and abundance for the breeding success of this resident woodpecker.

Effects of forest degradation on local populations of Magellanic woodpeckers: from territory allocation to population viability under climate change scenarios

Gerardo Soto

Major landscape changes driven by human activities and natural disasters are subject to further severity as future climate scenarios predict stronger droughts, lower precipitation and increased wildfire risk in forested areas. Forest specialists are the most threatened species and their loss implies the reduction of multiple ecosystem functions and services. Our research aims to inform conservation efforts by exploring how landscape features affect the population viability of the Magellanic woodpecker *Campephilus magellanicus*.

The Magellanic Woodpecker is a highly specialized charismatic species and is well known by local people from various social contexts. Its large size, contrasting colors, sexual dimorphism, association with mature and old-growth forests, and recognition as a hard-working species for its intensive pecking activities, makes people especially attached to them. This positive perception by local people provides a unique opportunity to use this species as a flagship for the conservation of the remaining *Nothofagus* forest in the region.

Using movement and genetic data we aim to understand 1) how roosting and breeding cavities affects the spatial structure of individual territories, 2) how landscape features and social behavior affects spatial structure of territories within local populations, 3) how forest degradation impacts natal dispersal, 4) how landscape structure determines regional genetic population structure, and 5) how climate change will likely affect the population viability of Magellanic woodpeckers.

Our results show how a combination of methods can precisely inform management actions towards the conservation of the habitat of this charismatic species for its use as a flagship, indicator and umbrella species.

Does Collared Flycatcher benefit from nesting in woodpecker-made cavities under the conditions of the primeval forest?

Wiesław Walankiewicz, Dorota Czeszczewik, Grzegorz Bednarczyk, Tomasz Stański, Anna Kapusta

We collected data on breeding biology of the Collared Flycatcher *Ficedula albicollis* in oak-lime-hornbeam stands of the Białowieża National Park (BNP) in 1988 - 2018. During breeding season, we were looking for its breeding cavities and each nest-site was individually classified into one of two categories: woodpecker-made (excavated by woodpecker) and non-excavated (cavities formed by decay or damage). All cavities and cavity trees were described and measured. The Collared Flycatcher is known for heavy breeding losses caused by various predators (i. e. mustelids, woodpeckers, rodents). We determined the breeding success of >180 broods of the Collared Flycatcher in woodpecker-made cavities and >900 broods in natural cavities. Flycatcher's broods in natural (non-excavated) cavities were safer than those placed in woodpecker-made cavities. An average more than 50% of successful broods were in non-excavated cavities, while only one third of broods in woodpecker-made cavities were successful. GLZ Model included five quantitative explanatory variables (tree dbh, height above the ground, width of the entrance, cavity volume and cavity depth) and three qualitative variables (cavity origin, tree condition and inclination of the entrance). The only variable influenced brood safety was the cavity origin – nests located in woodpecker-made holes were significantly more often destroyed by predators than these located in non-excavated cavities. In view of above the role of woodpeckers as creators of suitable breeding sites for the Collared Flycatcher is questioned under the natural conditions of the primeval stands of BNP.

Drivers of seasonal decline in reproduction in the cooperatively breeding acorn woodpecker

Eric L. Walters, Walt Koenig

Clutch size and reproductive success decline seasonally in a wide range of temperate avian taxa. Two competing hypotheses have been proposed to explain such declines: the “timing” hypothesis, which states that conditions affecting reproduction decline intrinsically with date, and the “quality” hypothesis, which proposes that high-quality individuals or individuals in high-quality situations breed earlier. We contrasted the relative

importance of these two hypotheses using a long-term dataset of the cooperatively-breeding acorn woodpecker (*Melanerpes formicivorus*) in central coastal California (USA). This population exhibits an 11% seasonal decline in clutch size, a 60% seasonal decline in fledging success, and a 77% seasonal decline in fledgling overwinter survival. Clutch size tracks seasonal availability of flying insects, which are a likely ecological driver of the seasonal decline in reproduction and, because of the nonlinear relationship of flying insects with date, constitute a likely factor constraining even earlier nesting. By parsing lay date data into within-female and between-female components, we found that only the within-female component had a statistically significant direct effect on clutch size, supporting the timing hypothesis. For both fledging success and overwinter survival, however, both within- and between-female effects were highly significant, with between-female effects (differences in female quality) being stronger than within-female effects. These results suggest that timing per se is a key factor affecting the seasonal decline in clutch size, but that both differences in female quality and an intrinsic seasonal decline in conditions drive the even more dramatic seasonal declines in fledging success and overwinter survivorship of fledglings.

Geographic variation in effects of changing climate on productivity of an endangered woodpecker in the southeastern United States

Jeffrey Walters, Stephanie DeMay

Many temperate bird species are breeding earlier in response to warming temperatures, and early nesters are often more successful than late nesters. We used boosted regression tree models to examine the effects of climate on productivity in 19 populations of the Red-cockaded Woodpecker (RCW; *Picoides borealis*), an endangered woodpecker endemic to pine forests in the southeastern United States. Breeding season temperatures are increasing range-wide, and RCWs in coastal populations are nesting earlier in response. However, advances in nesting date over time have not been accompanied by productivity increases. This suggests that benefits of early nesting evident within a year do not apply across years, and that RCWs in coastal populations must adjust timing of breeding to maintain baseline productivity. Changes in productivity in inland populations correlated with changes in laying date, which were advanced, delayed or unchanged depending on the population. Small RCW groups were less robust than larger groups to shifts in climate. Geographic

patterns included higher productivity at higher latitudes, and declining productivity in the southwestern portion of the range. The latter pattern was directly related to geographic variation in climate change. The RCW is a conservation-reliant habitat specialist with little capacity to shift its range, so its long-term viability depends on its ability to adapt to changing local conditions.

Local recruitment and natal dispersal in the Northern Flicker, a migratory woodpecker

Karen L. Wiebe

Local recruitment rates and natal dispersal has been well-studied in two cooperatively-breeding woodpecker species but not in other woodpeckers with biparental care. I tested hypotheses about natal dispersal using long-term data from a population of Northern Flickers in British Columbia that was monitored for 16 years. Flickers are migratory and of 8272 banded fledglings, the average annual local recruitment rate across all years was 2.97%. Female fledglings recruited into the local population at a significantly lower rate (2.55%) than males (3.36%) suggesting that the natal dispersal distance of females was longer. Among years, recruitment rates varied from 0.7-6.1% and were positively related to spring temperatures and local breeding density in the year of settlement. Recruitment was not associated with the breeding density in the year of hatch. Heavy fledglings and those hatched earlier in the year were more likely to recruit locally. Of local recruits, females (n = 105) settled on average 3.6 km from their natal cavity and males (n = 138) settled on average 3.0 km away but this distance did not differ between sexes. The majority of local recruits (57%) still had one or both parents present on the study site when they settled but there was no case of breeding with parents or siblings. The natal dispersal distance was not associated with whether or not there was a parent of the opposite sex on the study area so inbreeding avoidance was not driving dispersal patterns at a small scale. Male, but not female, local recruits that settled closer to their natal site had earlier laying dates than local recruits that settled farther away, suggesting that knowledge of the habitat around the natal site may facilitate finding a cavity tree and establishing a territory for males breeding for the first time.

POSTERS

POSTER 1

Rapid and intensive foraging activity of woodpeckers after conservation-oriented management

Réka Aszalós, Zoltán Elek, Tamás Frank, Krisztián Harnos, Szabolcs Csernák, Viktor Szigeti

By mimicking natural disturbances, complex conservation-oriented management was implemented in a 32 ha even-aged oak-dominated forest in Hungary. The active management actions were implemented in the winter of 2015-2016 and included the girdling of standing living trees, bark stripping of tree individuals, felling to create downed woods, high stumps, and gaps in the canopy. The foraging activity of five woodpecker species and nuthatch was detected soon after the treatments on the majority of the treated trees. Visual feeding sign survey was carried out one and two years following the active management actions. Foraging activity was described as a percentage, differentiating tree parts (i.e. trunk, branches) and feeding depth categories (i.e. outer bark, inner bark, sapwood). The investigated 110 tree individuals represented five treatment types: wounded-, girdled-, downed tree, low and high stump. We analyzed the relation of the three background variables (tree part, feeding depth, treatment type) and the two temporal replicates of the feeding activity with Generalized Linear Models. Our results showed the rapid answer of woodpeckers by the fast colonization of the treated trees. We found a significant difference between treatment types in foraging activity; girdled trees, high and low stumps attracted the highest activity. Difference between years in foraging activity was also revealed; higher activity was recorded on the high and low stumps than on any other treatment type in 2017, the second survey in 2018 detected the colonization of girdled trees and downed woods. Highest foraging activity was found on the outer bark, but feeding on the inner bark and sapwood increased between the two surveys. As woodpeckers are the primary cavity excavators in these habitats, we discuss how our results can assist policymakers in the development of conservation strategies.

POSTER 2

Are woodpeckers key providers of bat roosts?

Jordi Camprodon

Woodpeckers have been described as key species as providers of suitable roosts for other vertebrate species. This hypothesis is assessed in 6 species of forest bats: *Nyctalus lasiopterus*, *N. noctula*, *N. leisleri*, *Plecotus auritus*, *Barbastella barbastellus* and *Myotis alcaethoe* in managed forests of the Northeastern Iberian Peninsula, by means of radio tracking. Due to specialisation in roost selection, only noctule species, the largest forest specialist bat species, roost usually inside woodpeckers' nests, and they show a preference for large cavities. Noctules occupied old nests of great spotted woodpecker and green woodpecker. Most of the nests were located in dead or decaying trees. No discrimination is established for this type of refuge. Woodpecker holes are selected because they are the only large cavities highly available in managed forests. However, they can use other large cavities, if available. Where woodpecker's holes are not available, noctules are not found. Therefore, in the managed forests studied, where natural cavities are very scarce, woodpeckers are key species to provide suitable roost for bats. We suggest the conservation of these trees and the restoration of cavities by banding further trees.

POSTER 3

Assessment of the habitat conservation status for White-backed Woodpecker territories (*Dendrocopos leucotos lilfordi*) in several NATURA 2000 areas in Navarra (Spain)

Susana Cárcamo, Oscar Schwendtner

The habitat suitability for White-backed Woodpecker (*Dendrocopos leucotos lilfordi*) is closely linked to the forest maturity degree. We work with structural parameters to find out what are the key factors that differentiate the stands where the species is breeding from the others. For practical purposes, we try to create a simple management tool that allows to allocate a "habitat conservation objective category" for the stands where the species is present or not. The different categories are: not suitable, marginal conditions, good conditions, very good conditions. The structural data we have measured in each stand are:

- Proportion of different tree species.

- Range of diameters and maximum diameter found.
- Basal area and volume of living wood.
- Canopy height.
- Number of vertical layers.
- Proportion and size of gaps in the canopy.
- Amount of dead wood (standing and on soil).
- Number of big trees (DBH > 45 cm).

With this classification we hope to determine what the conservation status for these territories are, in order to design a right forest management that allows to maintain the species in the long term.

POSTER 4

Is low breeding success the cause of the decline of the Lesser Spotted Woodpecker (*Dryobates minor*) in UK?

Elisabeth Charman, Paul Bellamy, Ken W. Smith, Linda Smith

In this paper we examine the evidence that low breeding success is a key factor driving the decline of the Lesser Spotted Woodpecker in the UK. We use nest records from the British Trust for Ornithology, results from a short-term RSPB study and recent data collected by a citizen science project (www.woodpecker-network.org.uk) to explore the support for the low breeding success hypothesis.

The Lesser Spotted Woodpecker is declining in Europe, severely so in the UK. A short-term intensive study in the UK from 2005-2009 identified low breeding success as a possible driver of the decline. Loss of chicks, probably linked to food availability, was the main cause of nest failure although nest predation was a subsidiary factor. At the time, too few nesting attempts were being recorded nationally in the UK to test whether this was a widespread problem. In response to this, a citizen science project was initiated in 2015 to increase the number of Lesser Spotted Woodpecker nesting attempts monitored in the UK. Video nest inspection cameras are used to monitor nest contents and outcomes. There are now sufficient data to re-examine the low breeding success hypothesis and set this in the long-term context.

POSTER 5

Factors affecting population fluctuations of White-backed Woodpecker in a old-growth beech forest of Central Italy

Emiliano De Santis, Valentina Capraro, Leonardo Songini, Leonardo Pucci, Giulio Lariccia, Alberto Dominici, Emanuela Fabrizi, Ilaria Guj, Stefano Donfrancesco, Jacopo G. Cecere, Simona Imperio

Assessing the impact of density and climatic factors on animal population fluctuations is a persistent challenge in ecology. In this study we analyzed factors affecting population dynamics of White-backed Woodpecker *Dendrocopos leucotos lilfordi* (WbW) breeding in the old-growth beech forest of Monti Simbruini Natural Regional Park (Central Italy), where the species is the subject of a long-term monitoring (2004-present) carried out by park authority. A playback protocol was carried out at least twice every spring (March-May) at 26 fixed stations located 1200 to 1700 meters a.s.l. Data were used to calculate yearly population growth rate (between year $t-1$ and year t), which was then put in relation with the indexes of population abundance of previous two years ($t-1$ and $t-2$) and a number of meteorological variables relative to different phases of WbW life cycle. Our study population exhibited a cyclic pattern, with a period of five years, without a significant linear trend. We found in fact that population dynamics was strongly driven by both direct ($t-1$) and delayed ($t-2$) density dependence, whose effect on population growth rate is likely mediated by detrimental consequences of high densities of breeders on breeding success and juveniles growth. Population growth rate was also positively affected by temperatures in May and June of year $t-1$, which likely favour fledglings survival. Finally, population growth was negatively affected by temperature and precipitation in January of year $t-1$, whose combination may increase icing which in turn may delay breeding attempts, with known consequences on breeding performances. The strong density dependence of WbW population dynamic highlights the exigency of the species to rely on rich habitats where food resources are not a limitation for breeding outputs.

POSTER 6

Assessing “cryptic” woodpecker distribution with citizen science: the Middle Spotted Woodpecker in the Basque Country (N Spain)

José María Fernández-García

Although the Middle Spotted Woodpecker (*Leipicus medius*) is not particularly elusive, distribution depicted in bird atlas that record presence without using species-specific methods can be incomplete or unclear. This is probably related to a mismatch between the periods of higher detectability and that of atlas fieldwork, and to the woodpecker’s behavioural pattern of colonization-extinction of forest patches in fragmented landscapes. In the Basque Country, the core population of the Middle Spotted Woodpecker was not discovered until 1993 – then estimated at c. 400 pairs, in spite of two breeding bird atlas in the 1970’s and 1980’s. Moreover, smaller ranges later discovered had also gone unnoticed in the atlas carried out in the 1990’s. During March-April 2017 and 2018, we assessed the fine-scale (1x1 km) distribution of the Middle Spotted Woodpecker, aided by 17 skilled volunteers using standardized and woodpecker-targeted techniques. Sampled quadrants were previously selected for having a significant (>16%) proportion of oak-dominated forest. Overall, recent Middle Spotted Woodpecker presence was detected in 80 1x1 km quadrants, 47% of the investigated. Another spatially distinct and previously unnoticed range was discovered, and the boundaries of ranges peripheral to the core population were delineated. Although an increase in distribution could explain the occurrence of these “new” ranges, evidence is lacking, and the possibility that they merely had gone unnoticed is more plausible. On the contrary, current presence in certain forest massifs with poor connectivity to the core population, but where the species had been claimed in the past, was not confirmed. Species-specific methods are recommended to assess the Middle Spotted Woodpecker distribution, particularly if a spatial resolution adequate for conservation practice is needed, and in peripheral, discrete ranges. Citizen science, provided that standardized sampling protocols are applied, can be a useful tool in this context.

POSTER 7

Not only forests... Syrian woodpecker *Dendrocopos syriacus* – urban bird of special importance

Tomasz Figarski

Most of European woodpeckers live in forests or forest-like habitats. The only obvious exception is Syrian woodpecker *Dendrocopos syriacus*. This species occupies Middle East, but in XIX-XX centuries it had expanded across the Balkans and Middle and Eastern Europe. In Europe, Syrian woodpecker inhabits mostly rural and urban landscapes, utilizing woods of anthropogenic origin. Populations of Syrian woodpecker, altogether with sympatric populations of Great spotted woodpecker, were studied in two Polish cities in the Mazowieckie Voivodship. The main topics of these studies were: i) to determine the environmental factors crucial for the occurrence of both species in cities, ii) to evaluate the differences in behavioral reactions of both species in responses to playback stimulation. It was evaluated that niches of these two species overlapped in only 29%, what prove that they utilized other resources. Syrian woodpecker preferred scattered woods with a high share of walnuts, fruit trees, poplars and willows, especially of older age. On the other hand, Great spotted woodpecker chose larger woods (e.g. parks) and could breed also in coniferous trees.

Behavioral studies showed that in pairs of Syrian woodpecker both sexes defend their territories and that females could be even more active than males (Great spotted woodpecker did not show such pattern). Moreover, Syrian woodpeckers were more active in direct interspecific interactions than Great spotted woodpeckers.

These studies, besides broadening knowledge about the ecology and ethology of Syrian and Great spotted woodpeckers in urban populations, showed that co-occurring woodpeckers should not be omitted in population research, which are executed on only one of these species in sympatric populations. Moreover, it was proved that urban environments are important and undervalued sites for Syrian woodpecker occurrence and that for effective conservation of this species crucial is maintenance of old orchards and softwood trees.

POSTER 8

New information on the breeding biology of the Middle Spotted Woodpecker

Barbara Froehlich-Schmitt

Unusual behaviour of nestlings clambering out of and back into the nest hole was filmed at two nests. Additionally, visits to three nest holes occupied by nestlings by Starlings and Great Spotted Woodpeckers were recorded. Further occurrences were recorded of the feeding of nestlings with ivy berries and, for the first time, with poplar seeds.

POSTER 9

Microclimate of Great Spotted Woodpecker nest holes in living and dead trees

Grzegorz Hebda

The function of birds' nest design is to minimize the detrimental effects of predator and parasite pressure and to provide a suitable microclimate for developing nestlings. The insulating function of holes may be particularly important for woodpeckers, whose nestlings hatch naked and incapable of thermoregulation for at least a week. Insufficient insulation from ambient conditions may cause hypothermia during cold weather or hyperthermia on hot days. As the microclimate of holes can vary with position on a tree and internal dimensions, birds should excavate (or use) holes with the most favorable characteristics.

I present data on air temperature and humidity in tree holes used as nest sites by Great Spotted Woodpeckers (*Dendrocopos major*). Studies were performed in the oak-lime-hornbeam stands of the Białowieża Primeval Forest, using temperature and humidity loggers. I discuss how the nest hole's dimensions and its position on a tree influence the microclimate within. Particular attention was put to analyses of microclimate in respect to the condition of the nest tree and the location of the hole in a living or dead substrate.

POSTER 10

Will our woodpeckers soon start breeding in “winter”? The advance of fledging date in Great Spotted Woodpecker (*Dendrocopos major*) – triggers, benefits and risks

Rudolf Hennes

One of the obvious effects of climate change is that some bird populations advance the timing of the breeding. E.g. red-cockaded woodpeckers (*Picoides borealis*) have been observed to lay earlier year by year, and early laying females are generally more productive than late laying ones (SCHIEGG ET AL, 2002). The advancing of the laying date correlates with increasing temperature, however the climate change related triggers for egg-laying remain unknown. Apparently daylength is not an effective trigger for species which advance egg-laying with climate change.

A potential advantage of advancing egg-laying is that the synchronisation with temperature dependent food sources can be assured (for an overview see Both in Møller et al.2010). However, if the food species react in a different way on the climate change than woodpeckers, mis-timing might be the consequence. In fact, the Great Spotted Woodpecker (GSW) belongs to the bird species whose breeding success depends on the synchronisation of the availability of tree-living caterpillars, the most relevant food source to rear chicks, and therefore it might depend on the capacity to advance egg-laying in line with climate change.

The author monitors a colour-banded population of GSWs since 2006. Breeding success and date of fledging are being registered annually. Fledging dates have advanced at a rate of some 0,6 days/year over that period. In comparison with older studies from western Germany on GSW, the medium fledging date has advanced by some 18 days over the last 60. Apparently, the rate of advancement is now higher than in previous decades.

To understand better the annual variation of laying dates, potential triggers like temperature and development of vegetation will be analysed. Advancing egg-laying due to favourable conditions bears the risk that these conditions do not prevail over the whole breeding period. The effect of a cold spell and the reaction of the GSWs could be studied in 2017. On the other hand, the persistent warm weather in 2018 indicated that under favourable conditions a high breeding success even without a synchronisation with the availability of caterpillars could be possible. I come to the conclusion that despite some flexibility and adjustments

climate change might become a threat to the reproduction success of GSW and may-be other woodpecker species.

Literature:

Both, C. (2010): Food availability, mis-timing and climate change in: Møller A.P., W. Fiedler & P. Berthold: Effect of Climate Change on Birds. Oxford University Press 2010.

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POSTER 11

Home range size and utilization by the three-toed woodpecker during breeding season

Krzysztof Kajzer, Wojciech Sobociński, Patryk Rowiński, Karol Zub

The three-toed woodpecker (*Picoides tridactylus*) is not globally threatened (Least Concern according to IUCN criteria), but due to specific ecological needs is rather scarce in most parts of its distribution range. This species inhabits mature boreal and montane mixed coniferous forest, where it nests in cavities excavated in dead conifers and feeds on larvae and pupae of bark-beetles. The three-toed woodpecker could be locally numerous, e.g. in the Białowieża Forest, but our knowledge about habitat requirements and spatial ecology of this species is very limited. In years 2014-2015, during breeding season (May-July), we followed 8 individuals (4 females and 4 males) equipped with VHF transmitters, attached to the tail feathers. Total home range sizes calculated as 95% minimum-convex polygon (MCP) varied between 484 ha and 512 ha in males, and between 21 ha and 252 ha in females, and were smaller in coniferous tree-stands (on average 64 ha) than in mixed forests (252 ha). Three-toed woodpeckers only occasionally demonstrated signs of territorial behaviour after the eggs were laid and thus home ranges of neighbouring pairs overlapped at 33 percent. Area occupied by males during incubating and cavity-feeding period was larger (on average 327 ha) than when juveniles fledged and were fed outside the nest (on average 285 ha). During the nesting period parents were collecting food not only in the vicinity of the cavity, but made trips up to two kilometres from the nesting site. Our study indicates that three-toed woodpeckers require relatively large areas of mature tree-stands and were able to find enough trees infested by insects living beneath bark, forming bulk of diet of this species.

POSTER 12

Habitat fragment occupation and breeding density of the Middle Spotted Woodpecker (*Dendrocopos medius*) for a period of 22 years in the “Bryansky Les” state nature reserve, SW Russia

Serguei Kossenko

The dynamics of occupation of habitat fragments and breeding density of the Middle Spotted Woodpecker (*Dendrocopos medius*) were studied in 1997–2018 using playback technique within a study plot of 15 isolated old oak-dominated forests ranging from 7 to 17 ha in size with a total area of about 150 ha. On average, only 36% of the oak forests were occupied by the breeding pairs annually. The probability of occupation of a forest was related to its area and isolation. The number of territorial pairs recorded within the study plot varied yearly from 2 to 11, averaging over all years 5.7, corresponding to a breeding density of 3.8 territorial pairs per 100 ha of suitable habitat. This is only 28.4% of total capacity of the oak forests within the study plot. In general, the breeding density dynamics has a general downward trend, most likely due to the extreme action of external factors: abnormal heat of summer 2010 and cold, snowy winter of 2010/11. No significant correlations were found between breeding density and any other weather factors.

POSTER 13

Breeding behaviour of the threatened Great Slaty Woodpecker *Mulleripicus pulverulentus*: Crucial insights from study in northwest India

Raman Kumar, Martjan Lammertink

The Great Slaty Woodpecker (*Mulleripicus pulverulentus*) is one of the world's largest surviving woodpeckers native to south- and southeast Asia. Its population has declined drastically due to habitat loss under logging and has been placed in the 'Vulnerable' category on the IUCN Red List. In spite of its conservation importance not much is known about the ecology of Great Slaty Woodpecker, particularly its breeding biology.

We initiated a study in the sub-Himalayan dipterocarp dominated forests in northwest India to investigate the reproductive behaviour and nest site characteristics of this woodpecker. Between 2016 and 2018 we located nest cavities. We collected detailed observations on nesting, incubation

and fledging behaviour. This is crucial information obtained for the first time for the Great Slaty Woodpecker, which is potentially crucial for conservation of the species. We present preliminary results from this ongoing study.

POSTER 14

Comparison of nesting ecology of three co-existing Atlantic Forest woodpeckers reveals narrow specialization in the Helmeted Woodpecker (*Celeus galeatus*)

Martjan Lammertink, Juan Manuel Fernández, Kristina L. Cockle

The Atlantic Forest in southeastern South America is a biodiversity hotspot with high species richness and high forest loss. Three large to medium-sized woodpecker species (Robust Woodpecker *Campephilus robustus*, 265 g, Lineated Woodpecker *Dryocopus lineatus*, 209 g, and the old-growth specialist, globally threatened Helmeted Woodpecker *Celeus galeatus*, 129 g) coexist in the southern portion of the ecoregion, and show remarkable convergence in plumage patterns and colouration, possibly driven by interspecific interactions. We examined nest tree species, nest substrates, and timing of breeding, to assess differentiation in these niche dimensions and to evaluate whether nesting ecology may be a factor explaining an association with mature forests in the Helmeted Woodpecker. Robust and Lineated Woodpeckers excavated cavities in a wide diversity of nine and eight nest tree species, respectively, whereas Helmeted Woodpeckers specialized narrowly on laurel trees (88% of nest cavities in two species in genus *Nectandra*). Helmeted Woodpecker is further distinguished by a more frequent use of living, partially decayed trees (69%, vs 13% for Robust and 35% for Lineated) and by more frequent re-use of nest cavities (32%, vs 0% for Robust and 0% for Lineated). When nesting in selectively logged forest (vs. old-growth), Robust and Lineated Woodpeckers used trees with smaller DBH (mean 48 vs 79 cm for Robust and 34 vs 60 cm for Lineated) and Robust Woodpeckers excavated lower in trees (9 vs 17 m). Helmeted Woodpeckers selected nest trees with similar dimensions in both environments (mean DBH 51 cm, height 9 m), indicating lesser flexibility. Helmeted Woodpeckers bred 20-23 days later in the year than Lineated and Robust Woodpeckers, potentially allowing them to avoid nesting near the two larger species. The narrow specialization of Helmeted Woodpecker on nesting in *Nectandra* trees of specific sizes and conditions is a possible factor in making it more sensitive to selective logging effects.

Nectandra trees are fairly common in the Atlantic Forest and are less desirable timber trees, but are exploited at increasing frequency.

POSTER 15

The comparison of vocalization of two distant populations of the Middle Spotted Woodpecker *Leiopicus medius*

Konrad Leniowski, Ewa Węgrzyn, Hugo Robles

Studies of vocal behavior in birds have made central contributions to animal behavior and the neuro-sciences. However, contrary to songbirds, not many studies have been dedicated to vocalisation in woodpeckers. The subject of our study, the Middle Spotted Woodpecker, is known for habitat requirements, moderate dispersion, poor drumming abilities and complex vocalisation relative to other woodpecker species. The aim of our study was to investigate whether two distant populations of the Middle Spotted Woodpecker, one from Northern Spain and the other from Western Poland, differ in vocalization. Studied populations are not only distant but they also occupy considerably different habitats, which can lead to microspeciation. As vocalization is likely to play an important role in sexual selection/pair formation, intraspecific variability in vocalization between studied populations may suggest barriers in gene flow. The results of our study demonstrated that vocalization of both populations consisted of 3 types of calls. The structure and the function of these calls did not differ between the populations. The lack of vocal differences between distant populations occupying different habitats suggests that calls produced by the Middle Spotted Woodpeckers are rather conservative.

POSTER 16

The role of invasive tree species in the winter habitat use of woodpecker species in riparian forest stands

Gábor Ónodi, Bence Szántó, Dénes Bálint, Eszter Csikós, Dániel Winkler

Large extant of Central European riparian willow-poplar forests are in the process of transformation, as the proportion of native tree species is decreasing. The cause of this situation could be partly due to the past river regulations, and due to invasive tree species. The two most important such tree species are the North American green ash and boxelder maple. These

species successfully hinder the development of native riparian woody species through allelopathy and high reproduction rates. Comparing to the native tree species, the green ash and boxelder maple have less arthropod species, inhabited their wood. Little is known about the influence of these tree species on the riparian forest bird communities. As woodpecker species play key role in forest ecosystems, it is crucial to better understand their habitat utilization in such transforming habitats. From December 2018 to February 2019, we make three-repeat winter transect surveys throughout twenty transects (from 1 to 2 km length each) in two landscape protection areas, along the bank of the river Tisza, in Eastern Hungary. These transects were appointed in forest stands of different tree species proportions. We compute the variable, 'bird per km' for each encountered woodpecker species for the analyses. We collect data on forest stand structure, in 0.05 ha circular plots along transects, in every 250 m units. We analyze, which environmental variables predict the occurrence of each woodpecker species, with the special interest on the density and basal area of invasive tree species. Our results from earlier studies suggesting, that most species occur in highest numbers in such stands with high tree species diversity, where numerous native and non-native tree species are both present.

POSTER 17

The complex link between secondary habitats and Lesser Spotted Woodpecker in a highly modified landscape

Zeno Porro, Gianpasquale Chiatante, Giuseppe Bogliani

Land use changes in Europe have produced forest loss, fragmentation and degradation. These have mainly occurred in lowlands and along rivers. A typical inhabitant of lowland forests is the Lesser Spotted Woodpecker, a tiny forest specialist woodpecker widespread in Europe. Whereas its conservation status is overall good, in some regions the species is showing a significant decline, which specific drivers are often unclear. In the present study we defined the environmental factors determining the abundances of Lesser Spotted Woodpecker in a central portion of the Po Plain, in northern Italy. In the study area, less than 10% of the whole territory is covered by broad-leaved forests, mainly oak and riverine forests, and poplar plantations. To gather a full picture on its habitat requirements, during breeding season the species was surveyed by the means of 112 repeated transect counts, all located in woodlands. In order to maximize

species detectability, playback calls were used. We investigated the effect of the amount and configuration of the various woodland types spread in the area, by using n-mixture models. First, comparing single variables models' AICs, we selected for each variable the strongest scale of effect, ranging from a local scale (100 m around the transect) up to a broad landscape scale (8000 m). Then we built a full model including all the variables at each selected scales. A positive interaction between broad-leaved forests and poplar plantations was highlighted at a 500 m scale. However, fragmented stands of poplar plantations, i.e. presenting a patchy pattern instead of continuous cover, were preferred. Higher abundances were linked to an intermediate extension of exotic *Robinia pseudoacacia* woodlands at a local scale (100 m). Even though resulting strongly connected to original remnant forests, the Lesser Spotted Woodpecker showed a substantial relationship with exotic and highly managed woodlands. This suggests that these secondary habitats can play an important, yet complex, role in favoring the species persistence in highly modified landscapes.

POSTER 18

Occupation of old black woodpecker cavities by honey bee colonies in Germany

Benjamin Rutschmann, Patrick Laurenz Kohl, Luis Sikora, Jürgen Tautz, Ingolf Steffan-Dewenter

For a long time, it was a common belief that feral honey bee colonies (*Apis mellifera* L.) were eradicated in Europe through the loss of habitats, domestication by man and spread of pathogens and parasites. Interestingly, almost no scientific data were available, neither about the past nor the present status of naturally nesting honey bee colonies.

In the last three years we assessed the occurrence and density of feral honey bee colonies in two German woodland areas based on two methods, the tracing of nest sites based on forager flight routes, and the direct inspection of trees with old black woodpecker cavities.

Our results show that feral honey bee colonies are more common than is generally assumed. They regularly inhabit tree cavities in near-natural beech forests at densities of at least 0.11–0.21 colonies/km². We found that feral honey bees are among the most common secondary users of black woodpecker cavities, occupying up to 13% of these cavities. We extrapolate that there are several thousand feral honey bee colonies in

German woodlands. Their occurrence has implications for the species' perception among researchers, beekeepers and conservationists. Protecting large habitat trees in managed forests therefore not only helps charismatic forest birds, but can also promote the occurrence and abundance of feral honey bee colonies. The large number of woodpecker cavities known and mapped by ornithologists will enable us to study the ecology of European feral honey bee populations in the future.

POSTER 19

Population trends of woodpecker species in pine dominated forests of western Norway 1994-2014

Magne Sætersdal, Ivar Gjerde, Einar Heegaard

The pine dominated forests of western Norway have been found to harbour viable populations of woodpeckers. The aim of this study was to resurvey 60 plots (each 1 km²) originally surveyed during 1994/1995. The resurvey was performed in 2013/2014. The White-backed Woodpecker was found to be the most common woodpecker species in both time periods. The Grey-headed Woodpecker declined from 27 % of the 60 plots in 1994/95 to only 12 % in 2013/14. This decline was found to be statistically significant. The other four species all increased in frequency; although none of those increased frequencies were found to be statistically significant. We discuss possible explanations to why pine forests in western Norway constitute a valuable habitat for the White-backed Woodpecker. Furthermore, it is suggested that this species has increased in numbers and distribution in western Norway during the last 100 years at the same time as it has drastically declined in most of western Europe. The reduced density of Grey-headed Woodpecker is not fully understood, although we suggest that cold winters during the years prior to the surveys in 2013/14 may partly explain the reduction.

POSTER 20

Nestling diet and breeding success of the White-backed Woodpecker *Dendrocopos leucotos* in managed forests of Central Europe

Lisa Schenk, Antonia Ettwein, Gilberto Pasinelli

Most European forests are strongly shaped by forest management, causing an altered tree species composition and a reduced amount of deadwood compared to primeval conditions. The white-backed woodpecker is one of the rarest woodpecker species in Europe mainly found in deciduous forests with high amounts of deadwood, which is used for nesting and foraging for saproxylic invertebrates. Population declines in central and northern Europe over the last decades seem to be a consequence of intensified forest management. By contrast, the westernmost population of the subspecies *leucotos* located in Western Austria and Eastern Switzerland is increasing and also colonizes managed forests. Previous research indicates a relatively low breeding success in this population compared to other European populations. The aims of the study were to investigate, whether nestling diet, feeding rates and breeding success were related to habitat quality. Using camcorders and spotting scopes, feeding rates and the composition of the nestling diet were recorded at 26 nests in 2017 and 2018. Clutch size and the number of nestlings before fledging were determined with an endoscope camera attached on a fiberglass pole. Results on the relationships between feeding rate, nestling diet and reproductive success, respectively, and habitat factors (e.g. the amount of dead wood, tree species composition, forest age) within territories determined by VHF telemetry will be presented.

POSTER 21

Influence of microhabitat characteristics on the duration of foraging session in relation to sex of the Great Spotted Woodpecker in a primeval oak-hornbeam-lime forest of the Białowieża National Park

Tomasz Stański, Dorota Czeszczewik, Marzena Stańska, Wiesław Walankiewicz

Different foraging habits of particular woodpecker species reduce competition for food what allow them to coexist in the same habitat.

Resource partitioning is also common between sexes in many woodpeckers, which minimize intersexual foraging competition. The Great Spotted Woodpecker (*Dendrocopos major*) in spite of its flexible food demands may favor specific trees or localities as foraging sites. Moreover, such preferred places may be different for males and females of this species. The main goal of our study was to identify the parameters of the most attractive microhabitats for the Great Spotted Woodpecker, used as food resources, i.e. places where the foraging time was the longest, and to find the intersexual differences in microhabitat utilization during foraging. The study was conducted in the primeval oak-hornbeam-lime forest of the Białowieża National Park (E Poland). A total of 432 foraging observations (220 males and 212 females) were included in the analysis. Our study revealed that the longest foraging sessions were on the Norway spruce, whereas the shortest ones were on the hornbeams. Length of foraging session increased significantly with the height of foraging site. The microhabitat utilization for both sexes was generally similar. However, females significantly longer than males foraged on dead parts of trees while no such difference between sexes was found on alive parts of trees. Moreover, females foraged longer on trees with larger diameter at breast height. Our findings may suggest that even in the primeval forest of the Białowieża National Park, which is a very rich habitat, intersexual competition for food exists.

POSTER 22

Structure and function of drumming in Middle Spotted Woodpecker *Dendrocoptes medius*

Kyle Turner

Sound recordings made of Middle Spotted Woodpeckers in France during four breeding seasons demonstrated occasional use of weak and erratic drumming at potential nest hole sites. Eighty-nine drum roll elements were analysed, the majority being combined with tapping. Strike patterns and amplitude showed no regularity. Five additional, verified, recordings (four from Germany and one from Luxembourg) confirm the idiosyncratic nature of these instrumental signals. After a century of conflicting evidence for drumming in this species, this is the first study to give a clear description of this form of communication and to relate it to its behavioural context.

The poster will present tables of incidence, spectrograms, pulse train analyses (showing amplitude of strikes) and interval counts. Comparisons

with different forms of drumming in other European woodpecker species will also be illustrated. Headphones will be available to listen to a selection of examples.

POSTER 23

Good practices in forest management which are beneficial for keystone function of the Black Woodpecker in forest ecosystems

Bartłomiej Woźniak, Oliwia Karpińska, Mateusz Grzębkowski

The Black Woodpecker *Dryocopus martius* is quite common and widespread species in Polish forest ecosystems. Keystone role of this species is the most important in managed forests proof the habitat for secondary cavity-living animals. In this study we evaluate the Black Woodpecker's influence as a keystone species for secondary cavity-living animals in different types of forest including managed and protected areas. The study was conducted in area c.a. 36,4 km² in Sobibór Forest (eastern Poland) in 2012-2015. Whole study plot was carefully searched for all kind of Black Woodpecker holes in autumn-winter season. All cavities were checked at least twice during every breeding season (April-July) using climbing spurs and endoscope.

375 Black Woodpecker's holes were found on study area, a small percentage of them were cut off during the studies. 30 species from 3 Classes were found occupying holes. The most numerous were Stock Dove *Columba oenas*, tits *Paridae*, Black Woodpecker and also *Vespidae* family.

The occupancy of holes by the secondary hole-living animals were higher in conifer forests than broadleaf due to little availability of natural holes in this habitat. We found the highest occupancy in young age classes of forest (up to 60 years) and manage practices were moderately for settle those suboptimal habitats. The resignation from timber harvesting of black woodpecker-available trees: residual Scots Pines *Pinus sylvestris* and fast growing Common aspens *Populus tremula* were most important for hole nesters in young parts of conifer forests.

In order to save the biodiversity in managed forest it's important to preserve diverse tree stand structures which are beneficial for the woodpeckers and secondary cavity-living animals. Our recommendation for forest management is also to retain residual trees, old-growth patches and fast-growing with optimal soft woodtree species groups like Aspen and Birch.

POSTER 24

Does the forest management affect the choice of nesting trees by the black woodpecker?

Grzegorz Zawadzki, Dorota Zawadzka

The black woodpecker *Dryocopus martius* is recognized as a species dependent on the mature forests, needed at least a group of old trees to excavate cavities. In Poland, during the last 20 years, those species have shown a medium increase in number. In Augustów Forest, the black woodpecker is a numerous, common breeding species. In 2018, inventory of newly excavated cavities by the black woodpecker was carried out. The cavities were present exclusively in Scots pine *Pinus sylvestris*. Occupied old or newly created cavities were located: (i) inside of stands, (ii) on the edge of stands, (iii) in the old-growth islands, (iv) in the single trees growing on the clear-cutting areas. Among 30 founded cavity-trees occupied by woodpeckers, the most numerous were trees on the edge of stands (30%), then in single trees (27%), inside of stands (23%), and in old-growth islands (20%). Dead trees accounted for 40% of cavity trees found. Interestingly, all single trees on clear-cuttings were dead. The selection of individual trees on the cutting areas cannot be explained by the lack of old-growth trees in the surrounding and home ranges. Our results indicate that the black woodpecker in the Augustów Forest shows preferences for the decay phase of the stand, with a loosening canopy cover and a large proportion of the open area. In the managed forests in Poland, such tree stands have been missing so far, but putting into practice the recommendations of leaving old grow islands and individual cavity trees on the cutting areas in an artificial way promotes the reconstruction of the missing phase of the decay of stands. This has contributed to the previously unrecognized phenomenon of excavating cavities in individual trees left on logging surfaces. This proves the high ecological plasticity of the black woodpecker, and on the scale of the entire country, it may be one of the reasons for the increase in the number of species, despite the lowering of the age of cutting in Polish forests.

POSTER 25

Conservation measures in White-backed Woodpecker (*Dendrocopos leucotos*) and Three-toed Woodpecker (*Picoides*

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***tridactylus*) habitat in Natura 2000 sites Kočevsko – implementation of LIFE Kočevsko project (LIFE13 NAT/SI/000314)**

Denis Žitnik, Gregor Danev

Natura 2000 sites Kočevsko (SPA and SAC) measure more than 100.000 ha and are the largest Natura 2000 sites in Slovenia. They are located in southeastern part of Slovenia and are part of Dinaric mountain chain that continues into the Balkan Peninsula. Over 90 % of the area is covered with forests, dominated by beech (*Fagus sylvatica*) and silver fir (*Abies alba*). In the shelter of the forests, numerous rare and threatened species found their refuge, making Kočevsko one of the most biologically complex European forest ecosystems. In accordance with field data from 2015 woodpecker census, 40-50 pairs of White-backed Woodpecker and 30-40 pairs of Three-toed Woodpecker breeds in Kočevsko region. We estimate that low population densities of both woodpecker species reflects low amounts of deadwood especially in state owned managed forests. Project *Conservation of Natura 2000 sites Kočevsko* or LIFE Kočevsko (<http://life-kocevsko.eu/>) deals comprehensively with the active protection of Natura 2000 sites Kočevsko. The main objective of the project is the implementation of concrete conservation measures to improve habitat conditions and consequently achieve a favourable conservation status of some critically endangered forest bird species. For both woodpecker species, several new conservation measures were implemented in 2017 and 2018. Core management zone for each species was established based on habitat requirements and woodpecker census data. Management zones were then adopted in forest management plans and represent the basis for the implementation of short and long term conservation measures. In close cooperation with field foresters, 116 remote locations for implementation of conservation measures were selected. Specifics of each location such as tree species composition, growing stock, slope steepness, remoteness, economics and presence/absence of forest roads was considered during selection. In state owned forests, ecocells (set-asides, unmanaged forests) were established, leaving forests in those areas to develop naturally. Ring-barking (tree girdling) was used as silvicultural measure instead of regular thinning in some pole and regeneration stand stages. Ringed trees were then left in the stand to decay naturally, thus accelerating deadwood accumulation. In privately owned forests, leasing contracts with forest owners were signed for the period of 20 years. Forest owners agreed to left ecocells or single habitat trees to develop naturally in exchange for money compensation. Since this kind of forestry practice had previously

not been used in this area, special efforts have been made to educate field foresters and other forest managers about the new silvicultural techniques and conservation measures.

EXCURSION INFORMATION

Mid-conference excursion to the Białowieża National Park (March 18) – for all conference participants.

Walking tour (5-6 hours, but shorter route will also be available to those who are willing) to the oldest, strictly protected part of the BNP. Groups of 12 people led by experienced biologists will learn about several types of the best-preserved natural forests with primeval features. Observation of woodpeckers and other animals are possible.

Post-conference excursion to the Biebrza National Park (March 20-22) – for signed up participants only.

The excursion will take us to the famous Biebrza National Park, the largest of Poland's 23 National Parks. Biebrza National Park protects vast and relatively untouched fenlands with a unique variety of several communities of plants, rare wetland birds and mammals such as moose, wolf and beaver and other animals. Although difficult to predict, there should be huge flocks of migrating geese and other birds. In nearby forests, participants might be able to observe local woodpeckers.

March weather is difficult to predict. Participants should bring comfortable and waterproof shoes (longer rubber boots preferable, some trails can be partially flooded), clothes for warm and cold weather and necessarily something to protect against rain. Some walking tours will last several hours without the possibility of a quick return to the bus. Also, a small thermos can be useful.

Tentative plan of the post-conference excursion (subject to changes, depending on the current weather conditions):

Day 1 (Wednesday, March 20):

- 8:00 Departure from Hotel Białowieski. Transfer by bus through picturesque villages in the region of the Białowieża Forest to the valley of the Narew and Biebrza River. Observations in Burzyn and Brzostowo
- 13:00 Lunch in Dobarz
- 14:30 Walk along the path through the swamps in Barwik
- 18.00 Dinner in Dobarz

Day 2 (Thursday, March 21):

- 6:30 Breakfast
- 7:15 Travel to Leśniczówka Grzędy
- 8:45 Walk through Czerwone Bagno reserve (c. 8 km)
- 13:15 Travel to Dobarz (lunch in the bus)
- 15:30 Observations near Carska Droga: Bagno Ławki, Długa Luka (c. 15 min. walk), bridge near Zajki
- 18:00 Dinner in Dobarz

Day 3 (Friday, March 22):

- 7:00 Breakfast in Dobarz
- 8:15 Transfer by bus to Mocarze, Wizna (observations of migrating birds and moose). Then transfer to Warsaw where the excursion ends at about 15:00 at the Chopin Airport.

PROGRAM FOR ACCOMPANYING PERSONS

The fee paid by persons who will accompany a registered conference participant and not take part in the sessions and lectures includes lunches, dinners, conference dinner and the following excursions:

Sunday, March 17

Excursion to the Bison Reserve, walk through Żebra Żubra path, visit of the Natural History Museum.

Monday, March 18

Excursion to the BNP together with all participants.

Tuesday, March 19

Exploring of the Białowieża Forest: Krajobrazy Puszczy trail, Wysokie Bagno reserve; walk through Podolany and Białowieża village, watch tower, observations of beaver.

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