

Book of abstracts

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The scientific committee of IGS 2026



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Keynote talks

Resilience and vulnerabilities of *Lagopus* to environmental change; individual, population and species distribution perspectives

Kathy Martin — University of British Columbia and Environment and Climate Change Canada — Canada

Lagopus are high latitude and high elevation birds inhabiting tundra, taiga and mountain habitats across North America, Europe and Asia. As cold tolerant birds, *Lagopus* individuals and their habitats are considered vulnerable to climate warming. However, in places where populations have declined, the driving mechanisms have mostly not been determined. *Lagopus* species exhibit considerable life history variation from a relatively fast life style (short lived, high fecundity) of Willow Ptarmigan in lower latitudes to the slower life history of Rock Ptarmigan where the survival of adults is most important to population persistence. Within species, White-tailed Ptarmigan show considerable within life history variation such that the northern populations in Canada have faster life styles than in the Southern Rocky Mountains where they have a slower life style (smaller clutches, less re-nesting) but are longer lived. With climate variability, *Lagopus* experience immediate environmental challenges to breeding and ultimately to changes in their open habitats. I will talk about vulnerabilities and resilience of all *Lagopus* species to environmental variability from multi-scale perspectives (from eggs to landscapes). At the individual level, birds are challenged by strong temporal variation in snow melt conditions that can modify the onset of breeding and thermal dynamics during reproduction which can have consequences at the population level given changes in predation and fecundity/offspring survival. *Lagopus* are well adapted to cold temperatures and extreme environmental conditions, and can maintain hatching rates >90%, but show strong inter-specific variation. In response to delays in spring snow melt in northern Canada where two *Lagopus* species co-exist in sympatry, the slower life style Rock Ptarmigan had a greater reduction in clutch size than the shorter-lived White-tailed Ptarmigan (faster life style). At the landscape level, warming climates and extended growing seasons result in loss of snow fields and reduced habitat suitability with rising shrub and tree lines. Where habitats are secure, *Lagopus* species demonstrate good resilience to environmental variability. However, across their ranges, vulnerabilities are rising, with variable consequences for the status of *Lagopus* globally.

Grouse translocations: successes, failures, and lessons

Michael Schroeder — Washington Department of Fish and Wildlife — USA

Deliberate translocations have been used throughout the world to increase hunting opportunities and, more recently, to address conservation concerns. There is no group that illustrates this more than grouse in the northern hemisphere. Documented translocations in western North America include more than 9,000 greater sage-grouse (*Centrocercus urophasianus*), almost 500 Gunnison sage-grouse (*Centrocercus minimus*), and more than 4,000 sharp-tailed grouse (*Tympanuchus phasianellus*). There are similar numbers for the other species of grouse. Although many grouse translocations were introductions into areas where the species was not originally found, the vast majority could be considered conservation translocations, designed to either reintroduce grouse to an area where they had been extirpated, or to augment declining and/or at-risk populations. A general goal of these conservation translocations is to stabilize and/or increase the distributions and populations of the target species. There is a long history of these translocations, stretching back about two centuries. The vast majority of translocations can be considered failures in that the original goal was not achieved. The reasons for these 'failures' include insufficient habitat quantity and quality, methodological problems, and/or genetic incompatibility. If we believe that translocations are an essential component of effective management in an increasingly altered landscape, examination of these patterns of failure and success may provide insight into a path forward.

A century-long quest for the key to unlock the secrets behind the dynamics of Scandinavia's alpine food web

Erlend B. Nilsen — Faculty of Aquaculture and Biosciences, Nord University — Norway

The food webs in alpine and subalpine ecosystems in Scandinavia are characterized by large interannual fluctuations in many key species populations. The willow ptarmigan is among the species that have been characterized by such large-scale fluctuations. Willow ptarmigan is a species of high cultural value and for many people an iconic symbol of northern mountain landscapes. It is also an economically important species both historically and at present time. On that background, there is no surprise that willow ptarmigan population dynamics have been intensively studied over more than a century. In this talk, I will present key insights about the dynamics of Scandinavia's alpine food web, viewed through the lenses of historical and contemporary research on willow ptarmigan. I will describe how systematic research on willow ptarmigan in Norway was first initiated following an influential lecture by Dr. Fridtjof Nansen in 1914. I will track central hypotheses about the main mechanisms underlying the large-scale temporal fluctuations in abundance, from their initiation in the early 1900s. Interestingly, although Nansen in his influential 1914-lecture advocated for the key role of parasites in shaping the population dynamics, this model has in general received relatively little attention in Norwegian ptarmigan research. Other hypotheses, such as the migration hypothesis that was popular among many contemporary naturalists, were already dismissed based on early research in the 1920s and onwards. On the other hand, hypotheses that relate breeding phenology and breeding output to spring weather conditions remain supported by present day research. Moreover, the top-down impact of predation has received continued focus, and the "Alternative Prey Hypothesis", that was formally presented in the early 1950s, has since played a dominant role in the willow ptarmigan research program. Finally, the role of harvest has remained a topical issue for discussion from the early days of willow ptarmigan research, and has been thoroughly investigated based on both experimental and correlative data. Although much progress has been made, important knowledge gaps remains to be filled to understand food web dynamics in the era of rapid environmental change.

Monday 31. August

Chasing climate change: Temperature and precipitation affect temporal advancement rate in capercaillie lekking phenology across Europe

Keywords: *Climate change; Phenology; Capercaillie; Weather; Lekking*

Category: Talk 15

Joy Coppes — Forest Research Institute of Baden-Württemberg, Germany — Germany
Robert Moss — Station House, Crathes, Scotland
Emmanuel Menoni — retired from National Office of Biodiversity, France
Per Wegge — Faculty of Environmental Sciences and Natural Resource Management, Norwegian University of Life Sciences, Ås, Norway
Jim-Lino Kämmerle — Forest Research Institute of Baden-Württemberg, Germany

Climate change, particularly global warming, has been shown to affect the timing of breeding in many bird species. Here, we analysed long-term data on the timing of peak lekking activity in capercaillie (*Tetrao urogallus*) from eight study sites across Europe to assess the rate of advancement in relation to local climatic characteristics. The study sites spanned a wide geographic range, including Varaldskogen (Norway), the Southern and Northern Pyrenees (Spain and France), the Eastern Alps (Austria), the Scottish Highlands (Scotland), the Jura and Vosges (France), and the Black Forest (Germany), with time series ranging from 20 to 42 years per site. We found substantial differences among sites in the rate of temporal advancement. The slowest shift occurred in Varaldskogen (average 0.12 days per year over 42 years), while the fastest was observed in the Black Forest (average 0.58 days per year over 26 years). The rate of advancement in peak lekking activity increased significantly with both annual precipitation and mean minimum temperature: warmer and wetter sites showed faster advancement than colder, drier ones. Moreover, advancement was significantly faster at sites with smaller mean changes in minimum April temperatures. Cold sites showed the slowest progression regardless of precipitation volume or interannual temperature variation. In contrast, the warmest sites, characterized by higher precipitation volumes, exhibited the fastest advancement. A few sites that were warm but with relatively little precipitation, with low interannual variability in temperature, advanced more slowly. These findings demonstrate that climate-related factors—particularly temperature and precipitation—strongly influence the temporal advancement of capercaillie lekking activity across Europe. Although populations of bird species in colder regions typically advance breeding phenology more rapidly than those in warmer regions, our study revealed the opposite pattern. These differences suggest that local climatic conditions and the interaction between temperature and precipitation—rather than latitude or altitude alone—drive inter-population variation in the species' response to ongoing climate change.

Conservation of Capercaillie (*Tetrao urogallus*) in the Augustowska Forest, Poland

Keywords: *capercaillie; telemetry and habitat; corticosterone stress; breeding center; birds release*

Category: Talk 15

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Aneta Książek — Faculty of Biology, University of Białystok, Ciołkowskiego 1J, 15-245 Białystok, Poland
Sylvia Buczyńska — Faculty of Biology, University of Białystok, Ciołkowskiego 1J, 15-245 Białystok, Poland
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One of the few areas of capercaillie occurrence in Poland is the Augustów Primeval Forest APF (1000 km²), where, since the mid-20th century, a rapid decline in capercaillie abundance has been observed. In 2013, the population was estimated at around 30 individuals. To increase the number of these birds and

provide them with long-term protection, projects financed by the EU and Forestry Funds have been carried out in APF since 2013, with the key activity being the reintroduction of birds into the wild. In the years 2014-2025, 254 capercaillies were released in the PA, including 54 wild capercaillies translocated from Russia and 200 reared in breeding centers. The annual population inventories, based on direct observations and capercaillie voice and bioacoustic recordings collected at leks, confirmed that the decline trend had halted and that the current number of birds is at a minimum. 46 to max. 60 individuals. Studies using VHF and GPS telemetry (data from ca. 60 VHF and GPS transmitters) confirmed that capercaillies prefer marshy, fresh pine forests with blueberry (*Vaccinium myrtillus*), and their distribution is strongly influenced by habitat quality and reduced human pressure. Home ranges averaged for males: 17.44 ± 23.75 km² and females: 31.82 ± 42.89 km². Capercaillies introduced from wild populations had larger home ranges (26.06 ± 31.73 km²) than reared birds (17.90 ± 30.33 km²). The overall density of forest cover, including tree density and particularly understory density, negatively influenced capercaillie presence. To assess individual birds' responses to environmental stress, the level of fecal glucocorticoids (FG), a reliable biomarker, was analyzed (ca. 1000 fecal samples collected in 2016-2023). First, a quantitative method for measuring FG using an ELISA immunoassay was developed. Then, laboratory and statistical analyses of 863 fecal samples obtained from the wild-living population and the breeding center were conducted. The following results were obtained: FG levels are significantly higher in spring, March-May, than in other seasons, and do not depend on sex or the origin (wild vs. bred birds). Older (more than 1 year) individuals manifested slightly higher FG levels. Our results support the legitimacy of aviary breeding and releasing birds into the natural environment as a means for Capercaillie conservation. The breeding program carried out in APF will continue to provide a comprehensive approach to conservation, including bird release, habitat improvement, predator population control, sustainable forest management, and the use of advanced monitoring technologies such as audio and telemetry recordings, as well as genetic population monitoring.

Exploring demographic and climatic drivers of seasonal survival for white-tailed ptarmigan using a historical dataset from Colorado, USA

Keywords: *demography; ptarmigan; mark-recapture; seasonal survival; climate*

Category: Talk 15

Nicholas Parker — Colorado State University — United States

Greg Wann — U.S. Geological Survey, USA

Meghan Mahoney — Colorado State University, USA

Sara Oyler-McCance — U.S. Geological Survey, USA

Clait Braun — Grouse, Inc. USA

Cameron Aldridge — U.S. Geological Survey, USA

Differences in survival across seasons play a key role in structuring demographic trends in wildlife populations. For species occupying alpine and arctic environments, snow and cold weather make studying survival during the winter difficult, and most studies have focused on survival during the summer breeding season. Obtaining a better understanding of full annual cycle survival dynamics, particularly during the understudied winter months, is crucial to advancing knowledge of these unique species. We used a historical dataset collected over 20 years (1966–1985) to explore trends in seasonal survival for a breeding (May–September) and nonbreeding (October–March) population of white-tailed ptarmigan (*Lagopus leucura*) in Colorado, USA. We fit open-population mark-recapture models to estimate apparent survival and investigated the influence of demographic and weather variables on seasonal survival of white-tailed ptarmigan. We found differences in apparent survival between ages, sexes, seasons, and populations. Survival was lowest for juveniles during their first winter, especially in years with greater snow depth. Survival of yearlings (1 year old) equaled or surpassed survival of adult birds (2+ years old), regardless of season. Adult survival was generally high during winter, with greater winter survival linked to colder winter temperatures and increased precipitation in the previous summer. Summer survival did not exhibit clear trends with any weather variables examined, but was generally lower for females, likely associated with increased risk during reproduction and dispersal. Our results suggest key differences in white-tailed ptarmigan survival between seasons, with different climatic and demographic drivers underlying these trends. Unraveling such complexities across the full annual cycle provides insight into how species occupying highly seasonal alpine environments may respond to shifting seasons and weather patterns in the future.

Using genomic tools to understand diversity and diet in declining Columbian Sharp-tailed Grouse (*Tympanuchus phasianellus columbianus*)

Keywords: *genomics; conservation; evolutionary biology; metabarcoding; grouse*

Category: Talk 15

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Morgan Calahan — Boise State University, United States
Michael Atamian — Washington Department of Fish and Wildlife, United States
Jeffrey L. Beck — University of Wyoming, United States
Sven Buerki — Boise State University, United States
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Stephanie Hudon — Boise State University, United States
Michael Schroeder — Washington Department of Fish and Wildlife, United States
Justin Small — Nevada Department of Wildlife, United States
Jennifer Struthers — Idaho Department of Fish and Game, United States
Heather Talley — Utah Department of Natural Resources, United States

Columbian Sharp-tailed Grouse (*Tympanuchus phasianellus columbianus*, hereafter CSTG) were once widespread across western North America, but have experienced significant decline due to anthropogenic change and now occupy less than 5% of their former range. To improve our knowledge of this rapidly declining subspecies and inform management, our team has developed genomic tools to understand how remaining diversity is structured across the Intermountain West and how these birds are interacting with habitat through diet. We have developed a high quality reference assembly for CSTG and resequenced genomes of individuals across the range ($n = 130$) to estimate remaining genome-wide diversity (i.e., heterozygosity and runs of homozygosity) and population structure. Plains Sharp-tailed Grouse (*T. p. jamesi*) were additionally sequenced ($n = 15$), to provide a relevant outgroup for comparative analyses. Using non-invasively collected fecal samples, our team has also generated metabarcoding data (p-6 loop of trnL) to understand dietary diversity from the northern edge of the range (British Columbia, Canada) through its southern extent (Colorado, USA). Reference assembly statistics indicate that the CSTG reference assembly is high quality, but has low genome-wide heterozygosity, which may be a sign of recent demographic decline. Preliminary analysis of genome-wide variants indicates isolation and structure of populations across the range. Diversity—as measured through heterozygosity and runs of homozygosity—is variable across the range of CSTG, but heterozygosity is lower and runs of homozygosity are higher in CSTG when compared to Plains Sharp-tailed Grouse. Finally, diet metabarcoding indicates variation of diet across space and time of Columbian Sharp-tailed Grouse, with higher diversity seen from grouse in British Columbia. Results from this study provide an exciting first look into the range-wide genomic and dietary diversity of this declining subspecies and will assist managers in prioritizing populations for conservation actions and in identifying potential source and recipient populations for conservation translocations.

Greater sage-grouse and the expanding conservation genomics toolkit

Keywords: *sage-grouse; conservation; genomics; adaptive divergence; natural selection*

Category: Talk 15

Shawna Zimmerman — U.S. Geological Survey — United States of America
Cameron Aldridge — U.S. Geological Survey, United States of America
Jennifer Fike — U.S. Geological Survey, United States of America
Sara Oyler-McCance — U.S. Geological Survey, United States of America

Technological advancements over the past two decades have led to a rapid expansion of the conservation genomic toolkit available to species of grouse. Formerly limited to sampling a few loci in the genomes of a few individuals to understand basic genetic diversity and coarse population parameters, we can now sequence the entire genome of hundreds of individuals to better understand genome-wide patterns of

adaptive divergence and explore questions regarding functional differences among populations and investigate links to fitness. An understanding of how environmental variation has shaped populations is an important part of a species biology and crucial to effective long-term management. For the greater sage-grouse (*Centrocercus urophasianus*), previous work has characterized range-wide population structure, some of which is suggestive of environmental adaptation. In recent years, we have developed an annotated greater sage-grouse genome and created a range-wide whole-genome sequencing data set that includes 362 individuals from 26 populations across the range. We are currently using these data to better understand and gain conservation insight regarding two aspects of adaptive divergence for the greater sage-grouse: 1) climate adaptation and predictions of future maladaptation, and 2) dietary adaptation to digestion of secondary metabolites in sagebrush leaves. We will present our findings to date with focus on the relevance to conservation and management.

Geographic variation in the Spruce Grouse (*Canachites canadensis*) based on whole genome sequences

Keywords: *Spruce Grouse; DNA; phylogeography; hybrid zones; Prince-of-Wales Spruce Grouse*

Category: Talk 15

George Barrowclough — American Museum of Natural History — United States
Michael Schroeder — Washington Dept. Fish & Wildlife, USA
Rocky Gutierrez — University of Minnesota, USA

The North American Spruce Grouse (*Canachites canadensis*) has a geographic range extending across the coniferous forests of Canada and the northern United States. Although six subspecies are generally recognized, the complex is comprised of three morphologically distinctive populations: the nominate Spruce Grouse (*C. c. canadensis* plus three additional subspecies) in the northern boreal forest, the Franklin's Grouse (*C. c. franklinii*) in the western cordilleran forest, and the Prince-of-Wales Grouse (*C. c. isleibi*) on a few islands in southeast Alaska. The ranks of these major groups are controversial: at various times each of them has been considered a separate species. Prior genetic studies of the complex consisted of small fragments of the mitochondrial and nuclear genomes with apparently inconsistent results. For example, a recent mitochondrial DNA study, based on limited geographic sampling, suggested the Prince-of-Wales population was genetically divergent from the nominate Spruce Grouse, but Franklin's Grouse was not. We used whole genome sequences to investigate geographic variation and species status in the Spruce Grouse complex. The pattern of geographic variation among the nuclear genome sequences was concordant with the three distinctive plumage groups and consistent with little introgression between Spruce and Franklin's Grouse. Complete mitochondrial sequences also comprised three clades, but the Spruce Grouse—Franklin's Grouse division was geographically offset from the nuclear DNA and plumage transitions by approximately 500km. Along the front range of the Rocky Mountains in southern Alberta, the nuclear and morphological transitions between Spruce Grouse and Franklin's Grouse were both very sharp and consistent with restricted gene flow across the Bow River. We suggest these represent three species-level taxa. The Prince-of-Wales population is restricted to a few islands in the Alexander Archipelago in southeast Alaska. It is genetically distinct at mitochondrial, Z-linked, and autosomal nuclear DNA loci. It possesses less than half the genetic variability of the two continental populations, suggesting a significantly smaller effective population size and the possible need for separate conservation management.

Arctic-alpine specialists are being replaced by widespread species in Scottish mountain areas

Keywords: *alpine; arctic-alpine birds; mountain birds; thermophilization; Rock Ptarmigan*

Category: Speed

Anthony Wetherhill — British Trust for Ornithology Scotland — United Kingdom

David Jarrett — British Trust for Ornithology Scotland

Mark Wilson — British Trust for Ornithology Scotland

John Calladine — British Trust for Ornithology Scotland

Scottish arctic-alpine bird communities occur at the southern edge of the European range of several cold-adapted species and are likely to be particularly vulnerable to climate warming. However, repeat monitoring of these high-elevation communities is limited, making it difficult to assess long-term changes in abundance, distribution and community composition. We used repeat surveys to test whether Scottish mountain bird communities show evidence of thermophilization: a shift towards species associated with warmer conditions, through declines or upslope retreat of cold-adapted specialists and increases in more widespread generalist species. We repeated standardised transect surveys at 21 Scottish arctic-alpine sites across three survey periods: 2005–06, 2013–14 and 2024–25. Surveys were carried out between May and July and bird counts were standardised as count-per-kilometre to account for survey effort. For species with at least 50 recorded individuals, we modelled changes in counts in relation to survey period and elevation using generalised linear mixed models. We also tested for changes in species' elevational distributions between survey periods using pairwise ANOVA tests. Arctic-alpine specialists showed consistent declines in count-per-kilometre between 2005–06 and 2024–25, including Rock Ptarmigan *Lagopus muta*, Eurasian Dotterel *Eudromias morinellus* and Snow Bunting *Plectrophenax nivalis*. In contrast, several more widespread species increased across survey periods, including Meadow Pipit *Anthus pratensis*, Northern Wheatear *Oenanthe oenanthe* and European Golden Plover *Pluvialis apricaria*. Evidence for elevational shifts was mixed within the relatively narrow range of elevations sampled, although Rock Ptarmigan showed a significant upslope shift. These results are consistent with patterns reported from other European mountain systems, where warm-adapted generalists are increasingly replacing cold-adapted specialists in mountain habitats. They suggest a challenging outlook for Scotland's arctic-alpine birds, particularly the endemic Scottish Rock Ptarmigan subspecies, and highlight the need for targeted research to identify mechanisms of decline and inform conservation interventions.

Comparing the Effects of VHF and GPS Transmitter Configurations on Greater Sage-Grouse Survival

Keywords: *adult survival; animal marking effects; greater sage-grouse; high frequency location data; transmitter*

Category: Speed

Jonathan Dinkins — Oregon State University — USA

Stephanie M LeQuier — Oregon State University; USA

Terrah M Owens — Idaho National Laboratory; USA

Kayla A Ruth — San Diego State University; USA

Richard P Rich — Oregon State University; USA

Ian W Scott — Oregon State University; USA

Jonathan B Dinkins — Oregon State University; USA

Rump-mounted solar GPS Platform Transmitter Terminals (PTTs) have become widely used to collect location data on Greater Sage-Grouse (*Centrocercus urophasianus*; hereafter Sage-Grouse) and other gallinaceous species. These PTTs provide year-round fine-scale movement data that far surpasses the capabilities of traditional very high frequency (VHF) radio transmitters. However, there is evidence that rump-mounted PTTs negatively impact adult Sage-Grouse survival when compared to VHF necklace-style transmitters, which are known to have negligible survival consequences. While the mechanisms behind

this reduction in survival are not fully understood, the transmitter's placement on the rump rather than the neck is suspected to play a part. Unfortunately, use of VHF tracking requires labor-intensive ground tracking or costly telemetry flights with a limited number of location fixes per animal. To mitigate survival impacts while still collecting detailed spatial data, we tested a novel combination of VHF and GPS tracking technologies. We paired a 22g Holohil VHF necklace-style transmitter with a small, 4-6g GPS logger. We compared survival of hens fitted with this new configuration to hens fitted with VHF necklaces alone and rump-mounted PTTs. Using data from a total of 481 adult female Sage-Grouse captured in eastern Oregon and north-central Wyoming between 2017 and 2025, we analyzed the effects of each transmitter configuration on monthly and annual adult survival using a Cox proportional hazard model. This study quantifies the survival impacts of different tracking technologies, providing critical insights for researchers seeking to balance fine-scale data collection with the need to minimize risks to sensitive species.

Using GPS and drone technology to monitor the threatened population of Red Grouse (*Lagopus scotica*) in Ireland: a first look

Keywords: *Spatial ecology; Thermal drone; Gamebird; National Survey; Predator prey*

Category: Speed

James O'Neill — University College Cork — Ireland
John Quinn — University College Cork
Sinéad Cummins — National Parks and Wildlife Service

The Red Grouse (*Lagopus scotica*) is a threatened species in Ireland, with a severe decline in range since 1970 and a current population estimate of 4,000 individuals leading to its placement on the Irish red list of birds of conservation concern. Recent studies have shown that Irish Red Grouse are genetically and physically distinct from British populations, suggesting probable adaptation to local environmental conditions and indicating their inherent value as a unique member of the native Irish faunal community. The pressures faced by this species are thought mainly to be due to the loss and degradation of its preferred peatland and heath habitats because of intensified forestry, agricultural and peat harvesting activities. Predation, hunting and human disturbance may be additional concerns. Beginning in December 2025, this project is the first to use GPS tracking to investigate the movements of this species, with a focus on female individuals. With this method, in combination with the use of thermal drone technology, we aim to understand the habitat, dietary and landscape preferences of Irish Red Grouse in fine detail, monitor their breeding success, and better assess the effects of human activity on the species to inform effective land management practice for conservation balanced against the needs of stakeholders and landowners. Here, we report on the lessons and findings from our first season of using these methods at an upland site where forestry is a particular concern for the species.

An examination of white-tailed ptarmigan mating systems for two populations in Colorado, USA

Keywords: *Genetics; Mating systems; Extra pair paternity; Alpine; White-tailed ptarmigan*

Category: Speed

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Cameron Aldridge — Colorado State University, USA; U.S. Geological Survey, USA
Greg Wann — U.S. Geological Survey, USA
Nicholas Parker — Colorado State University, USA
Shawna Zimmerman — U.S. Geological Survey, USA
Sara Oyler-McCance — U.S. Geological Survey, USA

While field observations have shown approximately 90% of all bird species to be socially monogamous, genetic studies often reveal mismatch between social and biological parents of offspring, suggesting extra-pair mating (EPM) to be a pervasive avian mating strategy. Determining rates of extra- and within-pair

mating behaviors can be a useful tool in informing ecological, socio-demographic, and genetic pressures at the population- and species-levels. The white-tailed ptarmigan (*Lagopus leucura*) is a socially monogamous alpine-endemic grouse for which extra-pair mating has been examined, though only to a limited degree. We captured white-tailed ptarmigan and tracked pair bonds and broods in our Rocky Mountain National Park and Mt. Blue Sky study sites in Colorado, USA, during the breeding season (May to September) from 2011 to 2025. We genotyped 1,154 individuals at 16 microsatellite loci and used pairwise likelihood comparisons to assign parentage to 66 broods. By contrasting observed and true parentage, we found all chicks to be related to both social parents in only 64% of broods, suggesting EPM is more common than previously identified for this monogamous grouse species. This mating system is likely shaped by a number of factors. Ptarmigan have high annual survival, with repeated breeding opportunities possibly precipitating greater tolerance for suboptimal mates in a given year. Additionally, alpine habitats may shape ptarmigan mating systems, as they are highly seasonal with high breeding synchrony, have little cover and allow for rigorous mate guarding, and have harsh conditions necessitating greater parental care. In the context of rapid environmental change, particularly in sensitive alpine habitats, identifying rates of extra-pair versus within-pair mating can help to assess the selective pressures on these systems under shifting climate regimes.

Tuesday 1. September

Habitat patches, leks, and nesting areas shape the post-release dispersal movements of translocated sharp-tailed grouse

Keywords: *Dispersal; Reintroduction; Prairie grouse; Habitat selection; Movement ecology*

Category: Talk 15

Laura Dykstra — Montana State University — United States
Kristina Gunderson — Montana Fish, Wildlife and Parks; Montana, United States
Mikel Newberg — Montana Fish, Wildlife and Parks; Montana, United States
Beau Larkin — MPG Ranch; Montana, United States
Ty Smucker — Montana Fish, Wildlife and Parks; Montana, United States
Lance McNew — Montana State University; Montana, United States

Extensive post-release dispersal has challenged prairie grouse reintroductions because long movements through unfamiliar landscapes expose birds to high mortality risk. GPS transmitters now allow us to identify the ecological drivers of these movements and refine release strategies accordingly. We monitored 149 female sharp-tailed grouse released in the Bitterroot and Blackfoot Valleys of western Montana, USA during 2023–2025 as part of a 5-year reintroduction effort to evaluate how translocation characteristics and habitat features influenced post-release movements. We distinguished dispersing from settled movements using behavioral change point analysis, then classified dispersal into exploratory and encamped states using hidden Markov models. Both release sites were within the historical range of sharp-tailed grouse but differed ecologically: the Bitterroot is mixed development and agricultural lands, and the Blackfoot is rural ranchlands. Dispersal differed between sites; grouse released in the Bitterroot traveled an average of 147 km over 26 days prior to settling, whereas those in the Blackfoot traveled 47 km over 10 days. Grouse that spent more time in nesting areas during the first 72 hours after release ultimately traveled shorter distances. Other translocation attributes – including age, release group size, timing, and source population – did not influence distance moved. Because increasing lek attendance provides stronger social attraction, we expected movements in the Blackfoot to decrease over time but observed little interannual change. Dispersing grouse selected for greater grassland/shrubland cover at the landscape scale while in the exploratory state, and then selected for more perennial forb/grass and shrub cover at the local scale while in the encamped state. Ultimately, 30% of females in the Bitterroot and 42% in the Blackfoot settled and established home ranges. Settlement locations were typically in large, continuous grassland/shrubland areas with few trees, often in the foothills and near leks and established nesting areas, and females frequently settled near one another. Post-release movements were shaped primarily by the configuration of grassland/shrubland and proximity to nesting habitat, rather than individual or translocation characteristics. Release sites should be located near leks and nesting areas, and early establishment of these areas provides a benchmark for reintroduction success.

A review of black grouse translocation projects to inform future conservation programmes

Keywords: *Reintroduction; Translocation; Restoration; Conservation; Captive-breeding*

Category: Talk 15

Philip Warren — Game & Wildlife Conservation Trust — England/United Kingdom
Holly Appleby — Game & Wildlife Conservation Trust, England (UK)
Richard Francksen — British Trust for Ornithology, England (UK)
Zoe Allin — Natural England, England (UK)

Black grouse populations in the UK were once contiguous, allowing natural dispersal processes and gene flow. However, range contraction and fragmentation have led to physical and genetic isolation making remaining populations increasingly vulnerable to the impacts of climate change and further habitat

degradation. Reintroduction projects offer methods for restoring black grouse into formerly occupied areas. However, the last review in 2000 of black grouse reintroductions and releases in Europe concluded that none of the 14 black grouse reintroduction projects between 1980 and 2000, involving the release of more than 5,500 captive-reared birds, succeeded in establishing a self-sustaining population. Yet, reintroduction projects are becoming increasingly popular. Assessing metrics for success from previous attempts is urgently required to help guide and maximise success of future projects to contribute to black grouse conservation objectives. We undertook a literature review of all known black grouse reintroductions between 2000 and 2025. We identified 12 projects in six European countries. Five projects released captive-bred birds only, four translocated wild birds, and three trialled a combination of the two alongside other techniques. In total, 1,830 birds were released. Based on our assessment criteria we concluded that six projects failed, four projects using wild translocation of birds from Sweden increased numbers of birds at lek sites, but low survival means these appear reliant on annual releases to maintain a viable breeding population. Two projects in northern England, using wild translocation, show evidence that wild birds can successfully be translocated to help expand range. Results suggest that captive breeding programs for species recovery should only be viewed as a last resort, and that wild translocation offers a potential conservation tool where a range of conditions have been met.

Reestablished population of Japanese rock ptarmigan *Lagopus muta japonica* in the Central Japan Alps

Keywords: Japanese rock ptarmigan; reintroduction; In-Site conservation; Ex-Site conservation; Environmental capacity

Category: Talk 15

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Japanese Rock Ptarmigan *Lagopus muta japonica* is the southernmost sub-species and distributed on the alpine mountains in the central Japan. The population of the Central Japan Alps became extinct about 80 years ago. But one female came flying on the Alps in 2018. The reestablishment project of the population started in 2020. Three families, just after hatching, were induced into three cages. We led each family to the outside of the cage in the daytime and lived freely in the native alpine area. They were induced into cages every night. One month later, the three families (three females and their 16 chicks) were transported from Mt. Norikura to the Central Japan Alps and then released. Like this, the project has started with 20 ptarmigans (4 females and 16 chicks) including one fled female. Eighteen (8 males and 10 females) of them survived until the next year. Eight territories were established and all females attempted to nest. Six of 10 hatched families were induced into the cages and four families (4 females and 19 chicks) of them were released after one month's care. The other two families (2 females and 9 chicks) were moved to two zoos and bred in the next year. Three families (3 females and their 16 chicks) and 3 adults of them were returned to the alpine mountain in 2022. Seven chicks were raised by the zookeepers and they were released in 2024. In the same way, 11 chicks and 8 adults were released in 2025. Before release, all ptarmigans were marked by four leg-ring and they were distinguished by the color combinations. Almost of all full-grown chicks were captured in September and October, i.e. before the breakup of broods and marked individually. We monitored the population every year. The size increased quickly and total 198 ptarmigans bred in 2025. Almost of the alpine areas were occupied by a total of 87 territories, and the density has reached nearly at the environmental capacity. The following three years, we will stop all the supports which are done up to now and observe whether the reestablished population is maintained without our supports.

Post-release survival and breeding performance of translocated Black Grouse *Lyrurus tetrix*: identifying management levers for population reinforcement

Keywords: *Black Grouse*; *translocation*; *GPS-tracking*; *Predation*; *brooding*

Category: Talk 15

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Translocation is increasingly used to restore declining grouse populations, yet its effectiveness relies on understanding post-release survival and reproductive performance. We analysed demographic outcomes from five reinforcement campaigns of the last Belgian Black Grouse (*Lyrurus tetrix*) population (Hautes Fagnes), using wild-caught individuals translocated from Sweden between 2018 and 2024. Sixty-five birds were radio-tracked, allowing survival modelling and investigation of 44 mortality events. Predation accounted for 88.7–93.2% of recorded deaths, mainly due to mammalian predators (72.8%), with raptors representing 15.9%. Other causes were rare and no disease-related mortality was detected. Mortality risk did not differ between sexes. Survival analyses identified a distinct temporal pattern, with elevated mortality during the first two months post-release (26.7% per month), followed by substantially lower rates thereafter (7.5% per month). First-year survival averaged 24.6%, but varied markedly among years (60-day survival 30–100%), suggesting that management context and environmental conditions strongly influence short-term outcomes. Encouragingly, reproduction occurred already in the first year after release. Under natural predation pressure, 23.9% of first-year females initiated incubation during the translocation year, despite theoretical expectations of ~50% in the absence of predation. Among nesting females, one third of clutches failed by predation. Although sample size was limited, females surviving into their second year experienced no recorded predation events on themselves or their clutches, suggesting a potential increase in resilience or site familiarity with age. By quantifying survival probabilities, breeding initiation rates, and temporal mortality patterns, this study moves beyond descriptive assessment and provides a framework for predictive, adaptive management. Identifying a critical early post-release window offers clear opportunities for targeted predator management and optimized release strategies. Even under substantial predation pressure, documented first-year reproduction and apparent second-year resilience indicate that demographic reinforcement remains achievable when management is temporally focused and evidence-based.

Reintroducing sharp-tailed grouse to western Montana, USA: A population viability analysis

Keywords: *Integrated population modeling*; *Population viability analysis*; *Reintroduction*; *GPS transmitters*; *Prairie grouse*

Category: Speed

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Sharp-tailed grouse were extirpated west of the Continental Divide in Montana, USA in the early 2000s. A multi-year reintroduction effort began in fall 2021, during which 260 males and 398 females were translocated from leks in east-central Montana to three release sites in western Montana. We monitored female survival and reproduction using VHF ($n = 183$ grouse) and GPS ($n = 149$ grouse) transmitters. Our objectives were to: (1) evaluate the demography of reintroduced sharp-tailed grouse, (2) identify management strategies needed to achieve self-sustaining grouse populations, and (3) assess progress toward a minimum viable population size of 280 individuals. The three release sites were within the historical range of sharp-tailed grouse but differed in landscape composition: the Bitterroot Valley (mixed

development and agricultural land), Drummond (primarily working agricultural land), and the Blackfoot Valley (rural ranchland that supported a remnant population through the early 2000s). Across all sites, survival was relatively low during the first 1–2 months after translocation, consistent with other prairie grouse reintroductions. Female survival to 100 days post-release ranged from 0.27 in the Bitterroot to 0.48 in the Blackfoot, with mortality risk lower for yearlings than for adults. Most surviving females initiated a nest, and both nest survival (0.34; $n = 120$ nests) and brood success at 45 days post hatch (43%; $n = 63$ broods) were within the ranges reported for established populations (0.29–0.62 and 23–80%, respectively). We developed demographic submodels and integrated them with lek count data in a Bayesian integrated population model (IPM) to estimate productivity, population growth rates, and current population sizes. Posterior distributions from the IPM were used in a population viability analysis to project long-term trajectories under observed vital rates and under adaptive management scenarios, including continued translocations and improvements to nesting and wintering habitat. We defined a viable population as one with a $\geq 95\%$ probability of persistence over 50 years. Because GPS transmitters may reduce grouse survival and productivity relative to VHF transmitters, we evaluated how transmitter-specific demographic rates influence female recruitment and the number of individuals needed to achieve monitoring objectives.

Black Grouse Range Expansion in northern England

Keywords: *Reintroduction; Translocation; Re-establishment; Productivity; Conservation*

Category: Speed

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Black grouse were once widespread in England but have declined over the past 150 years due to habitat changes. Their range is now principally confined to the North Pennines where c.1,000 males remain, and where low breeding success, habitat fragmentation and landscape configuration limit recovery. Climate change in the form of wetter summers and more frequent extreme weather events, may further threaten this already small and geographically isolated population. This project aims to help mitigate against negative impacts of extreme weather and changing climate through (1) instigating measures to help increase breeding success, and (2) through expanding the current range into the North York Moors, an area to the east of the Pennines where black grouse used to be abundant but are no longer present, using a conservation translocation technique. To investigate factors potentially limiting breeding productivity, we fitted GPS-GSM tags to 34 females to allow remote monitoring of brood movements and to collect habitat, grazing, and invertebrate measures within brood home ranges. To quantify chick diet, we collected chick droppings from overnight roosts from three broods in 2024 and 13 in 2025. Breeding productivity differed between years, and initial analyses suggest sawfly larvae abundance was greater within brood ranges of successful broods. To expand black grouse range into the North York Moors, we translocated 20 birds (10 males and 10 females) in autumn 2024. Eight males and 8 females were equipped with VHF-transmitters. Seven males survived the first winter and went on to display at leks. On average, leks were 3.6km (range 0–9km) from the release site. Eight females survived the first winter, and seven nested at a mean distance of 5.6km (range 0.5–11.3km) from the release site. Five females hatched chicks. In August, six tagged females were present; four with a total of 12 chicks. Clutch size, nest and brood survival were all comparable with estimates from non-moved birds. All short-term success criteria were met. To further support establishment ten more males and ten more females were translocated in autumn 2025 with all females equipped with GPS-GSM transmitters.

Evaluating drone-based thermal imaging for monitoring capercaillie

Keywords: *Capercaillie; Drone surveys; UAV; Wildlife monitoring; Detection probability*

Category: Speed

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Barbara Zimmermann — University of Inland Norway

Capercaillie (*Tetrao urogallus*) is a popular game species in Scandinavia and of high conservation concern in Central Europe. In both contexts, reliable population estimates are essential for setting sustainable harvest quotas and evaluating conservation measures. However, obtaining accurate estimates remains challenging. In Scandinavia, populations are commonly monitored using line distance sampling with pointing dogs, but this approach may be problematic because birds often move before flushing. This behaviour violates a key assumption of the distance sampling framework—namely that individuals are detected at their original location—potentially leading to biased estimates. Alternative methods such as genetic capture-mark-recapture based on faecal or feather sampling, or bioacoustic monitoring, exist but are either restricted to lek sites in spring or are labour-intensive and costly. We therefore propose drone-based thermal imaging as a potential monitoring tool for capercaillie populations. We evaluated this method by conducting systematic grid flights over GPS-tagged capercaillie, using the tagged individuals as known ground truth to estimate detection probability. In additional trials, we assessed disturbance by progressively lowering the drone from its standard survey altitude (60 m) in 10 m increments down to 20 m above ground and recording behavioural responses. During grid flights, capercaillie were detectable on thermal imagery, but overall detection probability was low (25%), currently limiting the suitability of this method for monitoring. Surveys were conducted during an unusually warm spring when lekking occurred on snow-free ground. The absence of snow reduced thermal contrast between birds and the background, while features such as tree stumps and anthills created thermal noise that complicated identification. None of the approached birds flushed, although individuals showed increased vigilance at the lowest flight altitudes, interrupting foraging behaviour and visually tracking the drone. Given the minimal behavioural responses observed even at these low altitudes, disturbance during standard grid-flight altitudes is likely negligible. To fully evaluate this method, we plan to repeat grid flights under snow-covered conditions, where higher thermal contrast is expected to improve detection probability, and assess disturbance by comparing post-flight movements of disturbed and undisturbed individuals.

Management in Action: Implementing Multiple Techniques to Reverse Concerning Population Declines within the Baker Sage-Grouse Priority Area for Conservation

Keywords: *adaptive management; common raven; greater sage-grouse; habitat restoration; predator removal*

Category: Talk 15

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Several greater sage-grouse (*Centrocercus urophasianus*; hereafter sage-grouse) populations in Oregon, USA have seen population declines, including the Baker Priority Area for Conservation (PAC) with a precipitous decline over the past 25 years and estimated abundance currently ~80% lower than 2001. A comprehensive management plan to address threats to this population was developed by a local conservation and management group in 2017. This plan largely focused on improving sage-grouse habitat quality within the Baker PAC. Significant habitat restoration efforts, including treatment of >20,000 acres of invasive annual grasses and noxious weeds, removal of >4,000 acres of encroaching juniper, and seeding of >8,000 acres of native grasses and forbs have been completed since 2019. As habitat restoration efforts take years to mature, the plan also addressed potential impacts of high-density common raven (*Corvus corax*; hereafter raven) populations potentially suppressing sage-grouse productivity. Raven management efforts occurred 2021–2026, including removal of anthropogenic subsidies (i.e., carcasses and nesting structures) and targeted removal of raven nests and adults. Concurrently, a 10-year research program has evaluated how habitat conditions and raven management jointly influence sage-grouse habitat selection and demographic rates. This research has shown raven densities were reduced following lethal treatment (0.21 to 0.11 ravens/km²) relative to reference areas (0.26 ravens/km²), and sage-grouse nest survival increased in the Baker PAC (0.07 to 0.26) compared to reference areas declining (0.30 to 0.17). However, declining sage-grouse population trends within the Baker PAC have not yet reversed. In response, we are identifying limiting factors for key life history stages to inform targeted management, and managers are developing a translocation plan as a last resort attempt to prevent extirpation of the Baker sage-grouse population.

Spatial Conservation Prioritization for Sage-grouse: Co-producing management applications to optimize conservation delivery

Keywords: *Sage-grouse; Sagebrush; Spatial Conservation Prioritization; Co-production; Adaptive management*

Category: Talk 15

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Ecosystems continue to experience rapid rates of habitat and species loss. With limited resources to conserve and restore functional ecosystems, spatial conservation prioritization can facilitate strategic decision-making for targeted conservation planning and delivery, but complexities arise when management objectives include multiple species and ecological or management constraints. Sagebrush (*Artemisia* spp.) rangelands across the western United States continue to decline due to human development, invasive species, wildfires, and changing drought conditions. Both greater (*Centrocercus urophasianus*) and Gunnison (*C. minimus*) sage-grouse are sagebrush-obligate species of conservation concern that have undergone drastic population declines, and informed conservation planning could greatly assist with identifying management actions likely to provide suitable habitats to ensure persistence of these both grouse species and other sagebrush-obligates. We recently developed a spatial conservation prioritization tool (Prioritizing Restoration of Sagebrush Ecosystems Tool; PReSET) to guide conservation decision-making across the sagebrush biome, focused on co-producing adaptive management strategies for both grouse species. PReSET incorporates data on species occurrence, abundance, and habitat quality, as well as ecological resources, land use, and other socio-environmental variables, to then identify optimal places for different management actions to promote efficient allocation of resources. We summarize a diverse suite of applications with optimized conservation design focused on sage-grouse, using scenarios to assess management actions such as restoring mesic habitats or treating invasive annual grasses to achieve conservation and management targets. We also demonstrate how PReSET can optimize siting of energy production while minimizing conflicts with key species of conservation concern, thereby maximizing energy production and minimizing species losses and helping

expedite permitting processes. Our framework bridges the gap between research and implementation by providing an accessible gateway for producing and using spatial prioritization maps.

Can you have your grouse and eat them too? Understanding the effects of harvest on survival dynamics of greater sage-grouse in southeastern Oregon

Keywords: *hunting; harvest; sage grouse; survival; multi-state model*

Category: Talk 15

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The North American sagebrush (*Artemisia* sp.) steppe is increasingly threatened by environmental change and anthropogenic disturbance, leading to declines in sagebrush obligate species like greater sage-grouse (*Centrocercus urophasianus*). Despite these pressures, sage-grouse remain a regulated game species in 7 of 11 states where harvest is managed to ensure sustainable take. Our objective was to evaluate two critical components of sage-grouse harvest dynamics: (1) probability of being harvested, and 2) impacts of harvest on monthly and annual survival between two populations subjected to different harvest management in the Trout Creek and Warner mountains (hereafter Trout Creeks and Warners) in Oregon, USA. We used a multi-state survival model to estimate the probability of harvest mortality vs. natural mortality using a mark-resight-recovery dataset from 1,146 sage-grouse (2010–2022) that were marked with bands only, a necklace style VHF telemetry device, or a Global Positioning Systems (GPS) satellite backpack. Additionally, we estimated monthly survival under a known-fate framework using GPS locations from 420 adult female sage-grouse (2015–2022) on both study areas. The hunting season was closed in the Trout Creeks from 2013–2018 and reopened in 2019 resulting in 6 years without and 4 years with harvest, while the Warners was subject to continuous harvest serving as the reference. From the multi-state model, we found support for area-specific average probability of harvest during the hunting season (Trout Creeks = 0.012, SE=0.006; Warners 0.028, SE=0.006) with monthly natural mortality ranging from lows of 0.010 to highs of 0.200 depending on area, month, and year. Derived annual survival estimates from known fate models on Trout Creeks were higher after harvest was reinstated (2019–2022: 0.617 95%CI: 0.504-0.718) compared to years with no harvest (2015-2018: 0.459 95%CI: 0.378 to 0.543) and to Warners (2015-2022: 0.454 95%CI: 0.400 to 0.508). The low probability of harvest mortality and the higher survival on Trout Creeks following harvest season reinstatement suggests that natural mortality has a larger influence on annual survival than currently regulated harvest. Our findings highlight the importance of aligning harvest regulations with demographic monitoring to ensure that harvest remains sustainable amid ongoing stressors.

Greater Sage-Grouse Move Seasonally Along the Same Sagebrush Corridors as Pronghorn and Mule Deer in the Upper Green River Basin, Wyoming, USA

Keywords: *Corridors; Migration; Sagebrush; Sage-grouse; Ungulates*

Category: Talk 15

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The Upper Green River Basin (UGRB) in southwestern Wyoming, USA sustains the world's largest breeding populations of greater sage grouse (*Centrocercus urophasianus* 'sage-grouse') and some of the

longest remaining ungulate migrations in the world. Sage-grouse populations often migrate to access seasonal ranges to obtain resources needed for different life stages. We evaluated movements of sage-grouse in the UGRB between spatially distinct winter and summer ranges. Our analysis included 361 individual female movements between spring and summer ranges across five years (2019–2023). Average distance traveled between seasonal ranges was ~44 km and, on average, it took a female 9.5 days in spring and 6.5 days in fall to complete movements. Movements were not straight-line, instead sage-grouse followed continuous sagebrush (*Artemisia* spp.) corridors to reach seasonal ranges and rarely crossed areas of high-density oil and gas development or urban or exurban residential areas. During movements, 97% of GPS locations occurred in sagebrush landcover. Sage-grouse moved through the same sagebrush corridors pronghorn (*Antilocapra americana*) and mule deer (*Odocoileus hemionus*) used to migrate within the UGRB. There was a large amount of spatial overlap between sage-grouse movement corridors and designated pronghorn and mule deer migration corridors. Within the UGRB, sage-grouse movement corridors overlapped 73% of high-use and 64% of medium-use pronghorn migration habitat and 49% of both high-use and medium use mule deer migration habitat. During movements sage-grouse also moved through the same habitat “pinch points” as pronghorn and mule deer. For instance, one-third of the sage-grouse population funneled through the famous 0.6-km wide Trappers Point west of Pinedale, Wyoming when moving between seasonal ranges. There is a focus on conserving ungulate migration routes in Wyoming and the western United States. Our results will assist conservation efforts by documenting the relative importance of migration corridors for sage-grouse and wild ungulates in the UGRB.

Factors affecting nest and brood success of greater prairie-chickens

Keywords: *reproductive ecology; prescribed fire; patch size; landscape edge; patch mosaic*

Category: Talk 15

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Kiera Kauffman — Oklahoma State University

Torre Hovick — North Dakota State University

Laura Goodman — Oklahoma State University

Courtney Duchardt — Oklahoma State University

Jimmy Rutledge — El Coyote Ranch

David Londe — Fish and Wildlife Service

Samuel Fuhlendorf — Oklahoma State University

Avian functional response to landscape edges has been frequently examined in the context of grassland fragmentation. However, less attention has been given to how grassland birds respond to edges between structurally distinct vegetation patches within contiguous grasslands. Greater prairie-chickens (*Tympanuchus cupido pinnatus*) in the Flint Hills ecoregion select recently burned grasslands for brooding, and nest in areas that have been unburned for 1-3 years, suggesting the need for a mosaic of burn patches. However, it is unknown how patch size, configuration, and proximity to edges within such mosaics affect reproductive vital rates. We investigated whether nest placement relative to edges influences nest and early brood survival. Using eleven years of nest data and five years of brood data, we used a multi-step model-building approach to account for known sources of variation in nest and brood survival (i.e., temporal variables, female characteristics, drought, and weather) before modeling survival as a function of proximity to edges. Although the majority of nests were located in patches burned 1-2 years earlier, 71% of broods traveled to a recent burn within a week of hatching. We found no evidence that proximity to edges affected nest or brood success at our study site. Instead, daily nest survival decreased with nest age, day of season, and nesting-season precipitation, while 14-day brood survival probability decreased with increasing brooding-season precipitation. Our findings support previous work demonstrating the importance of seasonal precipitation for nest and brood survival. However, we did not find evidence that proximity to burns, trees, or water affected reproductive vital rates, at least in this landscape context, where prairie-chickens can generally avoid trees and where burned and unburned patches are well-distributed. Nonetheless, effective grassland management for prairie-chickens should aim to provide adequate cover from adverse weather and access to suitable nesting and brood cover across the landscape.

Toward Automated AI-assisted Monitoring of Lek-mating Grouse

Keywords: *AI; drone; machine learning; population monitoring; UAS*

Category: Talk 15

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Lane Faison — Lanceleaf Foundation, USA

Reliable estimates of population status and change are essential for managing lek-mating grouse, yet traditional monitoring remains limited by the logistics of field surveys. Human observers can visit only a subset of leks, for brief periods, under ideal conditions, leading to inconsistent observation error and sparse spatial and temporal coverage. These constraints reduce the precision and reliability of abundance estimates used in management decisions. Advances in artificial intelligence, particularly automated image recognition, offer a path to modernize lek monitoring. When paired with remote-sensing tools such as drones and camera traps, AI-assisted workflows can generate standardized, continuous observations that improve accuracy and precision relative to traditional methods. We evaluated custom computer-vision models for estimating lek size in two applications in Montana: 325 drone-based surveys of 23 sage-grouse leks, and 150 days of stationary camera-trap monitoring of 5 sharp-tailed grouse leks. Depending on flight profile, drone surveys coupled with a custom AI grouse counter produced unbiased and more precise estimates of population size than traditional ground-based visual surveys. Similarly, a separate AI model trained on images from stationary cameras accurately identified and counted sharp-tailed grouse and produced accurate and temporally-resolute estimates of lek attendance. AI-enabled lek monitoring offers a scalable path toward low-cost, high-resolution population monitoring needed to guide grouse conservation.

Using Automated Recording Units (ARUs) to Estimate Sympatric Dusky (*Dendragapus obscurus*) and Ruffed Grouse (*Bonasa umbellus*) Breeding Abundance in Utah, USA

Keywords: *Population Monitoring; Abundance; Autonomous Recording Unit; Dusky Grouse; Ruffed Grouse*

Category: Talk 15

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Reliable population monitoring is essential for species conservation and specifically for harvest management. Human observer-based surveys have been the standard for breeding, brooding, and fall population surveys. However, they can be logistically challenging, labor-intensive and expensive, and subject to observer bias. Autonomous recording units (ARUs) may provide a promising alternative, enabling passive monitoring of sonant species over extended periods offering high resolutions of both temporal and spatial data. We compared human observer and ARU-derived estimates of dusky (*Dendragapus obscurus*) and ruffed grouse (*Bonasa umbellus*) abundance using multiple modeling approaches. At $n = 102$ sampling locations in the Bear River Range of northern Utah, USA, just before the breeding season we deployed ARUs and conducted point-count-method surveys with human observers, with complete spatial and temporal overlap. We trained a convolutional neural network to classify dusky grouse vocalizations and applied a signal-processing tool to detect ruffed grouse drumming sequences. Abundance estimates per 20 ha sites were generated using Royle-Nichols, Time-To-Detection, and N-mixture models in the R package Unmarked. Human observer-based point counts produced the highest abundance estimates of male dusky grouse (10.42 ± 1.00 SE), while ARU-based models estimates were more conservative (Royle-Nichols: 5.59 ± 0.29 ; Time-To-Detection: 5.58 ± 0.28). For ruffed grouse, human observer-derived estimates (5.96 ± 1.04) were more aligned with ARU-based estimates (Royle-Nichols: 5.62 ± 0.32 ; time-to-detection: 4.64 ± 0.26 ; ARU-based N-mixture: 3.45 ± 0.26). Discrepancies between

ARU- and human-derived abundance estimates for dusky grouse may have occurred because of violated population closure assumptions due to yearling male movements during the breeding season. Our ruffed grouse results also demonstrated the effectiveness of ARUs, particularly a novel count-based model leveraging the species' tendency towards a 4-minute interval between breeding displays (i.e., drums). Despite differences in absolute values, ARU and human-derived estimates tracked parallel trends across transects, demonstrating ARUs' capacity to capture spatial variation in population density. My results support the integration of ARUs and automated classification tools into forest grouse monitoring, along with caution when interpreting human observer-based data for dusky grouse.

Who gives a hoot. Passive acoustic monitoring with AI-based detection and identification reveal sooty grouse hooting patterns in western Oregon, USA

Keywords: *autonomous recording unit; Dendragapus fuliginosus; forest grouse; population monitoring; sooty grouse*

Category: Talk 15

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Lauren Gramberg — Oregon State University

Jonathan Dinkins — Oregon State University

Many bird species are monitored using auditory point count surveys during the breeding season. Autonomous recording units (ARUs) can be used to better understand the daily and seasonal timing of when a species is vocalizing, which can help align surveys with the time period when the maximum number of individuals are present. We used ARUs to improve our understanding of sooty grouse *Dendragapus fuliginosus* hooting frequency to align our current point count hooting surveys with the dates of peak hooting. From 2020–2023, we deployed ARUs at 121 locations in western Oregon, USA near known hooting males. We evaluated the performance of PNW-Cnet, an AI-based detection application, for identifying the hooting song, the main breeding vocalization of male sooty grouse. Precision (true positives/apparent detections made by PNW-Cnet) was > 0.999, indicating the model was highly effective at avoiding false positive detections of hooting. Recall (true positives/true positives + false negatives) was 0.595, suggesting that while the model reliably identified hooting when detected, it missed a substantial portion of hooting events. We then used generalized additive models with random effects to examine breeding season patterns in hooting frequency relative to date, time, weather, elevation, and latitude. Expected hooting frequency peaked in late-April, providing guidance on the optimal timing of point count surveys. Daily patterns revealed a rapid increase in hooting 30 min before sunrise, then leveling at a relatively constant hooting frequency up to at least six hours after sunrise (latest recording time). Our results suggest males continue to vocalize throughout the entire morning allowing surveys to be conducted beyond three hours after sunrise. Hooting frequency decreased with increased precipitation and at high temperatures, whereas elevation and latitude effects varied. ARUs provided detailed hooting data that will enhance future surveys and improve population monitoring efficiency of sooty grouse.

Monitoring capercaillie populations in the Bernese Oberland, Switzerland

Keywords: *Capercaillie; Non-invasive monitoring; Genotyping; Population numbers; Genetics*

Category: Talk 15

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Iris Biebach — University of Zurich, Switzerland

Rahel Sollmann — Leibniz Institute for Zoo and Wildlife Research, Germany

Ana Sanz — Leibniz Institute for Zoo and Wildlife Research, Germany

The capercaillie (*Tetrao urogallus*) serves as an umbrella species for the flora and fauna of subalpine mountain forests. In Switzerland, populations have been declining since the mid 20th century primarily due to habitat alteration and increasing human disturbance. Switzerland comprises five distinct capercaillie populations, each characterized by limited population abundance and pronounced geographic isolation, including one along the central northern edge of the Alps, with a considerable proportion in the Bernese Oberland. The status and development of capercaillies in the canton of Bern remain largely unknown. This knowledge gap limits the ability to assess population viability and hinders the implementation of effective conservation measures. The project aims to generate fundamental insights into the population status of capercaillie in the canton of Bern. The study area is located at the Bernese Oberland and covers approximately 30 km². Field data are collected using a well-established method: searching for capercaillie droppings and feathers on snow. The study area is divided into distinct sampling perimeters. During winter, each perimeter is surveyed once by a single observer (within one day), with efforts made to ensure a uniform search coverage throughout the designated area. After the field season, samples are genotyped using 18 microsatellite markers and three multiplex PCR amplifications allowing for the identification of the species and individual birds. These data are used for a spatial capture-recapture model to estimate population density. Additional genetic analyses explore gene flow, kinship structures, and overall genetic diversity. In the first year of the project, the genotyping success rate was 97.5%. Of the 505 samples analysed, 367 were identified as originating from capercaillie. They were assigned to 62 distinct individuals. Spatial capture-recapture models yielded density estimates ranging from 0.32 to 0.93 individuals per km² across the respective study areas. Genetic analyses revealed no evidence of pronounced spatial genetic structuring within the study areas. Overall genetic diversity indicated a moderate level of genetic variation within the sampled populations.

Understanding drivers and consequences influencing use of a federal conservation program by Lesser prairie-chickens (*Tympanuchus pallidicinctus*) in Kansas, USA

Keywords: *Conservation Reserve Program; demographics; lesser prairie-chicken; private lands; selection*

Category: Speed

Elisabeth Teige — Kansas State University — USA

Daniel Sullins — U.S. Geological Survey, Kansas Cooperative Fish and Wildlife Research Unit, USA

Mark Vandever — U.S. Geological Survey, Fort Collins Science Center, USA

David Haukos — U.S. Geological Survey, Kansas Cooperative Fish and Wildlife Research Unit, USA

Since 1985, the U.S. Department of Agriculture Conservation Reserve Program (CRP) has increased grasslands across central and intermountain plains in the United States. The CRP allows landowners to voluntarily convert row-crop land to perennial grass under 10-15 year renewable contracts, receiving monetary compensation with some flexibility surrounding species planted and management allowed, including livestock grazing. A majority of studies (83%, n = 35/42) indicate CRP grasslands benefit prairie

grouse species (*Tympanuchus* and *Centrocercus* spp.) across life history metrics. However, further understanding of how variation within CRP grasslands, including vegetation structure and landscape factors, affects prairie grouse species may add support for program continuation and prairie grouse conservation. The lesser prairie-chicken (*T. pallidicinctus*) is a species of conservation concern that uses CRP when ecologically stressed; for example, during extreme drought, wildfire aftermath, dispersal, and translocation. We used several data sources including vegetation surveys of the most common CRP types in Kansas, which supports >80% of extant lesser prairie-chickens, to evaluate nesting and brood-rearing habitat and telemetry locations to investigate the landscape configuration as drivers of CRP use. Range-wide, ~30% of vegetation points in CRP fields met nesting guidelines. Availability of brood-rearing habitat varied by CRP management, with frequently grazed having the most (32%) points meeting brood-rearing requirements and fields with conservative grazing having the least (9%). The northern ecoregion of the lesser prairie-chicken range had the greatest proportion of points meeting nesting guidelines but the lowest meeting brood-rearing (39% and 15%, respectively). Across the range, CRP use increases when surrounded with more area of CRP within 5 km; 1% increase in CRP equates to a 4% increase in the odds of use ($\beta_{\text{CRP\%}} = 0.040$, 95% CI = 0.032 – 0.048). Our findings indicate CRP is providing structural vegetation at critical life stages and can create contiguous grasslands benefiting species population persistence.

Small-Scale Habitat, Big Impact: Greater Sage-Grouse Brood Space Use in Central Oregon

Keywords: *Sage-grouse; broods; microhabitat; sagebrush; Oregon*

Category: Speed

Olivia Sembach — Oregon State University — United States

Brieana Porter — Bureau of Land Management, United States

Larry Ashton — Bureau of Land Management, United States

Skyler Vold — Oregon Department of Fish & Wildlife, United States

Greater sage-grouse (*Centrocercus urophasianus*), a species of conservation concern, have experienced range-wide declines. Habitat loss, degradation, and fragmentation are among the leading threats to sage-grouse distribution. Understanding the microhabitat characteristics of brood-rearing hens is crucial to protecting the species and their habitat. We monitored two populations of sage-grouse in central Oregon, the Brothers/North Wagontire and Paulina/12-mile/Misery Flat Priority Areas for Conservation (PACs) (hereafter Brothers and Paulina), located at the western periphery of the species' range. This region is comprised of unique soils and vegetation communities relative to the core of the range. Our goal was to characterize brood habitat in terms of fine scale and broad scale vegetation composition. To determine whether greater sage-grouse broods select microhabitats based on specific vegetation, brood age, study site, or year, we captured hens and marked them with GPS PTT transmitters. From 2022-2025, we monitored 38 broods, collected 583 early brood GPS locations and 1049 late brood GPS locations in Brothers and Paulina. We classified broods as early (≤ 14 days post-hatch) or late (> 14 days post-hatch) based on the known shift in habitat preferences that occurs around this time. We quantified microhabitat using a used-available design approach, extracting vegetation cover data from the 10 m resolution Rangeland Analysis Platform. For each used brood point, we generated 10 random available points within a 435 m radius using a matched case control design approach. We used logistic regression to model habitat selection patterns and estimate relative selection strength for top model covariates. We discuss potential conservation implications of our findings in this unique region of greater sage-grouse habitat.

From Behavior to Treatment: Integrating Ecological Trap Theory Into Conifer Management Decision Support for Greater Sage-Grouse

Keywords: *Sage-grouse; Ecological trap; Conifer encroachment; Habitat selection; Conservation planning*

Category: Speed

Seth Dettenmaier — U.S. Geological Survey — USA
Megan Milligan — U.S. Geological Survey
Pete Coates — U.S. Geological Survey
Cali Roth — California Department of Fish and Wildlife
Mark Ricca — U.S. Geological Survey

Conifer encroachment into sagebrush ecosystems is a well-documented threat to greater sage-grouse (*Centrocercus urophasianus*), yet removal efforts remain controversial due to trade-offs with conifer-dependent species such as the pinyon jay (*Gymnorhinus cyanocephalus*). Effective management requires fine-scale data to identify where treatments will yield the greatest conservation benefit and for which species. We evaluated whether conifer-encroached habitats function as ecological traps for sage-grouse during the reproductive period. Using telemetry data from 1,688 sage-grouse across 24 field sites across the Western U.S. (2003–2021), we jointly modeled habitat selection and survival to assess both direct and behaviorally mediated effects of conifer cover. Although sage-grouse generally avoided conifers, individuals that selected conifer-encroached areas, particularly near mesic habitats, experienced reduced survival. These results indicate that conifer-encroached areas near productive habitats may function as ecological traps, where environmental cues attract individuals to areas that reduce fitness. We used outputs from these models to map high-priority areas for conifer removal where demographic benefits for sage-grouse are greatest. These spatially explicit outputs are designed to integrate directly with existing conservation planning frameworks, including the Conifer Management Tool (CMT), which supports land managers in evaluating and prioritizing conifer treatment decisions. By linking behavioral and demographic data to decision support tools, this approach enables more targeted, evidence-based allocation of management resources across the landscape. This work provides a replicable framework for integrating behavioral and demographic data into habitat management decisions, an approach with broad relevance for grouse conservation across ecosystems where anthropogenic habitat change creates mismatches between perceived and realized habitat quality.

Effects of free-roaming horses on vital rates of greater sage-grouse across their range

Keywords: *greater sage-grouse; free-roaming horses; survival; nest; brood*

Category: Speed

Megan Milligan — US Geological Survey Alaska Cooperative Fish and Wildlife Research Unit University of Alaska - Fairbanks — USA
Peter Coates — US Geological Survey Western Ecological Research Center
Jeffrey Beck — University of Wyoming
Jonathan Dinkins — Oregon State University
Christian Hagen — Oregon State University
Christopher Kirol — Kirol Applied Ecological Research
Terrah Owens — Oregon State University
Aaron Pratt — George Miksch Sutton Avian Research Center
James Sedinger — University of Nevada Reno
Kurt Smith — University of Wyoming
Jennifer Struthers — Idaho Department of Fish and Game
Phillip Street — US Fish and Wildlife Service
Cameron Aldridge — US Geological Survey Fort Collins Science Center

Across portions of their range greater sage-grouse (*Centrocercus urophasianus*) have coexisted with free-roaming horses (*Equus ferus caballus*) since they were introduced to western North America by European settlers. However, free-roaming equid numbers have increased to more than three times the levels considered sustainable by the management agencies. Grazing by free-roaming horses can affect both ecological structure and function of semi-arid rangelands, particularly in sagebrush (*Artemisia* spp.) ecosystems. For example, areas used by horses often have fragmented and reduced shrub cover, increased bare ground, decreased forage availability, and degraded riparian areas. Recent research in Wyoming indicates free-roaming horse numbers affected vital rates for critical life stages of sage-grouse. We expanded on this research and used data from marked sage-grouse across six western states to evaluate the effects of free-roaming horses on multiple vital rates, while also incorporating the effects of livestock grazing. We used logistic exposure models to estimate effects on survival during three key life stages: adults, nests, and broods. We found that overabundant horses had consistent negative effects on sage-grouse vital rates, particularly on brood survival, but that the strength of the effect varied spatially. For example, effects were stronger and occurred across more vital rates in states, like Wyoming, that had higher rates of overlap between sage-grouse and horse populations. Our results suggest that spatial context is important and that incorporating both horses and livestock can provide a more complete picture of interspecies interactions. Information is preliminary and provided for best timely science.

Understanding and Harnessing the Nutritional Wisdom of Grouse

Keywords: *Foraging; Physiology; Phytochemicals; Ptarmigan; Sage-grouse*

Category: Talk 15

Jennifer Forbey — Boise State University — USA
Ólafur K Nielsen — Natural Science Institute of Iceland, Iceland
Margit Zohmann-Neuberger — BOKU University, Austria
Carolyn Dadabay — College of Idaho, USA
Amanda Stromecki — University of Alaska Fairbanks, USA
Ursula Nopp-Mayr — BOKU University, Austria
Mario E Muscarella — University of Alaska Fairbanks, USA
Kristinn P. Magnússon — University of Akureyri, Iceland
Marcel Schäfer — BOKU University, Austria
Johannes Tintner-Olifiers — BOKU University, Austria
Maddy Skinner — Boise State University, USA
Stephanie Galla — Boise State University, USA

Nutritional wisdom is the outcome of signals among cells and organs in the body that inform food choices relative to the physiological needs of an animal at a given point in space and time. Grouse use this nutritional wisdom to successfully navigate a complex and dynamic foodscape and consume the right mixture of phytochemicals that promote growth, reproduction, and survival. I use new knowledge from collaborative grouse projects in Iceland, Austria, and North America to synthesize our current understanding of the physiological mechanisms shaping the nutritional wisdom of grouse. These projects showcase how sensory wisdom uses the chemical signals in plants to help grouse find ripe berries and avoid toxic leaves and how metabolic wisdom uses signals from digestion and detoxification to help grouse maximize nutrient uptake and prevent toxicity. I also propose new collaborative opportunities focused on restoring and harnessing the wisdom of grouse to benefit nature and humans.

Wednesday 2. September – Nordic day

Changes in Rock Ptarmigan Population Dynamics in Northeast Iceland 1981 to 2025

Keywords: *rock ptarmigan; population cycles; predator-prey; gyrfalcon; body condition*

Category: Invited Nordic

Olafur K. Nielsen — Natural Science Institute of Iceland — Iceland

The rock ptarmigan is a common and widespread breeding bird in Iceland. Its population has traditionally followed 10-year cycles. This pattern changed around the turn of the century, and now only the population in Northeast Iceland exhibits cyclic behavior, with a cycle length of about 5 years. Before 2000, the dynamics in the northeast were characterized by top-down regulation, with the gyrfalcon, a ptarmigan specialist, acting as the predator. After 2000, these dynamics shifted, and the system now appears to be regulated from the bottom up. The main factor seems to be an external influence, specifically spring weather, with effects transmitted through plant-herbivore interactions during summer. The ptarmigan's body reserves at the end of summer are affected by these interactions. Winter survival and subsequent population changes depend on body condition at the start of winter.

Wildlife triangles - Monitoring and research of grouse populations in Finland

Category: Invited Nordic

Andreas Lindén — Natural Resources Institute Finland (Luke) — Finland

Finland has a long tradition of voluntary population monitoring of grouse in late summer, now spanning over a period of 63 years. The post-reproduction survey is conducted from late July and throughout August. In 1964–1989 the survey was done along freely chosen routes, designed to cover the best brood-rearing habitats. From 1989 onward (piloted from 1987), the survey was replaced with wildlife triangles, which are 12 km long transects shaped as equilateral triangles and randomly placed in the boreal forest landscape. Both types of survey data were collected by tree persons advancing in a line formation with 20 m intervals, covering a 60 m broad survey belt. Over 2000 wildlife triangles have been established, and nowadays ca 900–1000 triangles are actively surveyed annually throughout Finland.

Based on the temporal overlap in 1987–1989 the older grouse transect survey data can be calibrated in accordance with the wildlife triangle data. This gives a view on the long-term grouse population trends in the boreal parts of Finland, but possible methodological biases can still be challenging to identify and calls for a cautionary interpretation of the results.

The wildlife triangle monitoring scheme – which is coordinated by Natural Resources Institute Finland (Luke) – is subject to trend analyses and reports made on an annual basis. The data are also used for annually regulating the hunting season length of each species regionally (done by the Finnish Wildlife Agency and the Ministry of Agriculture and Forestry).

Over the decades, wildlife triangle summer surveys have been extensively used in scientific research in over 50 papers. During the last 20 years scientific studies include topics such as: 1) habitat effects on grouse densities and reproduction, 2) forestry impacts and forest planning, 3) predatory-prey dynamics, 4) climate and weather effects, including phenological mismatch, and 5) zoonotic disease ecology. Future research is needed on how the interplay of climate, habitat and biotic interactions affect demographic rates, and ultimately spatial population dynamics. Also, the explicit effects of hunting and hunting regulation need further investigation.

Allele frequency fluctuations are associated with demographic cycling in Icelandic rock ptarmigan.

Keywords: *Lagopus muta*; Iceland; fluctuating selection; demographic cycling; genome resequencing

Category: Talk 15

Jacob Höglund — Uppsala University — Sverige
Theodore Squires — Uppsala University, Sweden
Alexandre Rego — Uppsala University, Sweden
Wanyi Wei — Uppsala University, Sweden
Patrik Rödin-Mörch — Uppsala University
Kristinn P Magnusson — Univ. Akureyri

Understanding how natural populations adapt to recurring environmental changes, such as demographic cycles, is a central question in evolutionary biology. Multi-annual population cycles impose fluctuating selective pressures, yet disentangling the resulting genomic signals from those of long-term directional selection and genetic drift has been challenging due to a lack of high-resolution temporal data. Here, we investigate the genomic consequences of demographic cycling in a population of rock ptarmigan (*Lagopus muta*) from northeastern Iceland. We analyzed whole-genome sequences from 91 individuals sampled over an 11-year period, encompassing two population peaks (in 2010 and 2018) and two troughs (in 2007 and 2013). Using a simulation-based framework, we identified 22,399 single-nucleotide polymorphisms (SNPs) exhibiting patterns of strong fluctuating selection. These patterns were highly correlated with fluctuating demography, consistent with density-dependent selection. The strongest fluctuating sites overlapped with numerous candidate genes that may be important in the context of density-dependent selection. The most significant candidate, CTNNA2 (Catenin Alpha-2), is associated with startle response and anxiety-like behaviors that may be associated with predator avoidance. We also found candidate genes such as GUCY2C and TRAF2, whose functions may intersect with key stages of host-parasite conflicts. Our findings suggest that multi-annual demographic cycles are a powerful evolutionary force driving rapid and widespread genomic changes, with density-dependent selection on traits potentially playing a key role in adaptation. This study highlights the significance of temporal genomics in clarifying the interplay between demography and natural selection in wild populations.

Genome-Wide Association study suggests highly polygenic architecture for condition-related traits in Icelandic Rock ptarmigan (*Lagopus muta*)

Keywords: *Functional Genomics*; *population cycling*; *SNP*; *GWAS*; *WGS*

Category: Talk 15

Kristinn P Magnusson — University of Akureyri & Natural Science Institute of Iceland — Iceland
Theodore E. Squires — University of Akureyri, Iceland & Uppsala University, Sweden
Alex Toros — Uppsala University, Sweden
Guðmundur A. Guðmundsson — Natural Science Institute of Iceland
Ólafur K. Nielsen — Natural Science Institute of Iceland
Patrik Rödin-Mörch — Uppsala University, Sweden
Jacob Höglund — Uppsala University, Sweden

Genome-Wide Association Studies (GWAS) are increasingly powerful tools for dissecting the genetic basis of complex traits in non-model organisms, providing crucial insights for ecology, evolution, and conservation. The Icelandic rock ptarmigan (*Lagopus muta*) offers a unique system for such research, as its populations exhibit well-documented, multi-year demographic cycles that mirror fluctuations in individual phenotypic condition. Here, we present the first exploratory GWAS for this population, leveraging whole-genome resequencing (WGS) data (20x coverage) from 90 young-of-the-year birds sampled across four years, representing two demographic "peak" and two "trough" years. We investigated the genetic architecture of morphological and condition-related traits, including body size metrics (Wing, Head, Sternum) and energetic reserves (Total Fat, Lean Dry Body Mass). Phenotypic analysis confirmed

that Total Fat fluctuated significantly with population cycle position, independent of sex. Using a univariate linear mixed model in GEMMA, we tested for associations between 6,024,856 high-quality SNPs and our target phenotypes, including a PCA-derived 'size' trait, Total Fat, and Lean Dry Body Mass. We found no genome-wide significant associations (FDR < 10%) for any trait. This null result may suggest that these complex traits are highly polygenic, with no single locus of large effect. A follow-up GxE analysis testing for SNP-by-cycle-phase interactions, and a targeted analysis using a priori SNPs displaying high multi-annual fluctuation, also failed to yield significant hits from reduced tests on 133,930 SNPs. While non-significant, we identify a set of putative candidate genes (e.g., HIVEP3, LAMA3, HTR1F) from the analyses with the strongest associations, providing testable hypotheses for future investigations. This study provides an important genomic foundation and underscores the polygenic nature of complex traits in this ecologically significant wild species.

Genetic risks to ptarmigan populations based on climate adaptations

Keywords: *local adaptation; population genomics; offset; ptarmigan; arctic*

Category: Speed

Theodore Squires — Stockholm University — Sweden
Kristinn P Magnússon — University of Akureyri, Iceland
Jacob Hoglund — Uppsala University, Sweden
Patrik Rodin-Morch — Uppsala Genome Institute, Sweden

This study examines the genetic diversity, local adaptation, and genomic offset of three cold-adapted bird species: rock ptarmigan (*Lagopus muta*), willow ptarmigan (*L. lagopus*), and red grouse (*L. scotica*), across 12 populations in the North Atlantic. Using whole-genome sequencing data from 99 individuals, we integrated genetic analyses with two global climate models (CHELSA and WorldClim) and two gene-environment association methods (BayPass and LFMM). Results revealed that genomic vulnerability predictions are highly sensitive to the choice of climate data, leading to conflicting conservation priorities for populations in Greenland, Svalbard, and the Alps. Genomic diversity was lowest in isolated populations (Svalbard, Pyrenees, Iceland), consistent with genetic drift, though this did not directly correlate with calculated genomic offset. Polygenic adaptation to climate was widespread, with selection acting on different SNPs within conserved genes related to neurogenesis and development, suggesting multiple evolutionary pathways to cold adaptation. Genomic offset analyses under future climate scenarios identified populations in Svalbard, Greenland, and the Alps as particularly vulnerable, with higher offset values under severe climate change scenarios (RCP 8.5/SSP 585). However, offset predictions varied significantly between climate models, highlighting the importance of critically evaluating foundational climate projections. The study underscores the need for conservation strategies that prioritize functional genetic diversity to support adaptive responses to rapid environmental change. It also emphasizes the necessity of integrating multiple climate datasets and genomic association methods to address uncertainties in vulnerability assessments. These findings provide valuable insights into the evolutionary and conservation challenges faced by Arctic bird populations in a warming world.

Temporal genomics of Willow ptarmigan (*Lagopus lagopus*)

Keywords: *temporal genomics; climate change; genetic diversity; museomics; population genomics*

Category: Speed

Maja Svedberg — Stockholm University — Sweden
Mafalda Ferreira — Stockholm University
Jacob Höglund — Uppsala University

Predicting species' responses to rapid environmental change is challenging, but especially important for cold-adapted species with limiting capacity to shift ranges or physiologically adapt, genetic adaptation

may be crucial for long-term survival. Willow ptarmigan (*Lagopus lagopus*) are especially vulnerable to climate change due to disrupted seasonal timing leading to mismatched camouflage as a consequence of less snowcover and thereby reduced survival. Populations have declined across Scandinavia where climate change is expected to further reduce the suitable habitat, which may reduce genetic diversity and connectivity giving constraints for future adaptation. Using historical specimens will enable a look into evolution in action and enable evaluation of the future adaptation possibilities of the species. Additionally, current levels of genetic diversity and degree of genomic erosion remains unstudied. The study uses willow ptarmigan as a system to understand adaptation to environmental change in seasonal environments by documenting recent decline in populations with temporal genomic approaches combining museum archives and modern sampling. To study recent demographic trends and adaptive potential, we conducted population genomic analysis across a temporal scale using approximately 400 modern and historical samples of Scandinavian willow ptarmigans. These genomes were combined with available genomic data for willow ptarmigan from Siberia, Scotland, North America to further contextualize levels of diversity in Scandinavia. This comprehensive spatial and temporal genomic dataset will be combined with demographic modelling and population viability analysis to assess the future evolutionary potential of willow ptarmigan.

Experimental harvest of willow ptarmigan, black grouse and capercaillie

Keywords: *Harvest; Willow Ptarmigan; Capercaillie; Black grouse; Hunting*

Category: Talk 15

Jo Inge Breisjøberget — Statskog — Norway
Erlend B. Nilsen — Nord University/NINA — Norway
Lasse Frost Eriksen — NINA
Jonas Hagen — Statskog
Stian Sundsvik — Statskog

Grouse species such as willow ptarmigan (*Lagopus l. lagopus*) and forest grouse species such as black grouse (*Lyrurus tetrix*) and capercaillie (*Tetrao urogallus*) are popular game species in much of their distributional range. Sustainable harvest management of game resources is an important goal in Norwegian nature management and is embedded in Norwegian legislation. A central concept for predicting the effect of hunting on wildlife populations is whether hunting mortality is additive or compensatory under different harvest levels. We systematically mapped the literature and found a general lack of robust study designs in research on harvest effects on Galliformes populations, with a few exceptions. Most experimental knowledge about sustainable willow ptarmigan harvest comes from experimental studies in Norway in the late 1990s. However, it is unknown whether past results are directly transferable to a broader set of new environmental conditions induced by climate change. Also, no similar studies exist for black grouse or capercaillie. We address these uncertainties by conducting a conceptual replication of the previous willow ptarmigan experiment and conduct similar experiments for black grouse and capercaillie. Starting from fall 2025, we have initiated a large-scale experiment on 64 hunting areas managed by Statskog (the Norwegian state-owned land and forest enterprise) across Norway. Each experimental area is subject to different harvest levels following a randomized crossover-design during a three-year experiment. The outcome will provide a novel contribution to the field and is expected to yield a solid foundation for sustainable harvest management for the three species. In this talk, we present the results of the systematic literature mapping and the experiences after the first year of the experiment, and discuss the current grouse management practices of Statskog in relation to the ongoing experiment.

Adaptive Management of Willow Ptarmigan in the era of rapid climate change: Combining Forecasting and Experiments

Keywords: *Adaptive management; Willow ptarmigan; Near-term forecast; Hunting experiment; Predator control*

Category: Talk 15

Eivind Flittie Kleiven — Norwegian Institute for Nature Research — Norway

Nigel Yoccoz — UiT, The Arctic University of Norway

Albert Chacón — Norwegian Institute for Nature Research

Kos Pepels — UiT, The Arctic University of Norway

Rolf Ims — UiT, The Arctic University of Norway

Adaptive management of harvested populations requires timely information about population status and a framework for testing the effects of management actions under environmental uncertainty and change. This is particularly challenging for species with complex dynamics due to high sensitivity to trophic interactions and climatic variability, such as the willow ptarmigan — one of Norway's most important game species. Climate-ecological Observatory for Arctic Tundra (COAT) develops near-term forecasts of willow ptarmigan populations in Finnmark, which is the subjected to the most extensive climate warming in Norway and constitutes the country's largest ptarmigan management unit. COAT's statistical forecasting models integrates biotic and abiotic state variables and delivers forecasts 2-6 months prior to the annual population monitoring thus providing the Finnmark Estate (FeFo) with extra time for planning harvest regulations. COAT collaborates with the FeFo on experimental management interventions to assess the responses of both hunters and the ptarmigan populations to contrasting harvesting regimes. In addition, ongoing red fox control allows us to assess predator reduction effects on ptarmigan dynamics. Evaluating the effect of these management actions is central to adaptive management, as it enables iterative improvement of decisions, and strengthens the scientific basis for sustainable use. We present the forecasting approach, evaluate its predictive performance, and discuss how integrating forecasting and management experiments can strengthen sustainable management in a long-term perspective that accommodates the impact of climate change.

Hønsefuglportalen - A collaborative platform for game bird monitoring

Keywords: *grouse; ptarmigan; monitoring; tetraonid; line transects*

Category: Talk 15

Lars Rød-Eriksen — Norwegian Institute for Nature Research (NINA) — Norway

Marius Kjønnsberg — University of Inland Norway (INN) — Norway

Lasse Frost Eriksen — NINA

Kaja Johnsen — INN

Erlend B. Nilsen — NINA

Sustainable management of harvested species must be based on knowledge of distribution and population dynamics of the species in question. "Hønsefuglportalen" was established in 2013 in Norway as a response to a call from management for strengthened collaboration and unified efforts in monitoring bird game species, particularly Willow ptarmigan. The aim was to accommodate the needs of multiple stakeholders, both landowners, managers, field personnel and researchers, and thus the portal acts as an electronic infrastructure for management and secure data storage, a project for analyzing and reporting results, and a platform for collaboration. A set of common field protocols for line transect surveys was developed for unified data collection, as well as a clearly defined procedure for analyzing and reporting results to stakeholders. Furthermore, development of training manuals and education of field personnel have been paramount in ensuring high-quality data collection. In Hønsefuglportalen we have developed strict guidelines for quality control. Continuous improvements to the e-infrastructure and associated tools, including a specifically developed mobile application for line transect surveys, have further improved the high-quality data that is now a recognized part of Hønsefuglportalen. In 2025, the collaborative efforts culminated in over 13.000 km of line transects surveyed in close to 350 areas in over 100 municipalities

across Norway and Finland, with over 40.000 ptarmigan observed. We will present trends of willow ptarmigan population dynamics across Norway based on the extensive data collected over the years and discuss different uses of such large-scale monitoring beyond its value for harvest management.

Examination and prediction of willow ptarmigan (*Lagopus lagopus*) detectability in relation to environmental and sampling event covariates

Keywords: *Distance sampling; Willow ptarmigan; Monitoring; Management; Detectability*

Category: Speed

Stian Sundsvik — Statskog — Norge
Erlend B. Nilsen — Nord University/NINA
Jan Eivind Østnes — Nord University
Lars Rød-Eriksen — NINA

Information about abundance/density of wildlife species is crucial for basic ecological research and to make effective management decisions. To gain insight into population density, researchers and management have often employed methods that either make assumptions of detecting all individuals of a population or methods that involve physically capturing and marking animals. An alternative to these methods is methods accounting for imperfect detection probability. In such methods, the abundance/density calculations depend on accurate estimates of the detectability to prevent skewed results. The detectability of species can be investigated within a distance sampling (DS) framework by modelling detectability as a function of distance from a transect, wherein detectability generally decays with increased distance. However, spatial, and temporal variation in animal behaviour, population density and environmental or sampling conditions causes detectability to vary. This heterogeneity in detectability can be addressed by using multiple covariate distance sampling models (MCDSMs). If the models have a fitting level of complexity, they can be used as a tool to predict species detectability in space and time. In this study, we explored the relationships between willow ptarmigan (*Lagopus lagopus*) detectability and environmental and sampling event covariates in MCDSMs by utilizing an exceptionally large DS dataset from a willow ptarmigan monitoring programme (>25000 willow ptarmigan observations). Data collected across Norway were used to develop a set of candidate models. Validity of the most parsimonious model was assessed by using both spatially blocked cross-validation and randomly sampled k-fold cross-validation. Finally, the most parsimonious model was used to predict willow ptarmigan detectability under different conditions across Norway except Finnmark. The model selection procedure revealed that willow ptarmigan detectability is affected by cluster size, land cover, terrain ruggedness, mean daily temperature and the number of dogs used. The cross-validation procedure showed high correlation values on average (> 0.80), suggesting good, yet not perfect predictions. The findings of our study demonstrate the potential of using MCDSMs in assessing the influence of various covariates on the detectability of species. It further explores how this detectability can be spatially and temporarily predicted, and how such predictions can be used as a tool in species management.

Increasing flushing distances of grouse throughout autumn: relevance to harvest management

Keywords: *Hunting; Managment; Willow ptarmigan; Capercaillie; Black grouse*

Category: Speed

Torstein Storaas — University of Inland Norway
Jo Inge Breisjøberget — Statskog
Jonas Hagen — Statskog
Torgal Sætre — Trysil

Norwegian willow ptarmigan (*Lagopus lagopus*) populations may only be a fraction of what they were formerly based on historic data from Catch-Per-Unit-Effort (CPUE). Nevertheless, the opening date of grouse hunting has differed in space and time. In Norway, opening day for grouse has varied between

August 15 and September 15 and is now September 10. In Sweden the hunt opens August 25. Using data from from 2021-2025 we have: 1) analyzed CPUE for a sample of forest grouse (*Tetrao urogallus*, *T. tetrix*) shot in Sweden and Norway during opening weeks, and assessed daily harvest and CPUE of willow ptarmigan shot on Norwegian State-Owned Land and Forest Enterprise (Statskog), 2) measured distance from hunters using pointing dogs to flushed willow ptarmigan, 3) measured the flushing distances at which ptarmigan were shot, and 4) used formerly published and current CPUE data to estimate the effect of varying opening day on harvest. The CPUE of forest grouse was twice as high for starting hunting August 25 in Sweden (n=141 grouse), compared to the September 10 opening in Norway (n=49 grouse). The highest number of willow ptarmigan on Statskog were shot during the first two weeks of hunting (73 %), and number and CPUE decreased rapidly (n=186 514 days of hunting) thereafter. The probability of bagging willow ptarmigan decreased when birds flushed at 25 m and few were harvested at >30 m (n=150 situations with bagged ptarmigan). Throughout autumn, an increasing portion of willow ptarmigan populations were flushed (n=939) outside shooting range (> 25 m), from 10 % before September 10 to 85 % in December. Thus, opening day may be set to influence the proportion of the population available for harvest. Opening day and year were heavily correlated in the published long-term dataset of Norwegian willow ptarmigan. However, delayed opening days may explain most of the decrease in CPUE over years, while changing ptarmigan populations or sampling challenges with old data may explain the rest of the variation. Norwegian willow ptarmigan populations may have decreased, but not to the extent suggested by historic CPUE.

Willow ptarmigan hunting on state-owned land – before and after reforms 1993/1996

Category: Invited Nordic

Tomas Willebrand — University of Inland Norway — Sweden

In Sweden, research efforts on willow ptarmigan was limited before approximately 60,000 km² of the state managed alpine tundra was open to public hunting in the early 1990's, and the management of small game harvest changed markedly. Earlier research was mostly concentrated in the Lövhögen area in the southernmost part of the tundra, where line transect counts were started in the early 1960's. In these early years the focus was on factors that could explain the large variation in breeding success. Recent research efforts have concentrated on harvest management. The policy shift triggered the development of a large-scale monitoring program based on line transects, with more than 20 areas surveyed annually, largely through voluntary effort. Ph.D.-projects included a study of radio-collared willow ptarmigan compared survival and population development on hunted and closed areas, temporal and spatial dynamics based on line transect counts, and how effort and bag varies between hunter. In this review, we present an analysis of population development at Lövhögen, and a preliminary analysis of how populations in Jämtland county responded to the the increased accessibility to hunters in Jämtland county. We recapitulate the results of the radio--marked study, and present recent results from two complementary modelling approaches, a hazard-based survival formulation and a Gompertz population model, to explore how harvest effort influences population dynamics. While both approaches provide useful insights, they differ in how harvest effects are expressed, reflecting alternative representations of density dependence and recruitment processes. Finally, we show how effort-based decision rules can support management under varying reproductive conditions, illustrating how long-term monitoring can be translated into operational decision support.

Life and death in the mountains: A decade of individual-based research on the willow ptarmigan in Central Norway

Category: Invited Nordic

Lasse Frost Eriksen — Norwegian Institute for Nature Research (NINA) — Norway

Erlend B. Nilsen — Nord University — Norway

Pål F. Moa — Nord University

Elise W. Ingvaldsen — Nord University

Markus F. Israelsen — NINA

Nils Vidar Bratlandsmo — Fjellstyrene i Lierne — Norway

Annabel Josien Slettenhaar — Nord University

Børje Cato Moen — Fjellstyrene i Lierne

Oddmund Kleven — NINA

Jan Eivind Østnes — Nord University

Saria Sato-Bajracharya — Nord University

Rakel Blaalid — Nord University

We present insights from our ongoing long-term study (2015-) on willow ptarmigan (*Lagopus lagopus*) ecology in the climate change era, in Lierne, Norway. Willow ptarmigan has experienced long-term population declines in parts of its range, calling for knowledge supporting sustainable management for the future. Based on a broad set of data from the study area, we have tested a range of hypotheses related to survival, reproductive success and movement strategies in seasonal environments, disentangling top-down and bottom-up effects. Our work is so far based on >350 captured and marked willow ptarmigan followed through the seasons, >130 willow ptarmigan nests monitored by automated camera, collection of fecal pellets for diet studies and DNA-analyses, as well as monitoring of gyrfalcon diet and nesting success, line transect surveys for ptarmigan density estimation, and collection of ptarmigan harvest data. Through the study we have had a particular focus on the influence of short-term climatic variation on the species' life history traits and demography. We have found evidence of snow conditions during autumn and spring affecting mortality risk, and relationships between spring weather and breeding phenology and breeding success. Variation in seasonal weather affected willow ptarmigan diet, and variation in spring conditions affected predation mortality from the gyrfalcon. Furthermore, individual differences impacted seasonal movement strategies. The combination of detailed individual-based data and an ecosystem-based approach in this study contributes to a broader understanding of the drivers of willow ptarmigan population change, giving insight for decision-making in future willow ptarmigan management under climate change.

Long-term wind turbine effects on grouse species in Finnish boreal forest

Keywords: *wind turbines; grouse; disturbance; Finland; wildlife triangles*

Category: Talk 15

Constantina Georgiade — University of Turku — Finland

Andreas Lindén — Natural Research Institute Finland, LUKE

Jon Brommer — University of Turku

Toni Laaksonen — University of Turku

Increasing energy demands have led to the rise of alternative renewable energy sources for mitigating climate change. Wind energy is among the top three most commonly used renewable sources in Europe. However, its development can threaten both volant and non-volant species due to direct or indirect effects, with significant consequences for their populations. Species like forest grouse are susceptible to human disturbance, often avoiding areas near wind turbines, especially during critical reproductive periods, such as lek and summer. This avoidance behaviour can differ among species and habitats, with varying implications for their population size. In Finland, wind energy is expanding rapidly, especially in forest areas, yet knowledge of its interaction with grouse remains limited. This study aims to estimate the long-term cumulative effects of wind energy development on the population of four grouse species dwelling in Finnish forests. The species used in the analysis were the western capercaillie, black, willow,

and hazel grouse. Using late summer grouse count data from the Finnish wildlife triangle monitoring scheme, and wind turbine records from 2000-2024, species distribution generalised mixed-effect models (sdmTMB) were employed to analyse the relationship between wind turbine pressure and grouse densities and reproduction. Wind turbine pressure was estimated using a Gaussian kernel density with fitted model- and species-specific bandwidths. Models were tested at two spatial resolutions, at the triangle level and a subdivided 2 km-transect level. Preliminary results from the triangle-level analysis suggest weak evidence for a negative effect on grouse densities as a response to the increasing wind turbine pressure. While these early findings do not yet indicate a strong impact, they underscore the need for careful monitoring as wind energy development continues to expand. Ongoing analysis at the 2 km-transect level will clarify these patterns, helping to balance renewable energy goals with biodiversity conservation in Finnish forest ecosystems.

Impact of wind turbine noise on black grouse vocalization display and communication during lekking season

Keywords: *wind power; sound pollution; human impact; lek; vocalization*

Category: Talk 15

Torfinn Jahren — University of Inland Norway — Norge
Mikkel Kvasnes — University of Inland Norway, Norway

Human-generated noise is produced every day by wind power, air and road traffic, and construction projects. Such noise can have dramatic consequences for biodiversity and has permeated nature. Exposure to anthropogenic noise creates challenges for species that depend on sound to perform vital behaviors. In Norway, the current focal area for wind power development is the coniferous forests of the southeast. Each individual turbine with its pad does not occupy much of the forest area, but noise contour mapping indicates that the effective impact of sound pollution may be much larger. The true extent of this impact likely depends on many factors, such as topography, surrounding forest structure, and periodic conditions in wind and snow. Here we use passive acoustic monitoring (PAM) to quantify vocalization display on black grouse leks situated at varying distances from wind turbines. Across 5 leks situated at distances from 900 m to 6 km from the closest wind turbine our preliminary results indicate lower vocal activity rates on leks close to turbines. We will quantify how the proportion of vocal activity rate (VAR) from a temporal window collected early morning during the peak in lek activity is impacted by turbine noise, proxied by operational data from turbines. To test whether turbine noise masked the vocal communication between lekking males and conspecifics, we will, in the spring of 2006 test auditory and activity responses of lekking males to playback of female and male vocal cues at varying distances from the leks.

Habitat selection of adult capercaillie in a human-dominated forest landscape: the roles of wind turbines and forest structure

Keywords: *Capercaillie; Forest; Habitat selection; Wind power; Forestry*

Category: Talk 15

Mikkel Andreas Jørnsøn Kvasnes — University of Inland Norway — Norway
Torfinn Jahren — University of Inland Norway

Knowledge of species' use and avoidance of different habitats and non-habitats is necessary for making informed land-use decisions. Central Scandinavian forests are currently under threat of conversion to (1) agricultural land, (2) renewable energy infrastructure such as wind farms, solar farms and hydro-electric installations, and (3) mining and quarrying, in addition to ongoing fragmentation from transport, energy transmission and urbanization. This study aims to identify capercaillie resource selection in a forest landscape heavily impacted by humans, including a network of forestry roads, electrical infrastructure (power lines and wind power facilities) and intensive forestry. We use a dataset with locations from 25 GPS tagged capercaillie of both sexes from 2024 to 2026, to develop step selection functions, comparing

used and available steps based on attributes from publicly available maps (forestry, topography, infrastructure and vegetation). Preliminary results for the snow-free season show that step selection is affected by wind turbine noise zones and further shaped by forest structure and vegetation types. Compared to loud noise zone (>55dB), birds showed a clear preference for intermediate noise zone (45-55 dB) and a weak preference for the low noise zone (<45 dB). Birds also selected older forest stands and stands of intermediate canopy cover. Vegetation type further structured habitat uses, where open bogs and other open treeless areas were strongly avoided relative to conifer and conifer mixed forest stands. We will develop our step selection model further, to account for seasonal variation and to include time-stamp matched production data from wind turbines to assess whether avoidance or selection of habitat patches near the turbines can be linked to turbine activity (i.e. visual stimuli or noise).

Scots pine (*Pinus sylvestris*) phytochemistry predicts male capercaillie (*Tetrao urogallus*) browsing during winter

Keywords: *Capercaillie; Pine; Browsing; Winter; Diet*

Category: Speed

Jonas Hagen — Statskog — Norge

During winter, the capercaillie (*Tetrao urogallus*) faces harsh conditions with only low levels of digestible food available. To cope with this, these birds consume large volumes to compensate for the low levels of digestible energy. During winter, capercaillies switch their diet to Scots pine (*Pinus sylvestris*), which is usually their main food source from November to March. Thus, capercaillies prefer mature Scots pine stands during winter. I collected 19 male capercaillie with rifle while feeding in pine trees (Norway/Sweden) during the winter season of 2018-2019. I took samples of crop contents and body measurements from each culled bird; in addition, I took pine material from selected, control and random pine trees at each site. There were four levels of pine samples: 1) crop contents, 2) selected tree (plant), 3) control tree (patch) and 4) random tree (habitat). I identified two plant parts, 1) needles and 2) twigs with needles and cone(s), as dominating within the crops. I conducted analysis on all pine samples, which included measuring plant secondary metabolites (PSM) and nutrients. In this study area, male capercaillies ate mostly Scots pine needles, but adults tended to eat more twigs with needles and cones than juveniles. The twigs with needles and cones had lower levels of PSM and twigs with needles and cones were thicker than needles in diameter, which may explain increased selection from adults with more experience, bigger beaks and bodies. I found no difference in PSM or nutrient content between plant, patch and habitat. Nutrient levels were higher in crops than in the other three sample categories. Consequently, male capercaillies seemed to select pine material with higher crude protein content regardless of selected feeding tree. Further, browsing strategies seemed to differ between adult and juvenile males. For juveniles, PSM levels were lower at the habitat level and nutrient levels were higher at the patch level compared to adults. These results suggest that predicting selected feeding tree for male capercaillies on the basis of PSM and nutrient levels is not possible. Factors other than nutritional quality of pine will probably better explain the phenomena of male capercaillie flocking to certain areas during winter.

Autumn habitat selection of Rock Ptarmigan at the southern range in Sweden

Keywords: *Rock ptarmigan; Habitat; Resource selection function; GPS telemetry; Climate change*

Category: Speed

Marius Kjørnsberg — University of Inland Norway — Norway
Kvasnes, Mikkel A.J. — University of Inland Norway
Nilsen, Erlend B. — NINA / Nord University
Karlstrøm, Isak — University of Inland Norway
Hörnell-Willbrand, Maria — University of Inland Norway

Understanding habitat selection is essential to evaluate how species will respond to rapid climate and land-use change. The rock ptarmigan (*Lagopus muta*), a sedentary grouse inhabiting alpine and Arctic environments, provides an important model for examining habitat preferences in extreme conditions. Rock ptarmigan distribution is typically associated with high elevations, dry heath vegetation, low-growing shrubs, rocky terrains, and steep slopes, habitats increasingly threatened by accelerated warming and altered seasonality, including changes in snow cover duration and molt phenology. Although the species is globally classified as Least Concern and European populations are considered stable, regional trends reveal local declines and near-threatened statuses in parts of its range. This study is conducted in the southern part of the Swedish mountain range on the border between Jämtland and Dalarna, representing both the southernmost habitat of rock ptarmigan in Sweden and a region particularly vulnerable to climate change. We captured rock ptarmigans and equipped them with GPS transmitters to examine time-varying habitat characteristics during the autumn period, a critical phase for juvenile distribution, brood breakup, autumn movements, hunting pressure, and elevated mortality. Using Resource selection functions, we aim to identify key environmental factors influencing habitat selection at different phases of the annual cycle. Our results will improve predictions of potential distributional shifts under ongoing environmental change and provide a scientific basis for targeted conservation and management strategies for rock ptarmigan in alpine ecosystems.

Demography of an Alpine Bird using Non-invasive Spatial Capture Recapture

Keywords: *demography; survival; density; genetics; Norway*

Category: Speed

James Martin — University of Georgia — United States of America
Erlend B. Nilsen — NINA, Norway

The estimation of animal abundance and vital rates is a central theme in applied ecology. Traditional methods such as mark recapture, distance sampling, and radio-tracking individuals are robust yet are often difficult to employ because of resource limitations. Moreover, the direct capture and handling of individuals can be difficult because of adverse field conditions, wariness of the species, or animal welfare concerns. Developing methods that are non-invasive while retaining the robustness of estimation is a worthwhile endeavor. Our central question was whether the use of non-invasive genetic sampling (i.e., fecal samples) and spatial capture-recapture (SCR) could produce biologically plausible vital rates for Rock Ptarmigan (*Lagopus muta*). The project occurred in Lierne Norway as part of a long-term study of ptarmigan in sub-alpine and alpine ecosystems. Sampling occurred during the spring and winters of 2014-2017 which produced 699 successfully genotyped samples from 418 unique individuals. Most individuals were only detected once; however, 140 individuals were detected repeatedly for a maximum of 11 detections. The detection probability at a respective bird's activity center was about 0.08 (95% CrI = 0.06, 0.10) and declined as the slope of the terrain increased. Survival rates across all years were estimated to be about 35% (range = 20-50%). The population increased during the study with an expected ptarmigan density (males and females) of 10/km² (95% CrI = 8, 14) in 2014 to 30/km² (95% CrI = 24, 36) in 2017. Our survival estimates are comparable to the published literature for rock ptarmigan. Density estimates appear greater than published estimates; however, our study area is assumed to be relatively high-quality

habitat, and many other studies rely on indirect methods of estimation. Non-invasive genetic sampling and SCR appear to be a useful sampling framework to understand ptarmigan demography in ecosystems where DNA degradation is minimized by the colder climate.

Long-term trends in capercaillie and black grouse populations in a changing boreal forest landscape

Keywords: *capercaillie; black grouse; population trends; forestry; landscape ecology*

Category: Invited Nordic

Jørund Rolstad — Norwegian Institute of Bioeconomy Research — Norway
Per Wegge — NMBU, Ås, Norway

Along the succession gradient of the boreal forest ecosystem, black grouse (*Lyrurus tetrix*) inhabits the early and capercaillie (*Tetrao urogallus*) the latest stages. When converting old semi-natural forests into clearcuts and plantations, commercial forestry has therefore been assumed to affect capercaillie negatively and to be favorable to black grouse. Over a 47-year period (1979–2025) we monitored sympatric populations of the two species at Varaldskogen, a 40 km² commercially managed, boreal forest of southeastern Norway. The study is based on annual autumn censuses with well-trained dogs, supplemented with spring surveys of lekking birds. During this period, clearcut harvesting reduced the proportion of old, semi-natural forest from 50 to 15 %, a 70 % decline, whereas the proportion of middle-aged plantations (40–80 years) increased more than 10-fold from 5 to 55 %. Clearcuts and young plantations almost halved, from 40 to 22 %. Thus, the landscape shifted from being dominated by old semi-natural forests, clearcuts and open, young plantations towards dense, closed-canopy, middle-aged plantations. Contrary to expectations, the long-term trend of capercaillie increased whereas black grouse decreased. Trend lines differed among sexes, with males of capercaillie increasing slightly, males of black grouse decreasing markedly, and females of both species remaining remarkably constant. Number of males at leks showed similar patterns. Breeding success of both species increased markedly, accompanied by increasing annual loss. This study shows that the capercaillie is more flexible in habitat use than previously believed, successfully substituting the old near-natural forest with middle-aged commercial plantations. The marked decline in black grouse males is more difficult to explain, possibly involving local migration events and changes in susceptibility to goshawk predation.

Population regulation in boreal forest grouse: Long-term monitoring of capercaillie and black grouse reveals possible quasi-cyclicity with delayed density-related winter loss

Keywords: *capercaillie; black grouse; population regulation; density-dependence; alternative-prey-hypothesis*

Category: Invited Nordic

Jørund Rolstad — Norwegian Institute of Bioeconomy Research (NIBIO) — Norway
Per Wegge — NMBU, Ås, Norway

When grouse populations remain stable during longer time periods, recruitment and losses are balanced through density-related mechanisms, such as territoriality, food availability, and predation. Monitoring the demography and population density of capercaillie (*Tetrao urogallus*) and black grouse (*Lyrurus tetrix*) during 47 years at Varaldskogen, southeastern Norway, we disclosed evidence of 5–8 year quasi-cyclicity regulated through density-related winter loss. Although the regularity and amplitude of the cycles varied, the cyclicity resemble the semi-regular 5–7 year pattern documented for Finnish grouse populations during 1964–1983. In our study, small rodents cycle with 4 (3–5) year periodicity. Notably, and contrary to what is known for ptarmigans, our forest grouse populations often were out of phase with the small rodent cycles, thus to some extent, contradicting the «alternative prey hypothesis». In our study

chick production varied independently of population density. Hence, we argue that the populations are regulated by density-related winter loss, possibly explained by delayed density-dependent predation by goshawk, and migration events during population peaks (emigration) and bottoms (immigration).

Grouse January hunting bag in Finnish state-owned forests in 2020-2026

Keywords: Capercaillie; Black grouse; hunting bag report; total harvest; sustainability

Category: Speed

Janne Miettinen — Metsähallitus — Finland

Eero Salonen — Metsähallitus

Ahti Putaala — Metsähallitus

The hunting season of male capercaillie and black grouse was extended to January in Finland at year 2020. At the four previous decades hunting seasons of capercaillie and black grouse were limited to autumn. However, the sustainability of winter hunting season has been questioned. To evaluate it, we analyzed the data of license hunters bag reports on state-owned land from the years 2020-2025. Our main focus was on the numbers of sold hunting licenses and the numbers of capercaillie (*Tetrao urogallus*) and black grouse (*Lyrurus tetrix*) in the hunting bag. Since all hunters do not leave a hunting bag report, we estimated the total bag based on the proportion of the bag reports to the number of licenses sold. The results were evaluated in the context of the long-term population management. The numbers of hunting licenses varied annually from 2452 to 5305, in average 3217/year. The number of given bag reports varied annually from 918 to 3077. The average proportion of bag reports of licenses sold was 47,1 %. The estimates of male capercaillie bag varied annually from 63 to 326, and the annual average was 222. The respective numbers for the male black grouse bag were 24, 527 and 252. In average, 12,8 % of the bag reports informed the catch of male capercaillie or black grouse, whereas 87,2 % informed 'no catch'. The total harvest rate varied annually between 0,1-0,2 % for both species. The winter hunting season can provide lots of hunting opportunities, while the hunting bag seems to be very low. It is nevertheless important to notice the additive characteristics of the winter hunt since the catch consists either old individuals or the most vigorous young individuals. In this light, the hunting bag also should also be kept low. The observed annual level was 0,1-0,2 % of the total population, which is much less than one-tenth of the average annual harvest rate in Finland. It may not affect population at the short-term, but the long-term effects need to be followed closely. In this, the role of the Finnish wildlife triangle counts is essential.

The Ringaby-method: aerial detection of capercaillie leks in boreal forest landscapes

Keywords: lek; landscape; detection; aerial survey; disturbance

Category: Speed

Torfinn Jahren — University of Inland Norway — Norge

Mikkel Kvasnes — University of Inland Norway, Norway

The capercaillie lek site is central to conservation of the species and the management of its habitat throughout Europe. The knowledge of lek sites can aid foresters to plan logging and leks can be monitored to inform population status. In Norway, most capercaillie lek sites are unknown, and known leks are often biased toward larger, long-used, "continuous" leks. On-the-ground searching and detecting new lek sites is often laborious and is rarely done. Here we evaluate systematic lek searches using helicopter flights along regularly spaced transects during the peak in lek activity. The method has been piloted in Sweden in relation to impact assessments and has produced expected inter-lek distances of 1.85 km but has never been properly validated. In spring 2026, we will conduct flights with an EC 120 helicopter during three consecutive mornings along transects spaced 300 m apart. Flight altitude will be 50-60 m above ground and flight speed will be 50-60 km/t. The total transect length is 550 km covering a total of 15000 hectares

of forest. The survey will exploit disturbance responses as females are flushed at distances up to ~150 m from the helicopter and their flush site is visited by the helicopter which subsequently flush the males revealing the lek location. The aim of our study is to map lek locations across a larger forest landscape, validate the detection probability of leks by quantifying the detection of known leks. By ground observations we evaluate any temporal lag in disturbance effects on leks from the method, and we quantify individual responses based on GPS-data from tagged birds.

Foxy ladies. Why do female capercaillies select people as mates?

Keywords: *Capercaillie; Mating display; Unusual behaviour; Human contact; Noise driven choice*

Category: Speed

Roar Solheim — Natural history museum and botanical gardens, Agder University Retired, emeritus connection — Norway

Each spring some female capercaillies turn up near people, laying down as inviting for mating in the same way as seen on capercaillie lekking grounds. I describe some observations of this behaviour, and recaptures of ringed females reappearing on the same localities for successive seasons. I also discuss some factors attracting such females, and possible explanations for this strange behaviour.

Forty-four years of change: Capercaillie and Black grouse responses to changes in forestry, climate and vole decline in central Sweden

Keywords: *state-space model; Gompertz; decadal trends; forest age structure; chick production*

Category: Speed

Tomas Willebrand — University of Inland Norway — Norge
Rolf Brittas — Fjällgrycksbo, Bjursås, Sweden
Jonas Kindberg — Swedish University of Agricultural Sciences, Umeå, Sweden

In this study, we analyzed 44 years of line transect counts of Capercaillie and Black grouse collected in an industrial forest landscape in central Sweden between 1980 and 2024. The area was heavily logged in the 1960s and 1970s, followed by large-scale replanting. A hierarchical Gompertz state-space model to assess long-term population dynamics of both species. The adult state model included a brood production submodel, and forest age structure, snow depth, vole abundance, and spring frost were covariates. Our results reveal strong density dependence and temporally variable environmental effects. Capercaillie and Black grouse exhibited contrasting decadal trends: Capercaillie increased markedly during the early study years, whereas Black grouse declined steeply before recovering later in the series. Increasing proportions of forest aged 21–40 years had a clearly positive effect on Capercaillie, whereas snow depth in the previous winter negatively influenced Capercaillie but not Black grouse. Brood production exhibited substantial interannual unexplained variation, although late spring frost reduced brood size in Capercaillie. Toward the end of the study, the two species reached similar levels of latent adult abundance, demonstrating that both can persist at sustainable densities across a broader range of forest structures than suggested in earlier studies.

Friday 4. September

A Hierarchical Monitoring and Modeling Framework for Range Wide Population Dynamics and Conservation Risk of Greater Sage-Grouse in Western North America

Keywords: *hierarchical state-space-model; monitoring; trend analysis; Centrocercus urophasianus; population dynamics*

Category: Talk 15

Peter Coates — U.S. Geological Survey, Western Ecological Research Center — United States
Brian Prochazka — U.S. Geological Survey, Western Ecological Research Center, USA
Cameron Aldridge — U.S. Geological Survey, Fort Collins Science Center, USA
Michael O'Donnell — U.S. Geological Survey, Fort Collins Science Center, USA
Adrian Monroe — U.S. Geological Survey, Fort Collins Science Center, USA
Carl Lundblad — U.S. Geological Survey, Western Ecological Research Center, USA
Michael Chenaille — U.S. Geological Survey, Western Ecological Research Center, USA
Lief Wiechman — U.S. Geological Survey, Bureau of Energy and Minerals
John Tull — U.S. Geological Survey, Southwest Climate Adaptation Science Center
Steve Hanser — U.S. Geological Survey, Fort Collins Science Center, USA

Effective conservation of greater sage-grouse (*Centrocercus urophasianus*) requires a monitoring system capable of capturing broad-scale population dynamics, accounting for environmental stochasticity, and identifying emerging risks across a heterogeneous landscape. We developed a hierarchical, range-wide modeling framework that unifies lek count data from a standardized monitoring strategy across 11 western states, producing the most comprehensive and methodologically consistent assessment of sage-grouse populations to date. This system integrates spatial clustering of biologically meaningful population units, a state-space modeling structure that separates process variation from observation error, and an annual warning mechanism designed to detect aberrant declines across multiple spatial scales. Using this unified database and updated results from the 2024 national lek-count compilation, we estimated short-, medium-, and long-term population trajectories across the range. Sage-grouse abundance declined by 41.2%, 64.1%, and 78.8% over ~20-, ~35-, and ~55-year periods, respectively, corresponding to an average annual change of -2.9%. Model estimates indicated that 13%, 19%, and 29% of populations exhibited extirpation probabilities >50% over the next two (~18 years), four (~37 years), and six (~55 years) oscillations, with elevated risk concentrated along the species' periphery and in landscapes undergoing rapid habitat degradation. To investigate long-term dynamics, we evaluated cycle behavior across population clusters, quantifying variation in amplitude, wavelength, and phase (cycle timing) through time. Although sage-grouse populations showed partial synchrony in broad-scale oscillations of abundance indices, regionally distinct and time-shifting cycle characteristics indicated nonstationary dynamics consistent with increasing environmental stress. We also found that environmental drivers (e.g., climate, wildfire, development) influenced population dynamics across ecological regions. Collectively, these results provide insight into how density-dependent processes, climatic forcing, and disturbance regimes interact to shape population regulation at large scales. By aligning these assessments with a recently developed Sagebrush Conservation Design Strategy, we provide a biome-scale foundation for identifying vulnerable landscapes, anticipating future risk, and guiding conservation actions across sagebrush ecosystems. Lastly, we developed interactive software tools that allow managers and researchers to explore model outputs, evaluate uncertainty, and track population performance across monitored regions. This integrated framework offers a repeatable foundation for evaluating conservation outcomes and advancing ecological understanding across the sagebrush biome.

Evaluating relationships between greater sage-grouse trends and seasonal habitats to identify population-level management targets

Keywords: *Growth; Landcover; Prioritization tool; Sage-grouse; Seasonal habitats*

Category: Talk 15

Gregory Wann — U.S. Geological Survey — USA
Cameron Aldridge — U.S. Geological Survey, USA
Matt Holloran — Bureau of Land Management, USA
Megan McLachlan — Bureau of Land Management, USA
Peter Coates — U.S. Geological Survey, USA
Brian Prochazka — U.S. Geological Survey, USA
Michael S. O'Donnell — U.S. Geological Survey, USA

In wildlife habitat studies, understanding the drivers of variation in population abundance is paramount. Selection patterns can vary across seasons, and the quality of habitats chosen by individuals may have direct consequences for their fitness. However, non-habitat factors may also be important. As part of the Hierarchical Monitoring and Modeling Framework for Range Wide Population Dynamics of greater sage-grouse in the western United States, we use recently developed range-wide seasonal habitat maps for greater sage-grouse (*Centrocercus urophasianus*) to evaluate links between population health and seasonal habitats. Specifically, we evaluated growth rates and other metrics from the framework as functions of seasonal habitat conditions. Quantifying these relationships identifies which population units are most responsive to seasonal habitat enhancements versus those driven by non-habitat factors. All evaluated seasonal habitats (e.g., nesting, brood-rearing, and wintering) influenced population growth trends, though certain periods imposed stronger constraints than others, depending on the region. These results complement the Sagebrush Conservation Design Strategy by identifying where seasonal habitat limitations align with broader landscape scale conservation priorities. Our approach clarifies the role of seasonal habitats in population dynamics, providing information to land and wildlife management agencies. Our tools can assist wildlife managers in focusing conservation and restoration efforts on habitats that have the greatest potential to boost sage-grouse population growth rates and abundances. Because this framework integrates hierarchical monitoring, seasonal habitat modeling, and population-level indicators, it can be applied to other species with similar data structures, providing a transferable basis for multi-species conservation planning. By aligning management actions with seasonal habitat needs, this approach offers a practical framework for enhancing wildlife populations while accounting for dynamic habitat selection patterns across the annual cycle.

Leveraging a novel hierarchical monitoring framework to evaluate conservation effectiveness for Greater Sage-Grouse and inform North American sagebrush ecosystem restoration

Keywords: *restoration; conservation effectiveness; monitoring; *Centrocercus urophasianus*; woody encroachment*

Category: Talk 15

Carl Lundblad — U.S. Geological Society Western Ecological Research Center — United States
Peter Coates — U.S. Geological Survey, Western Ecological Research Center, USA
Brian Prochazka — U.S. Geological Survey, Western Ecological Research Center, USA
Shawn O'Neil — U.S. Geological Survey, Western Ecological Research Center, USA
Cameron Aldridge — U.S. Geological Survey, Fort Collins Science Center, USA
Michael O'Donnell — U.S. Geological Survey, Fort Collins Science Center, USA
Adrian Monroe — U.S. Geological Survey, Fort Collins Science Center, USA
David Naugle — W. A. Franke College of Forestry and Conservation, University of Montana, USA
Jeremy Maestas — West National Technology Support Center, National Resources Conservation Service, USA
Joseph Smith — Numerical Terradynamics Simulation Group, University of Montana, USA
John Tull — U.S. Geological Survey, Southwest Climate Adaptation Science Center, USA
Lief Wiechman — U.S. Geological Survey, Bureau of Energy and Minerals, USA
Kevin Doherty — U.S. Department of Agriculture, Forest Service Research and Development, USA

The U.S. Geological Survey has established a novel range-wide hierarchical monitoring framework to evaluate Greater Sage-Grouse (*Centrocercus urophasianus*; sage-grouse) population trends across eleven western United States. Additionally, this framework facilitates robust evaluations of sage-grouse population responses to environmental perturbations, anthropogenic disturbances, and management actions targeting sagebrush ecosystem restoration and sage-grouse conservation. We leveraged this framework to quantify the efficacy of a large suite of conservation actions compiled from two large online repositories of habitat treatments targeting North American sagebrush ecosystems. State-space model estimates of abundance, derived from standardized lek counts, served as inputs to a progressive-change before-after control-impact paired series analysis to evaluate sage-grouse population responses to each treatment type. Model results provided evidence of substantial increases in population abundance associated with most conservation actions including conifer removal, invasive weed treatments, sagebrush planting, wet meadow restoration, and exclosures to exclude non-native ungulates from riparian areas. Sage-grouse abundance at treated leks improved cumulatively by 100.0% relative to populations not affected by the suite of conservation actions we considered, which resulted in an overall 22.1% improvement in range-wide sage-grouse abundance since 2000. However, efficacy, response lag times, and durability varied by treatment type, method, as well as along abiotic and disturbance gradients. For example, responses to conservation actions whose benefits are realized through the release of shrub and herbaceous vegetation components were often stronger in areas of higher ecological resistance and resilience (R&R). Removal of encroaching conifers was among the most effective conservation actions, at the scales of individual leks and larger clusters assumed to represent closed populations, and was most effective in areas of higher R&R and lower pre-treatment conifer cover. Sage-grouse population gains continued to accrue with greater area treated in regions of recent conifer encroachment, while sage-grouse responses were limited in closed-canopy coniferous woodlands. Finally, we related these results and trends to a Sagebrush Conservation Design Strategy, intended to help prioritize conservation efforts and resources within sagebrush ecosystems. Collectively, these results can help guide spatially targeted efforts to implement sagebrush restoration at landscape scales and stabilize declining sage-grouse populations. Results are preliminary and provided for best timely science.

Scientific posters

Black Grouse Breeding

Keywords: *breeding cietrzewi; black grouse; reintroduction; capture; galliformes*

Category: Poster

Aleksander Adamski — Spychowo Forest District, 3 Mazurska St., 12-150 Spychowo— Polen

The Spychowo Forest District is currently implementing an active conservation project targeting the black grouse (*Lyrurus tetrix*) within its managed area. This initiative, titled "Together for Nature - Conservation of Species and Habitats in High Natural Value Areas" (OPL2), encompasses a comprehensive suite of active management measures: from habitat restoration and enhancement, through the culling and live-trapping of predatory mammals and Northern goshawks (*Accipiter gentilis*), to the reintroduction (release into the wild) of individuals reared at our conservation breeding facility. The Black Grouse Breeding Centre at the Spychowo Forest District has been operational since 2018. To date, nearly 1,000 black grouse individuals have been successfully reared and transferred for population reintroduction and supplementation programs.

Title: "New insights in the breeding phenology of Capercaillie (*Tetrao urogallus*) from systematic camera trapping: A pilot project in the Italian Alps"

Keywords: *camera trapping; ground-display; Song-display; female presence; actual fighting*

Category: Poster

Michael Berchtold — Parco Naturale Paneveggio- Pale di San Martino — Italy

Marco Salvatori — MUSE – Museo delle Scienze di Trento, Italy and Dipartimento di Biologia, Università di Firenze, Sesto Fiorentino, Italy

Emma Centomo — MUSE – Museo delle Scienze di Trento, Italy

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We employed systematic camera trapping to assess ground-display activity in the Paneveggio–Pale di San Martino Nature Park (Italy). Camera traps were positioned on four leks using a grid-based sampling design, targeting sites with signs of capercaillie activity. Continuous recording of short video sequences was imposed (15-20s). We report on preliminary results, based on 898 video sequences recorded from 11.04.-02.06.2022. We distinguished an initial (11.-17.04.), a central (18.04.-07.05.; with females being present), and a final period (08.05.-02.06.) of ground display activity. The daily activity pattern showed a pronounced peak in ground-display activity between 05:00 and 10:00 am, with a smaller peak between 06:00-09:00 pm. The seasonal chronology pattern indicated highest ground activity during the central period, with a secondary peak by mid-end of May. Ground activity by males was dominated by display behaviour (95%), while non-display activity occurred almost entirely during the final period and in the absence of nearby-males. Complete Song-display appeared to be most intensive in the initial period, averaging 51% and diminishing to 42% in the final period, going hand in hand with a proportional increase of incomplete Song-display, from 11% to 18% respectively. Intimidatory postures seemed to be most frequent in the central period (27%), while actual fighting tended to decrease over time. When females were present on the ground, we recorded a marked increase in complete Song-display (66%), while males completely ceased both Belch-bow displays and actual fighting. It appears that, at the onset of the display season, the boundaries of individual male territories within the lek must be re-established, resulting in a comparatively greater investment in Song-display and antagonistic behaviour. In contrast, when females are present on the ground, the hierarchy appears to have already been resolved, a pattern

consistent with previous findings. Contrary to the popular belief of many stakeholders, we regularly detected late morning male activity on the ground, with females being present mostly around 08:00-10:00 am. Considering the increasing human pressure, there is an urgent need for updated management guidelines capable of effectively protecting lek sites, crucial to the species conservation on the long term.

An Adaptive Telemetry Framework Integrating Hybrid Power and Connectivity for Grouse Research

Keywords: *Grouse; Movement ecology; Wildlife tracking; Behavioral monitoring; Habitat use*

Category: Poster

Yiting Lin — Druid Technology Co., Ltd — China

Grouse inhabit diverse ecosystems, including forests, grasslands, and Arctic or alpine tundra, where variable environmental conditions and communication limitations create challenges for long-term wildlife telemetry. Reliable tracking solutions require flexible power management, robust positioning, and adaptive data transmission under real-world field conditions. We present an adaptive telemetry framework designed for long-term grouse monitoring across diverse habitats. The framework integrates hybrid solar power and high-gain GNSS technologies to support reliable operation under contrasting environments. By combining cellular and satellite telemetry, the system enables flexible communication across both connected and remote regions. A key innovation is the integration of two dual-channel communication configurations. The first combines satellite positioning with INTELINK LR short-range wireless telemetry, enabling continuous tracking through satellite communication and high-volume local data download within approximately 5–8 km. Smartphone-based tag localization with directional antennas further facilitates behavioral observation and tag recovery. The second combines satellite communication with 4G transmission, allowing continuous data delivery in remote areas while automatically switching to 4G when cellular coverage becomes available, improving data continuity and reducing communication costs. Beyond location tracking, the framework integrates micro-environment sensing, behavioral data output, and edge intelligence. Acceleration-based metrics and behavioral classification support adaptive sampling and energy optimization, while customized terminal configurations enable flexible deployment for different research objectives. By integrating hybrid power supply, dual-channel communication, edge intelligence, and short-range wireless telemetry, this framework provides a flexible solution for investigating grouse movement, behavior, and habitat use across contrasting ecosystems.

Icons in retreat: capercaillie on the brink of extinction in Germany's Black Forest

Keywords: *monitoring; lekking; population decline; capercaillie; distribution area*

Category: Poster

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Stéphanie Kraft — Forest Research Institute (FVA)
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Gerhard Fey — Forest Research Institute (FVA)
Rudi Suchant — Former department head, Forest Research Institute (FVA)

Although once widespread and regarded as an icon of forest biodiversity, the capercaillie has undergone a dramatic decline across southern and central Europe over the past century, leading to widespread local extinctions. In the Black Forest, southwestern Germany, capercaillie primarily inhabit mixed montane

(altitude up to 1500 m.a.s.l.) managed forests dominated by spruce, fir, beech, and pine. Here we present recent data on population trends and spatial distribution patterns of capercaillie in the Black Forest, based on more than five decades of Black Forest wide systematic lekking counts and distribution mapping. Over the past three decades, the species' range has contracted by more than half—from 606 km² (1989–1993) to 271 km² (2019–2023). Between 1983 and 1995, the population remained relatively stable between 448 and 498 males, followed by a marked decline at the end of the 1990s (minimum 268 males in 1999). Until 2012, numbers fluctuated between 225 and 335 males; from 2012 onwards, a renewed sharp decline occurred, so that in spring 2022 only 97 males were counted. Since then, the number of males per year has remained at a low level (2023: 106 males; 2024: 111 males; 2025: 103 males). Monitoring results indicate an ongoing, significant population decline that puts the Black Forest population at acute risk of extinction. Habitat deterioration is considered the principal driver. Other factors negatively influencing the population are high predation rates and anthropogenic disturbance due to recreational use. Although two successive “Capercaillie Action Plans” (2008; 2023–2028) have introduced region-wide prioritization of habitats and corridors, current measures remain insufficient to stabilize the population. We emphasize that large-scale habitat improvements—particularly through targeted thinning, selective logging, and grazing—can enhance habitat quality and mitigate the effects of climate change and disturbance. Further measures that can support the population include reducing predation pressure and limiting disturbance due to recreational use. We are convinced that, with large-scale implementation of suitable management measures, the long-term persistence of the capercaillie in the Black Forest can be secured.

Préliminary results of the capercaillie population reinforcement program in the Vosges mountains (France)

Keywords: *Translocation; Monitoring; movements; reproduction; survival*

Category: Poster

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The program for reinforcing the population of Western Capercaillie (*Tetrao urogallus*) in the Vosges Mountains is led by the State and the Ballons des Vosges Regional Natural Park. It involves the translocation of wild birds from Norway and the implementation of support measures aimed at improving the conditions for their reception in the massif. The first phase was authorized experimentally for 5 years (2024-2028). The first three translocation operations carried out in collaboration with Statskog made it possible to introduce 33 individuals (23 males and 10 females). GPS monitoring allows for the evaluation of key criteria regarding movement, reproduction, and survival. In light of the results from the first two years, predation of nests and adults is currently identified as the main limiting factor. The experience allows for improving the overall knowledge of the species in France and Norway.

Reproductive patterns and sexual behaviour in captive female capercaillie: implications of partial human imprinting

Keywords: *capercaillie; captive; human imprinting; sexual behaviour; fertility*

Category: Poster

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Julián Santiago Moreno — Department of Animal Reproduction, INIA-CSIC, Madrid, Spain

Within the framework of the ex situ conservation program for *Tetrao urogallus* conducted by the Regional Government of Castilla y León, Spain, reproductive patterns were analyzed in 22 females during the breeding season, focusing on sexual behaviour, laying chronology, and the influence of age on reproductive performance. Most females exhibited reproductive activity, with a high proportion engaging in copulation followed by egg laying. Notably, an atypical sexual behaviour was documented: copulations were functionally induced by the females themselves, which directed solicitation behaviour towards human caretakers rather than males. This phenomenon is interpreted as a consequence of partial imprinting derived from early-life habituation during the rearing phase, potentially modulating normal mechanisms of sexual recognition. Reproductive chronology showed consistent and repeatable patterns among individuals, with a mean interval of several days between copulation and the first fertile egg, and an approximate fertile window of 20 days. These findings provide a useful temporal framework for reproductive management. Fecundity was high, particularly in second-year females, which were identified as the most productive group. A high incidence of egg loss was observed, mainly concentrated in the early stages of the laying sequence, likely associated with the onset of reproductive activity in inexperienced females. Additionally, females showed a strong preference for a specific nest type, indicating defined criteria in nest-site selection. Overall, these results highlight the value of habituation as a management tool to facilitate reproduction under captive conditions, as well as the importance of age and experience in optimizing reproductive performance in this species.

Alzet® Osmotic Pump Delivery of Buserelin Activates Follicular Dynamics but Fails to Consistently Induce Ovulation in Long Term Anovulatory Capercaillie

Keywords: *buserelin; ovulation induction; Alzet osmotic pumps; follicular dynamics; capercaillie*

Category: Poster

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Reproductive failure in captive capercaillie (*Tetrao urogallus*) females represents a major constraint for conservation breeding programs, particularly in individuals with a long history of anovulation. This study evaluated the ability of controlled release osmotic pumps (Alzet®) delivering buserelin acetate to induce ovarian activation and ovulation in females that had not produced eggs for at least three years. In Experiment 1, four females received three 2 mL osmotic pumps (0.57 µg/day buserelin acetate; 15 day release per pump), each combined with an intramuscular injection of 0.84 µg buserelin i.m. at the time of implantation. No ovulations were recorded. One female died at the end of the treatment; necropsy revealed an active ovary with hierarchical follicles (F2–F3), suggesting partial stimulation without completion of the ovulatory process. In Experiment 2, three females received a single 200 µL osmotic pump delivering 1.2 µg/day buserelin, plus 0.84 µg i.m. buserelin at implantation. Ovarian status was evaluated by laparoscopy during treatment and after pump removal. One female ovulated and laid a single egg. All females showed ovarian activation, with several hierarchical follicles (F2–F3) but no preovulatory follicles (F1) at the time of the pump removal. These findings indicate that sustained delivery of buserelin effectively stimulates follicular development but is insufficient to reliably trigger ovulation in long term

anovulatory capercaillie females. Additional hormonal cues, such as progesterone administered at pump removal, should be investigated as potential triggers for final follicular maturation and ovulation in individuals with buserelin activated ovaries.

Study of the nesting period among capercaillie hens in the central Pyrenees

Keywords: *Capercaillie; Pyrenees; GPS; Accelerometer; Nesting*

Category: Poster

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Jérôme Coy — French National Forest Office

Jean Monge-Cadet — French National Forest Office

The Capercaillie (*Tetrao urogallus*), a species listed on the IUCN Red List with varying levels of vulnerability, receives particular attention in the Pyrenees, where populations shared between France and Spain are declining. Since 2017, within the framework of the HABIOS and TUIB projects, more than thirty individuals, both males and females, have been fitted with GPS transmitters by the French National Forest Office and the French Biodiversity Agency to improve knowledge of the species' ecology. Among the proposed research topics, the study of the nesting period of females was identified as a priority, as this phase is crucial for population maintenance and renewal. Poorly documented in France and across Europe, Capercaillie hen nesting was investigated using several parameters derived from GPS tracking. Results highlight the occurrence of replacement clutches and reveal a temporary distancing behaviour from the nest, interpreted as a strategy to reduce predation risk. Analysis of daily distances between female locations and their nests confirms the importance of this adaptive behaviour. Exit times during incubation show both similarities and marked differences compared with those described for subspecies from higher latitudes, particularly *Tetrao urogallus major*, suggesting ecological differences linked to the Pyrenean context. The study of activity during the ten days following hatching made it possible to distinguish females accompanied by chicks from those that had failed, as well as to analyse movements and activity patterns of broods. Furthermore, examination of home ranges during laying, incubation and post-incubation phases reveals strong territoriality of nesting areas, highlighting the importance of specific sectors for reproduction. Despite limitations related to the small sample size and constraints associated with transmitter programming, this work demonstrates the relevance of GPS tracking for monitoring the nesting period. It represents a first contribution to understanding the reproductive ecology of the subspecies *Tetrao urogallus aquitanicus* and opens prospects for improvement through increasing the number of tracked individuals.

Study of the seasonal evolution of activity among the capercaillie population in the central Pyrenees

Keywords: *Capercaillie; Pyrenees; GPS; Accelerometer; Seasonal activity pattern*

Category: Poster

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Nathan Pelletier — French National Forest Office

The Pyrenean Capercaillie (*Tetrao urogallus aquitanicus*), a subspecies listed on the IUCN Red List at varying levels of vulnerability, receives particular attention in both France and Spain, where declining populations are shared across the Pyrenean mountain range. In response to this alarming situation, several research programs have been implemented to improve knowledge of the ecology and requirements of this emblematic species. Since 2017, within the framework of the HABIOS and subsequently the TUIB projects, telemetry operations have equipped more than fifty individuals, including both males and females, with GPS tags incorporating tri-axial accelerometers. These devices provide high-resolution data on movements and activity levels, offering new perspectives for the study of behaviour.

This study aims to analyse annual and daily variations in activity according to the biological seasons that structure the species' life cycle. Accelerometry data were used to characterise activity intensity, its distribution throughout the day, and differences between sexes and seasons. The results reveal patterns largely consistent with those described for the subspecies *Tetrao urogallus major* at higher latitudes. In particular, a marked decrease in activity during mid-winter is observed in both sexes, likely reflecting an energy-saving strategy in response to harsh climatic conditions. Daily activity shows a bimodal pattern, with two main peaks occurring during the day. This structure may be influenced by environmental factors such as temperature, which could modulate the intensity of active phases, or photoperiod, which may affect the duration and amplitude of daily activity. Internal factors, especially those related to reproduction, also appear to play an important role in shaping seasonal variation in activity, particularly during spring when energetic demands are high. These findings provide essential insights into the behavioural ecology of the Pyrenean Capercaillie and constitute a solid scientific basis for guiding conservation actions by identifying sensitive periods and conditions that are favourable to population persistence.

When biological restoration fails but institutions change. Social viability of 50 years of capercaillie (*Tetrao urogallus*) reintroduction in Cévennes National Park, France.

Keywords: *Species translocation; Social viability; Wildlife management; Conservation governance; Western capercaillie*

Category: Poster

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Species reintroductions are a key instrument of contemporary conservation, guided by international frameworks such as IUCN guidelines and typically assessed through biological indicators: survival, reproduction, population trends and genetic viability. However, biological performance alone does not determine long-term outcomes. Reintroductions unfold within inhabited and governed landscapes, where they intersect with institutions, land uses and territorial identities. This raises a critical question: Can a reintroduction be biologically unsuccessful yet socially transformative? Here we examined the biological failure of the Western capercaillie (*Tetrao urogallus*) reintroduction program initiated in 1978 by the Cévennes National Park (France) in order to identify what lessons can be drawn, in terms of social viability, from the trajectory of a large-scale conservation project. Using a qualitative social science approach, we searched extensively through archival records on capercaillie population dynamics, stakeholder interactions, management measures, and produced knowledge, and conducted semi-structured interviews with key stakeholders. Based on this case study and on guidelines for translocation projects, we defined societal viability as resting on four pillars: project legitimacy, local appropriation, socio-economic integration, and institutional anchoring. Each pillar was stabilized by certain aspects, such as the Park's long-term tolerance towards the project, few local champions, strong genetic and ethical arguments toward the operation. But weakened by others, including the strong personalization of the operation, which limited broader appropriation, agricultural and tourism incompatibilities with the return of Capercaillie in this region, managerial skepticism in a context of climate uncertainty. Above all, the species became: a lever for forest reform ; a symbol of biodiversity policy ; a reference point for conservation debates. Hence, the project reveals a paradox: the capercaillie went extinct in the Cévennes, yet it profoundly reshaped forestry practices.

Can camera traps reliably detect Capercaillie? A GPS-calibrated framework for quantifying individual detection probability across European populations

Keywords: *Camera trapping; Detection probability; Capercaillie; GPS telemetry; Density estimation*

Category: Poster

Yon Halotel — University of Inland Norway — Norway

Camera trapping is increasingly used to monitor terrestrial wildlife, yet its potential for ground-dwelling forest birds such as Capercaillie (*Tetrao urogallus*) remains largely untested. Field practitioners report very low detection rates even at sites with confirmed presence, but no study has formally quantified individual detection probability for this species using camera traps. Without such estimates, camera-trap-derived density or abundance inferences remain unreliable. Here we present the design and rationale for a multi-site study that pairs GPS telemetry with experimental camera-trap deployments to quantify individual Capercaillie detection probability and evaluate whether it can inform density estimation. The study spans four sites across Norway, France, and Germany representing contrasting population contexts: a source population (Graveberget, Norway), a reintroduced population (Ballons des Vosges, France), a native declining population (Central Pyrenees, France), and a continental stronghold with unmarked birds (Bavarian Forest National Park, Germany). At the first three sites, GPS-tagged individuals are used to delineate core home ranges via Autocorrelated Kernel Density Estimation (AKDE). Within each home range, ten camera traps are deployed in a constrained-random design for 14-day sessions. Expected passes through each camera's detection zone are derived from the GPS trajectory and compared to observed detections using a binomial GLMM, with camera-trap model as a fixed effect and individual and site as random effects. Detection parameters estimated from paired GPS-camera-trap data will then be applied to derive density estimates using the Random Encounter Model (REM) and benchmarked against independent lek counts, historical monitoring series, and territory-mapping estimates. Finally, a transferability test will apply structured-deployment parameters to opportunistic camera-trap data from unmarked birds in the Bavarian Forest to assess whether detection estimates generalise beyond calibration sites. This poster presents the study design, deployment protocol, and analytical pipeline. We discuss the challenges of cross-site hardware heterogeneity, seasonal constraints on deployment windows, and implications for minimum camera-trap effort guidelines relevant to large-scale grouse monitoring programmes.

Design and development of a species-specific high-throughput molecular sexing assay for three bird species

Keywords: *Sex determination; qPCR; Rock ptarmigan; Gyrfalcon; Horned grebe*

Category: Poster

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Laia Bosch De Basea — Natural Science Institute of Iceland
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New high-throughput species-specific molecular sexing assays were designed and developed in this study for each of the three bird species: *Podiceps auritus* (the horned grebe), *Falco rusticolus* (the gyrfalcon), and *Lagopus muta* (the rock ptarmigan). The TaqMan qPCR assays that amplify the CHD1 gene orthologs. Fluorescent probes that anneal specifically to either the W or the Z gametolog are used for quantification. The samples from male birds (ZZ) give one fluorescence signal, and the samples from female birds (WZ) give two fluorescence signals. Primers and probes were designed in CLC Genomics Workbench from draft genomes assembled at The University of Akureyri. All three of these species are closely monitored in Iceland due to changes in population sizes. Hence, these three high-throughput sexing assays could prove highly useful for ecological researchers working with large sample sizes. The horned grebe has not previously been successfully sexed using molecular methods, so the development of this molecular sexing assay represents significant progress. The other two species can be sexed with the conventional avian

molecular sexing method of CHD1 PCR amplification and electrophoresis. That method, however, is both time-consuming and error-prone, so the option of using TaqMan qPCR with the probes and primers designed in this study is an improvement.

Habitat selection and efficiency of forest grouse hunters in Norway

Keywords: *Habitat selection; Hunting succes; Forest grouse; Telemetry; Norway*

Category: Poster

Sander Mikkelsen — University of Inland Norway — Norway

In boreal forests of Fennoscandia, forest grouse are both ecologically important and socioeconomically valuable, yet their populations face pressures from habitat alteration and harvest. A central task for the management of forest grouse in Norway is to acquire knowledge about the proportion of birds being shot and what are the sustainable harvest levels. A next step in management will then be to regulate the harvest within ecological and socioeconomic sustainable limits. In order to do so, it is valuable to investigate how hunters use the landscape during hunting and how efficient they are in different habitats and by extension, if hunting mortality is uniform across the landscape. This study used individual hunter movement data collected using GPS units carried during hunting days hunter track-logs and post-hunt questionnaires documenting bird encounters and harvest success to investigate habitat selection of hunters pursuing two focal forest grouse species, capercaillie (*Tetrao urogallus*) and black grouse (*Lyrurus tetrix*). I examined how these patterns of habitat selection influence encounter probability, harvest efficiency and harvest mortality throughout the hunting season. Habitat selection and movement behaviour were analyzed using integrated step-selection analyses. Analyses quantifying encounter rates and harvest efficiency are currently being finalized. In addition, hunter efficiency metrics, including harvested birds per hour, are being compared among hunter typologies and between participating study hunters and average hunters. Particular attention is being given to how habitat characteristics and hunting strategies influence hunting success. My predictions are that habitat selection by hunters will strongly influence encounter probability and harvest efficiency, and that experienced or specialized hunters will be more efficient than average hunters. I also believe that there is a difference in success between hunters with- and without dogs. By linking fine-scale movement ecology with human harvesting behaviour, this study provides new insight into the mechanisms shaping harvest outcomes in managed boreal ecosystems. The findings will contribute to adaptive wildlife management by identifying habitat contexts that influence hunter efficiency and encounter dynamics, thereby informing management strategies that balance sustainable harvest with conservation of forest grouse populations.

Living on the Edge: Greater Sage-Grouse (*Centrocercus urophasianus*) Use of Aspen Edge as Surrogate Mesic Habitat

Keywords: *Centrocercus urophasianus; Populus tremuloides; surrogate habitat; mesic; Utah*

Category: Poster

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The greater sage-grouse (*Centrocercus urophasianus*) is a galliform of conservation concern in the western United States, where its distribution and populations have declined. Most published literature suggests that greater sage-grouse avoid tree cover, presumably as a predator-avoidance behavior, and respond positively to the removal of trees, particularly conifers. In contrast, the Parker Mountain population of greater sage-grouse in southern Utah, USA, uses aspen (*Populus tremuloides*) edge as brood-rearing habitat. The Parker Mountain population does not have access to conventional mesic habitats, such as wet meadows, as many other populations do. Consequently, aspen edge, with abundant

forbs and insects necessary for chick development, is likely a surrogate for mesic habitat. We predict that males and non-reproductive females also use aspen edge as surrogate mesic habitat, especially during seasons of low precipitation. We will use fine-scale location data (e-obs, Grünwald, Germany) to assess the extent to which aspen is used during other seasons and life stages. This research will further our understanding of the behaviors and habitat use of the Parker Mountain greater sage-grouse population, one of the largest stable populations in Utah.

Translocations as an effective tool to aid in population recovery of endangered spruce grouse in New York

Keywords: *translocation; spruce grouse; population recovery; New York; endangered*

Category: Poster

Angelena Ross — New York State Department of Environmental Conservation — United States
Glenn Johnson — State University of New York at Potsdam
Tom Langen — Clarkson University

Species translocations can be an effective tool for population recovery. The spruce grouse (*Canachites canadensis*) is rare at the southeastern extent of its range. In New York, USA, it is endangered, having a geographic range that has decreased 71% since 1977 and a remaining population with relatively low genetic diversity. We found that increasing forest maturity and the resulting low genetic diversity of the remaining grouse population were likely driving the population decline. To reverse the decline, we began forest management in 2008 and have been evaluating success. We also explored the efficacy of translocations by releasing 144 female, 19 male, and 291 young-of-year wild-caught spruce grouse from Canada and Maine, USA, into occupied lowland boreal forest patches in New York from 2013–2019. We radio-monitored 121 translocated and 93 resident (i.e., New York-origin) adult grouse and evaluated movements, home range sizes, productivity, and survivorship of both groups through 2022. Translocated grouse remained in their release forest patch or an adjacent patch, moved over double the area, and had clutches and brood sizes similar to resident grouse during the first spring after release. Minimizing stress from handling and housing was of paramount importance for successful translocation; grouse held captive in enclosures with natural vegetation for ≤5 days had double the mean annual survivorship of captive grouse held for 6–10 days. One group held captive for 15 days had annual survivorship that approached zero. Translocated grouse that were handled the shortest duration had 72% of the mean annual survivorship of resident grouse. Similarity of life-history parameters among groups suggests that translocations of wild-caught galliforms into shrinking populations at range margins may be an effective means of augmenting population numbers and could be a useful tool for reversing declines and promoting population recovery. Long-term success of spruce grouse translocations with a goal of population recovery in New York may hinge on translocated grouse survivorship meeting target estimates defined in population viability analyses or by the adjustment of target numbers to compensate and effective habitat management to support the species' persistence.

Capercaillie *Tetrao urogallus* release projects in Germany from 1954 to 2024

Keywords: *capercaillie; reintroduction; reinforcement; translocation; captive-rearing*

Category: Poster

Ralf Siano — Office for Nature Conservation and Forest Planning — German
Siegfried Klaus — NABU Germany

The Capercaillie *Tetrao urogallus* is an endangered species in Central Europe, with declining populations and fragmented distribution. Reinforcement and reintroduction are common tools in grouse conservation. The aim of this report is to summarize and evaluate Capercaillie release projects in Germany during the past 70 years, and to draw conclusions. For this review we analysed extensive sources, including former reviews, peer-reviewed and grey literature, unpublished project reports and personal information from

the project leaders. To evaluate project success, the population size at the start of the project was compared with the population size after the project was finished. Extinction of a reintroduced or reinforced population was defined as a clear failure. We considered a project successful if the average population size remained stable for at least five years after the end of releases. About 5,800 Capercaillie have been released in seven reinforcement projects and four reintroductions in different parts of Germany. Nine projects have been concluded and two are still in progress (Thuringia, Lower Lusatia). Most released birds (83%) were reared in captivity and 4% of birds were released using the “born to be free” method, which combines captive-rearing with adaptation to the wild. Translocation of wild birds (13%) was used in two projects. Five of the 11 release projects failed. Success or failure could not be determined for four reinforcement projects, as the impact on the remnant population was unclear. In two ongoing projects, the only ones using wild-caught birds for release, a positive population trend was reported. However, birds are still being released there. Therefore, it is too early to draw final conclusions of the projects’ success. None of the German Capercaillie release projects have so far succeeded in establishing a viable population. The exclusive use of captive-reared birds in most of the projects resulted in low success. Captive-reared grouse suffered from physiological and ethological deficiencies, such as inadequate predator avoidance, reduced digestive ability, insufficient development of muscles and other organs, and abnormal behaviour. The “born to be free” method could be an alternative only if the quality of the reared birds is sufficient. Translocation of wild Capercaillie showed the best results and is clearly recommended. Basic preconditions, such as sufficient habitat quality and quantity to support a minimum viable population, must be fulfilled in any release area. Furthermore, future release projects must follow the IUCN guidelines and conduct feasibility studies before starting the project. Supporting a metapopulation should be prioritised.

Exploring a regional population trend of willow ptarmigan in Fennoscandia: A hierarchical distance sampling perspective

Keywords: *Willow ptarmigan; Lagopus lagopus; Population trend; Sweden; Hierarchical distance sampling*

Category: Poster

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Marius Kjønsgberg — Inland university of applied sciences, Norway

Maria Hörnell-Willebrand — Inland university of applied sciences

This study investigates a regional population trend of willow ptarmigan in Jämtland County, Sweden. This was done by using hierarchical distance sampling and Bayesian inference to estimate population densities from line transect surveys conducted for 29 consecutive years. The ptarmigan exhibits fascinating population dynamics, described to be influenced by habitat characteristics, predation, and climatic factors. The primary goal was to develop a robust model that captures annual density trends, enabling a broader understanding of population variability over time. The methodology employs hierarchical distance sampling models to analyze survey data, incorporating random effects for year, area, and transect to account for temporal and spatial variability. Field data were collected along systematically spaced line transects across varied alpine habitats using trained personnel with pointing dogs. Results show a generally stable population density over the last two decades, influenced by periodic fluctuations aligning with the species’ underlying cyclic patterns in population dynamics.

To see or not to see – what drives grouse to hide under the snow?

Keywords: *grouse; snow digging; anti-predatory behaviour; insulation; sight hunters*

Category: Poster

Roar Solheim — Natural history museum and botanical garden, Agder University (retired; emeritus connection) — Norway
Arne Flor — Norway

Grouse species are known to dig down into snow during winter. This behaviour is well known and described for willow grouse, ptarmigan, black grouse and capercaillie. Also North American ruffed grouse regularly dig down into the snow during winter. The most common explanation as a driving force for this behaviour seems to be insulation from cold temperatures. Based on our own experiences on this behaviour in capercaillie and black grouse, and reports from literature and old hunters, we discuss and propose that anti-predation behaviour is the ultimate evolutionary driving force of grouse searching shelter in the snow.

Climate Events Shape Ptarmigan Breeding Success and Juvenile Survival in Iceland

Keywords: *Rock Ptarmigan; Population dynamics; Climate indices; Breeding success; Juvenile winter mortality*

Category: Poster

Ute Stenkewitz — 360° LA Grimm & Steiniger PartG mbB (* affiliation at time of completion of study: Icelandic Institute of Natural History) — DE

Climate change theory predicts that ongoing climatic shifts can disrupt cyclic wildlife population dynamics and contribute to population declines. The resident Rock Ptarmigan (*Lagopus muta*) population in Iceland historically exhibited regular 10-year cycles, which have recently shortened to approximately 5-year cycles. This study evaluates long-term trends in breeding success and juvenile surplus winter mortality and examines their relationships with large-scale climate indices - North Atlantic Oscillation (NAO), Atlantic Multidecadal Oscillation (AMO), Polar/Eurasia pattern (POL), Northern Hemisphere Temperatures (NHT), and Scandinavian Pattern (SCA) - as well as regional weather conditions in northeast and west/southwest Iceland. Local weather conditions were closely linked to large-scale climatic drivers, particularly NAO and NHT, with regional and seasonal variation. In northeast Iceland, breeding success declined significantly, while juvenile winter mortality showed no temporal trend. In west Iceland, breeding success declined, and in southwest Iceland juvenile winter mortality increased significantly. In northeast Iceland, breeding success was significantly associated with NAO and NHT and declined under windier, wetter, and warmer summer conditions. Years of particularly low breeding success coincided with extreme summer weather, suggesting that summer extremes negatively affect reproduction. Juvenile winter mortality in northeast Iceland was significantly related to NAO and SCA, and marginally to NHT. Mortality increased with deep snow, strong winds, and heavy precipitation, but decreased during very cold, sunny conditions with deep snow. In southwest Iceland, mortality increased with strong winds and deep snow but declined under warmer and sunnier conditions. Overall, large-scale climate regimes partly explain changes in breeding success and juvenile winter mortality, key demographic drivers of population dynamics. However, climate likely interacts with additional ecological factors such as predation, parasitism, hunting, and food availability in shaping recent changes in Rock Ptarmigan population cycles.

Trends in adult densities of willow ptarmigan compared to hunting management

Keywords: *Willow Ptarmigan; Adult density; Management; Norway; Sweden*

Category: Poster

Eirik Sætren — University of Inland Norway — Norge

Trends in adult densities of willow ptarmigan compared to hunting management The willow ptarmigan (*Lagopus lagopus*) is an important small game species in Scandinavia and a key target for adaptive harvest management. In Norway, hunting management is largely based on estimated population size derived from annual distance sampling surveys, while management in Sweden relies more on spatial refugia and regulation through hunting days and bag limits. Despite long-term monitoring, recent trends indicate increasing adult densities of willow ptarmigan in Norway over the last 10–15 years, while production rates have remained relatively stable. The potential role of hunting management in explaining these trends remains largely unexplored. This master's project aims to investigate how hunting management influences adult density of willow ptarmigan in selected areas of Norway and Sweden. Specifically, the study will (i) quantify spatial and temporal variation in adult density from 2010–2025, (ii) evaluate relationships between adult densities and hunting regulations, and (iii) compare outcomes between different management regimes. The study will be based on standardized line-transect distance sampling data collected annually in August. Study areas will include selected and comparable management areas in central and northern Norway and Sweden. Adult density estimates will be derived using distance sampling analyses, and management measures will be compiled and evaluated through collaboration with local managers. The study will provide new insight into how different hunting management strategies influence breeding populations of willow ptarmigan and may contribute to improved knowledge-based management of this important game species.

The Ptarmy Army: current and future fieldwork in the Scottish Highlands focussing on an endemic Rock Ptarmigan subspecies.

Keywords: *Rock Ptarmigan; fieldwork; citizen science; tracking; Scotland*

Category: Poster

Anthony Wetherhill — British Trust for Ornithology — United Kingdom

Steve Willis — Tay Ringing Group

Katherine Booth Jones — Tay Ringing Group

Jacob Davies — Tay Ringing Group

Euan Ferguson — Grampian Ringing Group

The recently formed Scottish Ptarmigan Study Group (also known as the Ptarmy Army) has been developing fieldwork methods for the safe capture and study of the endemic Scottish Rock Ptarmigan subspecies (*Lagopus muta millaisi*). In this oral presentation I will give a summary of our efforts so far, challenges we face, and aspirations for future field research.

Augmentation improved genetic proxies of long-term population health for Columbian sharp-tailed grouse (*Tympanuchus phasianellus columbianus*) in Washington State (USA)

Keywords: *sharp-tailed grouse; augmentation; conservation; genetic introgression; management*

Category: Poster

Shawna Zimmerman — U.S. Geological Survey — United States of America

Jennifer Fike — U.S. Geological Survey

Michael Schroeder — Washington Department of Fish and Wildlife

Michael Atamian — Washington Department of Fish and Wildlife

Cameron Aldridge — U.S. Geological Survey

Sara Oyler-McCance — U.S. Geological Survey

Declining grouse populations have historically been among the most common targets of augmentation for conservation benefit, largely with mixed outcomes. In addition to remedying the original cause of decline, populations that received larger numbers of transplants over multiple years are generally more likely to have positive outcomes. Population trend improvements can be a strong indicator of transplant survival, but evidence of genetic introgression from the transplants is key to understanding whether there has been successful social integration and an infusion of genetic diversity that will reduce the risk of extinction and inbreeding depression. The Columbian sharp-tailed grouse (*Tympanuchus phasianellus columbianus*) is listed as Endangered by Washington State (USA). It persists as a complex of seven distinct and declining populations within remnant habitat patches amongst extensive agricultural lands. Recovery efforts have focused on protection of existing habitat and conversion of agriculture back to suitable shrub-steppe habitat. Additionally, six of the seven populations have been augmented with a total of 660 birds over multiple years (1998–2024) with individuals sourced from more stable parts of the range. Population trends increased, at least temporarily, for the augmented populations. Here we used genetic data to determine that there was strong evidence of genetic introgression in the populations for which we could evaluate. The amount of genetic introgression in one of the Washington populations was greater than expected based on local demographic rates, suggesting the traits of the transplants may have driven improvements in local trend. These results echo characteristics of other effective grouse augmentations (i.e., improved habitat, and large numbers of transplants, introduced across multiple years). Although much of the genetic introgression in Washington could be attributed to augmentation efforts, there was also evidence of movement among the isolated populations. This finding suggests that augmentation may also be more likely to achieve desired outcomes when multiple populations are within long-distance dispersal range.

From Heath to Lab Bench: Validating FTIR with Icelandic Ptarmigan Crops

Keywords: *Rock ptarmigan; Fourier-transform infrared spectroscopy (FTIR); Chemical fingerprints; Random Forest classification; Phytochemicals*

Category: Poster

Margit Zohmann-Neuberger — BOKU University — Austria

Marcel Schäfer — BOKU University, Austria

Jennifer Sorensen Forbey — Boise State University, USA

Johannes Tintner-Olifiers — BOKU University, Austria

Angelika Hromatka — BOKU University, Austria

Erich Inselsbacher — BOKU University, Austria

Ólafur K. Nielsen — Natural Science Institute of Iceland, Iceland

Ursula Nopp-Mayr — BOKU University, Austria

Identifying the specific plant parts and taxa consumed by herbivores is essential for understanding nutrition and foraging ecology. Fourier-transform infrared spectroscopy (FTIR) can capture phytochemical fingerprints that distinguish foods by functional traits beyond taxonomy, addressing limitations of DNA metabarcoding that rarely identifies plant parts differing in nutritional quality. We

leverage data from a long-term study on Icelandic rock ptarmigan (*Lagopus muta*). We analyzed 296 pure plant fractions separated from the crops of 236 birds collected over nine years. To derive pure plant fractions from the crop contents, the plant matter was separated according to species (or a higher taxonomic) level and plant parts, including *Betula nana* L. (both infructescence and catkins) and *B. pubescens* (only catkins); Berries from *Vaccinium* spp. L. (including both *V. uliginosum* or *V. myrtillus*) and *Empetrum nigrum* L.; stems with buds from *Salix herbacea* L. and from *S. phylicifolia* L.; leaves from *Dryas octopetala* L.. FTIR-ATR spectra were recorded in the mid-IR region (4000–400 cm^{-1}), excluding 2500–1800 cm^{-1} to remove atmospheric CO_2 and ATR crystal artifacts. We applied Principal Component Analysis (PCA) and Random Forests (RF) to classify plant parts and taxa based on spectral signals. PCA separated plant items primarily by plant part, with PC1 and PC2 explaining 70 % and 13 % of variance, respectively. RF achieved high accuracy for plant parts (overall accuracy = 0.951; kappa = 0.931) and moderate accuracy for combined taxa-part classes (overall accuracy = 0.822; kappa = 0.787). FTIR reliably classified plant parts and, to a lesser extent, taxa consumed by rock ptarmigan, reflecting variation in lipids, proteins, carbohydrates, and chemical defenses. These results highlight FTIR's potential for advancing plant and ecological research. The next critical step is applying FTIR to non-invasively collected fecal samples, enabling repeated studies of plant selection in free-ranging herbivores without direct interference. By focusing on the phytochemical traits as drivers of plant selection by herbivores, FTIR could become a cornerstone method for understanding plant–herbivore relationships, with significant implications for plant and wildlife ecology and conservation.

Reading the Menu in Feces: Functional Diet Calls from Feeding Trials

Keywords: *Feeding trials; Fourier-transform infrared spectroscopy (FTIR); Fecal analysis; food items; Grouse*

Category: Poster

Margit Zohmann-Neuberger — BOKU University — Austria

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Jennifer S Forbey — Boise State University, USA

Studies on feeding ecology that address dietary habits of wildlife species, food resource use, and trophic interactions form a cornerstone of wildlife biology and conservation. Accurate, scalable diet assessment is essential for linking plant–herbivore interactions to ecological change. Noninvasive approaches to characterizing diets, particularly the analysis of fecal samples, are central to field ecology because they offer ethical and logistical advantages and enable repeated population- and habitat-level comparisons. We conducted controlled feeding experiments with two grouse species (Black Grouse *Tetrao tetrix*, Capercaillie *Tetrao urogallus*) in two Austrian zoos to directly link known food items (“in”) to corresponding feces (“out”). Across 206 paired samples spanning multiple seasons (2022 to 2024) and plant organs, we recorded Fourier-transform infrared spectroscopy (FTIR) spectra (4000–400 cm^{-1}) for undigested plant samples and fecal droppings. This design provides a unique, digestion-aware benchmark for evaluating how plant chemical signatures persist through gut passage and how reliably diets can be inferred from feces.