GROUSE NEWS

Newsletter of the Grouse Group *of the*
IUCN-SSC Galliformes Specialist Group

Galliformes Specialist Group

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Chair Grouse Group within the IUCN-SSC Galliformes Specialist Group

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Editorial Board

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From the Editors

The 16th International Grouse Symposium 2026 was offered to be in Norway. More details will be published in later issues of Grouse News. This will be the second IGS in Norway. The 5th International Grouse Symposium was at Elverum, Norway in 1990 and was organized by Torstein Storaas and Tor Kristian Spidsø. Grouse News started after this conference where Professor David Jenkins suggested a need for such a publication. The primary function was to publish short interim papers, which the large peer-reviewed journals would usually reject. In this way it was hoped that hypotheses and new techniques could be described to colleagues in the grouse world without precluding eventual publication of a completed study elsewhere.

One of the most difficult aspects of editing Grouse News is not differences in language, writing or other editorial problems. The problem is getting contributed content from all of you for Grouse News. It is a struggle we face with each issue. Maybe you think it will not be of interest for other grousers, but we suggest that this is a wrong way of thinking. Your colleagues want to be kept up to date, and in return, you may very well benefit from their input and feedback.

If you work on grouse you are welcome to publish your work in Grouse News. It may be a presentation of a new project or some of the results from ongoing or finished projects, or merely observations that might be of interest. You may also publish news concerning conservation and management of grouse in your area. Even if you are not a professional grouse researcher, you may have interesting observations that may be of interest for others to read. So please don't hesitate from sending contributions. All kinds of information are welcome.

In this issue you will find information on 3 new books: Ecology and Conservation of Mountain Birds, Conservation and Management of Game Birds in Europe, and Rangeland Wildlife Ecology and Conservation. As usual Don Wolfe has arranged a list of all new grouse publications. Results from Media information from Game & Wildlife Conservation Trust Scotland, the 15th International Grouse Symposium in Białystok, Poland 2023, and Upper Midwest Prairie Grouse Summit – Addressing where fragmented Greater Prairie-Chicken and Sharp-tailed Grouse populations are found. Unfortunately we do not have any contrition about conservation news and no research reports.

A friend of many of us who attended the first conference at Culloden House, Inverness, Scotland in Scotland in 1978, Dr Franz Müller passed away August this year.

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From the Chair

Five years ago, at the last International Grouse Symposium in Logan, Utah, Dorota Ławreszuk volunteered to host the next triennial symposium in Bialystok, Poland. Everything was going according to plan when a year and a half ahead of the scheduled meeting, the world was mostly shut down by COVID and it was decided that a year delay was in order. Unfortunately, this was not the only delay for Poland. As the revised meeting date approached, Russia invaded Ukraine, unleashing many consequences beyond Ukraine's border – such as refugees and much uncertainty. Once again, this resulted in another year's delay.

Our Polish hosts, led by Chairman Dr. Marek Konarzewski, persevered and produced an excellent meeting from 11 to 16 September. The meeting was 2 years late, but worth the wait. On a personal note, I came down with COVID on the first day of the conference and had to miss most of the talks – ironic given that that first conference delay was due to the COVID pandemic. However, I was able to get firsthand accounts of the talks and the mid-conference fieldtrip. Everyone was impressed and thoroughly enjoyed themselves.

The conference in Poland was the 15th International Grouse Symposium, extending a long tradition which began in 1978 in Inverness, Scotland. The group was originally sponsored by the World Pheasant Association, but this association was eventually transitioned to the Species Survival Commission (SSC) of the International Union for Conservation of Nature (IUCN) in 1993. One issue of business that was decided in Poland was the location for the next International Grouse Symposium in 2026…Norway. It will be the second meeting in Norway, with a 36-year gap since the last meeting in 1990.

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NEWS FROM GALLIFORMES SG

John Carroll and Rahul Kaul, co-chairs of IUCN-SSC Galliformes Specialist Group.
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Rahul Kaul, co-chair of IUCN-SSC Galliformes Specialist Group.rahul@wti.org.in.

CONSERVATION NEWS

No contributions

RESEARCH REPORTS

No contributions.

CONFERENCES

Media information from Game & Wildlife Conservation Trust Scotland

10 May 2023

Notes of caution sounded at Scotland's grouse symposium

A one-day symposium, Practical conservation for Scotland's Grouse, organised by the Game & Wildlife Conservation Trust and the World Pheasant Association and sponsored by Hampden & Co took place at Balhousie Castle, Perth, on Friday 5 May.

The event was staged to bring land managers up to date with the latest research and advice relevant to the conservation of Scotland's four grouse species - black grouse, red grouse, ptarmigan and capercaillie - and to promote good practice in game and wildlife management.

A wide-ranging programme highlighted the pressures on Scotland's grouse species, not least climate change, disease, disturbance, failure to agree on the way forward among 'stakeholders', emerging land management regimes such as 'green washing' and carbon offsetting, extensive afforestation, and political change and its unintended consequences impacting on conservation effort.

The opening address was given by Finlay Carson MSP and Convener of the Rural Affairs and Islands Committee. He was followed by Patrick Laurie speaking about black grouse; Dr Kathy Fletcher of GWCT on ptarmigan; Matthew Colston of Elanco Animal Health on tackling tick; Dr Beth Wells of the Moredun Research Institute on vaccine development for louping ill; Ross Ewing, Director of Moorland, Scottish Land and Estates on threats emanating from the Wildlife Management and Muirburn Bill; and former GWCT Chairman Ian Coghill urging all to listen to the science.

The afternoon programme included Bruce Cooper, a specialist land management consultant; Dr Nick Hesford of GWCT on gathering evidence; Professor Neil Metcalfe of Glasgow University and Chair of the Scientific Advisory Committee on capercaillie; and Rory Kennedy, GWCT Director Scotland calling for collective action to save Scotland's capercaillie from extinction.

Patrick Laurie said that he had witnessed "the devastating collapse of black grouse in Galloway, their decline mirrored by other birds like the curlew, driven to a level below which they cannot survive by the massive expansion of commercial forestry" and that we were "shepherding birds into non-existence."

Kathy Fletcher said that the grouse of the high tops, the ptarmigan, was being challenged by climate change, by range contraction, by changes in food abundance, by parasites and disease, and by predator pressure particularly with snow cover receding. She said that "positive conservation must aim to minimise negative pressures."

Bruce Cooper, who prior to its sale was head keeper and stalker on Glen Prosen Estate, said that the estate under private ownership and when managed for both habitat and game delivered a range of important benefits, with an "endless list of companies and businesses supported by this form of land use," but that change of ownership and sale of the estate to Forestry and Land Scotland in November 2022 had brought "worrying times for those with an interest in biodiversity," and that "many species, along with the gamekeepers that work so hard to protect them, will become extinct on the estate."

Speaking on the subject of capercaillie, Rory Kennedy said that an adaptive management approach was needed and that this species, which has been saved from extinction in the UK once already, required especial effort with all options in play including access exclusion around lek and nest sites, fence marking, heightened predator control and the trialling of other possible solutions such as diversionary feeding for predators over limited time periods, and control of pine marten numbers through contraception.

Hugo Straker of GWCT, co-organiser of the conference, said:

"This was a highly thought-provoking event, and important for those with the knowledge and a broad range of opinions to come together to look at the status of our four grouse species. What emerged was certainly a significant note of caution that, whether through legislation or consequences on habitat and species in our bid to combat climate change, or as a result of many other factors that we can control, we do not in fact damage the important objective of biodiversity recovery – including the conservation status of our four grouse species. Evidence and common sense must not become casualties alongside biodiversity loss."

Issued by for GWCT in Scotland by:
Dick Playfair, Playfair Walker, Tel 0131 445 5570, E richard@playfairwalker.com.

The 15th International Grouse Symposium Białystok, Poland 2023

Michael Schroeder

The 15th International Grouse Symposium was held during 11–16 September 2023 in Bialystok, Poland. The previous meeting was held in Logan, Utah in 2018. Although the meeting is normally held every 3 years, an additional 2-year delay was required due to the COVID pandemic and Russia's war with Ukraine.

The meeting included workshops on 11 September with the regular conference beginning on the morning of the 12th with an attendance of about 120 grouse enthusiasts. There were 3 days of talks (12th, 13th, and 15th), including plenary talks by Dr. Ilse Storch, Dr. Robert Moss, Dr. Gail Patricelli, Dr. Sara Oyler-McCance, Dr. Robert Rutkowski, and Dr. Agnieska Kloch. There were also numerous 20-minute presentations, but also a poster session on the evening of the 13th. One of many highlights of the conference was an all-day fieldtrip on the 14th to the Głęboki Bród Forest District. This included a visit to the Capercaillie Breeding Center and an evening banquet. The final day of the 16th included optional full day fieldtrips to either Biebrza National Park or Bialowieza National Park.

The organizing committee, led by Chairman Dr. Marek Konarzewski, did an excellent job organizing the conference, especially considering the challenges they faced. A list of the presentations follows, alphabetized by the last name of the lead authors. Specific information about the conference can be found at https://igs2022.uwb.edu.pl/.

Participants at the 15th International Grouse Symposium in Bialystok, Poland.
uwb.edu.pl/fcp/iFBsTMCQZEyUgCg4WSHd4ak1VYTZUNlAGDzRMdA0bPTZDGw8jJRRUfHYlC1BGbzMrMBgzNlk4VjgSOQEgQVQlKBpcHg/_global/public/main/igs/xv_igs_common_foto_-_300_dpi_.jpg

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Plenary talks

Parasites and conservation biology.

Kloch, A.

Abstract: Parasites are considered major evolutionary force shaping dynamics of host populations. The effect of pathogens on endangered host species is not clear. From one hand, small isolated populations are more vulnerable to infections and parasites may decimate the host population making it prone to extinction due to random factors. On the other hand, if the population density drops below given threshold, a transmission of pathogens may not longer be possible. Another important factor is specificity of pathogen and its zoonotic reservoir that may act as a source of infection. At the individual level, the impact of parasitic infections on fitness remains unclear and surprisingly, their negative effect is not always evident. The outcome depends on the genetic background of an animal, including repertoire of genes coding components of the immune system. On physiological level, there is often a trade-off between costs of immunity versus costs of parasite burden. All these factors should be taken into account when planning conservation activities.

Harnessing molecular innovation for improved management of sage-grouse.

Oyler-McCance, S. J.

Abstract: For over two decades, genetic studies have been used to assist in the conservation and management of both greater sage-grouse (*Centrocercus urophasianus*) and Gunnison Sage- grouse (*C. minimus*), addressing a wide variety of topics including taxonomy, parentage, population connectivity, and demography. More recently, the field of conservation genetics has been transformed by dramatic molecular innovations allowing for improved characterization of 1) gene flow (including landscape features impacting it), 2) conservation units, and 3) adaptive divergence. Here, I recount this transformation and how it has improved sage-grouse management. I provide examples of research aimed at understanding how landscapes facilitate or impede gene flow, how areas across the landscape can be prioritized as most important for maintaining range-wide connectivity, and how genetic data can be integrated into monitoring programs. Further, I will discuss the shift from genetic to genomic methods, highlighting work examining potential dietary adaptation in both species and how this information is relevant for translocations and sagebrush restoration. The integration of newly developed genomic resources combined with the vast wealth of ecological and behavioral data for sage-grouse has the potential to shed light on mechanistic relationships that may ultimately improve the conservation and management of these species.

Civilisation and its discontents: human impacts on grouse, from large-scale niche loss accompanying climate change to local disturbance from outdoor recreation.

Moss, R.

Abstract: Grouse evolved as the global cooling of the Neogene Period opened a new niche for large birds able to survive through long, snowy winters on arboreal or shrubby diets. As this niche contracts northwards with anthropogenic global warming, the survival of geographically isolated southern grouse populations becomes increasingly precarious – and there are fears that this trend will extend northwards. It is unlikely, however, to operate uniformly throughout the northern hemisphere. Changing currents in the Atlantic Ocean, for example, might bring cooler air to western Eurasia while more frequent breaks in the polar vortex might allow more cold, polar air to flow southwards. In the medium term, such effects might slow down the expected adverse consequences of climate change and extend opportunities to maintain the existence of some local grouse populations by ameliorating other impacts – such as forest clearcutting, predation, collisions with forest fences and overhead wires as well as the increasing use of grouse habitats for human recreation. Indeed there are positive examples to inspire such efforts: in southern Norway, breeding success of black grouse and capercaillie has increased since 1979. In Scotland, forests with a moderate amount of recreational disturbance have supported better breeding success than less-disturbed areas – hinting that managed recreation might have an unexpected, beneficial effects. In the longer term, the declining human birth rate in developed countries offers hope that the human population will eventually decrease, with concomitant reduction in its impacts on grouse.

Robots, Telemetry & the sex lives of sage-grouse: Using technology to study courtship and conservation.

Patricelli, G. L.

Abstract: Males in many species must convince females to mate by producing elaborate courtship displays tuned to female preferences, like the song of a cricket or the train of a peacock. Much of what we know about the evolution of these displays by sexual selection comes from research on lek-breeding grouse, which examines which male traits are associated with reproductive success. But courtship in grouse and many other species is dynamic and interactive, more like a negotiation than an advertisement; therefore, in addition to elaborate displays, success in courtship may require tactics and social skills. These skills may include, for example, the ability to gather information and adjust their behavior in response to female courtship signals, and to the marketplace of other males and females. I will discuss my lab's research on greater sage-grouse using robotic females to investigate courtship interactions between the sexes and how the habitat structure can affect the flow of information among individuals on the lek breeding grounds. I will also discuss my lab's ongoing research investigating how foraging behaviors affect courtship displays in sage-grouse, and how this basic science has informed my lab's research into human impacts on breeding activities.

Tetraonidae – dying knights of Polish forests: genetic diversity and population structure in space and time.

Rutkowski, R.

Abstract: There are three species of woodland grouse in Poland: the hazel hen or hazel grouse (*Tetrastes/Bonasa bonasia*); the black grouse (*Tetrao/Lyrurus tetrix*) and the capercaillie (*Tetrao urogallus*). In Poland, their demographic history is rather similar. In the twentieth century, and especially after the Second World War, there was a systematic and rapid decline in the abundance of all three species, combined with the fragmentation of the range and the extinction of isolated populations in most of the area. In the case of the capercaillie and black grouse, this led to the almost complete extinction of species in Poland. The status of the hazel grouse seems a bit different. The population size also began to decrease significantly in the second half of the XX century, however since the beginning of the XXI century the population has been increasing, with the species recolonising some formerly abandoned areas. Until I have started research on population genetics of woodland grouse, nothing was virtually known about the genetic diversity and phylogeographical status of the populations occurring in Poland. Therefore, filling the gap in knowledge about their genetic variability was extremely important, especially in terms of woodland grouse protection in Poland. In my plenary speech I would like to summarize the collected genetic data on diversity and relationships between Polish populations.

Since in the case of most populations of the capercaillie and black grouse, the obtained data indicated a possible threat of unfavorable genetic processes, reintroduction activities and genetic reinforcement of the still existing populations were started. The genetic monitoring, based on microsatellite genotyping play a significant role in tracking the reintroduction effects of the capercaillie. Hence, in recent years biological samples have been collected from introduced birds of different origin: breeding individuals, as well as wild birds, captured in genetically compatible, stable populations from other areas of Europe. At the same time, non-invasive samples were collected in areas under active protection of forest grouse. In total, more than two thousand samples were analysed, using microsatellite genotyping. In my speech I would like to present the first conclusions from the results of genetic monitoring and genetic changes in supported populations, especially in the case of the capercaillie.

Research and the conservation of grouse in Europe: Past experiences and future challenges.

Storch, I.

Abstract: In the past 50 years, the wildlife sciences have experienced major technical and methodological progress. At the same time, there are positive trends in numerous wildlife species across Europe: beaver, wolf, brown bear, and lynx are making remarkable recoveries; others, such as wild boar, red deer and roe deer are expanding their range and continue to increase. Much of this, however, can be explained by effective legal protection, wildlife- friendly attitudes of an urbanized human population, and improved resource availability due to human land use and climate change. In fact, scientific research may have played a minor role in these wildlife success stories. I illustrate this thesis by reviewing the story of woodland grouse in Europe during the past 50 years. While scientific work focusing on conservation

management of grouse has increased over the decades, successes in grouse conservation are rare. I present several case examples of conservation programmes for threatened woodland grouse populations across Europe, that indicate that we have not sufficiently understood limiting factors, and/or limiting factors act at large spatial and temporal scales that are unlikely to be reversed in local-scale conservation programmes. The challenges of grouse conservation, especially at the edges of their global distribution ranges, lie in conflicting conservation objectives, increasing impacts of global warming and subsequent changes in ecosystem structure and functioning, which lead to changes in trophic interactions to the detriment of grouse.

Oral Presentations

How environmental factors and human disturbance affect the occurrence of black grouse (*Lyrurus tetrix*).

***Adamowicz, M.**, T. Gortat, P. Czortek, and M. Chiliński.*

Introduction: The Eurasian black grouse (*Lyrurus tetrix*) is one of the most rapidly declining species in Central and Western Europe. In this study, we analysed the impact of a number of predictors (type of land cover, topography, tourism pressure) on the occurrence of the black grouse in a Central European, mountainous refuge – Polish Tatra Mountains.
Material and methods: Data on black grouse occurrence in Polish Tatra Mountains was obtained during field inspections conducted in 2020–2021. We determined the study plots - the areas used by particular/group bird, based on the coordinates of each black grouse record. Then we designed a model in which we analyzed the impact of a number of predictors (land cover, topography, tourist pressure) inside and outside the study plots, on the occurrence of the black grouse in the Polish Tatra Mountains.
Results and discussion: We showed a positive effect of vegetation cover providing food, lekking sites and hiding places, and a negative effect on bare land cover forms such as rocks, on the black grouse occurrence. We did not confirm the negative effect of human disturbance inside the study plots on black grouse occurrence, but we found that the plots surrounded by high tourism pressure had significantly lower number of black grouse records.
Conclusions: The occurrence of the black grouse is determined by multifactor environmental conditions, primarily natural factors – mainly the way of land cover by different types of vegetation. Our results clearly show that effective protection of this species should consist of maintaining large open areas with a significant share of dwarf shrubs, in the vicinity of the forests. It should cover both the species' refuges and their surroundings – in order to enable the communication between subpopulations and local groups of birds. Tourism traffic should be maximally channelized to narrow strips, and in places where it is particularly intense - limited, not only during the mating season but also in winter.

Seasonal timing mechanisms in the Svalbard ptarmigan (*Lagopus muta hyperborea*).

***Appenroth, D.**, J. Kalinova, S. Wood, A. West, and D. Hazlerigg.*

Introduction: The Svalbard ptarmigan is one of few terrestrial birds which overwinter in the high Arctic. This overwintering strategy comes with challenges. Food shortage, continuous darkness and freezing temperatures in the winter and a short growing season in the summer define the Arctic. Svalbard ptarmigan have evolved a range of physiological traits which help them to survive under those conditions. These traits include a seasonal body mass cycle and precisely timed reproduction. In order to time these seasonal traits accurately, the Svalbard ptarmigan (as well as any other seasonal bird and mammal) relies on internal timing mechanisms within the hypothalamus of the brain. These timing mechanisms are crucial but too rigorous timing might be of disadvantage under the context of Global Warming. Rapid climate change can lead to timing mismatches, i.e. mismatches between the anticipated environment predicted by internal timing mechanisms and the prevailing environment. Hence studying those internal timing mechanisms can add predictive power about the adaption limits and survival chances of species depending on it, such as the Svalbard ptarmigan.
Material and methods: In our experiments we use Svalbard ptarmigan from our own breeding program and subject them to artificial changes in daylength. A range of behavioral, physiological and molecular techniques are applied to thoroughly study internal seasonal timing mechanisms.

Results and discussion: In our ongoing work, we show, on the example of the Svalbard ptarmigan, how the avian hypothalamus uses the annual changes in daylength to time its seasonal life cycles, such as reproduction or body mass changes.
Conclusions: The results of our studies on Svalbard ptarmigan give valuable insights into avian timing mechanisms. Among other implications, this can help to predict timing and mistiming of vertebrates in fast changing environments, such as in the Arctic.

Development of management recommendations for greater sage-grouse winter concentration areas.

***Beck, J. L.**, A. C. Pratt, C. P. Wanner, and K. T. Smith.*

Introduction: We designed our research to provide information from which the Wyoming Sage-Grouse Implementation Team can base management recommendation guidelines for winter concentration areas used by greater sage-grouse (*Centrocercus urophasianus*). Our research addressed 3 objectives to identify the: 1) timing of sage-grouse presence on winter range, 2) effect of snow cover/depth and sagebrush (*Artemisia* spp.) cover/height relative to sage-grouse winter habitat selection, and 3) potential thresholds of sage-grouse response to anthropogenic disturbance in winter.
Material and methods: We assessed environmental and anthropogenic variables within circular regions (0.1–10.0 km) to determine scales in which grouse selected winter habitats. We acquired data from multiple studies across 6 regions of Wyoming and obtained 864,766 year-round GPS locations from 536 grouse. Study regions encompassed a range of anthropogenic infrastructure and surface disturbance.
Results and discussion: The median date of arrival to and departure from winter range across all regions was 7 November and 13 March, respectively. Sage-grouse selected winter ranges in areas with gentle topography, demarcated by low slopes in proximity to breeding habitats and dominated by sagebrush and absent juniper (*Juniperus* spp.). In home ranges, sage-grouse used areas at a greater rate than available once sagebrush habitats and cover within 10.0 km exceeded 65% and 10%, respectively. Across all disturbances and circular regions, mean surface disturbance at grouse locations did not exceed ~7%, and mean surface disturbance from oil and gas development did not exceed ~1% surface disturbance.
Conclusions: These results will form the basis to develop management recommendations in winter range.

Increasing feral horses decrease greater sage-grouse nest and brood survival.

***Beck, J. L.**, K. T. Smith, C. P. Wanner, A. C. Pratt, M. C. Milligan, P. S. Coates, J. D. Hennig, J. Derek Scasta, and P. A. Street.*

Introduction: Across portions of their range greater sage-grouse (*Centrocercus urophasianus*) have coexisted with feral horses (*Equus ferus caballus*) since they were introduced to western North America by European settlers. Free-roaming equids have increased to more than 3 times the goal of 27,000 on Bureau of Land Management lands. Research in Nevada has implicated these increases as one of the drivers of sage-grouse population declines, affecting demographic parameters associated with reproduction.
Material and methods: To evaluate this hypothesis, we collected survival data for 907 nests laid by 559 unique female sage-grouse and 317 broods belonging to 265 unique female sage-grouse. These data ranged spatially across 6 Herd Management Areas as well as areas without feral horses, and temporally over 11 breeding seasons (2011–2021) in central and south-central Wyoming.
Results and discussion: Over this period, population estimates of feral horses for these HMAs ranged from 59–700% of the maximum appropriate management level. We used these data to train Bayesian hierarchical nest and brood survival models to investigate the impact of feral horses. Nest survival (βhorse = –0.080, SD = 0.048, F = 0.96), early brood survival (βhorse = –0.003, SD = 0.001, F = 0.99), and late brood survival (βhorse = –0.002, SD = 0.001, F = 0.96) all decreased as feral horse numbers increased.
Conclusions: Our results indicate increasing feral horse numbers affected two key vital rates influencing population growth of sage-grouse. Information is preliminary and provided for best timely science.

Spatiotemporal trends of sage-grouse populations in stochastic environments: six decades of declines in the American West.

*Coates, P. S., B. G. Prochazka, M. S. O'Donnell, C. L. Aldridge, D. R. Edmunds, A. P. Monroe, M. A. Ricca, L. A. Wiechman, K. E. Doherty, and M. P. Chenaille (Presented by **S. Mathews-Sanchez**).*

Introduction: Greater sage-grouse (*Centrocercus urophasianus*) population performance is at the center of western US land use policies surrounding rangeland conditions. Oscillations in sage-grouse population abundance, driven by environmental stochasticity, present significant challenges to trend estimation and investigations of habitat loss that threaten sage-grouse populations.
Material and methods: Using a Bayesian state-space hierarchical model and novel, trend-estimation approach, we derived range-wide population trends over different spatiotemporal scales relevant to sage-grouse ecology during 1960–2021. We investigated interactions between wildfire and climatic conditions on population trends and compared trends among varying levels of sagebrush ecosystem integrity (SEI). Lastly, we developed a user-friendly web-based tool for land and wildlife managers to annually acquire trend outputs across spatiotemporal scales.
Results and discussion: Models estimated 2.9% average annual range-wide declines, though percent declines varied among regions and sub-populations. Cumulative declines were 42.5, 65.6, and 80.1% across short (19 years), medium (35 years), and long (55 years) temporal periods, respectively. Models predicted 57.0% of populations exhibited >50% probability of extirpation by 2060. Interannual fluctuations were primarily governed by precipitation while loss of habitat from wildfire resulted in long-term population declines. Models also revealed population growth and greater cyclicity within areas of high SEI, while populations in areas of relatively low SEI were less cyclical with rapid declines. Although long-term population declines were estimated within nearly all areas of sage-grouse range, the most recent and substantial declines were in the western portion, largely a result of type conversion from sagebrush to annual grasslands following wildfire which decreased local carrying capacities.
Conclusions: Our findings support maintenance of core populations with high quality habitats (e.g., relatively high SEI) that buffer against environmental stochasticity. Our web-based tool facilitates planning and execution of conservation actions for maintaining and creating viable sage-grouse populations. Some findings are preliminary and provided for best timely science.

Is the black grouse (*Lyrurus tetrix*) an indirect victim of the sylvatic rabies eradication by fox vaccination?

***Delcourt, J.,** B. Brochier, D. Vangeluwe, and P. Poncin.*

Introduction: Since 2017, a reinforcement program was developed to save the last, endangered, Belgian population of black grouse (*Lyrurus tetrix*), in the High Fens Natural Park. To improve the success of this program, an analysis of past data of this population was undertaken to understand the causes of its past decline. Climate models, applied in previous studies to explain these population trends in the High Fens, failed to describe this major modification in this population's dynamic and its recent decline.
Material and methods: A time series analysis was applied on the core population to understand the causes of its past decline, using annual spring male census data recorded between 1967 and 2016.
Results and discussion: In the period 1967–1993, there was a fluctuation around an equilibrium of a population of ca. 40–45 males. After 1993, the population dynamic changed drastically, decreasing continuously until finally reaching quasi-extinction. On average, the population lost 15.4% of its size each year. Red fox (*Vulpes vulpes*) populations in Western Europe experienced a significant decline and stabilized at lower densities than observed in the past due to an outbreak of sylvatic rabies. In early 1990s, a fox demographic explosion followed a massive vaccination campaign, and fox populations became larger than had been observed before the epizootic. The eradication of the rabies was not the direct cause of this demographic explosion, as rabies-free areas experienced it also (but earlier). The causes are more to be sought in environmental modifications induced by humans.
Conclusions: Around 1993, the remarkable synchronicity between the beginning of the black grouse population decline in High Fens and the fox demographic explosion suggests a significant increase in predation on this bird species. If the fox is singled out for this change in black grouse dynamics, it should not be concluded that it is entirely responsible for this decline. It is quite possible that other factors have added up, such as the arrival or increase of other predators (the raccoon in particular, but also the wild boar, and better health of the populations of large raptors), deer overgrazing, and other subtle habitat changes and in climate.

Post-release acclimation of translocated black grouse (*Lyrurus tetrix*): a multi-time scale analysis using telemetry.

*Dewilde, J., **J. Delcourt**, D. Vangeluwe, and P. Poncin.*

Introduction: Translocation of living individuals is a conservation strategy used to reinforce declining populations. However, failures are not uncommon, notably due to factors such as high mortality or unexpected behaviors (e.g. absence of reproductive behavior, tendency to leave the release area, etc.). We translocated 88 black grouse (*Lyrurus tetrix*) from Sweden to Belgium to reinforce the last population occurring in the country. We tracked 58% of them by GPS telemetry and analyzed their movements to see if an acclimation in the release area was noticeable, but also to gain insights on the pattern of activity of the grouse (a) right after a translocation event and (b) over the course of the year.
Material and methods: The translocated black grouse were captured in Kårböle (Sweden) in late April 2017, 2018 and 2019 and 2022. Trapping took place on the leks, using fall traps. Individuals were then ringed, measured and placed in individual boxes to be transported to the 'Hautes Fagnes' Nature Reserve (Belgium), in which they were released circa 30 hours after capture. Spatial data was collected via solar-powered GPS-GSM backpack transmitters deployed on 51 individuals. Analyses were conducted using QGIS and RStudio.
Results and discussion: We noticed a high inter-individual variability, probably related to different stress-coping mechanisms and personalities. However, it is noteworthy that the longest movements, including explorations out of the reserve, are performed during the first 3 weeks post-release. All grouse then returned to the reserve and only moved over short distances for 3-4 months, until a second peak of higher activity in October. Although some grouse died during their long-distance movements, it was not an inevitable fatality.
Conclusions: Except the 3 weeks post-release, the general activity pattern detected is in line with the behavior of non- translocated black grouse, suggesting that translocated individuals need a short (but critical) period of acclimation to their new environment, then behave normally and have therefore the potential to thrive.

It takes guts to conserve grouse: unraveling the intestine to manage and monitor grouse from the bite to the biome

***Forbey, J. S.**.*

Introduction: Effective grouse management must consider a diversity of biotic, abiotic, and human-mediated threats. We propose that intestines are an under-appreciated "window to the soul" of grouse management. We demonstrate how the intestine morphology and contents can be used to predict physiology, health, species interactions, and demographics of grouse.
Material and methods: In collaboration with diverse organizations across Iceland, Sweden, Norway, and North America, we have collected whole body specimens donated by hunters and feces of free-ranging grouse species. We use genomic, biochemical, morphological, and physiological tools to assess foraging behavior, diet quality, digestion, detoxification, body condition, and species interactions in grouse.
Results and discussion: The chemical and morphological composition of intestinal contents offers insight into diet selection and foraging fidelity that can inform conservation, restoration, and translocation practices. Diet quality, morphology of the intestine, and physiological function of intestinal cells and the microbiome can predict the health of grouse. Finally, metagenomic and biochemical analyses of intestinal content allow us to detect how grouse interact with plants, parasites, and pathogens over space and time and therefore can be used to monitor and predict trophic-level responses to climate change and management practices.
Conclusions: We describe how partnerships among hunters, conservation and management practitioners, and academics can use gutsy approaches to sustainably manage and monitor grouse at scales from individual bites to the biome.

Implications of climate change on Greater sage-grouse conservation at their southernmost distribution.

***Frey, N.**, A. T. Beers, Z. S. Moffett, and B. C. Donnelly.*

Introduction: Greater sage-grouse (*Centrocercus urophasianus*, 'sage-grouse'), are sagebrush obligates that face threats to their persistence throughout their distribution in western North America. Their southern- most distribution is situated in the southern edge of the Great Basin, which is and will be experiencing a warming, drying trend into the near future. Studying sage-grouse in their southernmost distribution may provide us insights as to how these populations use habitat in conditions that are often considered unsuitable. Thus, we can adjust management actions to continue to support marginal distributions.
Material and methods: We studied sage-grouse movements and habitat selection over the course of 8 years. To model habitat selection and effects of climate (i.e. light intensity and heat) we used >116,000 GPS locations from >90 grouse across four study areas in southern Utah and Nevada from 2014-2020. We deployed dataloggers in two of these study areas to measure light and temperature every 30 minutes for 27 months. We created random forest models to explain differences in topography, vegetative cover, and influence of light and heat in sage-grouse locations throughout the year. Additionally, we compared shrub and herbaceous vegetation composition and density in an area treated to remove tree cover to paired random sites in sagebrush that had not been disturbed; we also compared sage-grouse use of these treated and untreated sites.
Results and discussion: We found that temperature influenced sage-grouse habitat selection in all seasons. In the warmer sites, sage-grouse used areas near trees during the winter and especially during summer, likely to avoid extreme cold and heat, respectively. We found that sage-grouse selected habitat that had greater herbaceous cover than that found in treated habitats, also greater than the suggested state management guidelines. Sage-grouse used sagebrush stands that had been treated within 2-5 years, but use declined in older treatments, possibly in relation to the reduced herbaceous cover in older treatments.
Conclusions: Traditional methods to select treatment locations and implement treatments to improve or create sagebrush communities along this marginal distribution may not result in the production of suitable sage-grouse habitat as we continue to experience climate change. In the face of the warming and drying trend, we can use these micro-site data to predict the change in sage-grouse habitat selection and movements, and adjust our conservation actions accordingly.

Conservation of the capercaillie in the French Jura mountains: Have we tried everything yet?

***Gardet, V.**, A. Peyric, and A. Depraz.*

Abstract: The Capercaillie is present in four very different massifs in France. As the different populations began to decline in all the regions, a National Strategy for the conservation of the Capercaillie has been launched in 2012. The different areas of this public political tool will be described briefly, as the population dynamics for each massif.

A focus on the situation in the French Jura mountains will then be made, with brief descriptions of the benefits of the LiDAR technology on habitat description and an ambitious monitoring of the human frequentation.

Finally, some perspectives for the conservation of the Capercaillie in this massif will be addressed. A new protocol aiming to better qualify the recruitment or the adult survival is among them, with a call for documentation or feedback on similar initiatives. The reinforcement of the populations is also highly considered, following a recent viability study. The creation of an European workgroup on this very subject could lead in a better pertinence and success of all the initiatives in the different regions considering this engaging action.

Active protection of black grouse and western capercaillie in the state forests in Poland.

Grzębkowski, M.

Introduction: Due to the low number of population, isolation, poor genetic status, limited areas of optimal habitats and strong predation pressure, the capercaillie and black grouse populations are an endangered species in Poland. Most of the refuges of both species are located on lands managed by the State Forests. The population of black grouse is estimated at 400–500 individuals, and decreases rapidly. In the case of the western capercaillie, the rapid decline in the population observed in recent decades has

stabilized at the level of 600–700 individuals. Active protection of these species takes place in about 25 forest districts, 4 breeding centers and the Forest Gene Bank "Kostrzyca". Each year, the State Forests allocate several million euros from their own or external funds for the protection of these species.
Material and methods: Among the most important activities are: adjusting forest management in refuges to species requirements, habitat forming through regulation of vegetation structure, water retention, disassembly or marking of fences around forest planting, survey, monitoring and reducing the number of terrestrial predators, goshawk translocation, eliminating foreign invasive plant species, reintroduction, genetic, ground and telemetry monitoring, manage breeding centres or reducing tourist pressure.
Results and discussion: The active and strict protection undertaken in recent years result in various ecological effects. In some refuges it has contributed to increase the populations numbers, while in others, the decline is still progressing. Protective measures encounter many problems, including progressive climate change, favorable conditions for the development of terrestrial predator populations, difficulties in obtaining an appropriate number of birds for reintroduction or problems resulting from the development of tourism and recreation in areas where the grouses appear.
Conclusions: Despite not fully satisfying ecological effects, further conservation projects are planned to improve the conservation status of these species. The State Forests will use the experience gained in them to improve the methods of active protection.

Acoustic signals of male black grouse: individual and subpopulation level.

Hambálková, L.

Introduction: Acoustic performance of black grouse represents a significant part of its life during the mating season and could also help in monitoring this species. Population of black grouse declines in many countries and hidden way of life is not conducive to a successful census. Monitoring based on acoustic performance could help especially at the areas with low population density and in an environment with dense vegetation. Male black grouse produce two main long-distance calls on leks: low frequency rookooing and hissing sound which is not produced by syrinx. Despite this, it has a strong potential for distinguishing individuals and even populations.
Material and methods: We recorded hissing calls from male black grouse from Finland, Scotland, Czech Republic and Russia. Hissing calls from 24 individuals were analysed for individual variability and from 82 individuals for geographical variability. We conducted cross-validated discrimination analyses (DFA) for both analysis.
Results and discussion: For individuality the discrimination model classified each call with almost 78% accuracy (conventional result) and for geographical variability with nearly 71% accuracy. Acoustic performance of birds has been predominantly studied for signals produced by the syrinx, which is why these outputs are unique.
Conclusions: We found out that hissing calls of male black grouse is individually distinct and therefore, it can be used for more precise monitoring. Secondly, range-level differences enhance knowledge and facilitate the assessment of species evolution.

Movement-based Metrics of Nesting Area Fidelity Determine Nest Success in Sage-Grouse: Implications for Grouse Conservation.

*Haynam, T., and **L. B. McNew**.*

Introduction: Spatial fidelity by animals may represent familiarity with the surrounding landscape that results in fitness advantages. If spatial fidelity is a fundamental adaptive trait for grouse, then fitness consequences of differential fidelity should be evident. We hypothesized that spatial fidelity would be evident and influence reproductive success in greater sage-grouse (*Centrocercus urophasianus*). Specifically, we predicted that 1) fidelity to nesting areas would be evident in our sage-grouse population, 2) fidelity would influence nest success, and 3) explicit modeling of fidelity via time- varying movement properties would attenuate or alter apparent effects of commonly evaluated landscape (e.g., habitat) conditions on nest survival.
Material and methods: We captured 89 (48 in 2018, 41 in 2019) female sage-grouse and outfitted them with GPS transmitters. We confirmed 185 nests of 76 individuals during the nesting seasons of 2018–2021. We tested prediction 1 with a generalized additive model of the relationship between distance from first nest and time. We evaluated predictions 2 and 3 with competing generalized additive and generalized linear models of daily nest survival versus movement properties and landscape conditions.
Results and discussion: We observed strong periodicity and therefore fidelity to nesting home ranges. Our top nest survival model included movement properties representing nesting area fidelity but not landscape conditions typically considered primary drivers of nest success. Our results demonstrate that 1)

female sage- grouse have strong fidelity to nesting regions, and 2) nest survival of sage-grouse is strongly associated with movement properties that indicate fidelity. Our study is the first to identify a positive relationship between fidelity to nesting regions and daily nest survival of sage-grouse. Movement properties derived from detailed relocation histories offer a flexible and complete means of studying space and time-use and therefore fidelity patterns in grouse.
Conclusions: Further research is needed to refine our understanding of which movement properties provide the best picture of fidelity patterns and consequences. Research is also needed to understand how fidelity benefits or harms grouse population performance in different landscape-disturbance contexts. Our findings support the fundamental importance of nesting area affinity, fidelity, and familiarity to sage-grouse ecology which has been overlooked in most nesting ecology research for sage-grouse, and grouse more broadly.

Effects and mitigation of wind-power on populations of capercaillie and black grouse in central Scandinavia.

*Jahren, T., M. Andreas, **J. Kvasnes**, and T. Willebrand.*

Introduction: The transition from fossil-based energy to renewable energy has led to a rapid increase in development of wind-power in Norway during last 10 years. Most wind power facilities are situated near the southern and western coast. Due to human conflicts and issues with wildlife as well semi-domesticated reindeer, sparsely populated forested areas are now in focus for developing new facilities. In recent years, some facilities have been built that are located in forest areas, overlapping the core distribution area of capercaillie and black grouse. The impacts of these facilities on wildlife in the boreal forest are yet to be investigated in Norway. One of these facilities, Kjølberget wind power plant was completed in 2022. Inland university of applied sciences will carry out a 10-year monitoring of the potential impacts of the power plant on capercaillie and black grouse. The monitoring program include radio-tracking of individuals to investigate changes in behaviors, habitat selection, reproduction and survival in the wind-power area and associated forest areas.
Material and methods: The study area is in Finnskogen, (61.0 lat., 12.2 long) in eastern Norway close to the Swedish border. The forest is dominated by Norway spruce and Scots pine and has been intensively managed by clearcutting practices. During the study period, we plan to capture and equip a minimum of 100 birds (25 of each category) with GPS transmitters. Bird captures and tracking will initially go on for the first 3–4 years to investigate short term effects and will be repeated in year 7–10 to investigate potential long-term effects (e.g., habituation). During the whole 10-year period we will search for carcasses around turbines. Turbine mortality will be estimated based on estimates of scavenger removal and detectability. Further we will monitor leks (attendance and behavior), the predator guild (using camera grid) and rodent populations (using camera box) in relation to turbine activity and proximity. Line transect monitoring with Distance sampling technique have been collected to estimate densities and chick production before hunting season for several years by hunters. We will investigate hunter behavior in relation to the wind power facility and their harvest efficiency. Finally, we want to investigate other disturbances potentially affecting grouse as traffic along main roads and hiking tourism.
Results and discussion: This long-term project will start autumn 2023 and the first results from the project are expected to be presented in 2026. We wish to invite interested members of the "grouse-community" to follow the project and we are very interested in collaboration with other research groups.
Conclusions: Project in preparation, no conclusions to be drawn yet.

Towards a science-based rock ptarmigan (*Lagopus muta*) management in Scandinavia.

***Kjønsberg, M.**, and M. Hörnell Willebrand.*

Introduction: There has been increasing pressure on ptarmigan populations due to climate change, land use changes causing habitat loss and fragmentation. Compared to other grouse species, however, little is known about the status of the rock ptarmigan (*Lagopus muta*) in many parts of its range. Although rock ptarmigan is the second most popular game bird in alpine areas in Sweden and Norway, it is among the least studied species and due to the lack of general biological knowledge about rock ptarmigan, current management of this species is based on that for willow ptarmigan - the management of which in Sweden and Norway has been developed in cooperation between managers and scientists.

We will estimate survival rates on rock ptarmigan, assess if the monitoring design, competing data on population trends and use of demographic data to evaluate whether a more species- specific monitoring and management of rock ptarmigan is needed. We will do this by assessing if: 1) distance sampling gives an unbiased and accurate result on population density for rock ptarmigan, 2) examine if

various monitoring data are correlated, complement each other or differ in estimation on population development over time, 3) analyse if there is evidence of a negative correlation between willow grouse densities from the distance sampling counts and observations of rock ptarmigan in the same area (and vice versa), indication an interspecific competition between the species, 4) measure survival rates and mortality causes on adult and juvenile rock ptarmigan and assess quantity and quality of seasonal habitat in the southern part of the mountain range in Sweden.
Material and methods: We use already collected data from the yearly distance sampling counts in Sweden and Norway, the Swedish bird count and the Norwegian terrestrial nature monitoring on both rock ptarmigan and willow ptarmigan. From 2021 we have conduct tagging of rock ptarmigan in the county Dalarna (Sweden).
Results and discussion: We will get some preliminary result to be presented at the conference. Three master students (Sondre Gottenborg, Adina Sitje and Isak Karlstrøm) are separately submitting abstracts to present posters in connection to our study.
Conclusions: Not to be concluded yet.

Capercaillie *Tetrao urogallus* recovery program in the Bory Dolnośląskie Forest, south-west Poland.

Kobielski, J., D. Merta, ***M. Kmieć****, A. Drgas, and A. Balak.*

Introduction: In the past, the Bory Dolnośląskie Forest was an important refuge of capercaillie in Poland – in the late of 1960s, 360 individuals inhabited this area. At the end of 1970s, the population collapsed and the last observations of wild birds come from 2009.
Material and methods: In 2009-2022, 422 young birds (219 males and 203 females) from Polish breeding centers were released in the Ruszów Forest District using "born to be free" method. Additionally, in 2014–2019, 123 capercaillies from Sweden and Finland were translocated. The adaptation was carried out in the special areas (ca.18 ha) where capercaillies were protected from terrestrial predators by "fladry" line and electric fence. More than 40% of birds were monitored by VHF transmitters with mortality sensors. The key activity of the project is reduction of the predators as well as and catching and translocating goshawks. Auxiliary measures included the evaluation and improvement of habitat, limitation of anthropogenic impact and environmental education.
Results and discussion: The chief cause of mortality (76,4%) was predation, mainly by red fox (*Vulpes vulpes*) and northern goshawk (*Accipiter gentilis*). The living area of all released birds (100% MCP) amounted to 121 thousand hectares, but in last years of the program, this area has been reduced to 20 thousand hectares. Sizes of monthly individual home ranges were highly variable, on average 675 ha (0.6–23.3 thousand ha). Since 2012 reproduction has been observed. In the spring 2023 the population size of capercaillie in the Bory Dolnośląskie Forest was estimated at 100–106 individuals.
Conclusions: The release of wild birds and using "born to be free" method of release coupled with reduction of predation creates a chance for recovery population of capercaillie in the Bory Dolnośląskie Forest.

Artificial insemination procedure in black grouse (*Lyrurus tetrix*) reproduction.

Kowalczyk, A., ***E. Łukaszewicz****, J. Rosenberger, and M. Kazimierczak.*

Introduction: In the recent decades the black grouse undergone in Central Europe a severe contraction of their range with remaining only a few small isolated populations (Segelbacher et al., 2014). Captive breeding of birds threatened by extinction in zoological gardens or other closed aviary centers is one of the methods allowing their protection and gene pool preservation ex situ in vivo. Such birds are usually kept in captivity lifelong and serve as parents of several new generations that can be further released into natural environment, or males are used as semen donors for artificial insemination (AI) and gene banking (Łukaszewicz and Kowalczyk, 2015). There are many reasons why AI is essential in bird kept in captivity. Most are related to inability of designated mates to achieve natural copulation, lack of libido or mating preference (Blanco et al., 2009). The aim of the experiment was attempting to use the AI in black grouse.
Material and methods: Semen was collected from 5 years old black grouse via the massage method, into micro capillary tube. Within five minutes following collection, ejaculate was evaluated macroscopically (clearness, volume) and microscopically (motility, sperm concentration). Sperm concentration was calculated with hemocytometer and Thoma-type grids. Sperm motility and motility parameters were examined using Sperm Class Analyzer (SCA, version 5.1, Microptic, Barcelona, Spain). Female (4 years old) was inseminated intravaginally at a depth of about 2 cm with the use of finger-guided method and the dose of 20 µL of net semen.

Results and discussion: Ejaculate volume was 30 µL and sperm concentration of 620 x106 mL-1. Sperm motility was 52.6%, and the motility parameters were as follows: VCL - 73.9 µm s -1; VSL - 47.6 µm s -1; LIN - 64.4%; ALH - 2.96 µm. The parameters of evaluated semen quality were lower than those obtained in this species by Ciereszko et al. (2009, 2011), but describes experiment was performed at the end the reproductive period, and male was not accustomed to semen collection procedure. After AI performed in this species the first time, female incubated 4 eggs, 3 of which were fertile (75%), and two healthy chicks were hatched. In the third chick some defects in leg structure were stated.
Conclusions: The possibility of using AI in black grouse reproduction has been demonstrated.

Reproductive parameters of capercaillie kept in aviary system in Wisła Forestry.

*Kowalczyk, A., **E. Łukaszewicz**, J. Rosenberger, T. Strzała, and Z. Rzońca.*

Introduction: The latest research shows that capercaillie reared ex situ in vivo after being released into the natural environment behave like free-living individuals. This observation may have a positive impact on reintroduction success of an extremely endangered species (Merta et al., 2016). The reproductive traits obtained in captive breeding affect the number of individuals released into nature. The aim of the study was to determine the impact of birds number in one family on selected reproductive traits.
Material and methods: The experiment was carried out in the Capercaillie Breeding Center in Wisła Forestry in season 2018 and 2019. Two groups of families were created: I - consisting of 2 males and 3–4 females (4 families) and II - consisting of 3 or 5 males and 7–10 females (3 families). Depending on birds number, one family occupied from 3 to 9 boxes with dimensions of 7.0x4.0 m each. Females of one family could move between boxes through holes with a diameter of 19 cm, while males occupied single boxes (without the possibility of movement). In each group, the following parameters were analyzed: number of set nests, egg fertility and chick hatchability. Genetic material was collected from all individuals of the breeding flock and offspring (including dead embryos) in order to determine chick. To identify each specimen, a set of 29 micro-satellite loci was used. Possessed data were analyzed manually by the confrontation of offspring genotypes with all potential parent-offspring pairs in analyzed family.
Results and discussion: In group I, 66.7% of females set the nest, egg fertility and chick hatchability amounted 65.2% and 83.3%; in group II the following values were obtained: 64.0%, 75.1% and 87.7%, respectively. The genetic analysis showed that, similar to the natural environment where females choose the dominant male (Tsuji et al., 2000), in each family, all offspring were fathered by one male.
Conclusions: Creating the families consisting of 3 or more males allows for a higher egg fertilization rate, however, the participation of only one male in the reproduction indicates that achieving the assumed genetic diversity in the ex situ population may be more difficult. Experiment funded by National Science Centre, Poland, Grant 2016/21/B/NZ9/02084.

Captive propagation of the Attwater's prairie chicken: Updates on Production and Fostering Methodologies.

***Larsson, L. C.**, J. P. Hoolihan, C. L. Brown, H. Caster, J. Hansen, A. Pratt, H. Ring, and S. K. Sherrod.*

Introduction: A million Attwater's prairie-chickens (*Tympanuchus cupido attwateri*) historically occupied coastal plains of southern Texas and Louisiana. This bird survives through captive breeding and annual releases of offspring. Captive breeding of galliformes is complicated and difficult, and presents numerous challenges to produce birds that exhibit high survival and significant reproduction in the wild.
Material and methods: Utilizing different methods for breeding and managing captive prairie-chickens, the Sutton Avian Research Center is experimenting with fostering techniques at a dedicated facility in Oklahoma. Mature birds are housed indoor in barns, and paired according to genetic suitability. Eggs are collected and incubated artificially, while hatching is either done in an artificial hatcher or with a female prairie- chicken who has been incubating fake eggs. Some chicks are raised by humans, while others are introduced to hens with broods.
Results and discussion: Hand-raised chicks commonly exhibit increased mortality at 4 to 10 days old due to inanition – a lack of nourishment and vitality. Chicks raised by female prairie-chickens did not exhibit a similar prevalence of inanition, and had fewer incidences of leg rotations. Chicks that are introduced to females are more active while hand-raised chicks often need coaching to eat. Different forms of common bacteria have been found to be lethal for chicks in the artificial environment, while we surmise that being with a hen boosts bacterial resistance in young birds.
Conclusions: We found positive outcomes with decrease in early mortalities, less hands-on labor, more robust chicks, and increased production by using fostering methods when raising Attwater's prairie-chickens in captivity.

Developing Unbiased Methods for Monitoring Populations of Dusky Grouse in the Western USA.

*Leipold, E., and **L. B. McNew**.*

Introduction: Rigorous monitoring programs for dusky grouse (*Dendragapus obscurus*) are lacking, despite the species status as a game bird in the western USA. Difficult-to-reach montane habitats and low probability of detection have made unbiased monitoring of dusky grouse populations difficult. New analytical methods show promise for overcoming relatively low detectability. Our objectives were to evaluate sampling and analytical methods for producing annual unbiased and precise estimates of local, regional, and statewide abundance.
Material and methods: During 2019–2022, we designed and implemented multiple survey protocols throughout western Montana, USA, including spring and summer point-counts (> 2200 and 110 sites, respectively) and transect-level (> 400 transects) distance sampling. We used a range of estimated survey-specific detection probabilities and abundances from initial survey seasons to develop thousands of population simulations where true abundances were known. We then tested the ability of three different population abundance models (N-mixture models, hierarchical distance sampling, and distance sampling with time removal models) to produce unbiased (close to the truth) and precise (<15% CV) estimates of abundance/density.
Results and discussion: Empirical-based simulations indicated that a survey protocol in which 240 survey points per strata were visited 4 times during the spring resulted in unbiased estimates of population size with the highest precision (CV = 0.11, 95% CI: 0.07, 0.17) when analyzed with N-mixture models. Nevertheless, transect-based distance sampling survey protocols during the spring also produced unbiased and acceptably precise (≤15% CV) estimates of grouse density when ≥40 transects of ≥2.6- km length were surveyed per area of inference (e.g., administrative region). Summer survey protocols resulted in few grouse detections and never yielded precise estimates or indices of abundance.
Conclusions: Ideally, a standardized population monitoring program would produce unbiased and precise estimates/index of annual population size. However, survey protocols also need to be easy to conduct and require the lowest possible effort to ensure programs persist. Although N- mixture abundance models based on repeated point-based surveys produced the most precise estimates, field biologists preferred single-visit transect-based distance sampling protocols. We hope the process used to identify rigorous and achievable monitoring programs will be adapted for other grouse monitoring programs.

Genetic evidence for reproduction of released capercaillie in Southern Brandenburg, Germany.

*Ludwig, A., **A. Erdbeer**, D. Lieckfeldt, and Lars Thielemann.*

Introduction: The capercaillie (*Tetrao urogallus*) was formerly a charismatic animal of the heathlands and surrounding forests in Southern Brandenburg. But habitat alterations resulted in its decline. The last hen was observed in the Rochauer Heide in 1998. Although conservation efforts were done in the 1990s, the capercaillie became extinct in Brandenburg. In 2011, a restoration has been started in the Naturpark Niederlausitzer Heidelandschaft close to Bad Liebenwerda, Brandenburg, Germany. In cooperation with Swedish partners (Länsstyrelsen Västerbotten, SCA, Holmen and Sveaskog) a release project had been initiated.
Material and methods: Capercaillies were captured in Sweden using nets along roads and transported to Germany primarily by aircraft. In addition, according to the "born to be free" method captive-bred capercaillies were released. From 2012 to 2021, 386 Swedish wild-born capercaillies and 69 animals originating from breeding had been released in the Naturpark. Genetic fingerprinting based on combined microsatellite analysis and mitochondrial DNA sequencing is in use to control their survival and the reproduction of the released animals. In detail, 13 microsatellites, 1 sex marker and a fragment of the mitochondrial d-loop have been genotyped. Overall, 455 released animals and 1058 field samples (feathers) were analyzed between 2012 and 2021.
Results and discussion: Eighty-three capercaillie (25 cocks and 58 hens) out of 455 animals were rediscovered based on their genetic profiles. Although most animals were found only in their first or second year after release, some individuals were observed for many years. For example, one hen was found in field samples from 2012 to 2019. The number of offspring increased from 2012–2014 (n=1) to 2017 (n=79) and declined in recent years (2021 n=34). Notably, sampling has a significant effort on the outcome. Sampling changed during the project (e.g. the focus shifted to formerly less investigated areas). For example, 216 feathers were collected in 2018 but only 89 feathers in 2021.
Conclusions: We can conclude that the release of capercaillie is a success story in the Naturpark Niederlausitzer Heidelandschaft. The animals accept the habitat and reproduce. Although long term

predictions are always difficult for release projects, we are convinced that there is a great chance building up a self- sustaining population of *Tetrao urogallus* in Southern Brandenburg.

Benefits and costs of translocation on augmented and source populations of greater sage-grouse.

***Mathews, S. R.**, M. B. Meyerpeter, M. Chelak, K. Lazenby, P. S. Coates, D. K. Dahlgren, J. Kolar, S. Picardi, B. Prochazka, and D. J. Delehanty.*

Introduction: Restoring avian populations using translocation is often ineffective because birds experience physiologic chronic stress that can lead to increased post-release dispersal, reduced reproduction, and increased mortality. Additionally, adverse impacts on source populations by removing birds is not well-studied and often is a substantial concern. Novel methodologies, based on species' biology and behavior, aimed at reducing impacts to source populations could be highly beneficial to help guide successful translocations.
Material and methods: We carried out three greater sage-grouse (*Centrocercus urophasianus*) translocations at different distinct study sites in the western U.S.A., and we tested a novel brood-translocation method against conventional translocation methods as part of ongoing reintroduction and augmentation efforts. For conventional translocations, we captured pre-nesting females on leks (traditional breeding grounds) and translocated them overnight to recipient populations. For brood-translocations, we captured females during the brood-rearing period and translocated them with their broods. We used integrated population models to evaluate annual rate of change (λ) in population abundance, as well as individual population vital rates (e.g., nest survival), at source and recipient sites within a Before-After-Control- Impact (BACI) study design. We also evaluated impacts on source population λ and developed cost- benefit ratios to identify the most effective translocation strategy.
Results and discussion: Both methodologies showed negligible impacts on λ for source populations after considering demographic variability driven by natural environmental stochasticity. Importantly, brood-translocations increased λ by 11–30% at the recipient populations over traditional translocation methods.
Conclusions: Brood-translocations provides managers with a new and effective method for successfully restoring populations in areas that can support larger numbers of sage-grouse. These findings are preliminary provided for timely science communication and are subject to change.

Quantitative estimation of capercaillie habitats in the French Alps as a prerequisite for their reintroduction.

***Ménoni, E.**, Q. Giry, N. Clouet, G. Rayé, and O. Patrimonio.*

Introduction: The Capercaillie disappeared from the northern end of the French Alps in 2000 but it was already rare and localized in the 1950s. This resulted mainly from widespread deforestation in the 18th and 19th centuries and secondarily from excessive hunting on the relict cores. Forest cover was largely recovered during the 20th century through plantations and natural forest regrowth following rural abandonment from the end of the 19th century and more after the First World War. Now that they have matured, many of these forests appear welcoming to the Capercaillie. Their canopy is often open enough to allow the development of shrubs and herbs on the forest floor. A national conservation strategy for the capercaillie includes the possibility of restoring one or more populations of the species in the Alps.
Material and methods: To examine this possibility, a habitat model was built using almost 10,000 locations of capercaillie in the Pyrenees range, where the species has remained relatively abundant and where the type and distribution of vegetation is organized in much the same way as in the Alps. The calibration of the model in the Jura and the Vosges, other mountains where capercaillie are present in France, shows that the model has very good predictive power.
Results and discussion: The subsequent application of this model to the French Alps shows that there is a large quantity of favourable habitats there. In particular, the southern internal Alps offer at least 200,000 ha of relatively unfragmented favourable habitat.
Conclusions: While this is promising for a potential reintroduction of the species, this will also depend on an analysis of human pressures, and the acceptability of the capercaillie's comeback by local people.

Changes in spatial distribution versus abundance for greater sage-grouse in a Distinct Population Segment.

***Milligan, M. C.**, P. S. Coates, B. G. Prochazka, S. T. O'Neil, S. P. Espinosa, D. Skalos, and S. Abele.*

Introduction: Changes in distribution or abundance are frequently used independently to evaluate trends and status of wildlife populations. It is often assumed, although not explicitly stated, that these measures are correlated. However, if population distribution and abundance become disconnected, such as when changes in a subpopulation drive overall population trends, then focusing on a single indicator, such as abundance, can mask important losses in distribution.
Material and methods: We combined population counts, demographic data, and information on space use from marked individuals to evaluate changes in abundance, distribution, and available habitat from 1995 to 2021 for greater sage-grouse (*Centrocercus urophasianus*) in the Bi-State Distinct Population Segment (DPS), a genetically distinct and isolated population straddling the border of Nevada and California, USA.
Results and discussion: The Bi-State DPS exhibited evidence of slight population declines of ~1.4–2% annually. Gains in distribution in two subpopulations were insufficient to offset losses in the remaining subpopulations and the net effect was a loss in area and available habitat across the Bi-State DPS as a whole.
Conclusions: The contractions in distribution combined with only slight declines in population suggest long-term patterns in redistribution of sage-grouse among subpopulations, with peripheral subpopulations declining while the largest core population increased, which could have implications for metapopulation persistence as peripheral populations become more vulnerable to stochastic events. Information is preliminary and provided for best timely science.

High anthropogenic specific mortality rate for black grouse in ski resort.

***Montadert, M.**, and C. Jerome.*

Introduction: Implantation of tourism activities in mountain range lead to a tremendous development of ski resorts in alpine areas. The alpine fauna leaving there have to deal with new specific and intense pressures among others, a massive multiplication of overhead cables that cause many deadly bird percussions. In order to document the impact of these infrastructures on mortality rate of local avifauna we have carried out a study on black grouse *Lyrurus tetrix* leaving ski resorts.
Material and methods: Black grouses were captured and equipped with gps tags in three major ski resorts in northern French Alps. Diagnosis of the four main mortality causes i.e. predation, percussion in infrastructures (mainly but not uniquely overhead ski cables), hunting and others marginal causes, were done by early checking of death cases, allowed by GSM location transmissions. Estimation of cause-specific mortalities where done by sub-distribution analysis of competing risks.
Results and discussion: We equipped 159 black grouses from 2017 to 2022 with GPS tags. 74 death cases were observed of which 91% could be correctly attributed to one of the four identified mortality causes: predation, percussion in infrastructures, hunting and others causes. The main result is that in this highly humanized landscape, anthropogenic causes of death i.e. percussion and hunting is of the same order of magnitude than natural predation in contrast to few earlier studies conducted in similar environment where percussions in overhead cables seemed of much less importance.
Conclusions: Human infrastructures in ski resorts constitute an important additional source of mortality for black grouse emphasizing the importance of conservative hunting management in these easily accessible areas and implementation of mitigation measures to prevent collisions in overhead cables.

Effect of midazolam sedation on sperm quality of capercaillie.

***O´Brien, E.**, A. Siegmund Sabaterb, A. Toledano-Díazb, C. Castañob, G. de Pedro Aguilara, C.O. Hidalgoc, R. Balserad, D. Cuberoe, E. Łukaszewiczf, and J. Santiago-Morenob.*

Introduction: Animal capture is an essential tool in conservation and management programs for both captive and wild capercaillies (*Tetrao urogallus*). To avoid lethal complication such as capture myopathy outcomes of stress, the administration sedatives drugs during capture procedures are recommended. We described the effect of midazolam sedation on the response to massage for obtaining seminal samples and on the sperm quality of capercaillie.
Material and methods: Ten capercaillie males (4 one-year-old Centro European males and 6 Iberian males aged 3-9 years) were used in this study. Animals were handled according to procedures approved by the CSIC Ethics Committee (reference regional government PROEX 044.4/22). Two experimental groups were established: 1) control group treated with 2 mL of saline (Control) and 2) 6 mg/Kg of

Midazolam waiting 10 minutes before application the massage to collect semen (HD-10). During the seminal collection process, the response times to the sedative and the proportion animal nervousness were registered. Once the seminal sample was obtained, volume, concentration, motility, viability and sperm DNA integrity were measured. Finally, the heterophile-lymphocyte ratio (H/L) of blood smears was evaluated as an indicator of stress.
Results and discussion: The sedation was associated with nervousness manifestations: 80% of the sedated animals were more nervous during dorsoventral massage than controls ($p<0.001$). Control volume was significantly higher than HD-10 ($p<0.05$) in European capercaillie samples. Nevertheless, there were no statistically significant differences ($p>0.05$) for any other sperm variables between treatments. No significant differences ($p>0.05$) were observed in the H/L ratio between groups.
Conclusions: Our results showed that sperm quality was not affected in capercaillies sedated with midazolam. However, males were more nervous during semen collection procedure than controls and thus midazolam sedation is not recommended to collect semen in captive conditions.

Capercaillie (*Tetrao urogallus*) egg incubation behavior – is there seasonal and environment depended variation?

***Rosenberger, J.**, A. Kowalczyk, and E. Łukaszewicz.*

Introduction: Egg incubation behavior depends on environmental factors, but the incubating parents must reach a compromise between the requirements of the embryo and their own physiological constraints. The aim of studies was to see whether capercaillie (*Tetrao urogallus*) female modifies their incubation behavior in particular seasons, depending on environmental temperature and humidity.
Material and methods: All birds were kept at the capercaillie Breeding Center in Wisła Forestry District (CBC-WFD) and were observed using cameras placed near the nests. All nests were set up at the outside aviary and were exposed to changing weather conditions. Monitoring was carried out 24 hours a day allowing to observe the time of nest leaving and return of each female. During the five years of observation (2018–2022), behaviors of 27 females were recorded. Temperature and humidity logger located in (CBC-WFD) recorded the environmental parameters every 5 minutes, which allowed to relate environmental conditions with the length of incubation recesses. Statistical analyses were performed using the Kruslal-Wallis test.
Results and discussion: The average ambient temperature when leaving the nest was 15.40C (SD = 3.9), while humidity was 73.79% (SD = 15.7). Single recess time was not related to ambient temperature ($p = 0.46$; $H = 128.93$) or humidity ($p = 0.496$; $H = 124.50$). The duration of a single nest recession differed between years ($p < 0.001$; $H = 23.28$). The longest recessions were observed in 2018 (20 min on average), the shortest in 2020 (17 min on average), which could be caused by female age, their diet or noise from woodcutters working nearby. Similarly, the daily time spent away from the nest differed between years ($p < 0.001$; $H = 45.13$). In 2018 and 2019, daily recess was 33 and 35 minutes, respectively; in 2020 and 2021 was only 22 minutes.
Conclusions: There was no significant correlation ($p>0.05$) between environmental conditions and Capercaillie female behavior. It is likely that other factors influence nesting behavior. Research was funded by NATIONAL SCIENCE CENTRE, Poland, grant no. 2016/21/B/NZ9/02084
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Evaluation of eggshell ultrastructure as a method of assessing egg status and embryo development - capercaillie example.

***Rosenberger, J.**, A. Kowalczyk, and E. Łukaszewicz.*

Introduction: The standard way to determine egg status in post-hatched eggs (whether egg was fertilized or not) is to check the presence of embryo during candling or after the egg is broken. For embryos that died at an early stage of development, the appearance of the germinal disc can be evaluated, or blastodermal cells can be isolated and/or vitelline membrane can be stained by photochrome. However, the process of decomposition of the egg content is so far advanced that it is not possible to determine the egg status by any of these methods. The egg content may also be spilled or eaten by a predator. Conducting the genetic testing is time-consuming and expensive. The aim of presented studies was to analyze the appearance of the ultrastructure of the eggshells containing embryos at different stages of development and to see how they changes due to calcium resorption by the embryo.
Material and methods: The study material consisted of 22 capercaillie eggshells with embryos died at different stages of development (from the 2nd to the 25th day of incubation) and post-hatching shells. Eggshell fragments measuring about 1 cm2 were obtained from the equatorial part of the egg. To expose the innermost, mammillary layer, the eggshells were boiled for 5 minutes in a 5% NaOH solution, rinsed

in distilled water, dried and prepared for analysis on an scanning microscope, EM Evo LS 15 (Zeiss, Oberkochen, Germany).
Results and discussion: From the 8th day of development, small signs of calcium resorption could be observed. The presence of these signs depended on the positioning of the embryo and its contact with the eggshell. Clear signs of calcium resorption were noticeable from the 17th and 18th days of development. From the 23rd day of development, signs of resorption were visible in all taken photographs. In post-hatching shells, knobs of the mammillary layer were almost completely dissolved and left no doubt about the status of the egg.
Conclusions: Analysis of eggshell appearance is a potential tool for determining egg status, but should be conducted on several fragments, taken from different areas of the egg to avoid false-negative results. Research was funded by NATIONAL SCIENCE CENTRE, Poland, grant no. 2016/21/B/NZ9/02084.

Optimization of capercaillie breeding (*Tetrao urogallus*) in ex situ in vivo conditions.

Rydzik, M.

Introduction: The increasing degradation of the natural environment, caused, among others, by industrial pollution, the intensification of forest management, the constantly increasing intensity of tourist traffic in forests and the high number of predators, causes a drastic extinction of wild animal species. One of them is the capercaillie (*Tetrao urogallus*), whose population in Poland in the 1960s was estimated at about 1500 individuals while currently 400–600 birds live in the wild. Since 1995 the capercaillie has been entered into the Polish Red Book of Animals with the status of CR - critically endangered. In order to secure a representative part of the population and to create genetic reserves, ex situ in vivo breeding centers for capercaillies were established under the Minister of the Environment. The aim of described investigations was to increase the capercaillie population, by developing the most favorable methods and conditions for breeding the basic reproductive flock and the rearing of their offspring intended for reintroduction to natural environment.
Material and methods: Experiments conducted in the years 1993–2020 in the capercaillie Breeding Centre in Leżajsk Forestry District included the following issues: the effect of keeping the reproductive flock in conditions similar to natural environment vs. controlled, high sanitary condition (1993–2012 vs. 2013–2020); the impact of aviary lighting intensity on breeding effects; hatchability and mortality of chicks incubated naturally by capercaillie female vs. domestic hen; the effectiveness of rearing chicks by capercaillies on paddocks vs. rearing house; the impact of egg harvesting on fertility, hatchability, chick quality and survival rates.
Results and discussion: The obtained results indicated that strictly controlled and high sanitary conditions significantly increased the average number of eggs obtained from one female - by 3.4 pieces, and chick hatchability by 20.5%, and thereby increased chick number per female from 2.8 to 5.9. When it is possible, the opportunities should be given for eggs incubation and then to lead and raise chicks naturally by capercaillie mother, which leads to increased breeding performance. Keeping capercaillies in x-rayed aviaries, with higher parameters of light and temperature, as well as a more favourable welfare status, allows for obtaining higher average number of reared chicks per female and their lower mortality. While maintaining the appropriate food base, collecting eggs increases their number from one female without reducing the hatchability rates, thus increasing the number of birds to be introduced/reintroduced.
Conclusions: This study may provide important information for centers dealing with capercaillie and other endangered bird species breeding ex situ in vivo.

Improving greater sage-grouse nest survival through oiling common raven eggs.

***Sanchez, C. A.**, P. S. Coates, T. A. Shields, M. Vaughn, S. R. Mathews, and D. J. Delehanty.*

Introduction: Greater sage-grouse (*Centrocercus urophasianus*) population abundances have declined by 80.7% range-wide since 1966 and are projected to continue declining. Increases in anthropogenic subsidies across sage-grouse habitat have correlated with increases in common ravens (*Corvus corax*), a generalist predator that consumes the eggs and chicks of sage-grouse and other vulnerable species. Nest predation by common ravens has become an important primary threat across most sage-grouse breeding areas and has contributed to sage-grouse population declines. We evaluated the method of applying oil to raven eggs to suppress raven reproduction and thereby improve sage-grouse nest survival.
Materials and methods: We used a before-after control-impact study design to monitor sage-grouse nest survival (n = 581) at 2 treatment sites and 4 control sites in Nevada and California, USA, from years 2016–2021. At treatment sites, raven nests were located and eggs within the nests were oiled during the sage-grouse breeding season.

Results and discussion: Egg-oiling treatments were successfully applied to raven nests (n = 28) using remote fluid application systems. We found an average annual increase in probability of sage-grouse nest survival of 145% (95% credible interval = 44–323%) in the treated areas relative to the controls, with an overall 99.9% probability of a positive effect of egg-oiling on sage-grouse nest survival.
Conclusions: Sage-grouse nest survival can be improved on a local scale by oiling eggs in nearby raven nests. These findings are preliminary, provided for timely science communication and are subject to change.

Living Fast on the Texas Prairies: Overcoming stochasticity to establish populations of an endangered prairie grouse.

Senner, P., L. C. Larsson, M. E. Morrow, J. Mueller, K. Pardy, ***A. C. Pratt****, and L. J. Faust.*

Introduction: The Attwater's prairie-chicken (*Tympanuchus cupido attwateri*) is a U.S. Endangered Species native to coastal Texas and Louisiana. Land use change, invasive species and extreme weather all contributed to this species' decline, and in 1992 partner agencies initiated an ex-situ breeding program. Birds have been released annually since 1995 but, despite these efforts, populations remain below recovery targets. Prairie-chickens have high reproductive rates and naturally high mortality rates, which pose a dual challenge to species managers; how to manage an ex-situ population within the limits of available space, and establish a "stable" in-situ population of a fast living species.
Material and methods: Using studbook data, data from wild radio-marked individuals and expert opinion we estimated model parameters and conducted a population viability analysis to assess the viability of both in-situ and ex-situ Attwater's prairie-chicken populations. In a meta-population model framework, we compared the impacts of disease, release strategy, hurricanes, land management and predator mitigation efforts.
Results and discussion: Results suggest that the ex-situ population will remain demographically stable over the next 50 years and can continue to support release efforts, but will lose more than 10% of its genetic diversity at its current size. Based on estimated demographic rates, in-situ populations have a high probability of extinction within the next 10 years without continued releases.
Conclusions: Management efforts aimed at increasing brood survival and continued releases may be critical to program success.

Ghost of hunting past' in rock ptarmigan: assessing long-term effects on behavior.

Sooth, F.*, and I. Storch.*

Introduction: Following the risk-disturbance hypothesis, hunting is the main factor causing predation avoidance behavior in wildlife that is directed towards humans. Amongst others, hunting has been shown to impact spatial and temporal movement patterns, vigilance, and flushing distances of wildlife. However, how far these behavioral modifications are reversible when hunting ceases, needs to be further explored.

The ghost of predation past hypothesis assumes a reversibility of antipredator behavior under evolutionary pressure that selects against its maintenance. Storch (2013) proposes the same mechanism applies in case of hunting. In my research I explore the validity of this ghost of hunting past hypothesis using the case study of rock ptarmigan.
Material and methods: To study the long-term effect of hunting I compared flight initiation distances (FID) of rock ptarmigan in hunted, traditionally not hunted and recently (since 2002) not hunted sites in Iceland in 2016 and 2018. The availability of comparable areas with differing hunting history for the sought-after game bird rock ptarmigan made the species predestined for my research. The FID data was collected outside of the hunting season to avoid confounding short-term and long-term impacts of hunting.
Results and discussion: In both years of my research, I found a significant difference in FID between the three area types. In the hunted areas the FID was highest and in the traditionally not hunted area it was lowest. The FID of the area where rock ptarmigan hunting was stopped in 2002 was found to be between the FID of the other two area types. This implies that the FID in the recently protected site might have decreased after the hunting ban, however, it has yet to reach its presumptive levels before hunting was taken place.
Conclusions: My research exposes the long-term effects of hunting on rock ptarmigan behavior, and hereby supports the ghost of hunting past hypothesis.

Black grouse conservation in the Krkonoše and Jizera Mountains.

***Tomášek, V.**, K. Mikslová, O. Volf, and J. Flousek.*

Introduction: In less than 35 years, the number of the black grouse (*Lyrurus tetrix*) in the Czech Republic has decreased by 60–80%, and this trend continues. Sub-populations are already isolated and only the Jizera – Krkonoše mts and Krušné mts may have a chance of longer-term existence separately. Our project determined key factors limiting black grouse in the Czech Republic and field results are unique. Now it is necessary to use our results and establish a management plan for protection of black grouse in Czechia.
Material and methods: Since 2018 there are in progress professional studies focused on the most significant factors threatening the Krkonoše-Jizera population of the black grouse such as biotope loss, population genetics, habitat fragmentation, disturbance by tourism, predation of black grouse nests and the risk of collisions with different types of structures. During our project each artificial lek site in Krkonose- Jizera population was monitored to identify occurrence of black grouse using camera traps and collecting droppings for DNA analysis. Predation was studied with camera traps placed next to artificial nests on every artificial lek site in Krkonose mts. Each study was carried out according to recent scientific knowledge and will be published as a separate paper, where you can after that see specific methods used by authors.
Results and discussion: Genetic analysis was made from 1006 samples of DNA, especially from faeces. Genetic confirmed 3 isolated populations in Czechia, nevertheless they are still in good condition meaning the genetic variability. Recapture of individuals (identifying DNA from droppings and feathers) showed that distance more than 5 kilometers was scarce (only 7 samples). Predation intensity varied between localities but none of the sites in Krkonose was unpredated. Main predators identified at the artificial nests were martens, red fox, wild boar, badger and raccoon dog. Project was also focused on dangerous bird collisions with obstacles like fences, ropes etc. During our project, 5 ski lifts were provided with diverters, more than 20 fences were removed or made visible with plastic tapes. Connectivity was researched using a population genetic and GIS habitat analysis, so now it is possible to arrange stepping stones on large gaps between occupied black grouse habitat. Removing hiking paths or retraversing them is also very important for establishing the quiet zones, but it is questionable in the direction of the national park. Twenty artificial lek sites were created in Krkonose in dense spruce forests, more than 2 hectares each of them. It is important to reduce disturbation in 10 key lek sites in Krkonose and 5 sites in Jizerske hory mts. Besides that, our project focused on public education and popularization of black grouse conservation. More negotiations and networking is necessary to protect the whole population on the national and international level.
Conclusions: Our project contributed to better knowledge of the ecology of the black grouse in Czechia. Habitat loss, landscape connectivity, tourism activities, fences and predation are the main factors affecting long term population decline of black grouse in Czech republic. Presentation summarizes a five-year project financed by the European Regional Development Fund (The Operational Programme Environment) implemented from 2018 to 2023. Important part of our project was identifying suitable biotopes in each subpopulation. Project should contribute to assessing problems of black grouse in Czechia. Results will be used for preparing the Action plan – management plan for conservation of black grouse directed by the Ministry of the environment.

Greater sage-grouse Genome-wide Adaptive Divergence May Influence Conservation Translocation Effectiveness.

***Zimmerman, S. J.**, C. L. Aldridge, M. A. Schroeder, J. A. Fike, R. Scott Cornman, and S. J. Oyler-McCance.*

Introduction: Implementing and evaluating conservation translocation efforts can be difficult, but genetic data can provide unique insights about selecting suitable source populations and quantifying impact. The isolated and declining Washington greater sage-grouse (*Centrocercus urophasianus*) population in the United States has been the target of conservation translocations in recent years.
Material and methods: We looked for evidence of genetic change by comparing observed and predicted genetic diversity values given translocation efforts. We also quantified the reproduction attributed to transplants as evidence of population integration. We then retrospectively characterized adaptive similarity (e.g., adaptive divergence) of source and recipient populations.
Results and discussion: We found evidence of increased genetic diversity and transplant reproduction, but to a lesser degree than predicted. Our adaptive divergence patterns suggest differing abilities to navigate unfamiliar environments (brain and neurological function, development, and differentiation

functional terms) and reproductive potentials (reproductive process and limb morphology functional terms) may have influenced the impact of conservation translocations.
Conclusions: Our findings illustrate adaptive divergence may contribute to lower-than-expected impact from conservation translocations and may guide future efforts.

Poster presentations

Close yet different: Diet selection of western capercaillie (*Tetrao urogallus*) in two bordering habitat types.

Berchtold, M., L. Rotelli, ***I. Storch****, and P. Partel.*

Understanding habitat and diet of wildlife is essential for conservation and wildlife management. Combining detailed habitat mapping, to quantify the resources available to capercaillie, with micro histological analysis of capercaillie droppings from different seasons as well as from different habitat types, we studied 1) how the diet changes throughout the year as well as 2) how capercaillie diet differs between two spatially close yet different habitat types and whether 3) diet selection was selective or opportunistic. This study was performed from 2009 to 2016 in the southeastern Italian Alps in the Nature Park Paneveggio Pale di San Martino. Availability data on habitat composition was obtained from a total of 3.013 random plots (radius 20m²) casually distributed in the home ranges of 24 capercaillie fitted with radio transmitters. The study site includes two areas with different geological preconditions: "dolomite habitat" and "silicate habitat". In total 431 droppings were successfully analyzed using a micro histological approach revealing a total of 47 vegetal species in the droppings, of these six were most abundant in the birds' diet: Silver fir (*Abies alba*), European larch (*Larix decidua*), spruce (*Picea abies*), bilberry (*Vaccinium myrtillus*); beech (*Fagus sylvatica*) and herbs (various species). As expected the frequency of usage depends on the seasonal phenology of the vegetation. In contrast with other studies we found conifers to be the most abundant food items all year round. In particular we noted a high proportion of European larch in the diet: 31,7% in summer and 47% in autumn whereas ground vegetation played a major role only during summer with an overall proportion of 53%. Berries of ericaceous shrubs which usually make up a fair amount in the diet during summer and autumn couldn`t be detected at all. Red deer (*Cervus elaphus*), their density is relatively high on a local scale (4,2–6,1 deer/100ha), may act as a competitor reducing considerably the biomass e.g. of ericaceous shrubs which are known to play a major role in capercaillie diet forcing them to forage on alternative sugar rich food resource s such as needles of European larch. Manly's selection ratio, comparing availability (habitat composition) to use (diet composition), revealed an intermediate foraging strategy, i.e. neither exclusively opportunistic nor exclusively selective. Capercaillie seems to select for essential food items even if their availability in the habitat is very limited, e.g. fir, arolla pine (*Pinus cembra*) in both habitat types and bilberry in dolomite habitats. Habitat composition seems to influence the frequency of usage as well, since smaller proportions of beech and grasses in the diet on silicate sites could be explained by their lower availability in this habitat type. As expected highly available food items such as spruce and herbs were selected negatively in both dolomite and silicate habitats. Our results emphasis the importance of a heterogeneous habitat structure, guaranteeing for a great variety of tree and ground vegetation species which enables forest grouse to compensate for possible resource exploitation of key species in their diet through browsing of large herbivores.

Interactions between capercaillie and ski resorts in the Pyrenean massif.

Coy, J., J. Rondeau, V. Parmain, and ***K. Foulché****.*

Introduction: In the French Pyrenees, ski resorts and capercaillie populations (*Tetrao urogallus* aquitanicus) are known to share the same habitats, which certainly generates interactions with users that can be assumed to be disturbing for this species with a high conservation stake. In a national forest in the Hautes-Pyrénées partly used for the practice of recreational activities throughout the year (hiking, cycling, snowshoeing, ski touring), individuals of capercaillie were tracked by GPS during the period 2018–2022 as part of the HABIOS european program.
Material and methods: Initially, in order to measure the use of the site by users, a qualitative and quantitative characterization of the frequentation was carried out by photographic trapping and eco-counters, which allowed a first cross-analysis with the movements of the birds tracked by GPS. In a second step, simulations of time-stamped and traced attendance (on foot, by bike, on skis) were carried out in order to study the response of tracked birds to these disturbances caused.

Results and discussion: The first results of this study revealed: the birds monitored show great reactivity in reusing their usual home ranges following a major disturbance caused by users, they seem more sensitive to the disturbance in winter caused by an interaction carried out at a short distance, during disturbances, they can take refuge in habitats deemed unsuitable for their ecology in the first place.
Conclusions: Interesting perspectives would be to better assess the stress caused by the disturbance with regard to the flight distance of the birds and to better identify the energy aspects related to the movement constraints encountered in a disturbance situation.

Ex situ conservation program of the Cantabrian capercaillie in Castilla y León, Spain.

***de Pedro Aguilar, G.**, S. Domínguez Alba, P. Álvarez Varona, N. Playà Montmany, N. Foces Herrero, **E. O'Brien**, and D. Cubero.*

Introduction: In recent decades, the Cantabrian capercaillie (*Tetrao urogallus cantabricus*) population has experienced a severe decline throughout its distribution area in Spain. For this reason, the Junta de Castilla y León, with the support of the Ministry for Ecological Transition and Demographic Challenge of the Spanish government, has launched an ex-situ conservation program consisted of establishing a captive population at the Capercaillie Breeding Center of Valsemana (CCUV), in order to breed optimal specimens for reintroduction into the wild.
Material and methods: The CCUV is located in Valsemana (province of León, Spain), a forested area away from the urban zone. It consists of a main building (video surveillance, laboratory, clinic, artificial incubation rooms and chick nursery), as well as indoor and outdoor aviaries for early-age chicks and breeding adults. The breeding center is equipped with state-of-the-art infrastructures and technologies thanks to a total investment of almost two million euros. One of the main aims of the project is to develop and apply a research program focused on reproduction technologies and artificial breeding. In this first stage of testing techniques and methodologies, the center housed central European specimens (15 two-year- olds and 12 one-year-olds). The Cantabrian capercaillie founders currently consist of a total of 14 individuals, 10 of them from egg clutches collected in the wild and hatched at the center.
Results and discussion: During the first breeding season (2022), sperm samples were obtained from one-year-old males and stored in the CCUV germplasm bank. Those samples were included in research experiments and academic training programs. Regarding artificial breeding, 11 eggs were obtained from two captive one- year-old boreal females and were artificially incubated. 100% of the eggs were fertilized, and the hatching percentage was 73% (8/11). Currently, there is a living specimen of almost one year of age. Regarding the 12 eggs of Cantabrian specimens obtained from the field, 100% were fertilized and hatched. The survival rate of the almost one-year-old Cantabrian chicks is 83% (10/12).
Conclusions: During the first year of captive breeding at the CCUV, progress was made in understanding the species' biology in terms of assisted reproduction, artificial incubation, nutrition, veterinary clinic, ethology, and management and animal welfare of the capercaillie.

Actions for capercaillie conservation in Catalonia (Eastern Pyrenees, Spain).

***Figueroa, I.**, G. Mas, and **A. Planella**.*

Abstract: The population of western capercaillie (*Tetrao urogallus aquitanicus*) in Catalonia is in a critical situation as the species has suffered a reduction of 30% average during the last decade (reaching 70% in some areas). As the threats and problems are multiple and can happen simultaneously in one site is difficult to solve them with a single conservation action. The NGO Paisatges Vius started PERIFER project in 2018 to carry out several actions to revert the situation.

The goal of the project is to maintain or increase capercaillie population in the Catalan Pyrenees, especially in the most peripheral population nucleus. The specific goals and the actions carried out in the last 5 years are the following:

- Reduce the human disturbance in the capercaillie forests. Main actions to reduce human disturbance were: 1. signposting in forests with high human presence indicating the need to not pass across, 2. modification of itineraries in ski stations and itineraries by foot, 3. Construction of barriers in ski stations to avoid the off-piste skiing or 4. Installation of solid barriers to avoid the pass of motorized vehicles.

- Reduce the mortality caused by the collisions with human infrastructures. Safety signs for the visualization of electric lines, ski lifts and livestock cables were installed. When possible, even some structures were removed (useless and abandoned ones).

- Improve the habitat quality. Application of a compatible forest management with the capercaillie requirements were promoted in the area and even was applied in an active lek. Two 0,5 ha. exclusion fenced areas were built to reduce the impact caused by the wild grazing ungulates. Inside fruit-producing shrubs were planted inside.

- Increase the awareness about the capercaillie presence and how to behave in its habitat: Divulgation and sensitivity materials were produced, especially focused on good practices to apply in forest to make compatible the ludic and sport activities with the presence of capercaillie. The main materials used were information panels, website, leaflets, paper tablecloth or an exhibition moving along the Pyrenees.

All actions were done in coordination with Catalan Government and involves landowners, municipalities, protected areas, sky resorts and electric supply companies. Actions are supported mainly by national and regional governments but also by some private funds.

Testing assumptions for line transect with distance sampling on rock ptarmigan (*Lagopus muta*).

Gottenborg, S.

Introduction: Distance sampling is a monitoring method developed by Buckland in the 90s and is used to estimate species abundance and density. The method has several assumptions that needs to be fulfilled to get appropriate results. However, if the behavior of the surveillance specie is known the method is somewhat flexible. Distance sampling with line transect is not actively used to estimate rock ptarmigan Lagopus muta density. In this study we want to investigate if some of the required assumptions of distance sampling with line transect meet the demands for rock ptarmigan. The assumptions we want to look at are: a) objects on the line are detected by certainty, b) objects are detected at their initial location, c) measurements are exact. We also want to see if external factors may influence the rock ptarmigan's behavior and discover rate.
Material and methods: My study area is in Dalarna, Sweden and the data collection are carried out in late summer 2022/2023. I use GPS-tagged birds logging position every 10 second and a field crew (observer using a pointing dog) walking the line transect approaching the bird. The field crew is unaware of the bird's position and record observations of birds according to the observed location and measure the perpendicular distance to the line.
Results and discussion: I completed a pilot study during late summer 2022 with a small sample size to gain experience on the approach. It provided me with some results on the ptarmigan's behavior, which shows that external factors may have an influence. The pilot study indicates that distance sampling with line transacts fulfill the assumptions of the method on rock ptarmigan if the conditions are suitable.

Habitat management measures for black grouse in The Netherlands.

Horsthuis, M.

Abstract: The Sallandse Heuvelrug is complex of heathland and woods on sandy soil. The area has great current and potential natural values, which is why it has been added to the Natura 2000 network of Europe's most important nature areas. Despite the qualities present, the area, like most of the Dutch nature reserves, is threatened by external influences: eutrophication, acidification, desiccation and fragmentation. Mid-20th century the Dutch Black Grouse population was widely distributed in the Netherlands with many individuals. Nowadays, the last Black Grouse population in the Netherlands lives at the Sallandse Heuvelrug.
Possible causes of black grouse decline:

- Habitat loss (Expanding of cities, intensive road network, expanding of forests, more intensive agriculture).

- Partly due to nitrogen deposition, the species richness of the heath has also declined in a broader context (insects, reptiles, plants and bird species).

- In recent decades, the genetic variation of the present black grouse population has decreased by more than half. It is likely that the decreasing percentage of hatched eggs in recent years is the result of this low genetic variation.

Major and large-scale remedial actions are needed to restore the legacy of acidification and eutrophication on the soil and ecosystem.

The task is to restore large core areas in such a way that the chick survival of grouse is greatly improved. This implies an improvement in the nutritional status of insects, which can be done in two complementary ways:

- Increase habitat
- Improving the structure variation of the heathland
- Improving the mineral balance on the heathland itself
- By connecting extensively used agricultural land, to which the animals have direct access from the heath.

Our presentation gives an idea of the measures that have already been taken in recent years.

Is population genetic structure driven by the landscape? – analyses of an Alpine black grouse metapopulation.

Kunz, F., P. Klinga, M. Sittenthaler, M. Schebeck, C. Stauffer, V. Grünschachner-Berger, K. Hackländer, and ***U. Nopp-Mayr****.*

Introduction: In modern wildlife ecology, preservation of gene flow is a high priority target in order to restore genetic diversity and prevent local extinction. Within Central Europe, the Alps represent the core distribution area of the black grouse, *Lyrurus tetrix*. At its easternmost Alpine range, extinction events have already been documented and the remaining subpopulations display a population genetic structure with limited gene flow. We assessed whether this observed spatial genetic variation is driven by the underlying landscape by making use of combined molecular and spatial analyses.
Material and methods: We addressed whether the spatial genetic variation of the Styrian black grouse metapopulation system is driven by isolation by distance or by isolation by resistance. We used correlative niche modelling to assess geographic distances and landscape resistances. We calculated population genetic indices and then applied regression-based approaches among individuals and among subpopulations to test whether isolation by distance or isolation by resistance explains the spatial genetic variation.
Results and discussion: The ecological niche model showed subpopulations to be clearly delimited by habitat structures. Spatial genetic variation could be attributed to effects of isolation by distance among individuals and isolation by resistance among subpopulations, yet unknown effects might factor in.
Conclusions: As spatial genetic variation was shown to be driven by landscape features, conservation assessments and actions should be based on spatially explicit landscape ecological analyses. As such, resistance models are important tools that subsequently enable the assessment of landscape connectivity.

Mixing translocated greater sage-grouse broods to minimize impacts to source populations.

Lindenauer, N. I.*, P. S. Coates,* ***S. R. Mathews****, and* ***G. L. Patricelli****.*

Introduction: The translocation of females with broods (termed, brood translocation) is a relatively novel technique with reported short-term success in restoring declining populations of greater sage-grouse (*Centrocercus urophasianus*) in California and North Dakota, USA. Brood translocations were successful in part because translocated females are less likely to disperse from the release site when accompanied by chicks, and translocated females with broods contribute reproductively more at release sites following translocation than do translocated females without broods. We sought to minimize impacts to source populations by augmenting translocated broods with chicks from additional source population females, thereby reducing the number of breeding hens needed for translocation. This is a novel approach, termed brood-mixing, builds upon and integrates existing successful brood translocation methodologies. In this study, we present (1) updated methodologies in brood translocations with an improved translocation release pen design, and (2) initial retention rates of natal and non-natal chicks translocated in a mixed brood.
Methods: We captured multiple females with broods from a source population on the same night and were careful to only capture broods with the same estimated hatch date so that chicks would be the same age in both broods. We then removed up to half of the chicks from one brood (i.e., the donor brood) and mixed them into the chicks in an otherwise normal brood translocation (i.e., the recipient brood). We

translocated multiple broods, some composed entirely of natal chicks, and some translocated with natal and non-natal chicks. We tagged a sub-sample of natal and non-natal chicks per translocated brood and tracked tagged chicks for multiple weeks following translocation. For retention rates, any tagged chick that was in close proximity to the female following translocation was considered retained, while any missing chick was considered not-retained.
Results and discussion: Natal and non-natal chicks had similar apparent post-release retention estimates (adopted = 45% successfully adopted into a brood; natal = 48% stayed with natal brood), indicating that non-natal chicks were successfully integrated into foreign broods. These initial findings indicate that brood- mixing appears to be an effective translocation strategy because surrogate females appear to adopt non-natal chicks. However, samples sizes of tagged chicks were limited and additional samples are needed to draw further conclusions. Nevertheless, brood-mixing has advantages of allowing for smaller impacts to source populations during translocation projects by removing fewer successful breeders (i.e. adult hens) in the translocation process. Data are preliminary, subjected to change, and subjected to revision.

Non-invasive genetic monitoring of black grouse as a tool for supporting the conservation and management of natural populations in Poland.

***Litkowiec, M.**, and **M. Pałucka**.*

Introduction: Ongoing habitat loss and fragmentation is forcing many terrestrial species to establish small, isolated populations. Such populations are more susceptible to inbreeding depression and genetic erosion. Genetic monitoring of such populations can help restore ecological corridors for more efficient gene flow and reintroduction of endangered species. However, the lack of detailed information on the genetic, sexual and health structure of populations poses a challenge to making informed decisions on active conservation. The black grouse (*Lyrurus tetrix* L.) is under strict species protection in Poland. It requires active protection. The black grouse is estimated at about 500 individuals, which live in several isolated populations. Non-invasive sampling, combined with molecular identification, is an invaluable tool in the active protection program for this species in Poland.
Material and methods: Genetic monitoring was conducted using a set of fourteen nuclear microsatellite loci and the CHD (chromobox-helicase-DNA-binding) sex marker. We analyzed 2,000 non-invasive samples from farmed and wild birds from across the entire study range of black grouse species in Poland.
Results and discussion: In total, 561 unique grouse genotypes have been identified. Of these, 191 genotypes belonged to "wild" birds and 370 to farmed birds. The level of genetic variation of the studied black grouse populations is lower than in large and continuous populations of this species. Genetic differentiation between the populations was geographically structured and occurred at a moderate level. A low effective population size was found, and the harmonic mean is 8.7. In addition, a high and significant level of inbreeding was found in black grouse breeding. In order to maintain a high level of genetic variation, which is a necessary component for the survival of natural populations, it is reasonable to introduce additional individuals (new genotypes) into the population while constantly monitoring the inbreeding coefficient, which can have a negative effect on the population if it is too elevated.
Conclusions: Understanding the spatial distribution of genetic diversity and gene flow dynamics within a range of endangered species is critical to ensuring sustainable long-term conservation and management of populations, especially in the face of unpredictable climate change. Therefore, long-term monitoring projects are highly recommended, such as genetic monitoring of black grouse in the areas of the State Forests in Poland, for the purpose of broadly understood active protection of the endangered species.

Level of corticosterone in capercaillie (*Tetrao urogallus*) as an assessment of an individual response to environmental stress.

Ławreszuk, D. B., **A. Książek**, **S. Buczyńska**, and **M. Konarzewski**.

Introduction: The success of an effective protective program for capercaillie and their survival after their release to the forest/natural habitat depends on the individual reaction of capercaillies to the environmental stress caused by humans, predators, new habitat and releasing methods, breeding methods used in the breeding centre. The response to environmental stress is the secretion of glucocorticoid hormones after activation of the hypothalamic-pituitary-adrenal axis. The glucocorticoid level is considered a reliable biomarker of individual adaptation.
Material and methods: In this research the method was developed for quantitative measurement of corticosterone level and then analyses of 679 samples of faeces (non-invasive samples) on the base of capercaillies stock from the breeding centre and also from wild living population were conducted. The analyzes proved different levels of corticosterone in individuals. Corticosterone level was performed

using the enzyme immunoassay ELISA. The results of laboratory analyzes were analyzed for the dependence of the level of corticosterone on the characteristics of the studied individuals, i.e. age, sex, origin (birds from breeding centre or wild) and season. Statistical analyzes were performed using the scripting language R: version 3.6.0. In order to verify the research hypotheses the Mann-Whitney test was carried out and the Kruskal-Wallis test was performed. Differences in the level of the stress hormone between the variables were tested at the level of statistical significance $p = 0.05$.
Results and discussion: Following results were obtained: corticosterone levels vary between seasons $p < 0,01$ and do not depend on sexes ($p = 0,844$); the level of corticosterone is the same in individuals of both sexes, regardless of the origin of the capercaillies ($p = 0,281$); the age of the individual affects the level of corticosterone ($p = 0,003$).
Conclusions: Tests confirm no differences in corticosterone concentrations from faeces of individuals kept in artificial aviaries and those living in the wild. This confirms the legitimacy of aviary breeding and releasing birds for their introduction into the natural environment. Tests confirm that the highest concentration of corticosterone is maintained in faeces deposited in spring (March-April-May). This may be due to the mating and breeding season of these birds. There is more stress hormone in the faeces of birds older than a year, which may be crucial for finding a breeding scheme, and above all, for the process of reintroducing capercaillies to the natural environment. The further analyses must be carried out to confirm trends and identify other factors influencing survival of bred and released birds.

Chick weight at time of tagging affects survival of radio-tagged greater sage-grouse (*Centrocercus urophasianus*) chicks.

***Malley, B.**, P. Coates, **S. Mathews**, and **G. Patricelli**.*

Introduction: Chick survival is a critical life-stage for greater sage-grouse (*Centrocercus urophasianus*; hereafter 'sage-grouse') populations in the American West and for several other grouse species worldwide. Uncertainty in detection probabilities by chick counting methods remain unclear and many studies lack tests of chick detection during final chick counts. In this study, we sutured small ratio-tags to chicks to estimate chick survival probabilities of marked individuals to better estimate chick survival at time of fledging, but we were unsure if tagging chicks could have adverse effects on chick survival. Therefore, we tested the effects of tagging on survival of marked chicks vs non-marked chicks in the same brood. We also tested the effect of predictive covariates of chick age, chick mass, and chick mass/transmitter weight (% body mass) on chick survival.
Materials and methods: We captured females with broods and sutured small (range 0.6–1.4 g) VHF radio-tags to chicks, ranging from 1.0–2.5 % of the chick's body mass at time of tagging. We then tracked females with broods every 3–7 d and recorded if a tagged chick was still alive or presumed dead, until 35-d post hatch, wherein we flushed broods and recorded the total number of non-tagged and tagged chicks still alive at the time of fledging. We used Binomial regression analyses in a Bayesian hierarchical modelling framework to test if chick survival varied across tagged and non-tagged chicks, and we employed nest survival models on radio-tagged chicks to estimate effects of covariates on 35-d survival probabilities.
Results and discussion: Radio-marked tags reduced chick survival but overlap in poster distributions between tagged and non-tagged groups indicates that the effect is not yet significant. Radio-tagged chicks had survival estimate of 0.31 (95% CRI = 0.11–0.59), while non-tagged chick survival was estimated to be 0.55 (95% CRI = 0.35–0.75). Nest Survival models revealed that the weight of chick at the time of tagging significantly predicted survival in that heavier chicks at time of tagging had higher survival probabilities than lighter chicks (β = -0.1, 90% CRI -0.31 – -0.01). Data are preliminary, subjected to change, and subjected to revision.

The extinctions of the capercaillie in the Vosges Mountains. What went wrong?

***Menoni, E.**, **J. J. Pfeffer**, and G. Jacob.*

Introduction: The Vosges mountains are a small massif northeastern France. Like many populations in Western Europe the capercaillie faced a long-term decline throughout the 20th century in terms of distribution and population. Despite management measures taken in favour of the species, the population is now on the verge of extinction. We are trying to find out what went wrong.
Material and methods: We collected all the data concerning the species in the Vosges from 1972 to 2023 (surveys conducted by the Office Français de la Biodiversité, Groupe Tétras Vosges and our own data) We are presenting all the measures that were taken in favour of the species throughout this period (suitable forestry, prohibition of hunting, protected areas, etc.). A survey of genetic diversity has been conducted since 2015.

Results and discussion: Despite these management measures the decline increased (diagrams) None of the measures seemed to be efficient. We wonder what went wrong? What was not taken into account?

- predation /wild boar
- hitting cables
- the impact of deer on low lying vegetation
- the loss of heterozygosity.

Conclusions: Predation and genetics seem to be of great importance. The solutions which are to be experimented in the Vosges will help conserve other small endangered populations in Europe.

Evaluation of counting methods for monitoring rock ptarmigan population at Mt. Hiuchi, Japan.

Nagano, Y.

Introduction: The Japanese rock ptarmigan (*Lagopus muta japonica*) has been monitored by counting the number of territories as an index of population size. However, without sufficient observation time, territorial boundaries are difficult to determine; therefore, territory count results could be biased. The objective of this study was to evaluate the relative accuracy and precision of three population counting techniques (territory counts, simple counts, and mark-resight model estimates) at Mt. Hiuchi, the northernmost and smallest rock ptarmigan population in Japan.
Material and methods: The survey was conducted between 2010 and 2022, and birds were counted 2–8 times from May to mid-June. A GPS receiver was used to record the positions of the detected birds to determine territorial boundaries and avoid the replacement of unmarked individuals. Some individuals were identified based on their color rings. I collected rock ptarmigan sighting data to count the number of individuals and compared these with abundance estimates derived from the mark-resight model and the number of territories reported by the Ministry of the Environment.
Results and discussion: The simple counts of rock ptarmigan were positively correlated with the abundance estimates derived from mark-resight model. However, the number of territories were not correlated with the estimates from the mark-resight model and the number of simple counts. Moreover, the territory count results were not correlated with the number of marked males seen. Whereas the number of territories showed a declining trend over the 13-year period, the number estimates based on the mark-resight model and simple counts revealed fluctuating but stable population abundance. The results of the territory count may lead to a misunderstanding of the population trends.
Conclusions: The territory count method does not incorporate detection probabilities which may vary across the distribution range. To monitor population trends, field sampling should be based on other methods which account for imperfect detection, such as the mark-resight model.

The use of sedation in grey partridge and capercaillie to reduce capture-related mortality.

Nicolas, O., I. Afonso, C. Sacristán, I. Sacristán, D. Garcia, A. Carolina Ewbank, ***K. Foulché****, and* ***E. Ménoni****.*

Introduction: GPS tracking offers key information for the study of endangered galliform populations dynamics and management. Nevertheless, placing these devices implies an invasive procedure, including the capture and handling of the birds, that could, paradoxically, become a challenge for their survival after release. Sedation could reduce the stress related capture and handling of the animals; however, little is known regarding sedation protocols for Galliformes. The goal of this study was to test five sedation protocols in captive-born grey partridges (*Perdix perdix*) as a model for safe sedation during handling and translocations of wild endangered galliforms in the Pyrenees, and to report the results observed with the drug of choice in captured Pyrenean capercaillies (*Tetrao urogallus aquitanicus*).
Material and methods: A total of 65 grey partridges received intramuscular sedation with different doses of midazolam (10 and 15 mg/kg), diazepam (10 and 15 mg/kg), a combination of butorphanol-midazolam (4 mg/kg and 5 mg/kg, respectively) or sterile distilled water for injection (control group). From 2018 to 2021, 23 free-ranging capercaillies were captured and sedated for GPS harness tagging. Based on the previous results on grey partridge, midazolam was chosen for sedation (dosages ranging from 2 to 8 mg/kg). Those animals that had to be released after twenty minutes of handling were reversed with intramuscular flumazenil (0.1 mg/mL).

Results and discussion: The sedative that had the fastest onset of anesthesia in grey partridges was midazolam (2 to 3 minutes), while the drug that kept more animals sedated for a longer time was diazepam. The mortality observed in capercaillies related to capture and handling (from the capture event to the fourth week after capture), dropped from 16% (n=100) to 4.3% (n=23) when sedation with midazolam was used.
Conclusions: Sedation has shown to be a useful tool to reduce mortality related to capture and handling in the Pyrenean capercaillie.

Dramatic extinction of capercaillie (*Tetrao urogallus major*) in the Vosges Montains (North-eastern, France).

Preiss-Levasseur, F.

Abstract: The Vosges massif represent a small distinct geomorphologic entity of low elevation range (max elevation: 1424 m a.b.s.) located Northeastern France. As observed in many capercaillie populations in Western and Central Europe, the population of this elusive forest grouse in the Vosges Mountains has undergone a dramatic decline during the last decades and is now on the verge of extinction.

In 1972, a first survey carried out by ornithologists estimated around 250 males on the entire massif. In 1989, a more detailed assessment of the number of capercaillie on the entire Vosges massif was carried out by the Groupe Tétras Vosges (GTV) and the NFB/ONC Tetra Mission. This study estimated 170 (156–189) territorial cocks. The area of occupancy was evaluated to 31 500 ha. Since 1991, capercaillie cocks were counted each year on display sites (leks). In 1999, the number of territorial cocks were estimated to 95 (84–105) representing thus a fast and dramatic decline (44%) and the aera of occupancy decreased to 12 800 ha (60%) and was strongly fragmented. From 2010 to 2015, a genetic survey based on feces revealed a dramatic demographic decline of 52% over 6 years. In 2015, 22 males were genotyped on leks whereas 23–32 cocks were estimated by lek counts. In 2020, only 8 cocks were contacted on leks and none in 2022.

The decline of capercaillie in the Vosges mountains started several decades ago and is multifactorial. Despite habitat restoration measures undertaken over the past several years, the global surface of suitable habitat remains too low to support a sustainable population and the loss of connectivity is still increasing. Moreover, the few protected areas are small in size and those strictly protected are anecdotal.

Human disturbance mainly due to outdoor recreational activities including off-trails activities have strongly increased and are no longer restricted to winter summer months but all year-round and sometimes even during the night.

Significant climate change which are obvious and documented in the Vosges probably causing deleterious direct and cascading effects on the ecology and biology of capercaillies as well as its ecosystem. Moreover, the genetic study has revealed that the population showed low levels of genetic diversity and high inbreeding. Another factor to be considered is the high populations of ungulates. For example, *Cervus elaphus* has deleterious effects on trophic resources such as *Vaccinum myrtillus* and *Abies alba* whereas *Sus scrofa* may predate the nests. Finally, the predation by mesopredators (which is a natural factor), may have some effects but we argued that previous factors are from far more important.

Tetrao urogallus is a emblematic species of the Vosges Mountains. However, reinforcement/reintroduction by 2024 with birds from Scandinavia is already proposed by authorities but such a intervention seems doomed to failure because the threats that led to its decline are far from being eliminated or reduced to have any chance of success.

Genetic differentiation between black grouse from the Tatras and the Sudetes.

***Rutkowski, R.**, T. Zwijacz-Kozica, A. Pałucki, S. Szczepański, and A. Santorek.*

Introduction: Mountain areas are of key importance for European nature and its conservation, as well as for the evolutionary processes that generate biodiversity. There are several examples of clear genetic differentiation between populations found in the Sudetes and the Carpathians. Most studies to date have focused on plants, but clear genetic differences have also been found in animals.
Material and methods: Since the black grouse is an endangered species, and its largest populations are concentrated in mountainous areas, we decided to check whether the birds from the Sudetes and the Tatras are genetically different. For this purpose, non-invasive material was collected in the Tatra and Karkonosze National Parks. Individuals were identified using microsatellite genotyping. Based on the unique genotypes, genetic parameters characterizing both populations were determined.
Results and discussion: A very clear genetic differentiation was found between the black grouse from the Tatra and Karkonosze National Parks.

Conclusions: The gene flow between the black grouse, living in the Sudetes and Tatras is significantly reduced.

Comparison of genetic differentiation in Carpathian capercaillie subpopulations over time.

***Rutkowski, R.**, T. Zwijacz-Kozica, Z. Żurek, P. Armatys, B. Pregler, A. Bilska, and A. Santorek.*

Introduction: Genetic research to date has shown that the Carpathian capercaillie population consists of several more or less isolated subpopulations. At the same time, in the case of endangered species, a periodic comparison of changes in the genetic structure is extremely important in the context of conservation. Therefore, we decided to check whether and in what direction the genetic diversity of the three main capercaillie subpopulations in the Polish part of the Carpathians is changing.
Material and methods: Non-invasive biological samples were obtained in two periods: 2012/2013 and in 2022. The material for genetic research was collected in the Babia Góra, Tatra and Gorce National Parks. Individuals were identified using microsatellite genotyping. Based on the unique genotypes, genetic parameters characterizing gene flow and genetic differentiation in populations were estimated.
Results and discussion: In both study periods indicators of genetic differentiation among Carpathian strongholds were lower than in the case of lowland populations, investigated in previous studies. Mountain forest environments allow gene flow among subpopulations.
Conclusions: Carpathian Capercaillie population seems to have stable genetic structure.

The role of the gut microbiome in the health and population dynamics of Icelandic rock ptarmigan (*Lagopus muta*).

*Stromecki, A., M. Muscarella, S. Galla, K. Pétur Magnússon, Ó. Nielsen, and **J. Forbey**.*

Abstract: Rock ptarmigan (*Lagopus muta*) populations in Iceland fluctuate in multiannual cycles. Historically, the populations had temporal dynamics with peaks every 10–12 years, yet since the turn of the century populations have shown an overall negative trend with cycle periods accelerating to roughly every five years. Trophic connections to the resident specialist predator gyrfalcon (*Falco rusticolus*) contribute to population fluctuations; however, ptarmigan health also plays a role. Rock ptarmigan are obligate herbivores that live in arctic and sub-arctic regions where high-quality food is relatively scarce and birds must invest in either selective foraging or metabolizing less nutritious and potentially chemically defended plant species. In support, the proportion of less digestible leaves in the diet is positively correlated with mass specific length of the intestines and negatively correlated with body condition of Icelandic ptarmigan. Additionally, juvenile Icelandic ptarmigan have, on average, longer ceca and lower body condition and health metrics than adults. These results may indicate that body condition is impaired because of gut dysbiosis. We hypothesize that the cecal microbiome plays an important role in the overall fitness of Icelandic rock ptarmigan. Furthermore, we hypothesize that variability in microbial community structure correlates to diet, intestinal morphology, and body condition and these relationships influence population dynamics over time. To test these hypotheses, we leveraged an 11-year longitudinal study to characterize the cecal microbiome of Icelandic rock ptarmigan. The study period captured high and low population fluctuations as well as high and low body conditions that were phase shifted compared to population dynamics. We used 16S rRNA amplicon sequencing of 100 individuals per year across the 11-year study to compare changes in the cecal microbiome to diet, intestinal morphology, health metrics, and population size. Preliminary data suggests temporal dynamics in the cecal microbiome and relationships to diet and body condition. These findings may reveal functional relationships between the gut microbiome and diet quality that impact the health and population dynamics of herbivores.

Relationship between semen quality and males' level of heterozygosity in western capercaillie.

***Strzała, T.**, **A. Kowalczyk**, **J. Rosenberger**, M. Frąszczak, and **E. Łukaszewicz**.*

Introduction: Sperm quality is a very important population survival factor, which can be influenced by the level of male's genetic diversity and can influence reproduction effectiveness. Thus, on the basis of the European capercaillie (*Tetrao urogallus*), relationship between selected sperm traits and male's heterozygosity and age was analyzed. The goal of the analysis, was to check whether such a correlation is present in capercaillie and whether this knowledge can be used in species protection.

Material and methods: 22 males from two breeding centers were analyzed in terms of sperm quality and level of genetic diversity. Sperm morphology was evaluated with the nigrosine-eosin histological smears analyzed under a light microscope. The level of male's homozygosity/heterozygosity was revealed with the set of 23 microsatellite loci. In order to check whether the considered traits are dependent on the heterozygosity, different regression models were applied.
Results and discussion: The percentage of live sperm in total, and live normal sperm ranged from 91.56 to 98.00% and from 37.66 to 81.95%, respectively. Bulb heads were the most frequent sperm abnormalities (7.6 to 39.3%), while the least frequent were presence of spermatids (0 to 1,58%). The level of heterozygosity of all males varied from 0.48 to 0.86 (0.674 on average). Basing on polynomial regression dependencies between heterozygosity and bent neck, midpiece deformations, spermatids and other deformities were observed while no correlation was found between heterozygosity and total sperm cells, live sperm cells, dead sperm cells and bulb heads.
Conclusions: The male's level of heterozygosity in capercaillie may be a useful indicator of male semen quality, however further research is required to determine the limit of variation that will determine the inability to fertilize and thus the survival of the population. Experiment funded by National Science Centre, Poland, Grant 2016/21/B/NZ9/02084.

Translocation of wild Swedish black grouse to prevent extinction in The Netherlands.

***ten Den, Paul**.*

Abstract: Around 2010 the last, isolated black grouse population in The Netherlands showed a dramatic decline. A low chick survival and in the end a reduced egg fertility were the main causes. To prevent extinction and to reinforce numbers, BG are captured in Central Sweden and translocated to the Sallandse Heuvelrug, a Nature 2000 dry heathland reserve. Since 2016 these translocations occur on a more or less yearly basis with around 25 birds each Spring. Additionally, some reared BG are released in autumn, but not on a yearly basis and in a much smaller number. For monitoring all birds are provided with color rings and some with radio transmitters (50%).

Capture, transport and release methods will be presented as well as monitoring results, with focus on survival and population growth.

Breeding and raising of captive Svalbard rock ptarmigan (*Lagopus muta hyperborea*) for research.

*Thorvaldsen, R., **D. Appenroth**, L. Folkow, J. Ness, I. Helena Nymo, M. Tryland, and H. Lian.*

Introduction: Ptarmigan (*Lagopus* spp.) have been bred and raised at UiT – the Arctic University of Norway (UiT) since 1972, for use in research on physiology and behavior, as well as on breeding-related topics (e.g., nutrition and health). From 1984, focus has been on the breeding and raising of Svalbard rock ptarmigan (*Lagopus muta hyperborea*) for use as a model in basic research concerning evolutionary adaptations to life at high latitudes. In this research, mechanisms relating to energetics/temperature regulation and timekeeping (chronobiology) have received particular attention. This paper aims to share some of the experiences – and discuss some challenges – related to breeding, raising, and maintaining (Svalbard) ptarmigan in captivity.
Material and methods: The review of current routines for upkeep of captive ptarmigan is based on over 50 years' experience and will emphasize practical issues, related to e.g., caging facilities (including enrichment), feed and nutrition, breeding, chick rearing, health and disease.
Results and discussion: The present UiT animal facility has the capacity to maintain a breeding population of up to 24 cock-hen pairs in a newly constructed outdoor roofed building. We can brood, hatch and raise up to 100 chicks annually, mainly by use of incubators and hatchers. Moreover, we have the capacity to keep some 36 adult birds in indoor (light- and temperature-controlled) conditions, in connection with research. The standing population and production will vary from year to year, depending on research needs. At intervals, the population is supplemented with wild-captured chicks from Svalbard, to prevent in-breeding problems. Both the facility and our use of birds in research projects are approved by the Norwegian Food Safety Authority and the Norwegian Environment Agency.
Conclusions: The current routines for upkeep of ptarmigan in captivity at UiT are based on more than 50 years of experience that has taught us how to keep these birds healthy and happy. It has enabled the generation of new knowledge on the biology of these birds, as published in more than 125 peer-reviewed research articles and one book. We hope to continue improving routines and animal welfare to support the generation of further understanding of these fascinating birds.

Reducing nest predation of the endangered Western Capercaillie using Conditioned Food Aversion.

Tobajas, J., J. Roig, and I. Afonso.

Introduction: The populations of capercaillie (*Tetrao urogallus*) have experienced a progressive decline throughout Europe, particularly pronounced in the fragmented and threatened populations of the Iberian Peninsula. This decline has been attributed partially the impact of generalist predators. The objective of this study has been to develop and evaluate Conditioned Food Aversion (CFA) to reduce predation on nests of Pyrenean capercaillie.
Material and methods: We applied CFA in different areas with capercaillie breeding presence (2 treatment and 1 control) in the Alt Pirineu Natural Park (Catalonia, Spain). We used artificial nests with chicken eggs and chicken odor monitored by camera traps to evaluate the CFA effectiveness to protect the natural capercaillie nests. The experiments were conducted in three phases, pre-conditioning (normal eggs prior incubation), conditioning (eggs with aversive) and post conditioning (normal eggs during incubation).
Results and discussion: The results showed a significant treatment effect in reducing (2.35 times) the red fox probability of predation in the treatment zone (Pre-conditioning: 0.47, Post-conditioning: 0.20) than control zone (3.1 times increase, Pre-conditioning: 0.27, Post-conditioning: 0.83), likely due to the dispersal of yearling offspring. The risk of predation by pine marten/beech marten increased in the control (2.1 times), while in the treatment zone, it slightly decreased (from 0.34 to 0.33). The results demonstrate the effectiveness of CFA in reducing nest predation by foxes, but its impact on mustelids was limited.
Conclusions: The obtained results showed the foxes and mustelids as the primary nest predators of capercaillie, with potential high impact on capercaillie population. The experiment indicates that CFA can be a potential tool to reduce capercaillie nest predation by foxes. However, it is necessary to apply this technique widely while monitoring the capercaillie population, preferably monitoring natural nests.

Improvements to walk-in traps for capturing prairie grouse on leks.

***Wolfe, D. H.**, **A. C. Pratt**, and J. E. Toepfer.*

Abstract: For decades, various designs of walk-in traps have been used for capturing prairie grouse for relocation and telemetry studies. The basic design is a series of circular wire traps, each containing one or more funnel openings, usually attached to drift fences arranged in a large "W" manner across a prairie grouse lek. We will present some significant modifications we have developed, over the course of many years, to improve capture rate as well as detect captured birds when visibility of traps is limited. Other researchers and managers involved with the study or translocation of sage-grouse, sharp-tailed grouse, and prairie-chickens may also find these modifications advantageous, and some of these modifications may be applicable to other study species as well.

FTIR analyses of capercaillie crop contents and pine samples.

***Zohmann-Neuberger, M.**, J. Tintner-Olifiers, **U. Nopp-Mayr**, E. Inselsbacher, A. Hromatka, M. Kriechbaum, and **J. S. Forbey**.*

Introduction: Studies on the foraging ecology of wildlife species are of fundamental ecological interest. As particular plant parts and their quality might distinctly drive population dynamics of herbivores, methods are needed that can assess both diet composition and quality at different spatial and temporal scales. Analyses with Fourier Transform Infrared spectroscopy (FTIR) hold a clear advantage to DNA metabarcoding approaches (Sullins et al. 2018) as they support the determination of specific parts of a plant or phytochemical composition. We are currently working on the establishment of spectral fingerprints of typical feeding resources of different grouse species.
Material and methods: In this study, we analyzed crop contents of juvenile and adult capercaillie birds and samples from trees from a previous study in Scandinavia (Hagen 2020). For our analyses, 117 samples were available including crop contents, samples from pine trees (Pinus sylvestris) being selected for feeding and non-browsed trees (Hagen 2020). FTIR spectra of crop contents and tree samples were recorded on a Bruker® FTIR spectrometer (Tensor 27) in the Attenuated Total Reflectance (ATR) mode.
Results and discussion: We compared the spectra of crop contents with the one of sampled trees. Addressing age-specific feeding ecology, we also compared spectral signals of juvenile vs. adult capercaillie males.

2023 Upper Midwest Prairie Grouse Summit – Addressing Fragmented Greater Prairie-Chicken and Sharp-tailed Grouse Populations.

Jodie Provost

The Upper Midwest Prairie Grouse Summit was attended by about forty greater prairie-chicken and sharp-tailed grouse managers and researchers on August 1-2, 2023. Here participants are pictured behind metal art of displaying sharp-tailed grouse outside the Crex Meadows Wildlife Area visitor center. It was created in honor of Jim Evrard, long-time Wisconsin Sharp-tailed Grouse Society leader.

Last March, a call went out from managers of Minnesota, Wisconsin, and Michigan. They were concerned about the state of sharp-tailed grouse and greater prairie-chicken populations, their common issue of fragmented populations from loss and degradation of habitat (primarily from natural succession, fragmentation, and conversion), and lack of awareness of the birds and the issue. Thus, the idea of an Upper Midwest Prairie Grouse Summit was "hatched".

The North American Grouse Partnership (NAGP) proceeded to gauge interest from the Minnesota Sharp-tailed Grouse Society (MSGS), Minnesota Prairie-Chicken Society (MPCS), Wisconsin Sharp-tailed Grouse Society (WSGS), Wisconsin prairie-chicken population and festival managers, and Michigan Sharp-tailed Grouse Association (MSGA). Then invited each state's Department of Natural Resources (DNR) to also be involved on a planning team to craft the agenda. WSGS and NAGP teamed up to co-host, tackling logistics and securing speakers.

The Summit occurred on August 1-2 at the Crex Meadows Wildlife Area in the Northwest Sands of Wisconsin. Its primary purpose was to serve as a forum for professionals to share management and research information, learn from one another, and initiate a more collaborative approach to determine and implement strategies to sustain and recover prairie grouse populations across our ecoregion. A secondary purpose was to raise awareness and understanding among the public for the birds and their habitats to increase support for their management. The agenda consisted of one and a half days with twenty presentations and three designated open group discussions, and a half-day, morning tour of habitat projects on Crex Meadows Wildlife Area.

The Summit was launched by a welcome from WSGS and NAGP, population and management overviews from each state's DNR, and history, accomplishments, and challenges from each grouse organization. A presentation regarding the "Conservation Strategy for the Greater Prairie-Chicken and the Plains and Prairie Subspecies of Sharp-tailed Grouse" then framed the event and noted why fragmented populations are a concern. The Strategy, completed in 2022, was developed by an interstate work group of fourteen states and endorsed by the Western and Midwestern Associations of Fish and Wildlife Agencies. The intent is to use greater prairie-chicken and sharp-tailed grouse as flagship species to conserve and restore large blocks of grasslands and shrublands, ideally a network of 50,000 acre blocks, because the status quo is not working, and their habitat continues to be lost.

The remaining agenda was broken into population (the birds), habitat (the places), and outreach (the people) management-related presentations, along with three designated times for open group discussion and brainstorming. Topics included translocation, hybridization, 'rolling barrens', prescribed fire, conservation ranching, private land biologists, a festival, Farm Bill policy, and ramping up conservation delivery. All presentations and the program are available on the NAGP website as pdf files under the "Lakes States Collaborators & Resources" tab. The program has the agenda and abstracts of each presentation along with e-mail addresses for speakers.

A morning tour of Crex Meadows Wildlife Area focused on challenges and management approaches to creating and enhancing barrens habitat. Local staff described how Wisconsin DNR uses a comprehensive set of management tools, including prescribed fire, mechanical treatment, chemical treatment, and commercial timber harvest, to restore and maintain it. They also shared how the property's management contributes to habitat connectivity for sharp-tailed grouse and other barrens species at the landscape scale within the Northwest Sands. Managers, researchers, and grouse enthusiasts asked questions of local staff and provided insights from their own experience elsewhere in the Upper Midwest.

Key take-home messages from the presentations, discussions, tour, and parting questionnaire included:

Population Management

- Urgency exists in turning population declines around, such as sharp-tailed grouse in east-central Minnesota and greater-prairie chicken in North Dakota.
- At a minimum, a goal should be populations that support limited hunt seasons to maintain hunter interest and support. Many hunters simply appreciate the opportunity to see birds and experience the hunt.
- Translocation is costly, time consuming, and should only be used if the receiving habitat is of high enough quantity and quality to sustain a population. It is much more efficient to sustain and recover populations while they still exist.

Habitat Management

- Most managers struggle to meet their prescribed burn acreage goals due to factors such as weather and ground conditions (e.g., drought, too wet, no frost), restrictions from poor air quality due to wildfires, and lack of qualified burn bosses.
- All habitat management tools are needed in an array of space and time to mimic the natural disturbances under which prairie grouse evolved, including burning, mechanical, selective herbicide, grazing (and rest), and biomass harvest treatments. Each site/plant community and landscape are different.
- More creative methods are needed, such as Bayfield County's 'rolling barrens' and their incredible cooperation, and Michigan's hunting access program that incentivizes farming practices for sharp-tailed grouse.
- Prairie grouse can move long distances if needed, but large blocks of habitat should be present and connected enough to increase the likelihood they will find and use them. The birds should not be forced to move long distances to meet their habitat needs.
- Collaboration across landownerships is essential to attaining large habitat blocks such as the 50,000 acre blocks recommended in the Conservation Strategy.
- Landscape-scale conservation programs, such as the Farm Bill's Conservation Reserve Program and Environmental Incentives Quality Program with adequate incentives and ability to meet landowner and wildlife needs, are critical for positive, broad-reaching habitat impacts across private lands.

Outreach

- Public and professional awareness, understanding, and support must be raised about grasslands, shrublands, and prairie grouse. Social media can be instrumental, as evidenced by WSGS recent growth in support, as well as festivals and viewing blinds, especially those that engage youth.
- Partnerships and community/private landowner support are critical, take much work, and require a designated care taker. Great opportunity exists in collaborating with Indigenous nations.
- Sufficient local, on-the-ground staff, such as Farm Bill Biologists, to deliver assistance to private landowners is essential. Pay and benefits should be high enough for them to stay in positions long-term, to build relationships and a projects base.
- Volunteers can play an important role in habitat management and provide in-kind support to leverage grants, such as through Adopt-A-WMA and Brush Cut Habitat Days.

Overall

- The states have a great deal in common, all struggling to hang on to habitat and prairie grouse populations. Yet they do not communicate or collaborate regularly.
- Management plans to sustain and recover populations are key communication tools and guides for securing and directing resources to targeted areas. Each state should have a plan and

designate priority open landscapes. A coordinator is needed to implement the plan and serve as a liaison with partners.

- Attendees appreciated the array of speakers and stakeholders at the Summit and opportunity to exchange information, hear what has worked and what has not, and network. They would like to stay connected and gather again in two years.
- A work group should be formed to explore Summit ideas and collaboration, implement strategies, and organize the next Summit.

Thank you immensely to WSGS, especially Ken Jonas their president, for co-organizing this event with NAGP. And to all that shared information and attended from local grouse and conservation societies, universities, and agencies. Our shared knowledge is power for a better tomorrow for grouse, their habitats (and the multiple benefits they bring), and grouse enthusiasts.

Submitted by Jodie Provost, Sept. 28, 2023
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Grouse Presentations at the 30th Wildlife Society Conference, 5-9 November 2023, Louisville, Kentucky, USA

Oral Presentations

Predicting range-wide seasonal habitats for Greater Sage-Grouse: Leveraging local studies for broad-scale inference - Greg Wann

Abstract: Wildlife populations commonly change their habitat associations temporally to meet resource needs. Identifying and protecting habitats associated with discrete seasonal periods is therefore an important conservation strategy to ensure populations have access to suitable conditions throughout their full annual cycle. However, populations spanning large geographic extents often pose challenges in terms of quantifying finer-scale habitat associations (e.g., corresponding to third-order habitat selection) due to data limitations in understanding habitat associations that can vary spatially. We compiled a use location dataset comprised of tracking studies spanning the U.S. range-wide distribution of Greater Sage-Grouse (*Centrocercus urophasianus*), a declining sagebrush specialist, to develop a set of models used to create predictive habitat maps to help inform management strategies implemented by the Bureau of Land Management, the largest administrator of sage-grouse occupied lands. We estimated resource selection functions (RSFs) using a suite of models applied to used-available locations collected from over 14,000 individual sage-grouse. Our models included regional effects to allow for flexibility in estimated habitat associations. Our candidate models were selected using cross validation based on their ability to optimize predictive performance to out-of-sample datasets (withheld sites used for testing). Optimizing our models in this way should enhance their predictive performance in areas where we lacked data. Our study demonstrates the benefit of broad collaborative research to help inform management strategies for a wide-ranging species, but also highlights the critical importance of supporting local wildlife studies since conservation strategies are often needed at multiple scales.

Exploring Old Data with New Tricks: Using Long-Term Harvest Monitoring Data to Conserve Prairie Grouse in the Nebraska Sandhills - Danielle Berger

Abstract: Wildlife agencies have long collected harvest monitoring data for game species to inform hunting regulations. However, annual monitoring produces longitudinal, population-focused data with broad spatial coverage, matching the spatiotemporal scale of greatest concern for species conservation planning. The length and spatial extent of monitoring time series likely captures sufficient environmental variation to provide insight into the processes that shape population trends. Historical monitoring data can be repurposed to address questions of modern-day conservation concern, like identifying drivers of abundance, if data analysts are willing to take on the challenge of exploring old data with new tricks. First, harvest monitoring data were collected to address a different question, which is reflected in their sampling protocol. Data exploration and simulation can help analysts determine how historical sampling practices may introduce bias when data is repurposed, allowing for appropriate quantitative corrections. Second, portions of monitoring time series often predate satellite technology, meaning that remotely-sensed measurements of large-scale environmental covariates do not exist. To use the complete time series, analysts must explore alternative sources of covariate data. We provide an example of how to

address these two challenges of repurposing historical data using a 63-year time series of greater prairie-chicken (*Tympanuchus cupido pinnatus*) and plains sharp-tailed grouse (*Tympanuchus phasianellus jamesi*) breeding ground counts collected in the Sandhills of Nebraska, USA. Our case study demonstrates that legacy data have the potential to tell new stories with important conservation implications, and that it might be time for wildlife practitioners to revisit our old data.

Landscape Scale Constraints on Greater Prairie-Chicken Lek Site Selection in Kansas - Rachel Rusten

Abstract: Lek locations are a focal point for individual greater prairie-chicken (*Tympanuchus cupido*) space use and facilitate population monitoring. Surveys conducted in Kansas indicate state-level declines over the past 30 years and suggest a 66% decline from 2015 to 2021 in the Flint Hills Ecoregion. To target conservation efforts, knowledge of broad-scale landscape features and possible links to lek site selection is needed. We evaluated the relationship between landscape variables to lek site use on Kansas leks. We compared grassland composition, woody vegetation cover, pesticide use estimates, and anthropogenic vertical structure densities between used (n = 245) and available lek site locations. Landscape variables were summarized within 5 km of used and available lek sites. Each variable was integrated into a separate generalized linear mixed-effect model and ranked using an Information-Theoretic approach. Our best-supported model predicted the highest use probability in landscapes having 78% grassland within 5km (β =10.16, SE =2.34; $\beta 2$ = -6.39, SE= 1.87). Also within 5km, woody encroachment (β= -6.87, SE= 3.4973) and vertical structure densities (β = -0.046, SE= 0.02) on the landscape predicted a negative effect on use. Although pesticide use did not impact lek site selection, the previous two-year pesticide application's average predicted lower abundances at sites. Our analysis suggests that the amount of grassland at a landscape scale is the primary driver of lek site selection and greater prairie-chicken distribution. Conserving large grassland-dominated landscapes with minimal anthropogenic features will be essential to maintaining greater prairie-chicken populations.

Non-Breeding Space Use and Survival of a Constrained Population of Greater Prairie-Chickens on Fort Riley Military Reservation - Mary Ware

Abstract: Although management focus of prairie grouse has traditionally been on the breeding season, understanding nonbreeding ecology is important for conservation and may provide insight into subsequent breeding season relationships. We evaluated nonbreeding ecology of greater prairie-chickens (*Tympanuchus cupido pinnatus*) on Fort Riley Military Reservation, Kansas, USA. The Reservation is surrounded by crop fields and anthropomorphic development, which constrains movement by greater prairie-chickens. Management includes prescribed fire, haying, and food plots, but not livestock grazing. We evaluated survival, resource selection, and space use of greater prairie-chickens during the 2019-2022 nonbreeding seasons (Sep 15-Mar 14) using Kaplan-Meier estimation, selection ratios, and biased random bridge movement models, respectively. We trapped and deployed GPS backpack transmitters on 47 female greater prairie-chickens on leks during spring. Overall, 16 females survived the breeding season, resulting in 22,272 locations during the nonbreeding season. Estimated nonbreeding season survival was 74%. We divided the nonbreeding season into early (Sep 15 – Dec 15) and late (Dec 16 – March 14) periods. Greater prairie-chickens selected hayed areas during the early period and cropland during the late period. Home range area differed between early and late periods at the 50% isopleth, but not at 95%. Food plot, crop, and hayed area encompassed 5% of their home range during the early period, but area doubled to 12% during the late period. Given the relatively high survival rate, high quality winter resources are present on Fort Riley, but foods may be limiting late in the nonbreeding season based on increasing crop use during late winter.

The Mixing Pot: Hybridization of Sharp-tailed Grouse and Greater Prairie Chicken in North Dakota - Amalie Victoria Jørgensen

Abstract: The greater prairie-chicken (*Tympanuchus cupido*) population in Grand Forks County, North Dakota has declined since 2005, after initial success following restoration efforts from 1992-1998. During this period, sharp-tailed grouse (*Tympanuchus phasianellus*), which co-occupy the area, have increased. We conducted annual spring lek counts (15 March to 15 May 2019 - 2023) to monitor the population trends for both prairie grouse species. Within two study blocks, we attempted to identify all leks of both species through listening surveys and then return to count the number of birds on each lek by species and sex. We counted between 24 and 38 active leks annually. We observed steady decreases in prairie chickens (only seven male prairie chickens were observed in 2022); increases in sharp-tails; and increases in hybrid greater prairie-chicken x sharp-tailed grouse (8/31 leks in 2022). Previously, managers assumed that hybrids were relatively rare, but we documented as many as 16 hybrids that could be identified

morphometrically in a single year. Future work will be needed to evaluate the genetics of grouse where they co-exist to further determine accurate hybridization rates within the population.

Avian Predator Occupancy and Diet at Communication Sites in Sage-Grouse Habitat - Shawn Szabo

Abstract: Habitat fragmentation resulting from anthropogenic features can pose a threat to Greater Sage-Grouse (*Centrocercus urophasianus*; hereafter, Sage-Grouse). Studies have shown that Sage-Grouse avoid tall structures, and both transmission lines and communication towers have been linked to Sage-Grouse nest failure, lek abandonment, and extirpation. These unnatural features provide nesting and perching substrates for ravens and other avian predators of Sage-Grouse and their nests. We designed a field study to assess how the design, arrangement, and location of communication towers influence nesting and perching of avian predators within Sage-Grouse habitat. We visited over 700 communication sites in over 200 sage-grouse habitat clusters across California, Idaho, Nevada, Oregon, and Wyoming during the March-June nesting seasons in 2021 and 2022. Site visits consisted of a point count survey, measurements of available nesting substrate, inventory of avian predator nests, and collection of genetic materials for dietary analysis. Avian predators preferentially nested on large, wind-blocking antenna types, and areas of the tower structure with dense steel lattice. Site occupancy was also influenced by topographic, landcover, and land use characteristics. Next-generation sequencing of the scats and regurgitated pellets collected from predator nests indicated that these species ate a diverse diet that varied by location and included multiple anthropogenic subsidies as well as Sage-Grouse and other species of conservation concern.

Trends in Spatial Distribution Decoupled From Abundance for Greater Sage-Grouse in a Distinct Population Segment – Megan Milligan

Abstract: Changes in distribution or abundance are frequently used independently to evaluate trends and status of wildlife populations. It is often assumed, although not explicitly stated, that these measures are correlated. However, if population distribution and abundance become disconnected, such as when changes in a single subpopulation drive overall population trends, then focusing on a single indicator, such as abundance, can mask important losses in distribution. We combined population counts, demographic data, and information on space use from marked individuals to evaluate changes in abundance, distribution, and available habitat from 1995 to 2021 for greater sage-grouse (*Centrocercus urophasianus*) in the Bi-State Distinct Population Segment (DPS), a genetically distinct and isolated population straddling the border of Nevada and California, USA. The Bi-State DPS exhibited evidence of slight population declines of ~1.4–2% annually. Gains in distribution in two subpopulations were insufficient to offset losses in the remaining subpopulations and the net effect was a loss in area and available habitat across the Bi-State DPS as a whole, with an 89% probability of range contraction. The contractions in distribution combined with only slight declines in population abundance suggest long-term patterns in redistribution of sage-grouse among subpopulations, with peripheral subpopulations declining while the largest core population increased. This decoupling between trends of abundance and distribution could have implications for metapopulation persistence as peripheral populations become more vulnerable to stochastic events. Information is preliminary and provided for best timely science.

Poster Presentations

Preliminary Study of Roost Site Selection by Male Ruffed Grouse - Everly Eldeen

Abstract: Ruffed grouse (*Bonasa umbellus*) are an important game bird species in the Great Lakes region. Males perform a unique drumming display atop fallen logs to maintain territory and attract females. Diurnal activities such as drumming and foraging behavior of ruffed grouse are well studied. Excluding winter roosts, nocturnal roost site selection has not been extensively investigated. As part of an undergraduate research project at the University of Wisconsin - Stevens Point, male ruffed grouse were trapped on drumming logs and fitted with VHF radio telemetry collars. Over the course of the spring and summer of 2023, we triangulated the locations of collared ruffed grouse during the night on an unhunted property in Northern Wisconsin. We utilized triangulated points obtained at night to analyze roost site characteristics. Understanding the factors that influence roost site selection in ruffed grouse is critical for effective habitat management and conservation.

Modeling Sound Characteristics and Propagation of Ruffed Grouse Drumming - Ava Cross-Weisbeck

Abstract: Ruffed Grouse (*Bonasa umbellus*) are an important ecological, cultural, and economic game species throughout North America, especially in Wisconsin and the upper Midwest. Male ruffed grouse perform a breeding display called drumming, which typically takes place on elevated platforms such as a fallen log. Drumming produces a low frequency sound that travels through dense vegetation. Because ruffed grouse rely on an auditory courtship display for reproduction, they could be choosing drumming sites with better sound propagation potential. To investigate this, specific sound source characteristics of drumming ruffed grouse were collected using autonomous recording units and analyzed with a sound analysis software. Sound characteristics of drumming ruffed grouse were used to model the area of sound propagation from known drumming sites and randomly generated points. Our hypothesis that the area of sound propagation of drumming log locations would be greater than randomly generated points was analyzed using a t-test. If male ruffed grouse are selecting sites with greater sound propagation potential, there could be sampling and management implications.

Comparing the effects of lethal and non-lethal raven management on sage-grouse – Richard Rich

Abstract: Common raven (*Corvus corax*) populations have been increasing throughout much of western North America thanks largely to increasing anthropogenic activity which subsidizes raven populations by increasing the amount of food sources available like roadkill and landfills or by increasing the amount of nesting substrate on the landscape like transmission lines, towers, and other structures. Ravens prey on sensitive species including the greater sage-grouse (*Centrocercus urophasianus*) and recent studies indicate sage-grouse nest success is negatively impacted by high raven densities within sage-grouse breeding habitat. Raven reduction by lethal means has been determined to be a viable strategy to alleviate potential negative pressures on sage-grouse populations and increase sage-grouse nest success. However, the efficacy of removing subsidies used by ravens as a form of non-lethal management has not been researched. Thus, non-lethal management of ravens as a potential alternative to lethal control has yet to be tested or quantified. We aim to evaluate raven and sage-grouse population responses to lethal and non-lethal raven management actions meant to reduce predation and pressure on sage-grouse by comparing pre- and post-manipulation raven density and sage-grouse nest success across five study sites in eastern Oregon, including a lethal management site, a non-lethal management site, and three reference sites. I will present nest success data from 2017–2022, including four pre-treatment and two post-treatment years. These preliminary analyses will compare the efficacy of varying raven management methods and their impacts on sage-grouse populations and can help inform management agencies about sage-grouse conservation and raven management.

Modeling and Assessment of Habitat Suitability for Ruffed Grouse in Ohio – Joe Hinz

Abstract: Ruffed Grouse (*Bonasa umbellus*) were once a common forest species in Ohio but are now sparsely distributed at low densities in the state. Our study aims to identify areas where suitable habitat can be managed to sustain early successional forest habitat. We used a presence-only modelling framework to model available grouse habitat. Grouse presence data was compiled from the Ohio Breeding Bird Atlas and e-Bird observations. Land cover data of forest type and forest loss were compiled from a previously developed model of forest type in southern Ohio and updated with forest loss information from the Global Land Analysis and Discovery imagery. We used an ensemble model to assess availability of suitable habitat based on maximum entropy, generalized additive and random forest models. Model results were averaged and fuzzed to create overlays of the predictive models. These individual overlays were then overlayed using an additive function in ArcPro to create the final version of our initial predictive raster. The model had a predictive accuracy of 0.96 based on ROC/AUC. The overlayed raster was used as predictor to create a grid of predictive presence points. A cutoff of 70% was used to select only the most highly predictive points. We performed ground truthing at these points to assess model suitability by validating site level habitat quality and presence of ruffed grouse. While structurally suitable habitat exists on managed areas, drumming counts are detecting few ruffed grouse. We demonstrate applications of our modeling to conserve habitat for ruffed grouse in Ohio.

8th International Galliformes Symposium Taman Safari, Prigen, Java, Indonesia – 9-13 October 2023

The World Pheasant Association (WPA) had a symposium on the conservation and sustainable management of all species of Galliformes (megapodes, cracids, guineafowl, quails, turkeys, grouse and pheasants), with a special emphasis on threatened species and their habitats. It was organised by WPA and Indonesian partner organisation, Taman Safari Prigen. Invited and contributed oral presentations, posters with short talks, are in the Abstract Book Edited by Geoffrey Davison. Topics at the symposium were: Ecology and conservation of the species and their habitats in Indonesia and in other range states around the world. Habitat degradation, fragmentation, climate change, forest management and genomics are cutting edge topics. Ecological studies of threatened species. Implementing and monitoring management actions and protected areas. Conservation breeding of rare species, management, welfare in captivity. Genetics and taxonomy. Techniques: - Designing and carrying out field projects - Analysing and communicating results - Managing captive populations - Developing, implementing and monitoring recovery programmes.

The abstract book is found at the home page of WPA
https://www.pheasant.org.uk/symposiumoct2023.aspx.

NEW BOOKS

Ecology and Conservation of Mountain Birds

Editors: Dan Chamberlain, Aleksi Lehikoinen and Kathy Martin

Part of Ecology, Biodiversity and Conservation

High mountain habitats are globally important for biodiversity. At least 12% of birds worldwide breed at or above the treeline, many of which are endemic species or species of conservation concern. However, due to the challenges of studying mountain birds in difficult-to-access habitats, little is known about their status and trends. This book provides the first global review of the ecology, evolution, life history and conservation of high mountain birds, including comprehensive coverage of their key habitats across global mountain regions, assessments of diversity patterns along elevation gradients, and adaptations for life in the alpine zone. The main threats to mountain bird populations are also identified, including climate change, human land use and recreational activities. Written for ecologists and naturalists, this book identifies key knowledge gaps and clearly establishes the research priorities needed to increase our understanding of the ecology of mountain birds and to aid in their conservation.

- The first global reference work with wide geographical coverage on high mountain bird ecology and conservation
- Includes summaries of all birds known to use alpine habitats and their key traits, forming an essential basis for classifying and studying high mountain birds
- Establishes clear priorities to reduce knowledge gaps and to guide research and conservation strategies for high mountain birds (and biodiversity in general) over the coming decades

1. Mountain birds and their habitats; 2. Avian adaptations to high mountain habitats: solving the challenges of living in alpine ecosystems; 3. Global bird communities of alpine and nival habitats; 4. Birds of treeline ecotones; 5. Population trends of mountain birds in Europe and North America; 6. Climate change impacts on mountain birds; 7. Anthropogenic activities and mountain birds; 8. Modelling large-scale patterns in mountain bird diversity and distributions; 9. The alpine avifauna of tropical mountains; 10. Priorities for information, research and conservation of birds in high mountains;
Bird species index; Subject index.

Dan Chamberlain, University of Turin
Aleksi Lehikoinen, Finnish Museum of Natural History, University of Helsinki
Kathy Martin, University of British Columbia, Vancouver

Dan Chamberlain, Aleksi Lehikoinen and Kathy Martin (Editors) 2023. Ecology and Conservation of Mountain Birds, Paperback, ISBN: 9781108940429.

https://www.cambridge.org/us/universitypress/subjects/life-sciences/ecology-and-conservation/ecology-and-conservation-mountain-birds?format=PB.

Conservation and Management of Game Birds in Europe

Thibaut Powolny and Alexandre Czajkowski.

The book, produced by the European Institute for the Management of Wild Birds and their Habitats, in collaboration with the European Federation for Hunting and Conservation and with the support of the Association of European Manufacturers of Sporting Ammunition), the Francois Sommer Foundation for Hunting and Nature and the French Hunters Federation, documents the conservation status and management of the game birds in Europe listed in the Annex IIA of the Birds Directive.

These birds are a renewable natural resource, the hunting of which is increasingly controlled. Hunters do more than just harvest; they play a key role in maintaining habitats and ecosystems and preserving protected species, many of which are threatened by the persistent development of human activities. By studying the impact of its actions, the hunting community supports the concept of adaptive management, a pioneering idea well-proven in North America and still in its early stages in Europe, for the wise and sustainable use of the species (migratory or not) on an international scale.

By subordinating harvesting to the demographic availability of bird populations scientifically monitored in ecosystems, this management method introduces the flexibility lacking in the application of the Birds Directive for greater efficiency. Adaptive management appears to be the best way to maintain the good conservation status of game bird populations, to ensure that they can be used in a sustainable and equitable manner, taking into account local situations and cultures, and to ensure consensual hunting practices.

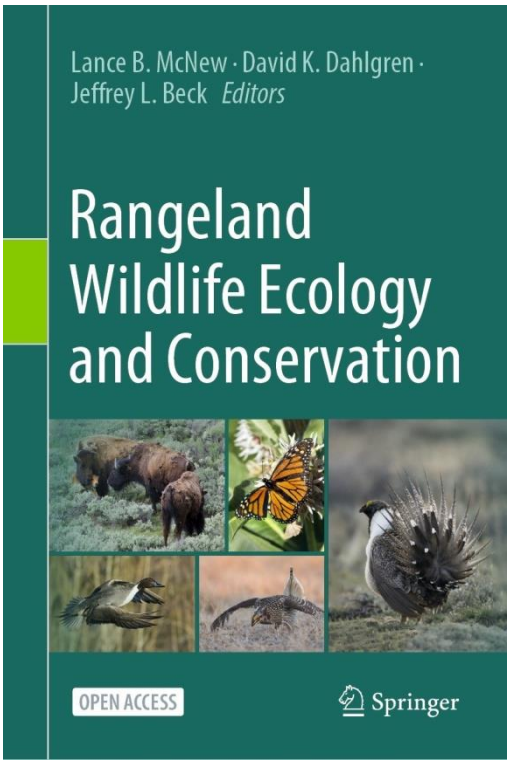
Powolny, T., and. Czajkowski A. 2023. Conservation and Management of Game Birds in Europe. Oiseaux Migrateurs du Palearctique Occidental. Paris, France. 464pp. ISBN: 9782956013136

https://www.nhbs.com/conservation-and-management-of-game-birds-in-europe-book.

Rangeland Wildlife Ecology and Conservation

Lance B. McNew, David K. Dahlgren and Jeffrey L. Beck, *Editors*.

This open access book reviews the importance of ecological functioning within rangelands considering the complex inter-relationships of production agriculture, ecosystem services, biodiversity, and wildlife habitat.



More than half of all lands worldwide, and up to 70% of the western USA, are classified as rangelands—uncultivated lands that often support grazing by domestic livestock. The rangelands of North America provide a vast array of goods and services, including significant economic benefit to local communities, while providing critical habitat for hundreds of species of fish and wildlife.

This book provides a compendium of recent data and synthesis from more than 100 experts in wildlife and rangeland ecology in Western North America. It provides a current and in-depth synthesis of knowledge related to rangeland ecosystems, and the tools used to manage them, to serve current and future wildlife biologists and rangeland managers in the working landscapes of the West. Chapters 9-11 cover the ecology and habitat management of 4 species of grouse as well as 6 species of quail; other chapters cover the predators of grouse. The book also identifies information gaps and serves as a jumping-off point for future research of wildlife in rangeland ecosystems. While the content focuses on wildlife ecology and management in rangelands of Western North America, the material has important implications for rangeland ecosystems worldwide.

Lance B. McNew, David K. Dahlgren, and Jeffrey L. Beck, (Eds.). Rangeland Wildlife Ecology and Conservation. Springer. ISBN 978-3-031-34036-9, ISBN 978-3-031-34037-6 (eBook), https://doi.org/10.1007/978-3-031-34037-6

RECENT GROUSE LITERATURE

For a complete bibliography on grouse, go to: http://www.suttoncenter.org/about/publications/

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RESEARCHERS AND THEIR BEST FRIEND ASSISTANTS

Grouse chasing and bear conflicts: Ideas for grouse research & hunting using dogs in bear country

Melissa Chelak

While hunting dusky grouse (*Dendragapus obscurus*) in northern Utah recently, I found fresh black bear (*Ursus americanus*) tracks in the newly fallen snow. With my bird dog ahead of me and the absence of bear spray on my belt, I called her back, and we headed in the opposite direction of the track and back down the steep mountain slope. Having recently read a local news article[1] highlighting the increased probability of a bear attack with dogs, I wanted to avoid testing out our luck. However, it piqued my interest in how often it occurs with hunters or researchers with dogs.

Human-Bear Conflicts

Many grouse species overlap with bears (*Ursus* spp.) across the globe. However, the probability of encountering a bear and if it attacks varies depending on species, subspecies, time of year, and region[234]. In their review on human-bear conflicts in Alaska between 1880 and 2015, Smith and Herrero[4] found that brown bears (*U. arctos*) were far more likely (83.5%) to attack than black (9.2%) or polar bears (*U. maritimus;* 1.2 %, n = 346). However, they also reported an average of 2.6 attacks per year in Alaska, with 2005-2015 increasing to 7.6 attacks yearly. Globally, Bombieri et al.[2] report an average of 39.6 attacks per year, 11.4 attacks/year in North America and 18.2 attacks/year in Europe. Romania elevates this number, where excluding it leaves Europe with only 10 attacks/year on average. Most studies report that the increase in human-bear conflicts is proportional to the human population density[234], with the highest probability existing around higher bear and human population densities[2]. Despite these probabilities, bear attacks are rare, and there are ways to avoid/lessen the possibility of human-bear conflicts while in bear country.

Conflicts Involving Hunters & Researchers

When we examine some of the specific activities of the humans involved in human-bear conflicts, hunting and hiking are consistently at the top[234]. There were fewer reports when examining other activities, such as fieldwork or research. Bombieri et al.[2] only reported 12 out of 560 (2.3%) global human-bear incidents involving wildlife-related fieldwork, and Smith and Herrero[4] only reported 35 out of 421 (8.3%) involving researchers performing fieldwork in Alaska. Given the increased amount of time researchers/technicians spend in the field, we would expect there to be more incidents. However, this group typically has higher education levels than the general public—especially field-related safety education.

The human-bear conflict information on dogs is less straightforward. In my brief review, I could not find direct comparisons of hunting/researching with- and without- dogs. Furthermore, the result likely may be the same for hunting/research bird dogs and lay-person dogs (some of you bird dog trainers may thoroughly disagree). Separating by dog breed/owner activity would be interesting to explore, if possible, for future analyses. A report by Hristienko & Herrero[5] found that 49 out of 92 (53%) black bear attacks in North America between 2010 and 2014 involved dogs, where 21 of those 49 (43%) instances involved a female bear with offspring. Penteriani et al.[3] reported that most large carnivore attacks on humans involved the presence of a dog. Smith and Herrero[4] reported that dogs were present and intervened in 40 out of 420 (9.5%) bear attacks, and dogs were successful in terminating the mauling 47.5% of the time. In 12.5% of those attacks with dogs, however, the dog was most likely responsible for inciting the attack. Bombieri et al.[2] found 17% dog presence while assessing 289 global bear attacks. Dogs could act as an early warning sign for detecting bears or protecting their owners, but they also may be more likely to lead to an attack, potentially initiating the conflict by leading the bear towards their owner or barking at the bear [345].

While there are differing probabilities that your dog 1) may or may not incite a bear conflict, 2) may or may not intervene, and 3) may or may not successfully save you from being mauled, it is still best practice to employ proper bear safety tactics as a human in bear country with a canine companion searching for grouse. I do not intend at all for this article to deter grouse-lovers from using bird dogs. Instead, I aim to provide some suggestions for ensuring safe research and hunting in bear country.

Minimizing Conflict

1. **Always carry bear spray!** – The literature is clear[467] about bear spray's role in disengaging a bear, especially compared to firearms. Just ensure you point the canister in the right direction and do not get downwind of its spray.
2. **In heavy cover, large groups & hone your bird dog in close!** – Smith & Herrero[4] found heavy cover to lead to a higher probability of conflict, due to surprise encounters from either party. If you or your team may be in heavy cover, designate groups of >2 people hiking together and hone the bird dog in close, if possible. If large groups and reducing your bird dogs' search radius are not possible, then undoubtedly have bear spray.
3. **Hire trained bear-dog teams?** – Alongside your bird dogs, hire some bear dogs trained to deter the bear and minimize the conflict and mortality between bears and humans. I found an excellent example of hirable trained bear-dogs online through the Wind River Institute (https://beardogs.org/).
4. **Know your territory!** – Researching in areas where there could be females with cubs would lead to a higher probability of a conflict[234]. Avoid these areas, if possible. If not possible— large groups of people, hire a bear dog team, and everyone carries bear spray!

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A special thanks to Codi Backen for permission to use the grizzly photo. If anyone would like to look at more of Codi's work, go to backennature.com

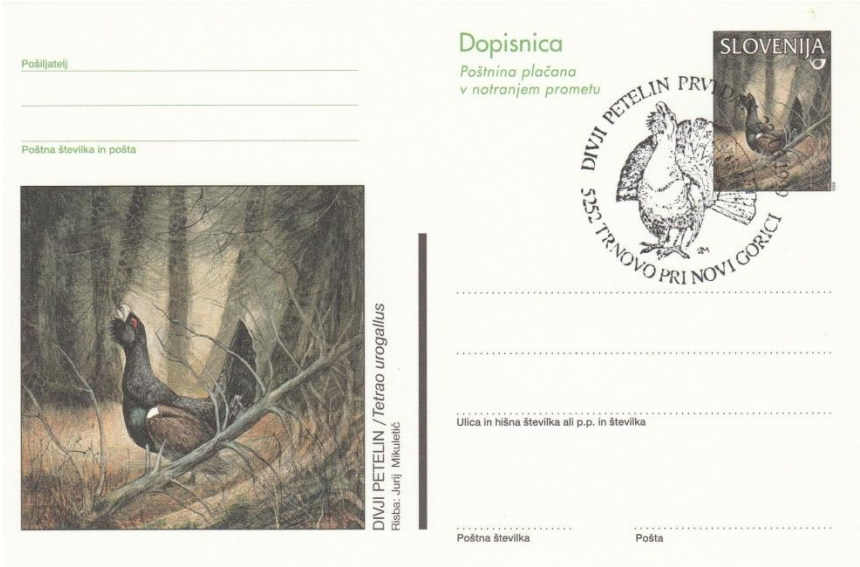
SNIPPETS

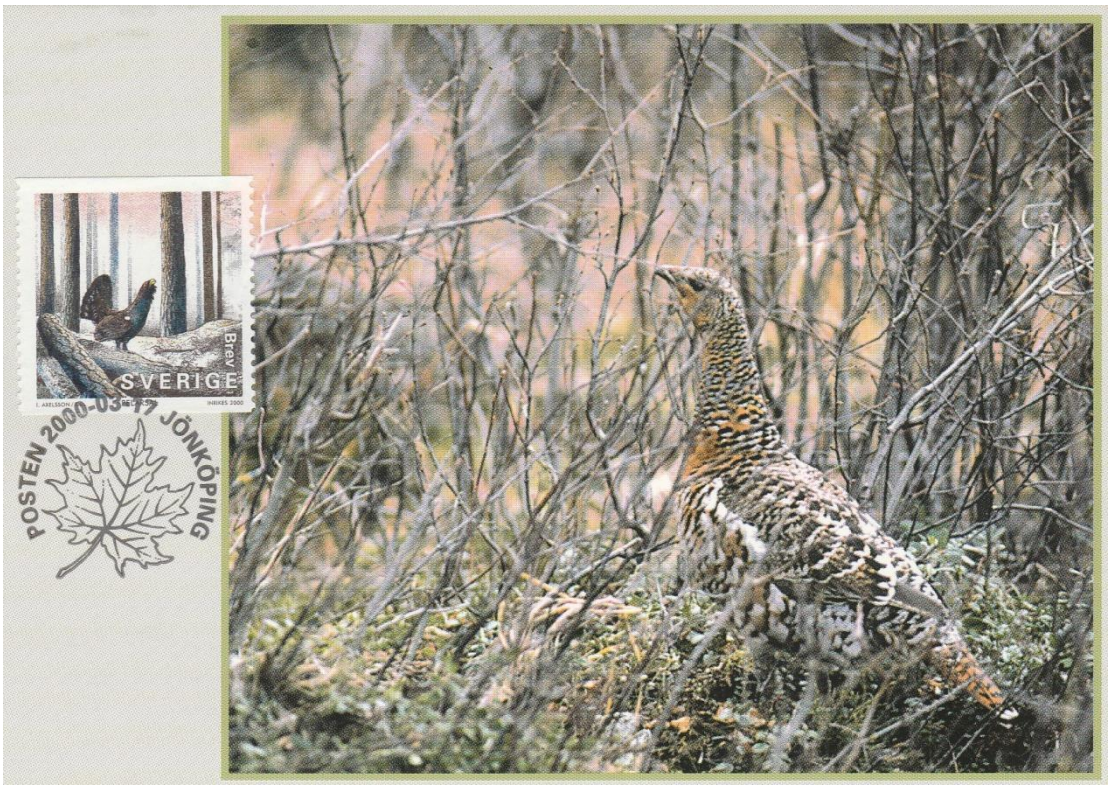
Human names on North American Grouse Species

The American Ornithological Society is removing human names from all North American Species, due to a few early ornithologists for whom birds were named having questionable ethics or morals. This will affect about 80 species. The new species names are not all yet determined, but will be of a descriptive nature. Thus the Attwater's Prairie-Chicken and Gunnison Sage-Grouse may both be receiving new descriptive names. The Gunnison Sage-Grouse is technically named for the Gunnison Basin area of Colorado, which in turn was named after John W, Gunnison, a U. S. Army officer who surveyed the area for the transcontinental railroad. We will await the decision on that, as well as the new descriptive names for both. Perhaps some of our readers have suggestions for the new names for these two grouse species.

Grouse on stamps

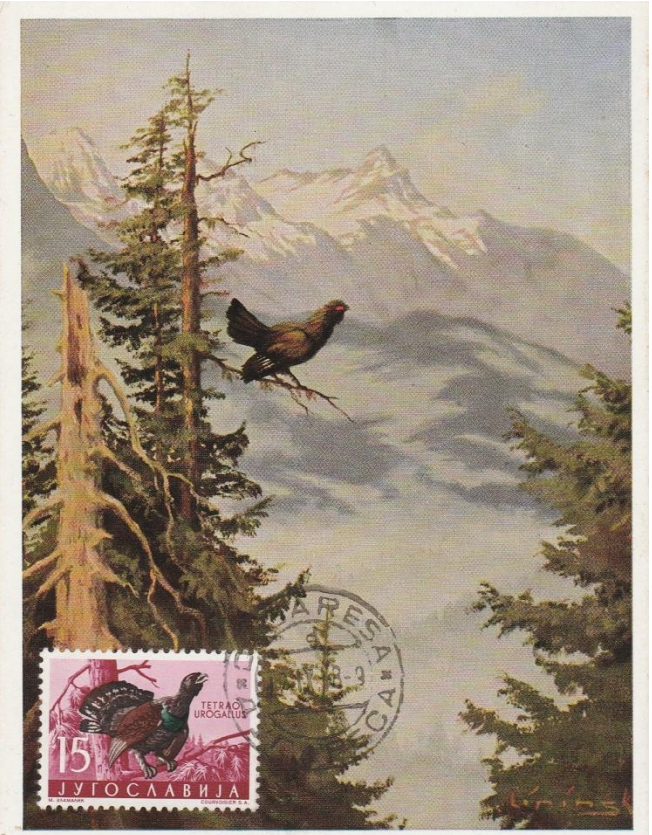
These are the last stamps with grouse published in Grouse News. We started in issue 59 after a suggestion from Ladislav Paule paule@tuzvo.sk in Slovakia. The first stamp showing a capercaillie *Tetrao urogallus* was a stamp of Tuva (at present the autonomous republic within Russia) issued in 1934. Fifteen years later, the postal authorities in Liechtenstein and Finland issued the next stamps with capercaillie. The history of stamp issues with black grouse *Lyrurus tetrix* started in 1950 in Liechtenstein. Many of the grouse species around the world are later found on stamps.


Pošiljatelj
Poštna številka in pošta
DIVJI PETELIN / Tetrao urogallus
Risba: Jurij Mikuletič
Dopisnica
Poštnina plačana
v notranjem prometu
SLOVENIJA
DIVJI PETELIN PRV
5252 TRNOVO PRI NOVI GORICI
Ulica in hišna številka ali p.p. in številka
Poštna številka
Pošta


SVERIGE
Brev
POSTEN 2000-03-17 JÖNKÖPING


POSTA CUBA TOUVA
10 KOP
AIR MAIL POSTAGE
10 KOP


საქართველო GEORGIA
Tetraogallus caspius Gmelin
0,5 GEL
2010



Konstantin Lipinski Auerhahn am Roggelskopf (Arlberg)

Endangered species stamps.

Don Wolfe

For the past two decades, National Geographic photographer Joel Sartore has traveled the world in his effort to photograph every animal species found in zoos, aquariums, and captive-breeding facilities to illustrate the amazing biodiversity, and what could be lost without proper conservation. To date, over 14,000 species have made have been photographed for this PhotoArk project. This year, the United Postal Service issued a set of stamps high-lighting several North American Endangered Species from the PhotoArk project in recognition of the 50th Anniversary of the Endangered Species Act. Please notice that there is one grouse species depicted, that of Attwater's Prairie-Chicken. For more information on Joel and the PhotoArk project, or to purchase prints or books:
https://www.nationalgeographic.org/society/our-programs/photo-ark/
https://www.joelsartore.com/gallery/the-photo-ark/

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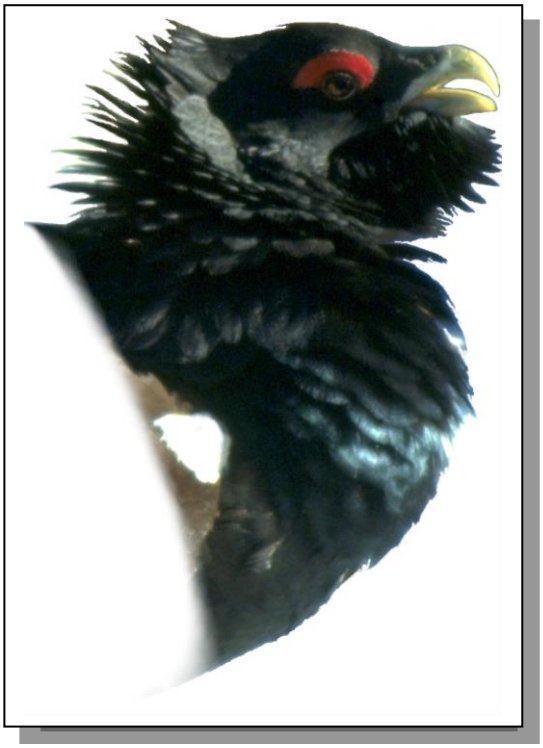

Grouse News

Newsletter of the Grouse Group of the IUCN-SSC Galliformes Specialist Group

What is Grouse News

Grouse News is a biannual newsletter of Grouse Group (GG) of the IUCN-SSC Galliformes Specialist Group (GSG) which is one of many specialist groups within Species Survival Commission (SSC) in IUCN. The primary function of this newsletter is to publish short papers and under way reports from research projects and conservation news. This will not prevent you from publishing in international review journals. Also short notes telling who you are and what you are doing is of interest. Information of upcoming conferences dealing with any grouse species and review of new books may be published. Also news from GSG and GG is published.

Interested in subscribing

When working with grouse you may be a member of Grouse Group (GG) of the IUCN-SSC Galliformes Specialist Group. To be a member you have to apply to chair of GG, Mike Schroeder, Michael.schroeder@dfw.wa.gov. As a member of GG you will receive Grouse News. You may also subscribe to GN without being a member of GG. The subscription is free. For subscription please contact chair of GG, Mike Schroeder, editor of Grouse News, Tor Kristian Spidsø, tks.grouse@gmail.com, or co-editor Don Wolfe, dwolfe@suttoncenter.org.

Writing in Grouse News.

If you do work on grouse you are welcome to publish your work in Grouse News. It may be a presentation of a new project or some of the results from finished projects. You may also publish news concerning conservation and management of grouse in your area. Even if you are not a professional grouse researcher, you may have interesting observations that may be of interest for others to read. So please don't hesitate from sending contributions. All kinds of information are welcome.

IN MEMORIAM

Dr. Franz Müller (1939-2023)

Siegfried Klaus & Hans-Heiner Bergmann

Our friend Franz Müller, zoologist, wildlife biologist, artist, co-author in our grouse monographs on capercaillie, black grouse and hazel grouse, passed away on August 3, 2023, in Hettenhausen/Rhoen, Hesse, where he has lived for decades, together with his beloved wife Elvira. Born 1939 in Müglitz/ Sudety (Czechia today), he studied biology at the universities of Marburg and Giessen/Hesse/Germany. Deep love of nature and excellent capabilities to observe animal behaviour delivered the base for his careful long-term studies and the topic of his doctoral dissertation „Territorial behaviour and population structure of a Capercaillie (*Tetrao urogallus major* C.L. Brehm“) population in Central Europe.

Franz visited the first International Grouse Symposia held in Inverness, Scotland, in 1978, presenting „A 15-year study of a Capercaillie lek in the Western Rhoen Mountains“ and the 2nd in Dalhousie castle, Edinburgh in 1981, York 1984 and Lam/Bavaria 1987. One example of his artistic book illustrations on wildlife has been used for the back cover of Grouse News in the print version from the early beginning in 1993-to 2002. Starting with grouse biology and protection, Franz subsequently extended his interests and activities in a much wider field including wildlife biology, studies on game species and small mammals. In a series of books on „Wildlife biology information for hunters“, European game species were presented by careful hand-made sketches of behaviour and basic data of biology. After years as a free working biologist and consultant, in 1988 Franz changed to the position of a leader of the nature department in the Vonderau Museum in Fulda. Here he could combine his knowledge in wildlife biology and art in the creation of diarama expositions, a hot point for visitors up to date.

Nature protection in his home area Rhoen (today Biosphere reserve of the UNESCO) became a central point of Franz‘activities. In addition, his live-long interest in morphology of birds and mammals and training as taxidermist resulted in a collection of thousands of measurements of vertebrate morphology and anatomy, a unique set of data. Part of the results were published together with co-authors in two books (2010: „Small mammals-body and skull measurements-ecology“ and „Medium and large mammals -skull data“, in 2016).

Nature conservation, wildlife and grouse biology will miss our friend and colleague Franz Müller. The gap he left will hardly be closed.

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