

GROUSE NEWS



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



Galliformes Specialist Group

Issue 39

May 2010

Contents

From the editor	3
From the chair	4
News from GSG	
New members of the Co-chair Advisory Board of the Galliformes Specialist Group (GSG)	5
Research Reports	
Problems of ice crust formation for grouse or partridges, and the possible relation to climate change	6
Cattle, bilberry and capercaillie in a Scottish pinewood	10
Density and vulnerability of capercaillie <i>Tetrao urogallus</i> in the area of Vitoroga in the Republika Srpska	10
Ptarmigan, red grouse, dotterel and mountain hares favouring snow-fences on ski-areas	12
The Influence of habitat, female preference and male behavior on male territory selection in ruffed grouse: a novel approach	19
On pines and capercaillie in the Cantabrian Mountains	24
A Spatially-Based Planning Tool Designed to Reduce Negative Effects of Development on the Lesser Prairie-Chicken <i>Tympanuchus pallidicinctus</i> in Oklahoma	26
Energy development and greater sage-grouse.	28
New Books	
New Book on Grouse	31
Conferences	
Gyrfalcons and Ptarmigan in a Changing World	32
12 th International Grouse Symposium, Matsumoto, Nagano Prefecture, Japan, 19-23 July 2011.	32
Recent literature	34
Snippets	
Interior Expands Common-Sense Efforts to Conserve Sage Grouse Habitat in the West	37
Sage Grouse Listing Warranted but Precluded	38
Comments to Sage Grouse Listing Warranted but Precluded	38
Webmaster for Galliformes Specialist Group	38
Probably the largest Black Grouse <i>Tetrao tetrix</i> lek in Europe!	39
Review article on trends in grouse research	39
Translocation under way to prevent extinction of the Röhn black grouse, Germany	40
The Mediterranean <i>Quercus pyrenaica</i> oak forest: a new habitat for the Capercaillie?	40



From the Editor

Grouse News welcome articles, reports from projects, conservation news; abstracts from papers (if permitted by the journal) and also other things you think may be of interest to grouse people. Those of you planning a new project may write a short article to GN telling about the plans. Also ongoing projects are of interest to know about.

In this issue you will find information on possible relations between grouse and climate change and use of snow-fences by grouse in Scotland. Three articles on capercaillie are published and a paper dealing with male territory selection in Minnesota, USA. Under the heading energy development and greater sage-grouse abstracts from PhD and MSc thesis are published.

Be aware of two conferences next year. We are invited by Professor Hiroshi Nakamura to come to Matsumoto, Nagano prefecture, Japan in July next year. It is only a year from now, so start planning for this and be sure you set aside time to participate. Also there is a conference on Gyrfalcons and Ptarmigan in a Changing World to be held at Boise State University in Boise, Idaho, USA in February 2011.

In the future we hope it will be possible to increase contributions to GN from outside Europe. In the last few years the contributions from America have increased, but we still have problems getting material from the east. The aim is to have a more even distribution of contributions throughout the grouse area, and also species of grouse. From this issue we have a new co-editor. Don Wolfe was asked to be a Co-Editor for North America to help getting stuff from that area to Grouse News. We are happy he accepted. Below is a brief word from the North American Co-Editor.

Greetings, fellow grouse enthusiasts on both sides of "The Pond". I am both honored to be asked and excited to assist with this fine publication. When talking conservation issues with grouse researchers and managers in North America, it becomes obvious that many are completely unaware of the fine work that is being done in Europe and Asia; and it is sometimes surprising how few even know what a Capercaillie is. I am sure that some biologists in Europe likewise aren't familiar with research and conservation efforts in North America. While there certainly are morphological and behavioral differences between some iconic North American species (e.g. sage-grouse and prairie-chickens) and the equally iconic Eurasian black grouse and capercaillie, the similarities greatly outnumber the differences. This is especially true when comparing the conservation concerns. Climate change is occurring on both landmasses, sometimes altering timing of reproductive effort, sometimes causing shifts in range, and sometimes leading to isolation of remnant populations within increasingly smaller blocks of suitable habitat. Grouse on both landmasses seem to avoid large anthropogenic developments, and are vulnerable to collisions on the smaller, seemingly benign, structures such as fences, power lines, and lift cables. I hope that I can help facilitate better exchange of information and ideas between continents. For those of you that are in North America, be forewarned that I will be hounding you for abstracts, research summaries, or book reviews, just as Tor Kr. Spidso has been and will continue doing for our colleagues in Europe.

Thanks to Anne Westerberg for help editing the language in some of the contributions.

Tor Kristian Spidsø, Editor Grouse News

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From the Chair

The roots of the International Grouse Symposia (IGS) and later the Grouse Specialist Group had been in Europe, and thus, it happened that Grouse News had long been biased towards European contributions and readership. However, a European focus was never intended, and we improved constantly to involve colleagues from all parts of the grouse range. As the 2002 IGS in Beijing brought Asian colleagues to the grouse group, and also to GN, the 2008 IGS in Canada initiated much closer professional links with grousers from North America. Starting with this issue, Don Wolfe from Oklahoma will help growing our trans-Atlantic grouse links into a tight network. We are happy to announce that Don has accepted our invitation to join Grouse News as the Co-Editor for North America. Tor Kristian Spidsö from Norway will continue acting as Editor. For those who do not know them, please find a short introduction to Tor and Don below.

Ilse Storch,

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Tor Kristian Spidsö is an Associate Professor in biological sciences and has his education from the University of Bergen, Norway. He also completed a Post-Graduate Certificate in Education at the



University of Bergen. Tor Kr. worked at the Department of Ecology and Natural Resource Management, The Norwegian University of Life Sciences, and also at the Norwegian Institute for Nature Research before joining the Department of Natural Resource Sciences and IT, Nord-Trøndelag University College in 1994. He teaches courses in ecology, zoology and wildlife ecology/management, and his research interests are woodland grouse, woodland grouse and the effect of acid rain, and effect on ground nesting birds of trampling by free grazing cattle. Tor Kr. is member of IUCN/SSC-WPA Galliformes Specialist Group and editor of Grouse News. He is also a member of the Core Committee of Grouse Group.

Don Wolfe

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Don Wolfe is a Senior Biologist at George M. Sutton Avian Research Center, University of Oklahoma, where he has been employed since May 1984.

Currently Don is supervising Greater and Lesser Prairie-Chicken research and conservation efforts, and conducting White-tailed Ptarmigan surveys in New Mexico. He has authored or coauthored over 20 publications on Greater Prairie-Chickens, Lesser Prairie-Chickens, and White-tailed Ptarmigan, and approximately 40 other publications on other avian species. Don is a member of the following grouse societies or organizations: IUCN Galliformes Specialist Group (since 2009), and before, IUCN Grouse Specialist Group (2004-2009), Prairie Grouse Technical Council (since 1997), Lesser



Prairie-Chicken Interstate Working Group (since 1997), North American Grouse Partnership (since 1999). His other interests include: birding, upland game bird hunting, hiking, and camping.



NEWS FROM THE GSG

New members of the Co-chair Advisory Board of the Galliformes Specialist Group (GSG)

Two Grouse have been invited to serve on the Co-chair Advisory Board of the Galliformes Specialist Group (GSG), Brett Sandercock, Associate Professor at Kansas State University and currently Visiting Researcher at the Norwegian Institute for Nature Research, and Gilbert Ludwig, Researcher at the Department of Biological & Environmental Science at the University of Jyväskylä, Finland. Brett will bring his expertise on Nearctic grouse and Behavioural ecology to the CAB, while Gilbert is the Co-editor of the GSG's newsletter G@llinformed, and covers Palaearctic grouse and Population dynamics and monitoring. Ilse Storch continues as the Chair of the Grouse Group and in this function, is also Co-chair of the GSG (together with Peter Garson).



RESEARCH REPORTS

Problems of ice crust formation for grouse or partridges, and the possible relation to climate change

Emmanuel Ménoni, Patrick Léonard, Jean-François Desmet & Christian Nappée

Grouse and some other galliformes (mountain grey partridge *Perdix perdix hispaniensis*, rock partridge *Alectoris graeca*, snowcock *Tetraogallus sp.*) live in habitats where temperatures can fluctuate rapidly and over a wide range. Such variations can lead to ice crust formation, from local to landscape scale, and this phenomenon can cause at least 3 different problems for these birds, on the basis of our own observations or as documented in the literature:

First, because, in late autumn and winter, they often sleep in snow burrows or on the ground, in shelters such as herbs, shrubs or rocks, they can die if they are trapped by frost when it occurs very suddenly.

Second, a strong ice crust may cause individual or collective death, by preventing access to food, if this is entirely covered by an ice layer.

Third, ice crust formation, or marked changes in the snow layer, may greatly increase the birds' risk of predation.

Birds trapped in their snow burrows or shelters

On 8 June 2004, in the northern French Alps, we discovered the corpse of a radio-tagged rock ptarmigan *Lagopus muta* female, which we had located at a distance over the preceding few months, sitting in the snow in a resting position (Figure 1). Because the bird was completely white, we conclude that she had probably been dead for several weeks. The situation suggested that she died in her snow burrow. Indeed, the bird was sitting with toes spread out, typical for a bird sleeping on the ground, and there were about 20 droppings beneath the body (Figure 2). The most likely explanation was that this bird had been trapped in her snow burrow due to a rapid hardening of the snow, or a slide of the upper snow layer.

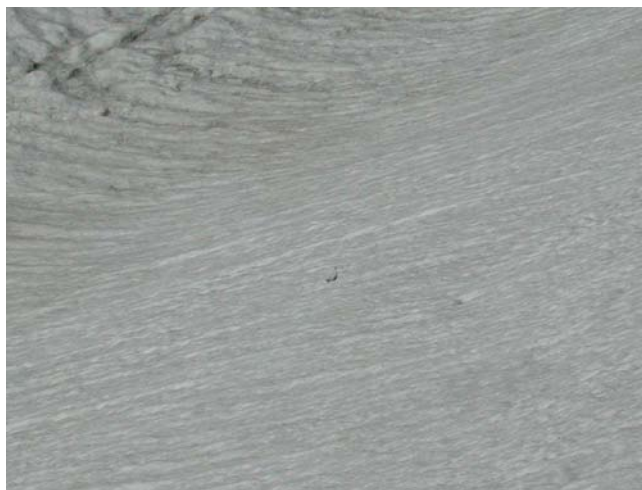


Figure 1. The dead ptarmigan, frozen in sitting position, during snow melt.



Figure 2. The dead ptarmigan, turned onto her back, with droppings under her legs

On 17 April 1996, in the central French Alps, we were looking for a radio-tagged yearling black cock *Tetrao tetrix* which, according to the signal from the tag, had been dead for 7 days on the steep slope where he was located. The bird was found under about 20 cm of very heterogeneous snow, completely locked in a very hard shell of hardened snow, as shown in Figure 3.



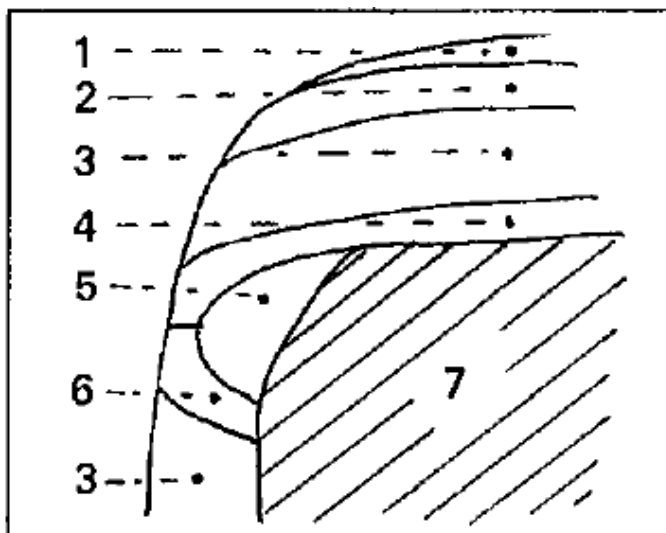


Figure 3. Description of the situation of the dead black cock; vertical section. 1: Powder snow; 1 cm; 2: sheeted snow; 2-3 cm; 3: tumbler snow, 10-12 cm; 4&6: very hard snow, formed by re-frozen crystals of smelting snow, 3 cm; 5: burrow of the cock; 7: stone.

The bird was completely intact, lying in a resting position, frozen in his snow burrow, sitting on quite a large quantity of droppings. The best scenario to explain this was that the bird had sheltered between snow layers 4 and 6, then, due to the slope, as often occurs in late winter, the snow has probably slipped, locking the bird in the burrow.

Further examination by laboratory veterinarians has shown that this bird was in good health; his crop and gizzard were empty.

In autumn 2008, in the Spanish Pyrenees, a hunter's dog pointed 4 mountain grey partridges trapped under frozen grass. The birds had been trapped during the previous night, when an icy rain fell, hardening the grass. The birds were alive, but could not escape, and without the hunter that released them, they would probably have died, since the weather remained very cold for several days.

Dement'ev et al. (1967), mentioned,

for black grouse, that "sometimes after sharp cold snaps following thaws the snow becomes covered with such a hard crust that emergence is impossible, and mass mortality ensues"; he cited the case of a flock of 20-40 black grouse that had simply vanished like this in 1944 in the Moscow region.

Borchtchevski (written com.) related that a game keeper, after accidentally finding a black cock trying to flush unsuccessfully in his area, searched snow burrows visually, and rescued a black grouse flock (not less than 10 birds, mostly cocks) from frost traps, in one day in late winter (north of Moscow region). He attributed their plight to the phenomenon of recrystallization, under the influence of, even quite small, weather changes.

Situations where hard ice crust led to a local or regional population crash, probably due to starvation

In 1983, a flock of 5-6 hand reared young male black grouse released in autumn became very sedentary, and were regularly observed by local people and staff at the National Park of Cévennes (France). They disappeared very suddenly, following a night of icy rain, where everything was covered with thick, very hard ice, including the thinner branches. The ice was so thick and its formation so widespread, it was thought that the birds were also trapped by the ice at their night roost, and died, even though they were never found.

Before 1956, a huge population of mountain grey partridges lived in the Massif Central (France), over a range of more than 40 000 km², and were a common game species. The winter of 1956 was exceptionally cold in all south western Europe, and the mountains of the Massif Central remained covered in icy snow for several months. At the end of the winter, most of the partridges had disappeared, and many farmers and hunters told us that they found many dead birds, as well as the feathers of partridges eaten by predators. Very probably, food became unavailable for the birds, due to the ice crust. Only a few birds survived in spring, and the population never recovered. Some very small and fragmented populations survived to the year 2000, but are now almost extinct.

According to Westerskov, 1964, also in Finland..."snowy winters with occasional thaws and subsequent formation of an ice-crust on top of the snow are particularly detrimental to partridges, preventing the birds from reaching their food..."

McGowan (1969) reported a case of important grouse mortality in a locality in Alaska, when thick accumulation of ice cut off food supplies and roosting sites: at least 10 birds were found dead, and 3, (1 sharp tailed grouse *Tympanuchus phasianellus* and 2 ruffed grouse *Bonasa umbellus*), finely examined, showed evident signs of starvation (weight loss from 27 to 38% compared to normal birds, no fat, breast musculature severely wasted). He reported that grouse signs were commonly seen before the ice, but abruptly stopped after it, for the rest of the winter.



Borchtchevski (written communication) related that in the Pinega district of Arkhangelsk region (north Russia), the spring of 2006 was not typical in terms of weather conditions: it rained (instead of snow) in early January (highly unusual for this region), and there were hard frosts ($-15/20^{\circ}\text{C}$, up to $-30/40^{\circ}\text{C}$) immediately following the rainfall. The frosts remained until late February or early March (without thaws). At the same time snow fall was rare and new snow cover only very thin. So, grouse habitat offered almost no snow cover during conditions of hard frosts for some two months. As a result: 1: The Arkhangelsk regional press consistently reported high mortality of other birds, not only grouse. 2: Grouse remains were found more frequently in transect counts (analysis in progress). Remains of hazel grouse were most numerous (the most abundant species in the area), followed by black grouse and then willow grouse (rarest grouse species). Remains of capercaillie were least abundant. The majority of birds had died not during January (after thaws and rains) but between late February and April.

Interaction between ice crust formation and predation

In the Pechora-Ilytch Nature Reserve (Russia), a big capercaillie *Tetrao urogallus* lek (about 30 cocks) disappeared suddenly after the winter of 1970, where reserve staff observed the phenomenon of ice crust formation; they found several instances of cocks having been caught by foxes *Vulpes vulpes* under the snow (Blagovidov, oral communication). The capercaillie is strong enough to break an ice crust, even if it is solid enough to support a human being; according to Teplov (1947a, b), the red fox has a heavier tread than pine marten *Martes martes*; therefore in the Petchora forests, where snow cover is usually deep and friable, the fox tracks the pathways of martens in winter; foxes move almost exclusively along the marten tracks and eat the remains of marten prey. Where there is an ice crust, foxes can move very easily, and are adept at detecting birds through the ice (Borchtchevski, written communication).

Discussion

The subject of icing as related to roosting and predation has been discussed many years previously by several authors, and isn't a novelty, neither for America (Bump et al. 1945, in Mc Gowan 1969), nor in the Old World (Dement'ev et al 1967).

It's well known that sleeping or resting under the snow during cold days and nights is important for the birds to save energy (Andreev 1978, Ott 1990, Thompson and Fritzel, 1988, Marti, 1985), and also to reduce predation (Marjakangas 1990), and therefore can be considered as an adaptive advantage for the species. Dement'ev et al. 1967 carry a strong argument as to the great importance of snow cover as a protective element, as evidenced by the numerous cases of mass mortality suffered by hazel grouse in winters poor in snow, in the Amur region. Even at low latitudes, where winter temperatures are less cold than in northern countries, small and medium sized species try to dig snow burrows as soon as possible: e.g.: Hazel grouse in the Jura (eastern France), as soon as the temperature is -5°C and the snow depth is 30 cm (Desbrosses 1999, Montadert pers. com.), more or less the same figure for black grouse in the Alps (Glutz von Blotzheim 1973); in the Pyrenees (France-Spain) and the Cantabrian mountains (Spain), grey partridges very often use snow as shelter (Novoa pers. com.), rarely creating true snow burrows (Castroviejo 1970) but the Capercaillie, much larger, generally does not, only very rarely during exceptionally long cold spells (less than 10 cases reported in the capercaillie for several thousand birds observed over 25 years (Brenot & Fosty 1994), in contrast to the northern countries, suggesting that saving energy is more crucial for the smaller bird species (Marti 1985). It may be concluded that, if this behaviour is still genetically conserved by the capercaillie in these southern populations, its regular use is avoided because it could represent a danger due to the speed and high frequency of the temperature change, and the resultant change in the snow, with its associated dangers.

The fact that the early literature mentioned also that snow or ice can occasionally become a death trap, or enhance winter mortality, sometimes on a vast scale, suggests that the behaviour of using snow as a shelter, especially for those species regularly using snow burrows, has probably always existed in the galliformes. But very probably, the cost of this accidental mortality for the species is weak in comparison to the advantage of using snow as a shelter.

Perspective in relation to climate change

If climate change leads to more frequent changes in snow conditions, and/or changes of greater amplitude, we can expect the formation of an ice crust to occur more frequently, especially during the night - or for there to be longer time periods with little or no snow cover. Thus, in consequence, there could be an increase in the associated causes of mortality described in this paper, until a threshold is reached after which the behaviour of using snow burrows or snow shelters becomes disadvantageous.

Until now, the causes of mortality described here seem to be exceptional, based upon the observations of field workers and biologists; but this could also be underestimated, because it is likely that in many cases trapped or starved birds will be eaten by mammal predators, and therefore, if found, the remaining



evidence will lead to the cause of death being attributed to predation. (See above the evidence reported by Blagovidov and colleagues).

These climatic events are an element of environmental stochasticity; from the perspective of climate change it is likely that the frequency of events could alter. In studies currently underway, or planned, on climate change and grouse, we suggest paying special attention to the phenomenon of rapid ice crust formation, as one of the abiotic variables able to explain some demographic events (catastrophic crashes), or a negative population trend. Modelling changes in the probability of the occurrence of crust formation from meteorological data could be important in predicting the future populations of these birds.

In addition, according to Borchtchevski (written communication), “good frost after hard thaw forms not only the snow crust (sometimes this crust may be absent), but frost also makes the snow cover denser, turning it into a stronger substrate, favourable for the wide-ranging movements of predators such as foxes. As a result, the fox turns from a disadvantaged hunter to an active one (more powerful and more dangerous than marten) until the first of the subsequent snowfalls. In addition, dense snow cover reduces the accessibility of voles to foxes.

Lastly, of course, if the duration of the phenomenon is sufficiently long, we can also expect to see indirect effects, such as poor physiological condition of hens in late winter, with the possible consequence for reproductive success.

When finding dead animals, we insist on the necessity of a very meticulous examination of dead birds before concluding the cause of mortality: indeed, in several cases, intact birds found in winter had in fact died from predation or injuries: e.g. one capercaillie hen with only two very small holes (diam.~ 1 mm) on the top part of the neck (on 1-2 spondylus), very probably made by a male goshawk; another capercaillie hen with a fracture (almost accreted) of humeral bone, was certainly unable to fly onto the tree branch for feeding, (Borchtchevski, written com.); a hazel grouse with only the jugular pierced by a predator (Montadert pers. com.).

Future outlook for research - and call to grouzers

Because the French grouse team of the ONCFS has recruited a student, Karine Dillet, (Lyon University: dillet@biomserv.univ-lyon1.fr) in order to write a PhD. thesis on the relationships between climate change and mountain galliformes (4 grouse, 2 partridges) in France, we are interested to know your opinions, your feelings, and eventually some observations about this topic. Indeed, the change in the frequency of ice crust formation at different scales could be a key area of research, helping us to understand some of the trends in population dynamics.

Acknowledgments

Many thanks to Claude Novoa and Marc Montadert for their comments and suggestions about this project. Many thanks also to Vladimir Borchtchevski, for his help with detailed comments, and for the many observations from the Russian taigas, considerably enriching our discussion.

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The language was edited by Anne Westerberg.

Cattle, bilberry and capercaillie in a Scottish pinewood.

Mark Hancock

Short periods of cattle grazing, in some pinewood sites, may help improve habitat for capercaillie broods, according to recent research results from Scotland. The Scottish capercaillie population has been the subject of considerable conservation efforts, and these have included trials of management techniques, like mowing, burning and cattle grazing. Some of these trials took place at a key site for capercaillie in Scotland: Abernethy Forest National Nature Reserve, managed by the conservation NGO, the Royal Society for the Protection of Birds. The initial stages of these trials were outlined in an article in Grouse News in 2005 (Grouse News 26, pp9-10).

Several years have passed since cattle were allowed to graze and trample a trial area at Abernethy, and follow-up monitoring has now shown that this pulse of cattle impact has been followed by a change in the ground vegetation. This change is characterized by a relative increase in the dwarf shrub, bilberry *Vaccinium myrtillus* at the expense of heather *Calluna vulgaris*. A single autumn pulse of cattle grazing was followed four years later, by an approximate doubling in bilberry cover (from initial values of around 7%). This result is likely to be important for capercaillie, because bilberry has been shown to be a key plant for foraging capercaillie broods, probably because of the abundant insect life it supports.

Full details of the management trial can be found in a recent paper in the European Journal of Forest Research, via the following link:

<http://www.springerlink.com/openurl.asp?genre=article&id=doi:10.1007/s10342-009-0330-2>

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Density and vulnerability of capercaillie *Tetrao urogallus* in the area of Vitoroga in the Republika Srpska.

Goran Zubic

Summary

Vitorog Mountain is a typical habitat of capercaillie *Tetrao urogallus*. However, the state and hazard for vulnerability of this micropopulation have never been studied, although the operations of felling, silviculture and forest protection have been underway since the seventies of the last century. For this reason, the aim of this research was to assess the density of this micropopulation and to make a comparative analysis of the forest state in FMU "Vitoroga".

Vitorog Mountain is located in the western part of central Bosnia (Republika Srpska). Our research was performed in the south-eastern side, which covers the area of 1,500 ha at the altitude from 1,120-1,906 m. The climate is montane. Mean annual air temperature is 6.1°C, mean annual precipitation is 1,246 mm. Forests in FMU "Vitoroga" are classified into three management classes: high forests of beech and fir with spruce (1209); high forests of fir and spruce (1212); and high forests of beech and spruce



(1217).

The capercaillie density was assessed in the spring. The birds were observed in morning hours during their gathering and mating at two known and active leks according to the inventory form A (Adamič, 1987, Čas, 2000). Both leks were visited and observed three or more times during the four successive seasons (2004-2007). The comparative analysis of forest state was based on the data of the regular forest inventory, i.e. the comparison of forests by management classes in two different periods (1982 compared to 2000). The analysis of forest management measures and operations (scope, type and period) was based on the records and archive documents of the Forest Estate -the manager of this area.

Spring density of the capercaillie micropopulation in the period 2004-2007 (0.7-1.3 birds per km^2) was lower compared to the majority of Eurasian habitats (1.0-3.0 birds per km^2). Compared to the neighboring (adjacent) habitats, the study area is surrounded by bare lands and poorly stocked forest lands. Therefore, it can be presumed that the study birds are not related to the habitats located east, south and west of Vitorog Mountain. These birds are a separate (marginal) part of a larger population which lives in the connected and large montane complex of forests north-west of Vitorog Mountain, which is an additional indicator of their highly threatened status.

The analysis of forests in FMU "Vitoroga" shows significant changes in all management classes. The felling of larger-diameter trees caused the canopy thinning and an intensive development of ground vegetation. Also, the mixture proportion of conifers changed and the number of trees in smaller-diameter classes (≤ 30 cm) increased. On the other hand, in recent years spruce has been endangered by bark beetle outbreaks, so the diseased trees had to be removed and a great number of pheromone traps had to be placed and controlled, which caused frequent capercaillie disturbances throughout the habitat. As forest management affects the habitat suitability for capercaillie, instead of the practiced selection system, we recommend the implementation of group-selection system which is designed by forest management plan, and forestry operations should be harmonized with the biological demands of the capercaillie.



Map showing the capercaillie study area in the Vitorog Mountain.

Summary reproduced from Zubić G. 2009. Density and vulnerability of capercaillie (*Tetrao urogallus*) in the area of Vitoroga in the Republika Srpska. Bulletin of the Faculty of Forestry 100: 71-84.

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Ptarmigan, red grouse, dotterel and mountain hares favouring snow-fences on ski-areas

Adam Watson

Summary

Ptarmigan, red grouse and dotterel favour resting and nesting beside snow-fences, and mountain hares favour resting beside them. Snow buntings, twites and meadow pipits use them as perches. They afford physical cover and shelter, and safety from raptors.

Introduction

Prostrate plants can hide small birds, but not larger ones such as adult ptarmigan (*Lagopus muta*). The open terrain at Scottish downhill ski-areas affords little physical cover or shelter. To boost snow-depth on towlines and runs, ski companies erected snow-fences, which also give protective cover and shelter. Here I report how ptarmigan and other animals use them.

Made of wooden palings 1.2–1.5 m high, they are connected by wires and often a wooden rail near the top, and attached to posts hammered into the ground. By reducing wind speed, they collect blowing snow, which is deposited near the fence. As well as providing shelter they raise air temperature, especially at ground level on the fence's sunny side. The greater warmth is obvious to anyone putting a hand on the vegetation.

Methods

The fences are marked on large-scale maps. By measuring fence lengths, I calculated the area within a given distance on either side, and expressed it as a percentage of a study area. (There is also a tiny extra area within the same given distance, out from the ends of each fence. I excluded it, because all birds seen at a fence had a length of fence behind them.)

Knowing the area, I could compare the number of animals near the fence with the number expected from the null hypothesis that use is proportional to area. Because expected frequencies were very low, I used Poisson probabilities. In each case this was the cumulative probability of obtaining the observed frequency of use or a more extreme one. Table 1 gives examples on study areas about 1 km apart on the Cairnwell and Meall Odhar, two hills rising to 933 m and 922 m at Glenshee ski-area. The study areas occupy 20 ha each. For brevity below, I use the terms the Cairnwell and Meall Odhar to mean these two study areas, not the two hills as a whole.

A snag is that some individuals on successive visits may be counted more than once, which inflates sample size artificially. To avoid this, for statistical analysis I randomly chose only one count from a given period. For such analyses one should see all animals present, which is feasible for counts of red grouse and ptarmigan at all seasons except the nesting period, using dogs or other methods that provide a total enumeration (Jenkins *et al.* 1963; Watson 1965). When animals are clustered, however, as in a pair or family, data on individuals are not statistically independent. I therefore use one 'sighting' for any group of two or more animals. Analyses rest on sightings, except where I specify total numbers.

Results

Ptarmigan

Winter

The first fences at Cairngorm ski-area occurred in autumn 1961 and at Glenshee ski-area in autumn 1962. At both areas I saw no birds near fences in the winter of 1962–63 or in November–January 1963–64.

Later in 1964, however, I recorded sightings at fences on the Cairnwell. Out of 20 sightings totalling 30 birds on 8 February, a hen rested only 5 m from a fence and a cock joined her, signs that birds might be starting to favour fences. On 29 February, I noted two sightings near fences and 16 far away, and on 7 March a cock that was 3 m from a fence flew to land at another fence, a pair stood 8 m from a fence, and there were 13 sightings far from fences, in a total of 29 birds. On 5 April I saw a cock 10 m from a fence, out of five sightings. I noted a cock 9 m from a fence and 16 sightings far away, and at Meall Odhar three sightings between towline fences 25 m apart and 10 sightings far away. Birds had apparently begun to use fences.

At Cairngorm ski-area also, I noticed this on snow-free days in these winters. I wrote, 'two ptarmigan nested only 3 m and 8 m from pylons, and others rested alongside snow fences' (Watson 1979); the nests were at Cairngorm area, the others at Cairngorm and Glenshee ski-areas.

I made no more notes until the mild winter of 1988–89, when I worked at Glenshee on many days and noticed that most birds in November–December were at or near fences (Table 1). The percentage seen at fences in January–February 1989, when many had dispersed on territories in the forenoons and sometimes in the afternoons, was lower. In another example from 2004, two pairs at Meall Odhar on 19 February rested among boulders away from fences, but an unmated cock rested only 2 m from a fence.



Table 1. Percentage of ptarmigan at or near (m) snow-fences on days of 0% or <1% snow cover in 1988–89 at the Cairnwell (540 m of fences) and Meall Odhar (2250 m), each 20 ha.

	Months	At	0.5–5	5–10	10–15	15–20	20–25	>25	n*	Total ^
The Cairnwell	Nov–Dec	23	40	21	0	0	0	17	4	159
	Jan–Feb	6	26	2	1	0	0	65	11	333
Meall Odhar	Nov–Dec	41	38	11	0	0	0	10	6	175
	Jan–Feb	5	27	11	1	0	0	55	6	143

* Number of counts

^ Cumulative total seen on all counts

For example, 24 were on the 20-ha at Cairnwell on a randomly chosen count in November–December. On that count, three singletons stood far from fences, a pack of 14 rested and fed < 20 cm from a fence (several touching it), and 7 fed < 5 m from a fence. The cumulative probability of obtaining the observed or a more extreme frequency, if use were proportional to area, was almost zero. Even when I treated sightings of 2 or more birds as 1, the probability of a random sighting at a fence was still very low at < 0.01.

Likewise at a snow-less Cairnwell on 24 February 1998, all eight birds in the forenoon were paired on territories far from fences. When in packs that afternoon, however, all 10 birds rested at a fence, and in late afternoon fed <5 m away, 5 of them at <1 m, including three almost at the fence at <0.3 m. As late as 11 March 1997, all four in the afternoon rested <5 m from a fence, and on 18 March all seven fed <3 m from a fence, three of them at <0.3 m.

During snow-less days in each winter since 1988, I often saw birds preening or resting at fences, sometimes touching them. Birds tended to be further out when feeding; such as a pack of 9 in December 1999 sitting <2 m from a fence when first seen. They walked to feed up to 5 m away, but others fed as near to the fence as they had been while resting. In fog on 27 February 2009, the sole two birds on Meall Odhar rested on snow-free ground at a fence, the hen 15 cm from it, the cock 90 cm.

On days when birds had dispersed on territories, numbers seen near fences did not exceed those away from fences. The evidence from many counts in spring and watches of territorial behaviour was that the spacing of pairs and cocks across Meall Odhar with its dispersed fences did not differ in the same spring from that across the Cairnwell area with its fences only along the north side. Also, the territorial spacing across each of these areas in years after birds strongly favoured the fences did not change materially. It resembled what it had been in years before they favoured the fences.

Autumn

The habit evidently spread to birds in partly white dress on snow-less days in late autumn. On 28 October 1997, the sole sighting on 46-ha of Glas Maol where 2.6 km of snow-fences were erected in late 1987 was a group of five birds resting <40 cm from a fence. Subsequently I observed such sightings beside fences each autumn in 1998–2009.

On 14 September 2002 at Meall Odhar, 10 birds in a flock rested within 30 cm of a fence, as did a hen with a juvenile at another fence (each $P < 0.01$). The sole bird on the area on 7 November 2003 was feeding 60 cm from a fence ($P = 0.01$).

Nests

At Cairn Gorm ‘two ptarmigan nested only 3 m and 8 m from pylons’ (Watson 1979). These were chairlift pylons. I found nests annually on Cairnwell and Meall Odhar, but saw none near a fence till 1987, when I discovered a hen incubating eggs in a nest on a Cairnwell towline with a fence 2.5 m on either side, northwest of my Cairnwell study area. On Meall Odhar in 1988, Glenshee manager Dave Patterson senior found a nest where two fences met in a V, the hen touching the palings on either side while brooding. Also on Meall Odhar, assistant manager David Patterson junior in 1999 found a hen nesting in a small gap between the bottoms of two paling stakes. Both managers showed me the nests. In 1988 (Figure 1) and 2000 there, I found a nest on the south side of a fence, so close that the nest’s inner rim lay 1 cm from the nearest stake.





*Figure 1. Partly hidden by a tuft of mat grass *Nardus stricta*, a hen ptarmigan sits on a nest at a snow-fence on Meall Odhar, June 1988. (Photo Adam Watson).*

Because all nests were not found, I could not calculate probabilities for each nest location. However, the total number of hens was known from spring counts and from seeing cocks moving to divert me away from the hen's location during the nesting season (unmated cocks do not show this). The probabilities of nests being placed randomly so near fences were very low in cases where nests lay under a fence or almost touching it. In the 1999 and 2000 cases, for instance, the study area held four and six pairs, and ground <10 cm from a fence comprised only 0.002% of the area.

Two hens nested beside other man-made features. In 1968 on Glas Maol, long before the first snow-fences were erected there in 1986, a hen nested on an expanse of smooth vegetation with no boulders or bare ground, her nest amongst broken rusty wire from a derelict sheep-fence (Fig. 2). In 1988, manager Dave Patterson senior found a nest on Meall Odhar, 1 cm from a pile of rusty wire after broken snow-fences had been burned in the previous year, and he showed me the hen and nest. Chicks hatched from all above six nests.



Figure 2. A hen ptarmigan sits on a nest under a derelict sheep-fence on Glas Maol, June 1968. (Photo Adam Watson).



Broods

Table 2 gives examples. At the Cairnwell I occasionally saw a brood near a fence, but less often than at Meall Odhar. I reasoned that this was because the Cairnwell area had fences only along its northern side, whereas Meall Odhar had four times the length of fences on the same-sized area and also had fences right across the middle of the area.

Table 2. Distance (m) of well-grown ptarmigan broods (4 weeks+) from the nearest snow-fence, these being the only broods present during total counts of ptarmigan.

Area	Date	Behaviour	Distance (m)	P
The Cairnwell	7 August 1998	resting	1	<0.01
		foraging	40	0.2
		foraging	100	0.4
	31 July 2001	foraging	1	>0.01
		foraging	250	0.75
Meall Odhar	7 August 1998	resting*	<1	<0.05
		foraging	10	0.2
		foraging	15	0.3
		resting	<1	<0.05
	1 July 1999	foraging	2	<0.05
	3 August 1999	resting	<2	<0.05
		foraging	200	0.9
	14 August 2000	foraging	2	<0.05
		foraging	2	<0.05
		resting	1	<0.001
	5 July 2006	resting	0.5	<0.001
	17 August 2007	resting	1	<0.05
	30 July 2008	foraging	2	<0.05

* A few almost touched the wooden palings. A group of cocks rested at <1 m (<0.05).

On 30 August 2006, the only birds present at the Meall Odhar area fed <1m from a snow-fence ($P < 0.05$). When I approached, the hen and full-grown young walked round the top end of the fence and then crouched low on the far side, almost touching the fence. Likewise on 17 August 2007 the sole family foraged between fences on a towline, 2 m from the nearest fence ($P = 0.05$).

There was a striking case on 1 July 2009, when Graham McCabe, Allan and Iain Cameron and I spent three hours walking in ptarmigan habitat on Glas Maol, Mr McCabe with a sheepdog ranging. The only ptarmigan seen were two hens with broods of three flying young each, separate but within 1 m of a snow-fence at Glas Maol Tow. When disturbed, all birds in the first family flew downhill to land at and crouch below the fence. The second hen showed distraction display and walked in a direction away from her chicks. The chicks ran across the towline to crouch at the far side of the other fence, and as we walked onwards the hen returned to stand alert at the fence beside her chicks until we had gone out of sight. Allan Cameron took a photograph of her (Figure 3).

Red grouse

Red grouse (*Lagopus lagopus scoticus*) on sub-alpine short vegetation began to favour fences, more than 30 years later than ptarmigan on the same area. In August 1997, one of my only two sightings of red grouse on a 25-ha study area at Cairngorm ski-area was a family on a towline between fences 10 m apart. In September 2000, my sole sighting there was of a family between the same fences. They flew off, but turned to land higher up, only 8 m from the fence. Likewise on 23 March 2003 my sole sighting was a pair between fences on the same towline, only 1 m from the nearest fence.

I have seen no evidence so far that red grouse tend to rest on the ground or feed beside snow-fences at the study areas for red grouse on subalpine moorland along the lower part of the Cairnwell and the opposite slope of Sunnyside on Meall Odhar Beag. However, heather there is much taller and covers a far higher proportion of the ground than at the ptarmigan study areas on alpine land higher up.

On snow-less ground, the only two pairs of red grouse seen on 27 March 2000 on the ptarmigan study area at the Cairnwell rested <2 m from a fence ($P < 0.005$). At Meall Odhar, two out of five sightings on the same afternoon were <2 m from fences (each $P < 0.05$), and a pair on 2 November 2001 was on short grass 0.5 m from a fence ($P = 0.01$). On 29 July 2004 at Meall Odhar, I had only three sightings of red grouse



during a total count there of ptarmigan and red grouse, a cock, a cock, and two cocks together. They were resting respectively 20, 0.05 (almost touching) and 1 m from the nearest fence ($P < 0.001$, 0.35, < 0.001).



Figure 3. A hen ptarmigan stands alert at a snow-fence on Glas Maol Tow while her three large chicks crouch beyond the fence, 1 July 2009. (©Photo Allan Cameron).

At the Lecht ski area, most heather is taller than on sub-alpine ground at the ptarmigan study areas on the Cairnwell and Meall Odhar where the above observations of red grouse were made. Staff first erected snow-fences there in autumn 1978, and the number and length increased greatly up to 1988. On 16 May 2001, I raised a cock only 15 cm from a fence, and a second cock that flushed 1.5 m from a fence was joined by a hen leaving a nest with 10 eggs, only 2 m from the fence. These birds rose from tall heather 30 cm high, which covered most ground well away from the fence, and so had good cover and shelter from heather without resorting to a fence.

In 2003 I first saw evidence of red grouse favouring snow-fences for roosting in summer. This was on the southern Coire Fionn piste at Glenshee on 14 July, when fairly fresh piles of overnight dung along with a few feathers of red grouse had occurred within the previous two days by groups of five and four roosting birds. They had roosted within 15 cm of a fence on its inner side, and ground within 15 cm comprised only 0.02% of the area. Five observers who spread out while walking slowly up this piste, inspecting ground carefully for signs of damage by skiers or machines in the previous winter, found no other piles of dung on this piste.

At the Lecht, adult cock and hen red grouse, including pairs with families of fully-grown young, often perched on top of fences around the manager's house. His house stands on the other side of the main public road from the café, and so the frequent presence of people may deter raptors. Cocks also use the fences as vantage points for display. On 14 December 1988 at Glenshee, for example, when thin wet snow coated the heather from a dawn shower, most cocks on the Sunnyside slope, which carried 35 fences dispersed along pistes and towlines, stood on the rails along fence tops to crow during the dawn chorus. Again, a house, workshops, café and car parks, with frequent movement of staff, vehicles and visitors, may deter raptors and encourage cocks to display from very conspicuous high fences.

Ptarmigan and red grouse in deep snow

On days with almost complete snow-cover, ptarmigan at Cairngorm and Glenshee, and red grouse at all three ski-areas foraged in packs away from fences. I observed this from the start of each ski-area. In such conditions, deep snow lay near fences, covering all vegetation. The birds found food only on windswept patches where plants protruded through the snow. When both species rested or preened on such days, however, commonly around midday, they often went to sit or stand at the bottom of fences.

Ptarmigan in their white winter plumage were well camouflaged on snow, but the dark-plumaged red grouse were extremely conspicuous. In association, red grouse in snowy conditions rested at fences far more frequently than ptarmigan on the same area at the same time. I saw this so often that I did not take notes on it, but did so on 20 February 2005 as a recent example. On the Cairnwell, all of six sightings of 19 red grouse resting in early afternoon were at fences, until skiers disturbed some of them, whereas only



one of four sightings of 12 resting ptarmigan were at fences, the rest being on steep scree with big boulders.

Dotterel

At Glenshee ski-area in August 1971, my father photographed a juvenile dotterel (*Charadrius morinellus*) that was resting under the criss-crossing wires from a derelict sheep-fence on the plateau of Glas Maol (Figure 4). The first snow-fences on dotterel ground at Glenshee were erected in autumn 1986, totalling 1800 m in length. The Nature Conservancy Council was concerned that fences might deter dotterel from settling to breed. In many years before the fences were erected, I had seen no dotterel nesting on the areas that were later fenced and found no pair well-established there immediately before egg-laying.



Figure 4. A juvenile dotterel rests under a derelict sheep-fence on Glas Maol, August 1971, close to the site in Figure 2. (Photo Adam Watson)

During many searches of Glas Maol plateau and nearby hills with Robert Rae in April–August 1987, we saw no dotterel beside the new snow-fences. On 26 May 1988, however, I found a cock sitting on eggs at a nest inside a snow-fenced corridor, only 8 m from the nearest fence. When leaving or returning, he walked easily through small gaps between stakes at the foot of the fence. On the same day, three pairs called and displayed above the top of the ski-tow, within 10 m of a fence. On 29 May a cock additional to the one with the nest was standing 3 m outside the fence, and a pair displayed and called 15 m outside.

In June 1994, Dave Scott (pers. comm.) in the course of botanical study found a cock sitting on eggs inside the corridor, 4 m from the nearest fence. He showed me the location on a large-scale map and I saw the nest later, again with the cock incubating the eggs. During a later year in the 90s he saw a cock with a nest and eggs about 30 m outside the upper fence on the corridor. In 1997, ski worker Jack MacCowan found a cock on eggs only 1 m from a right-angled fenced corner. He showed me the nest on 27 June, when the cock was incubating eggs. These cases suggest that dotterel favoured snow-fences for nesting and also displaying before nesting.

It should be noted that there was a concentration of human effort at and near fences on dotterel ground, involving botanical work by D. Scott and fence repairs by ski staff. Hence any dotterel nesting there would be more likely to be found than a bird nesting elsewhere on the hill. Also, as with ptarmigan, all nests on the study area were not found, so a calculation of probability for a given nest location would be invalid. Nevertheless, the total number of pairs was known from the period immediately before egg-laying, and the number of cocks was known from observations during visits when birds were on nests or with downy chicks. On the dotterel study area of 107 ha, 6–7 dotterel pairs were found annually in 1967–86 (Watson 1989), eight pairs in 1988, and no more than nine pairs in other years up to 1997 inclusive (AW, unpublished). Ground <8 m from a fence covered 0.03% of the area, and <1 m only 0.003%. Hence, although the evidence for nests is partly circumstantial, the probability of a bird nesting so near a fence on the basis of random events must be extremely low. In short, it is likely that dotterel displaying before nesting favoured ground near fences, and likewise nesting dotterel.



Other birds

At all three ski-areas, snow buntings (*Plectrophenax nivalis*) and occasionally twites (*Acanthis flavirostris*) often perched on fence-top wires or rails. On 29 March 2002 a twite and a meadow pipit (*Anthus pratensis*) stood at the foot of a snow-fence at Meall Odhar study area, on a day when I saw no others there during a ptarmigan count with a dog. At Meall Odhar on 30 August 2006, the only meadow pipits on the study area were in a flock of 15, foraging 1–2 m from a snow-fence, in sunshine on its south side. On 19 April 2005, a cock ring ouzel (*Turdus torquatus*) at 840 m on Meall Odhar flew to land on a snow-fence top.

At Glenshee ski area on 8 February 1989, a flock of 70 snow buntings used snow-fences on snow-free ground beside Meall Odhar café. Most foraged on patches of reseeded grass, apart from a few on short heather and hill grasses. Then, up to 15 at a time bathed in a stream beside the café, with a total of 40 bathing. Immediately after bathing, they flew to the nearest snow-fence, where they fluttered their wings and dried in the sunshine. On 26 March 2002 I saw a cock snow bunting perched on a snow-fence at Cairnwell. When I came near, he flew to land at the foot of a nearby fence and ran out of sight between two stakes.

Mountain hares

Mountain hares (*Lepus timidus*) also favour snow-fences, but I saw no sign of this until more than 30 years after ptarmigan showed this on the same area. At Cairngorm ski-area, the only hare found on a 25-ha sub-alpine area on 16 August 1997 was on a towline between fences 10 m apart, and unusually many hare droppings lay on the towline. On 28 October 1997, 10 sightings of 14 mountain hares on the Glas Maol towline and fenced corridor involved hares running out from fenced areas, and at the Coire Fionn south piste on 2 November 2001 there were two hares, both resting < 1 m from a fence. One was a leveret on its own, about two-thirds grown. These observations were made on days with no snow.

Annually since 2001, a high proportion of the hares that I saw during counts of ptarmigan and red grouse at the Cairnwell and Meall Odhar in February–April were resting at fences. For example, on 19 February 2004 at the Cairnwell, six out of 21 sightings of individual resting hares were < 1 m from a fence, two almost touching it. On Meall Odhar later on the same day, five out of 18 sightings involved a hare < 1 m from a fence, and six at 1–4 m. At the Cairnwell on 15 April 2007, a hare disturbed during a count was still mostly in white winter coat and hence conspicuous against the dark snow-free hillside; it ran quickly to the nearest fence 150 m away and crouched at the foot, touching the fence. Even as late as 7 May 2004 at the Cairnwell, when hares were well-camouflaged in dark summer coats, one sighting out of five was of a hare feeding 2.5 m from a fence.

Discussion

Cover and shelter

Snow-fences obviously provide cover. When disturbed during counts at Glenshee ski-area, many ptarmigan that I had flushed far from fences flew to land at fences. In winter 1988–89 on the Cairnwell, a singleton chased by a peregrine (*Falco peregrinus*) and one chased by a golden eagle (*Aquila chrysaetos*) escaped by landing beside a fence, whereupon the raptor flew away.

Even a wire fence provides cover from predators, and to favour any kind of fence or wire may be widespread among birds, whether snow fences or wire fences. In May 1965 on Hrisey, a small island in north Iceland, ptarmigan flew from the moor to gather in packs beside the village, where they ate freshly growing weeds in fields surrounded by wire fences with posts, erected to exclude sheep. Birds flew to stand at the foot of fences whenever a flying gyrfalcon (*Falco rusticolus*) approached, and while resting or preening moved to sit or stand beside or under fences. Dr Finnur Guðmundsson, who led a study of ptarmigan there, said this was typical behaviour. Dr Arnthor Garðarsson, who worked on the study, later wrote of birds ‘taking cover in small groups, e.g. along a fence’ when a falcon appeared (1988). In my experience during an all-season study of corn buntings (*Emberiza calandra*) on arable farmland, raptors do not attack birds sitting at fences or on overhead telephone or electricity wires, perhaps for fear of injury. I have often seen a kestrel (*Falco tinnunculus*) or a sparrowhawk (*Accipiter nisus*) perched on an overhead wire or pole, only a few metres from finches and buntings that showed no alarm postures or calls.

Snow-fences also afford shelter, reducing wind speed by about a half, as a person finds when walking or sitting on the lee side. On the sunny side, air temperature rises, especially at ground level, and vegetation and stones feel warmer.

During gales, animals often favour the lee side. Here are two examples at the Cairnwell. On 12 December 1988, a sunny day but with a cold wind, all nine ptarmigan that were resting < 2 m from fences stood on the lee and sunny side. On 2 February 1989, a south-west mild gale of force 10 blew across snow-free ground, and two groups of five resting ptarmigan were on the fence’s north lee side. The lee and sunny sides coincide on some occasions, whereas on others they are on opposite sides of the fence.



Mountain hares tended more than ptarmigan or red grouse to seek fences for shelter. They are much larger than the birds, and while resting they put their backs to the wind, whereas resting ptarmigan or red grouse face the wind. On 14 August 2003, when a cool wind of force 5–6 blew, five hares on the Glas Maol topline almost touched a fence while sheltering on its lee and sunny side, with their backs next to it. During an overcast day with a force 7 wind on 7 November 2003, 12 hares sheltered <1 m from the lee side of a fence on Meall Odhar, and I found only two on the rest of the 20-ha study area. In observations on 19 February 2004, mentioned above, six hares sitting <1 m from fences at the Cairnwell and five likewise on Meall Odhar were on the lee and sunny side of the fences. By using the lee side when it was facing sunshine, they received not only shelter, but warm sunlit air at the foot of the fence.

Shortage of tall cover due to overgrazing and burning

Overgrazing by unnaturally high densities of domestic sheep and red deer (*Cervus elaphus*) for centuries has almost eliminated dwarf birch (*Betula nana*) and willow (*Salix* spp.) scrub on alpine land and moorland, not just in the Scottish Highlands but in almost all of Scotland, England, Ireland and Wales. Frequent burning of moorland in all these countries for centuries has exacerbated this shortage of tall vegetative cover. All these practices continue, except in a tiny minority of small areas under protective management for nature conservation. Any extra cover or shelter such as a snow-fence may therefore be especially useful on the overgrazed or burned terrain. It is perhaps likely to be more useful in these relatively scrub-less countries than on most alpine and subalpine land in the northern hemisphere, such as Alaska and northern Canada, where grazing animals are not at unnaturally high densities and where scrub consequently abounds.

Acknowledgements

I thank Stuart Rae for useful discussion and Allan Cameron for his fine photograph.

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The Influence of habitat, female preference and male behavior on male territory selection in ruffed grouse: a novel approach.

Lorelle I. Berkeley

Introduction

The ruffed grouse *Bonasa umbellus* has been studied extensively in Minnesota since 1931 (Gullion 1967). Such topics as the display of the males (Gullion 1967), habitat associations (Gullion and Marshall 1968), catkin diet (aspen *Populus tremuloides*; Jakubas and Gullion 1991) and population biology (Zimmerman et al. 2007) have been investigated. However, the behavioral ecology of ruffed grouse remains largely unknown in any portion of its range because they are difficult to observe in their densely forested habitat (Rausch et al. 2000). In addition, it is rare for studies of habitat selection in population biology to include behavioral ecology (Sutherland 1996). Information about behavioral ecology may benefit population studies by helping identify the evolutionary mechanisms influencing population parameters (Sutherland 1996). This knowledge, in turn, enhances one's ability to predict the response of organisms to environmental change in the future (Sutherland 1996).

I am in my final year of doctoral research studying habitat selection by ruffed grouse in northern Minnesota (MN; see **Methods**, *Location of Grouse Territories*), and I am incorporating a behavioral ecology perspective into my research. The ruffed grouse is ideal for habitat selection studies because it is



common and territorial males are easily detected when they display. It is well known that ruffed grouse use aspen-dominated stands of varying ages to provide both food and protective cover (Gullion and Marshall 1968). However, some males select territories in conifer-dominated forest stands (hereafter “conifer”) even when aspen-dominated forest stands (hereafter “aspen”) seem to be available. This selection of presumably lower quality habitat presents a conundrum to biologists interested in understanding the mechanisms of habitat selection: are the male ruffed grouse simply making mistakes or are there other reasons for their selecting such habitats (Zimmerman and Gutiérrez 2008)?

In many grouse species, communal display (i.e., a lek) is a common mating strategy (Wittenberger 1978). The lek strategy can be thought of as a continuum, from tightly clustered groups (e.g., sharp-tailed grouse, *Tympanuchus phasianellus*) to more dispersed groups where males establish territories but still form loose clusters [dispersed lek; e.g., capercaillie, *Tetrao urogallus*; (Wiley 1974, Höglund and Alatalo 1995)]. The ruffed grouse is one of the earliest species to diverge in the grouse family, Tetraonidae (Gutiérrez et al. 2000). At one end of the lek continuum, species that share some ecological similarities to ruffed grouse [e.g., the hazel grouse *Tetrastes spp.*] form pair bonds between males and females (Wiley 1974). At the other end of the continuum, many later-diverging species (relative to ruffed grouse) are known to form leks (e.g., prairie chickens, *Tympanuchus spp.*; sage grouse, *Centrocercus urophasianus*). Some suggest that this phenomenon is habitat-related and that lek behavior evolved in grouse species after they invaded open country habitats (Wittenberger 1978). Although there is little support for communal display in ruffed grouse, it has been suggested that males of this species may exhibit a dispersed lek strategy (Gullion 1967, Höglund and Alatalo 1995). Under this hypothesis, males may be selecting habitats based on proximity to other males to increase their overall fitness.

The dispersed lek strategy may be evolutionally driven by female preference for males clustered in groups which, in turn, may motivate males to choose habitat that will increase their fitness by improving their chances of mating (Ryan 1997). There may be several alternative or combined mechanisms for the evolution of dispersed leks that are plausible regarding a female visiting several displaying males before selecting a mate (Atwater and Schnell 1989). First, females may prefer to mate with males that display the most attractive qualities because such qualities (e.g., relatively high frequency of display) might indicate that the male may have superior genes. Less preferred males may settle near these more attractive males to try to increase their own chances of mating (Gibson 1992, Jiguet and Bretagnolle 2006), even if they are relegated to suboptimal habitats by these “superior” males. Second, females may prefer visiting dispersed leks (rather than isolated males) to minimize their time and energy expenditure for mate selection, which would ultimately enhance their fitness. Third, female preference for specific habitat attributes may influence male territory selection (Ryan 1997) because males may cluster around these preferred areas to increase their chances of encountering a mate. Finally, when clustering, males may gain valuable knowledge about their neighbors that may improve their own fitness (Beletsky and Orians 1989). For instance, McBurney (1989) has shown that male ruffed grouse are familiar with the location of nearby males and may move to a “better” territory if it becomes vacant. All of these mechanisms could contribute to male habitat selection to some degree if they are operational, but some may be more important than others.

In this study, my main goals will be to evaluate *a priori* hypotheses or models (see **Methods, Habitat Variables and Analysis**) about the following questions regarding the ruffed grouse population on my study area.

- Are males forming dispersed leks, and how should a dispersed lek be defined (i.e., when are males that are spatially close together considered a dispersed lek)?
- How important are behavioral variables (e.g., number of female visits, male display frequency) when compared with habitat variables that are known to influence male habitat selection?
 - Is there a relationship between the number of females that visit males and (1) the males’ habitat type, (2) male display frequency, and/or (3) the density and/or display frequency of neighboring males?
 - Is there a relationship between the frequency of male displays and (1) the males’ habitat type (aspen vs. conifer) and/or (2) the density and/or display frequency of neighboring males? What distance defines neighboring males?
 - Are males in conifer relatively isolated or are they closer to males in aspen than they are to other males in conifer habitat?

If my *a priori* models do not explain much variation in the data, this would suggest that male grouse are selecting conifer habitat for other reasons or male grouse are making mistakes due to imperfect knowledge of the location of better, unoccupied habitat [an alternative to the Fretwell-Lucas model of ideal knowledge (Fretwell and Lucas 1970, Kristan 2006)].

Ruffed grouse are one of the most popular game birds in the United States (US), resulting in great interest in this species from both the public and wildlife managers (Larson 2008). Even though ruffed



grouse habitat varies regionally, habitat components such as the structure of vegetation remain similar across their range (Rusch et al. 2000). Thus, knowledge about the mechanisms underlying habitat selection in my population will have implications for this species wherever it occurs. In MN, ruffed grouse are the most important forest game bird and economically important to rural communities. The MN Department of Natural Resources (MnDNR), which manages this species, wants to increase ruffed grouse densities in the future, yet is also proposing substantial conversions of aspen forest to conifer forest for economic (conifers are more valuable) and ecological reasons (i.e., restoration because some ecologists suggest that conifers were the dominant trees in pre-European settlement times (MnDNR 2008)). From our general knowledge about ruffed grouse habitat needs, these two major goals appear conflicted. Other states in the northern Great Lakes region (e.g., Wisconsin, Michigan) are also converting aspen to conifer forest. In contrast, states in the western US where ruffed grouse have also been shown to be closely associated with aspen species (Buhler and Anderson 2001), aspen is disappearing from its native range and managers are attempting to restore aspen at the expense of conifer species. Thus, ruffed grouse are simultaneously losing their preferred habitat in several regions throughout their range, which could have negative implications for this species as a whole. Therefore, another goal of this study is to determine how large of a population can be sustained in habitat compositions comprised of different amounts of aspen and conifer.

Methods

Location of Grouse Territories: My study area is located at the University of Minnesota's (UMN) Cloquet Forestry Center (CFC) in Carlton County, Minnesota, USA (46° 31' N, 92° 30' E). I use auditory surveys to detect and locate actively displaying male ruffed grouse, which entails walking transects through the forest and locating the males by their conspicuous drumming displays (a display created by the male rapidly rotating its wings, creating a vacuum of air within them that results in a low frequency sound likened to a mini sonic boom). The detection probability of male ruffed grouse during individual surveys is 33% (Zimmerman and Gutiérrez 2007). I survey each route 15 times over the course of the breeding season, which provides a 99% probability of detecting an actively displaying grouse. Males spend a majority of their time drumming from a specific perch site (drumming structure; e.g., a log) in their territory (Gullion 1967), which can be identified by either seeing the male display or finding an accumulation of droppings on a structure. They also tend to use a specific spot on that structure (drumming stage; Gullion 1967), which better enables me to trap specific males on their territories using mirror traps (Gullion 1987). I trap males to determine ownership of territories and collect measures of body condition for each bird (e.g., wing chord length, tarsus length, mass). I also collect fecal samples from drumming structures to estimate stress levels of the birds using conifer and aspen because risk of predation is presumed to be higher in conifer habitats (Gullion and Marshall 1968).

Collection of Video Data: I will quantify female visits to male ruffed grouse using video cameras. I randomly select a sample of males displaying either in aspen or conifer at the start of the breeding season and place video cameras at their drumming structures. The tendency of males to use a specific drumming stage (discussed in the above paragraph) allows me to accurately place cameras to record their activity. Cameras are mounted on a tree two to five meters from drumming structures, dependent upon habitat. The black and white, infrared cameras (SuperCircuits, Inc., Austin, Texas) are connected to a time-lapse digital video recorder (DVR; Fuhrman Diversified, Inc., Seabrook, Texas) and powered by 12V, 10.5 Ah lithium ion batteries. The recorders are set to record at 5 frames per second (time-lapse) onto Sandisk 4GB EXTREME III SDHC SD cards (Digital Media Source), which allows the systems to run for at least 48 hr before batteries and SD cards need to be changed. I also use analog video recorders (VCRs; SuperCircuits, Inc.) powered by marine deep-cycle batteries that are set to record at 5 frames per second. The recorders are housed in durable, waterproof Pelican cases. I operate the video systems continuously for the duration of the breeding season (24 h per day from April through the first week of June). I will determine the sex of visitors by the behavior exhibited by the resident male on his detection of the visitor.

Habitat Analysis: I will quantify habitat characteristics at male territories and across the study area. Territory characteristics include woody plant species composition, vegetation structure (e.g., tree density), distance to nearest aspen (conifer) patch, and size of the nearest aspen patch (for territories located in conifer forest). Study area characteristics include forest type, basal area and density of each tree species, age of the stands, proportion of habitat types available to each grouse, and the proximity of aspen patches to the stand the bird is using as its territory center. I will use a Bayesian multi-level modeling approach to assess the influence of habitat and behavioral variables on habitat selection of male ruffed grouse (McCarthy 2007, Royle and Dorazio 2008). This approach will allow me to incorporate prior knowledge about my study population with the data that I collect to estimate the variables that most influence habitat selection and predict the areas that male grouse are most likely to use in the future. [I have access to



grouse data collected by previous researchers at CFC to develop priors for the Bayesian analysis (Zimmerman et al. 2009).]

Potential Significance of Research

I am integrating tools from both population and behavioral ecology to answer questions about habitat selection and the nature of mating systems. Despite the many previous studies on this important game bird, their behavior is not well-described because they inhabit densely vegetated forests and are difficult to observe (Rusch et al. 2000). Therefore, my study will contribute significantly to understanding the population and behavioral ecology of the ruffed grouse across its range, and more broadly to the nature of habitat selection in birds. My research will also provide insight into the evolution of mating systems within the grouse family and possibly a key to the evolution of lek behavior. Finally, my study will identify the types of management activities (e.g., management for appropriate compositions of aspen and conifer) that will benefit ruffed grouse, and help guide wildlife and forest managers to ensure robust populations of this and ecologically similar species in the future.

Preliminary Population Data

Since 2002 population data has been collected via auditory surveys and habitat data has been collected at multiple spatial scales (from smallest to largest: the male display site, the male territory, and the entire study area [3,505 acres]). Zimmerman (2006) has collected these data from 2002 to 2005, and I have continued it from 2006 to 2009. The population is on the up-swing of its typical 10-year cycle (the population exhibits repeated 10-year cycles where it increases, on average, for five years and then declines, on average, for five years), as shown by the steady increase of actively drumming males found on the study area each year from 2002 to 2009 (74, 52, 47, 46, 50, 63, 65, and 111 respectively; Figure 1). Of interest has been the selection of a relatively larger proportion of conifer (red pine *Pinus resinosa*, jack pine *Pinus banksiana*, mixed swamp conifers) stands by males. Aspen *Populus tremuloides* is still occupied by most grouse, while the remaining habitats types (northern hardwoods, birch *Betula papyrifera*, mixed hardwood/conifer, bottomland hardwoods, marsh and upland brush) on CFC were inhabited by the least number of males. Thus, I will be able to model the changes in habitats selected by male ruffed grouse as the density of individuals (i.e., competition for drumming structures) increases. From 2007 to 2009, I have been able to monitor 25 structures where males have engaged in their

drumming displays using my automated video systems. I am currently in the process of data analysis and writing, and results of this study are forthcoming within the year.

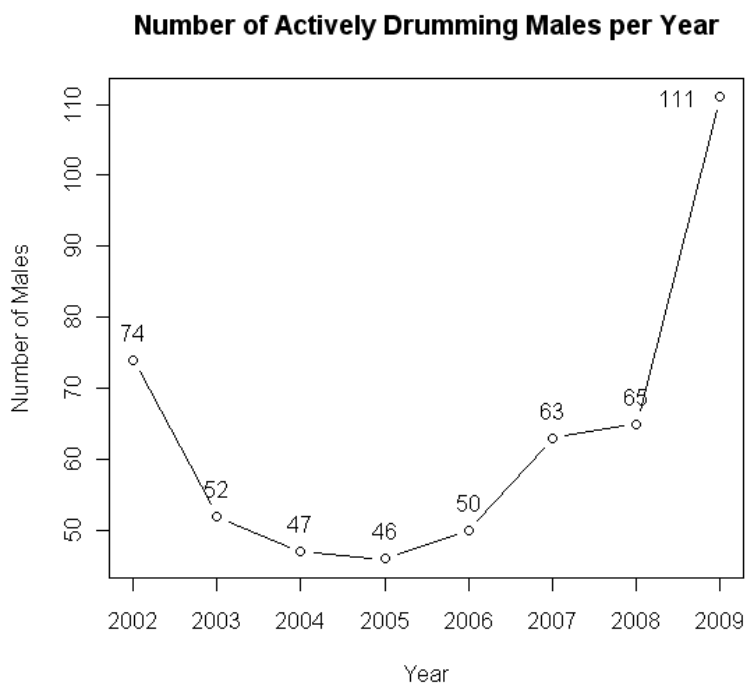


Figure 1. The number of actively drumming males found during auditory surveys on Cloquet Forestry Center, Cloquet, Minnesota, USA during annual breeding seasons from April to June 2002-2009.

Acknowledgements

I thank my advisor, R. J. Gutiérrez, for his guidance throughout this research project; Ron Severs and the staff of the Cloquet Forestry Center for logistical help in the field and making me feel welcome on the forest; Guthrie Zimmerman for sharing his ruffed grouse expertise and providing his data as priors for my Bayesian analysis; and my field technicians that made my data collection possible including Kristin



Waatti, Anna Sidie, Paul Bailey, Kelsey Maloney, Teresa Drury, Natasha Gruber, Michael Ingrassia, Daniel Stangle, and Rachael Berthiaume. Funding has been provided by the University of Minnesota (UMN) Agricultural Experiment Station; UMN Cloquet Forestry Center; Legislative-Citizen Commission on Minnesota Resources; UMN Leigh Perkins Fellowship; UMN Graduate School; UMN Richard and Judi Huempfer Ruffed Grouse, Woodcock, and Avian Endowed Fellowship; American Museum of Natural History Frank M. Chapman Memorial Fund; UMN Department of Fisheries, Wildlife, and Conservation Biology, and the Minnesota Forest Industries.

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On pines and capercaillie in the Cantabrian Mountains

Rolando Rodríguez-Muñoz, Mario Quevedo & María José Bañuelos

In the previous issue of Grouse News, Rubiales and co-workers link the decline of Scots pine (*Pinus sylvestris*) woods in the Cantabrian Mountains to the current decline of Cantabrian capercaillie. Here we show that there is no evidence supporting their hypothesis.

Cantabrian woodlands are composed by different species of broad-leaved trees. These are not man-made forests, but the result of the complex succession of vegetation traceable back to the last glacial maximum (Muñoz Sobrino *et al.* 1997, 2005). The changes since the last glaciation involved also *Pinus* species, which seemingly waxed and waned leaving behind a few relict stands (e.g. García Antón *et al.* 1997; Benito Garzón *et al.* 2007). Writing about the extinction of Scots pine (Rubiales *et al.* 2008) is indeed misleading, as the species is still present in these mountains. Records of capercaillie in the Cantabrian region can also be traced back at least to the period of transition between the last glacial maximum and the early Holocene (Tyrberg 1998). Moreover, the Cantabrian capercaillie belongs to a southern lineage that is only found in the Iberian Peninsula and the Balkans. This lineage does not seem to have expanded northwards through the Pyrenees and the Carpathians after the last glaciation, so it did not merge with the boreal lineage inhabiting the conifer forests across most of the species range, with the only exception of those two mountain ranges where both lineages are in contact (Duriez *et al.* 2008). Altogether, this suggests that the Cantabrian Capercaillie has been confined somewhere in the Iberian Peninsula at least since the beginning of the last glaciation, hence following and coping with all those major vegetation changes.

The available information on feeding ecology (Castroviejo 1975, Rodríguez and Obeso 2000, Blanco-Fontao *et al.* 2010) and habitat selection (Quevedo *et al.* 2006b, Bañuelos *et al.* 2008) shows that the Cantabrian capercaillie uses a wide range of habitats and food resources, including also pine stands and pine needles. From the available information, we cannot infer any dependence on pines in this population, but just that capercaillie use them in the very few places where they are available. We cannot assert that it depends on beech or ferns either, even though these seem to be important resources along with several other plant species (Blanco-Fontao *et al.* 2010). Altogether, this shows that the Cantabrian capercaillie is unique in relation to its habitat (Storch 2007), and it is deceptive to describe this singularity as something “traditionally assumed” (Rubiales *et al.* 2009).

It has been shown that deforestation has largely reduced the available habitat for capercaillie and every other dweller of mature forest in the Cantabrian Mountains (García *et al.* 2005; Quevedo *et al.* 2006a; Quevedo *et al.* 2006b). Published data on the species in this range are very recent, and the current decline is thought to have started on the second half of the twentieth century, after several decades of severe hunting and deforestation (García 1973, Castroviejo *et al.* 1974). However this deforestation did not include pines, as their presence in this range have been very reduced for thousands of years (e.g. Muñoz Sobrino *et al.* 1997; Muñoz Sobrino *et al.* 2005; Benito Garzón *et al.* 2007). Although it may well be that the capercaillie population had fluctuated over that period, we know nothing about it. Bearing this in mind, there is no point to explain the ongoing decline from a vegetation transition that happened several thousands of years before.

Doing research on the Cantabrian capercaillie is a difficult task. It is a rare, shy bird, and lives in a rugged landscape, so that gathering data on its ecology is physically and logistically demanding. Although it is considered as a flagship species in the region, scientific knowledge about it is quite scarce. This combination of troublesome research with the emblematic character of the species, results in a fruitful nurturing ground for speculation. We consider that the Scots pine story is just another example. Together with the much voiced speculation about excessive predation, both are in the list of causes of decline that can be faced with “action”, i.e. by planting pines or killing predators. On the opposite side of such “action” is the development of further research to unravel the causes of the decline and, ultimately, shed light on the required conservation management. Although speculation can be important to stir research, we feel that it should be explicitly labelled to avoid the impression of certainty based on hard data. Unfortunately, there is no hard data support for any of the proposed causes of decline for the Cantabrian capercaillie so far.

With our present knowledge, it is nonsense to link the current decline of this capercaillie population to the history of Scots pine in the range, or to suggest that pine afforestation is likely to improve its recovery more than the natural restoration of deciduous forests. It is noteworthy that the best remaining areas for the Cantabria capercaillie are those that have been left unmanaged for several decades, with no agricultural, livestock or forest uses. Pine relicts in the Cantabrian Mountains merit conservation and attention on their own (we are not aware of any threat on them though), but that is unrelated to capercaillie conservation. Pushing this pine story will add another excuse to stimulate forest managers to keep replacing the natural hardwoods with pine plantations, an ongoing activity since the mid of the



twentieth century. A more sensible policy would be to protect the few natural forests still remaining and to allow for the natural recovery of the vast deforested areas around them, mostly preventing the recurrent shrub clearing and man-made firing that halt it. Preserving its natural habitats is the only way to preserve the singularity of Cantabrian capercaillie and to allow its population to develop naturally.

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A Spatially-Based Planning Tool Designed to Reduce Negative Effects of Development on the Lesser Prairie-Chicken *Tympanuchus pallidicinctus* in Oklahoma: A Multi-Entity Collaboration to Promote Lesser Prairie-Chicken Voluntary Habitat Conservation and Prioritized Management Actions

Luke Bell

Purpose

The purpose of the model is to provide a tool for proactive planning to avoid, minimize and mitigate the negative effects of development on the lesser prairie-chicken (LEPC) in Oklahoma. The model accomplishes this by providing industry and wildlife professionals a tool that can help: 1) site development with consideration to LEPC conservation, 2) estimate the amount of a voluntary contribution to the LEPC habitat conservation fund needed to offset the impact of potential developments, and 3) locate areas to apply habitat conservation fund contributions for effective LEPC conservation work.

Justification

The impetuses for the LEPC model are the steady decline of the LEPC populations and increasing development pressures in the range of the LEPC in Oklahoma. The LEPC is a candidate species for listing under the Endangered Species Act and its listing priority number was elevated in 2008 from 8 to 2 (U.S. Department of Interior 2008), bringing the species closer to listing (U.S. Department of Interior 2008). The historical range of the LEPC has declined to approximately 10 percent of its former range and the species' population has declined to only 5 percent of historical numbers. According to the USFWS, "the most serious threat to the lesser prairie-chicken is the present and threatened destruction, modification, and curtailment of its habitat and range" (U.S. Department of Interior 2008).

In Oklahoma, the LEPC occurs only in the northwest portion of the state (Figure 2). The LEPC is sensitive to habitat fragmentation caused by roads, human development, and habitat conversion and requires large contiguous patches of suitable habitat. LEPCs can collide with electric lines and fences, causing injury and mortality, and avoid or abandon areas with vertical structures such as wind turbines, oil wells and transmission towers and areas with human activity.

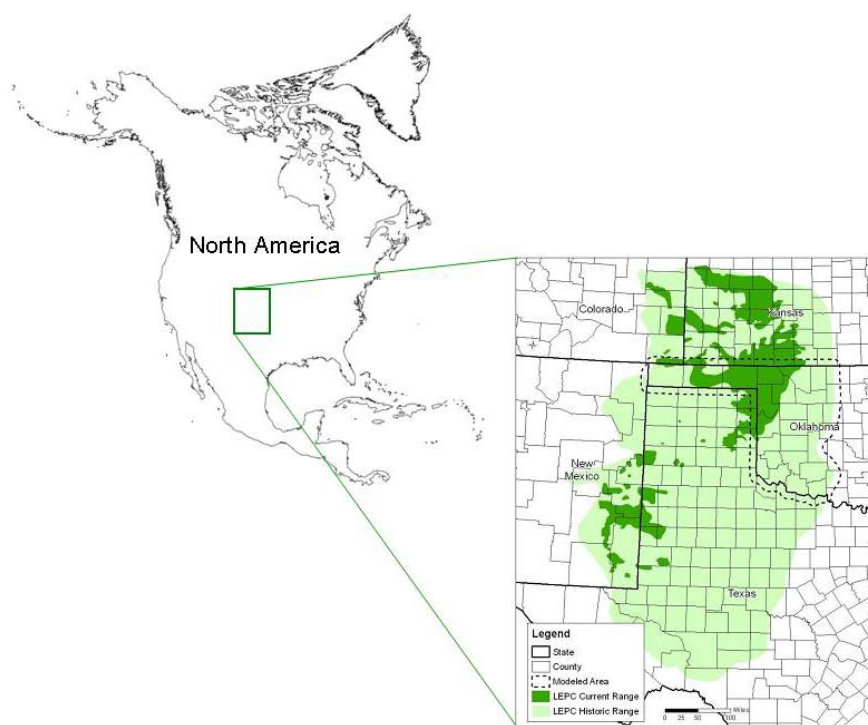


Figure 1. Map of the historical and current range of the lesser prairie-chicken. Modeled extent is delineated by dotted line.



Model Overview

The LEPC model is a conceptual spatial model that ranks land relative to its importance for LEPC conservation. The LEPC model produces a spatial grid spanning the historical range of the LEPC in Oklahoma in which each 30m x 30m pixel is numerically ranked (1 to 8, Figure 2). The higher the rank, the more valuable that pixel is to the LEPC. Ranks are determined by comparing each pixel in the grid against a set of eight criteria addressing LEPC occurrence, habitat requirements and threats. Each rank value is associated with a dollar value reflecting the cost of replacing that land if it were destroyed or degraded. The model can be used to evaluate any type of potentially detrimental development (e.g. wind energy farm, road construction, oil and gas wells, transmission line).

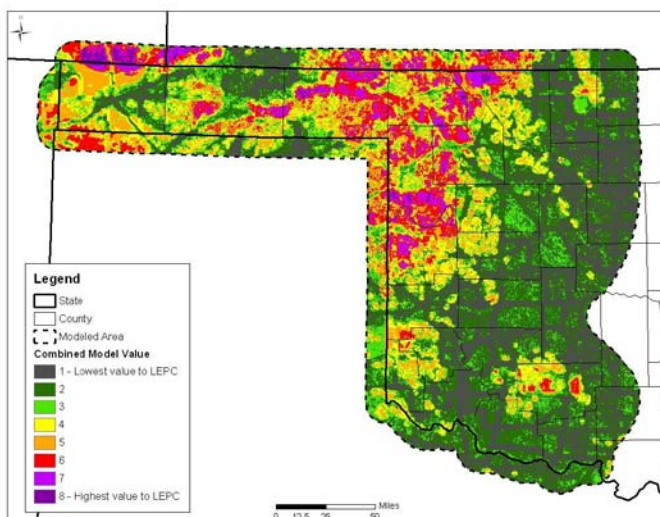


Figure 2. The final LEPC model output resulting from the addition of the eight binary factor grids. The higher the pixel value, the greater its value for lesser prairie-chicken conservation.

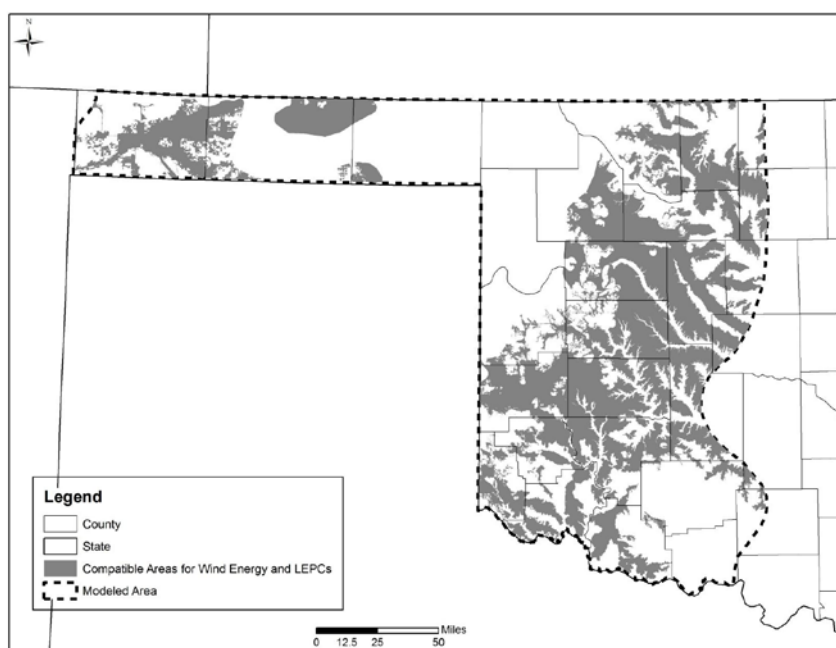


Figure 3. Where wind energy could go and have no effect on LEPC conservation using the Oklahoma Wind Power Initiative's wind potential neural network model.

Recommended Citation

Horton, R., L. Bell, C. M. O’Meilia, M. McLachlan, C. Hise, D. Wolfe, D. Elmore and J.D. Strong. 2010. A Spatially-Based Planning Tool Designed to Reduce Negative Effects of Development on the Lesser Prairie-Chicken (*Tympanuchus pallidicinctus*) in Oklahoma: A Multi-Entity Collaboration to Promote Lesser Prairie-Chicken Voluntary Habitat Conservation and Prioritized Management Actions. Oklahoma Department of Wildlife Conservation. Oklahoma City, Oklahoma. 79 pp. <http://www.wildlifedepartment.com/lepcdevelopmentplanning.htm> (Accessed: Date).

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Energy development and greater sage-grouse.

Greater Sage-Grouse Ecology, Chick Survival, and Population Dynamics, Parker Mountain, Utah

David K. Dahlgren, Doctor of Philosophy, Utah State University, 2009

Major Professor: Dr. Terry A. Messmer

Department: Wildland Resources

We estimated survival of ~ 1-day-old chicks to 42 days based on radio-marked individuals for the Parker Mountain greater sage-grouse (*Centrocercus urophasianus*) population. Chick survival was relatively high (low estimate of 0.41 and high estimate of 0.50) compared to other studies. Brood-mixing occurred for 21 % of radio-marked chicks, and within 43 % of radio-marked broods. Our study showed that brood-mixing may be an important ecological strategy for sage-grouse, because chicks that broodmixed experienced higher survival. Additionally, modeling of chick survival suggested that arthropod abundance is important during the early brood-rearing period (1 – 21 days). We also used life-cycle modeling (perturbation analyses and Life Table Response Experiments) to assess the importance of various vital rates within this population. We determined that adult hen survival and production (chick and fledgling survival) had the most influence on growth rate. Moreover, we assessed various methods (walking, spotlight, and pointing dog) for counting sage-grouse broods. Spotlight and pointing dog methods were more effective than walking flush counts, and the latter may underestimate chick survival.

Sage-grouse and Energy Development: Integrating Science with Conservation Planning to Reduce Impacts

Doherty, Kevin, Ph.D., Autumn 2008, Fish and Wildlife Biology

Chairperson: Dr. David E. Naugle.

Effective conservation planning in the face of rapid land use change requires knowledge of which habitats are selected at landscape scales, where those habitats are located, and how species ultimately respond to anthropogenic disturbance. I assessed sage-grouse (*Centrocercus urophasianus*) large scale habitat ecology and response to energy development in the winter and nesting seasons using radio-marked individuals in the Powder River Basin, Montana and Wyoming, USA. Landscape scale percent sagebrush (*Artemisia spp.*) cover at 4-km² was the strongest predictor of use by sage-grouse in winter. After controlling for vegetation and topography, the addition the density of coal-bed natural gas wells within 4 km² improved model fit (AIC -6.66, $w_i = 0.965$) and indicated that sage-grouse avoided energy development. Nesting analyses showed that landscape context must be considered in addition to local scale habitat features ($w_i = 0.96$). Findings provide managers a hierarchical filter in which to manage breeding habitats. Twice the amount of nesting habitat at 3, 5 and 10-km scales surrounded active leks versus random locations. Spatially explicit nesting and wintering models predicted independent sage-grouse locations (validation $R^2 \geq 0.98$). I incorporated knowledge of energy impacts into a study design that tested for threshold responses at regional scales analyzing 1,344 leks in Wyoming from 1997-2007. Potential impacts were indiscernible at 1-12 wells within 32.2 km² of a lek (~1 well / 640 ac). At higher wells densities a time-lag showed higher rates of lek inactivity and steeper declines in bird abundance 4 years after than immediately following development. I spatially prioritized core areas for breeding sage-grouse across Wyoming, Montana, Colorado, Utah and the Dakotas and assessed risk of future energy development. Findings showed that bird abundance varies by state, core areas contain a disproportionately large segment of the breeding population and that risk of development within core areas varies regionally. My analyses document behavioral and demographic responses to energy development, offer new insights into large scale ecology of greater sage-grouse and provide resource managers with practical tools to guide conservation.

Sage-grouse and the human footprint: implications for conservation of small and declining populations.

Tack, Jason, M.S., December 2009, Fish and Wildlife Biology

Chairperson: Dr. David E. Naugle

Implementing conservation in the face of unprecedented landscape change requires an understanding of processes and scales that limit wildlife populations. We assessed landscapelevel processes influencing



sage-grouse (*Centrocercus urophasianus*), to a migratory population in the Milk River Basin (MRB), northeast Montana, USA, and south-central Saskatchewan, Canada. A regional analysis of leks (e.g., communal breeding sites) documented that populations are impacted by the increasing extent of agricultural tillage, roads, and energy development out to spatial scales larger than previously known. Using bird abundance as a novel way to evaluate human impacts revealed relationships that would have been missed had we not incorporated lek size into analyses. For example, large leks are 4.5 times less likely to occur than small leks when agricultural tillage fragments 21% of land within 1.0km of breeding sites. Sage-grouse in the MRB met or exceeded demographic rates of stable or increasing populations, and thus, are not likely the cause for annual declines. Spring and summer survival of radiomarked females was higher in 2008 (0.91), than in 2007 (0.55), the year we documented an outbreak of West Nile virus. Nest sites in the MRB had lower shrub cover (15%) than rangewide estimates (15-56%), and overall shrub cover instead of sagebrush cover, was a better predictor of nest-site selection. Plains silver sagebrush (*Artemisia cana cana*) made up half of total shrub cover (7.1%) at nest sites, suggesting that other shrubs compensate for lower sagebrush densities in the MRB. We discovered the longest migratory event observed for sagegrouse, with females travelling 40-120km from breeding to wintering areas in Wyoming big sagebrush (*A. tridentata wyomingensis*) habitats in Montana. Habitat may be sufficient to maintain a small population in the MRB, but its ability to persist through time and to buffer against stochastic events is depressed now that this once-large population has become small and isolated. For example, impacts of disease are compounded when acting on fewer individuals and working synergistically with fluctuations in growth rates. Consequently, conservation of sagegrouse in the MRB will depend on maintaining the current habitat base, and on restoring sagebrush-dominated grasslands currently occupied by agricultural tillage.

Greater Sage-grouse and Energy Development in Northeastern Utah: Implications for Management

Leah S. Smith, Master of Science, Utah State University, 2009

Major Professor: Terry A. Messmer

Department: Wildland Resources

Concern regarding the effect of energy development on greater sage-grouse (*Centrocercus urophasianus*) is increasing as the search for fossil fuel intensifies. Sagegrouse may be especially sensitive to energy development because they require large, diverse areas of sagebrush (*Artemisia* spp.) habitat to complete their life cycle. Additionally, the network of pipelines, roads, and wells required by energy development may fragment sagebrush habitat isolating populations and contributing to genetic drift, inbreeding, local extinction, or rapid divergence. Seep Ridge, located in northeastern Utah, is one area where sage-grouse habitat and energy development plans overlap. Approved leases call for the construction of an additional 4,000 natural gas wells in an area currently occupied by a small sage-grouse population. This research was completed to 1) collect baseline data on the survival, reproductive success and habitat use of the Seep Ridge sage-grouse population, 2) examine sage-grouse habitat use patterns in relation to development, and 3) describe sage-grouse mitochondrial genetic diversity in 3 northeastern Utah populations relative to other parts of the species range.

I captured and monitored 16 sage-grouse from the Seep Ridge population in 2007 and 2008. Adult mortality rate of the Seep Ridge population was high (65.2%) and recruitment was low (7.1%) compared to other sage-grouse populations in Utah. Additionally, the monitored sage-grouse used habitats located farther from wells more frequently than habitat located near wells, relative to well spacing. Current habitats occupied by this population do not meet recommended guidelines.

No unusual haplotype compositions were observed in the genetic survey of the northeastern Utah sage-grouse populations. However, differences in haplotype composition between the Anthro Mountain and Strawberry Valley populations and other northeastern grouse populations indicate there may be a barrier to gene flow in the area. I also documented that the Seep Ridge population is connected to another population inhabiting Ute Tribal land. This observation suggests that the populations inhabiting Ute Tribal land may constitute a source population to recolonize Seep Ridge during the postenergy development periods.

I recommend that mitigation measures incorporate restricting development in breeding habitat, maintaining connections between populations, and actions to reduce adult mortality on the summer range. I also recommend that biologists continue collecting genetic samples from northeastern Utah sage-grouse populations to understand population structure, divergent evolution, and inform decisions concerning translocation.



Greater Sage-grouse Response to Coal-bed Natural Gas Development and West Nile Virus in the Powder River Basin, Montana and Wyoming, USA.

Walker, Brett, Ph.D., Spring 2008, Fish and Wildlife Biology

Chairperson: Dr. David E. Naugle

Understanding how population dynamics respond to landscape-scale disturbance and disease are crucial for effective wildlife management and conservation. Two new potential stressors on greater sage-grouse (*Centrocercus urophasianus*) populations in the Powder River Basin of Montana and Wyoming are coal-bed natural gas (CBNG) development and West Nile virus (WNV). I first examined how CBNG development, habitat, and other landscape features influenced trends in the abundance of displaying males and the status of sage-grouse leks. Second, I used rates of WNV-induced mortality and seroprevalence from radio-marked birds to estimate rates of WNV infection. Third, I studied the influence of female characteristics, season, and environmental variables on nest, brood, and female survival. I then used population models to estimate potential impacts of WNV on population growth. From 2001-2005, numbers of males on leks in CBNG fields declined more rapidly than leks outside CBNG. Of leks active in 1997 or later, only 38% within CBNG remained active by 2004-2005, compared to 84% of leks outside CBNG. By 2005, leks in CBNG had 46% fewer males per active lek than leks outside CBNG. Persistence of 110 leks was positively influenced by proportion sagebrush habitat within 6.4 km of the lek and negatively affected by CBNG development at multiple scales. Prohibiting CBNG development within 0.4 km of sage-grouse leks is inadequate to ensure lek persistence. From 2003-2005, minimum WNV-related mortality rates from 1 July-15 September ranged from 2.4-13.3% and maximum possible rates ranged from 8.2-28.9%. In spring 2005 and 2006, 10.3% and 1.8% respectively, of newly-captured females tested seropositive for neutralizing antibodies to WNV. Annual WNV infection rates were lower in habitats without CBNG development. Summer mortality from WNV occurred every year, decreased annual female survival rates by 0-27% per year, and reduced estimates of population growth by 7-10% per year. Changes in epizootiology of WNV and in distribution and management of surface water from CBNG development will play an important role in long-term impacts of WNV on greater sage-grouse populations in the Powder River Basin. Management should focus on eliminating man-made water sources that support breeding mosquitos known to vector the virus.

Greater Sage-Grouse Seasonal Ecology and Responses to Habitat Manipulations in Northern, Utah

Eric T. Thacker, Doctor of Philosophy, Utah State University, 2010

Major Professor: Dr. Terry A. Messmer, Department: Wildland Resources

Declining greater sage-grouse populations (*Centrocercus urophasianus*; hereafter sage-grouse) have led to increased concern regarding the long term stability of the species. Previous research has identified factors contributing to the observed population declines. Habitat degradation and loss have been implicated as major factors in population declines. Although much is known about sage-grouse biology, more information is needed about population responses to specific management actions. This research was conducted to document sage-grouse responses to site-specific management actions. Additionally, I evaluated sage-grouse temporal and seasonal habitat-use and the comparability of techniques used by range and wildlife managers to measure vegetation responses of habitat management. Specifically, I evaluated; 1) whether chemical analysis (gas chromatography) of sage-grouse fecal pellets could identify sagebrush species in sage-grouse winter diets, 2) the comparability of the line-point intercept and Daubenmire canopy cover methods for estimating canopy cover, 3) the response of sage-grouse broods to prescribed burns in a high elevation sagebrush community in north eastern Utah, and 4) the vegetation and insect characteristics of sites used by sage-grouse broods during a 24 hour period. I was able to determine wintering sage-grouse diets using gas chromatography by analyzing fecal pellets. This research also confirmed that black sagebrush (*Artemisia nova*) was an important component of sage-grouse winter diets in western Box Elder County and Parker Mountain populations. The line-point intercept and Daubenmire methods for estimating canopy cover are not comparable. Sage-grouse broods selected small (~ 25 ha) patchy prescribed burns in high elevation mountain big sagebrush (*A. tridentata vaseyana*) communities in northeastern, Utah. 4) Sage-grouse brood-site use in northwestern Utah did not differ during the diurnal hours, but nocturnal roost sites were characterized by shorter statured shrubs and more bare ground when compared to midday sites.

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NEW BOOKS

New Book on Grouse

Sharp-tailed grouse, greater prairie-chickens, greater sage-grouse, and ruffed grouse are beautiful and interesting birds that often face challenges due to disturbance or loss of their habitats. A book devoted specifically to these grouse species (*Grouse of Plains and Mountain—The South Dakota Story*) has been completed and will soon be available through the South Dakota Department of Game, Fish and Parks (SDGFP). The book was written to increase interest and appreciation for grouse and is meant for a general audience. The authors are hopeful the book will help in conserving grouse and their habitats. The book is coauthored by Les Flake (retired from South Dakota State University in 2003), Jack Connelly (Principal Wildlife Research Biologist, Idaho Department of Fish and Game), Tom Kirschenmann (Chief of Terrestrial Resources, SDGFP), and Andy Lindbloom (Regional Wildlife Manager in charge of grouse surveys, SDGFP, Pierre). These authors have been involved with grouse through research, surveys, teaching, observing, and hunting and have a deep interest and appreciation for these remarkable birds.

The book covers an array of topics including historical and current distribution, physical characteristics, behavior, mobility and habitat, nesting, brood rearing, survival, population monitoring, harvest statistics, hunting, habitat loss, and conservation. The book is loaded with striking photos of grouse and grouse habitats, to encourage interest by a broad readership. Even though the book is meant for a general audience, grouse specialists, wildlife administrators, conservation officers, ornithologists, and other wildlife professionals will find much of interest in this book.

As soon as published, the book can be ordered over the Internet at the South Dakota Department of Game, Fish and Parks website (<http://www.sdgfp.info/> under Online Shopping/Books, or under Publications). The cost of the book including shipping will be about U.S. \$15.00. Les Flake lives in Springville Utah and can be contacted at 801-491-0854 or e-mailed at LDFlake@Yahoo.Com.

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CONFERENCES

Gyrfalcons and Ptarmigan in a Changing World

International conference 1-3 February 2011 in Boise, Idaho, USA

This international conference will explore evidence for a range of environmental changes in arctic ecosystems affecting the Gyrfalcon, its competitors, and its prey, ptarmigan, waterfowl, seabirds and others, to predict effects and outcomes of global climate change, identify areas of uncertainty, and develop global strategies for measuring and mitigating them. We will publish a conference proceedings in what we expect will be a landmark publication of information, ideas, and strategies.

The conference will take place in the Simplot Ballroom at Boise State University in Boise, Idaho, USA, beginning on Tuesday 1 February and running through Thursday 3 February 2011. It will feature three days of invited and contributed scientific papers and posters, as well as strategy workshops and tours of The Peregrine Fund's World Center for Birds of Prey.

Convened by: The Peregrine Fund, Boise State University (the Raptor Research Center and the Biological Sciences Department), and the US Geological Survey (Snake River Field Station).

Important dates: Early Registration Ends 1 November 2010. Abstract Submission Deadline 1 November 2010. Draft Paper Submission Deadline 1 January 2011. Final Paper Submission Deadline 1 March 2011.

Registration fees: Early registration \$200 per person (on or before 1 November 2011). Regular registration \$300 per person (after 1 November 2011 and throughout the conference, as long as space is available). Closing Banquet on 3 February 2011 (optional) \$25 per person.

For more information see the conference website at http://www.peregrinefund.org/gyr_conference/, or contact at the following e-mail tpf@peregrinefund.org.



12th International Grouse Symposium, Matsumoto, Nagano Prefecture, Japan, 19-23 July 2011.

The Japan Rock Ptarmigan Meeting, the Institute of Mountain Science, Shinshu University, and Mountain city of Matsumoto are pleased to invite you to the 12th International Grouse Symposium to be held in Matsumoto, Nagano prefecture, Japan, 19th to 23rd July 2011. This symposium, which is held every three years, brings together grouse specialists and biologists from many countries from Europe, North America and Asia. The conference will be held in M-Wing Matsumoto city central public hall. The official language will be English.

Scientific program

The congress will focus on all aspects of grouse biology, research and management.

The Special themes will be:

Behavioral Ecology,
Grouse Genetics,
Population Dynamics and Monitoring,
Habitat and Landscape Ecology,
Conservation Biology and Wildlife Management,
Global Warming,
Grouse and their Habitats.



On Saturday afternoon 23rd July a bus tour in Matsumoto City for sightseeing and shopping. The city is a small historic castle town located at the foot of the Japan Alps.

Post Conference Tour

The post conference field trip will start on Sunday morning 24th July and return on the evening of 26th July. One field trip is to the North Japan Alps to observe the Rock Ptarmigan *Lagopus mutus japonicus*. You can see the tame Rock Ptarmigan and their cute chicks at close range. Another field trip is to Hokkaido to observe Hazel Grouse *Tetrastes bonasia vicinitas*. For more information see the website and also second announcement.

Important dates:

Second announcement: 30 April, 2010.

Deadline for intent to register: 30 Dec., 2010.

Deadline for abstract submission and Registration: 30 March, 2011.

Contact Persons

For general conference details contact:

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SNIPPETS

Interior Expands Common-Sense Efforts to Conserve Sage Grouse Habitat in the West

WASHINGTON, D.C. - The Department of the Interior will expand efforts with state, local and tribal partners to map lands that are vital to the survival of the greater sage-grouse. The greater sage-grouse warrants the protection of the Endangered Species Act but listing the species at this time is precluded by the need to address higher priority species first. The greater sage-grouse will be placed on the candidate list for future action, meaning the species would not receive statutory protection under the ESA and states would continue to be responsible for managing the bird. The sage grouse's decline reflects the extent to which open land in the West has been developed in the last century. Adding the species to the candidate list will allow the Fish and Wildlife Service and other agencies an opportunity to continue to work cooperatively with private landowners to conserve the candidate species. This includes financial and technical assistance, and the ability to develop conservation agreements that provide regulatory assurances to landowners who take actions to benefit the species. One such agreement was signed last month in western Idaho, encompassing an area of over half a million acres.

Bureau of Land Management Director Bob Abbey, whose agency manages more greater sage-grouse habitat than any other government agency, said that the BLM will today issue guidance that will expand the use of new science and mapping technologies to improve land-use planning and develop additional measures to conserve sage-grouse habitat while ensuring that energy production, recreational access and other uses of federal lands continue as appropriate. The BLM guidance also addresses a related species, the Gunnison sage-grouse, which has a more limited range, and which is in the process of being evaluated by the U.S. Fish and Wildlife Service to determine whether it also warrants protection under the Endangered Species Act.

Under the guidance, the BLM will continue to coordinate with State fish and wildlife agencies and their Sage and Columbian Sharp-tailed Grouse Technical Committee in the development of a range-wide key habitat map. This mapping project, which is not intended to replace individual State fish and wildlife agency core habitat maps, will identify priority habitat for sage-grouse within each of the western states and reflect this across the known range of sage-grouse. Greater sage-grouse are found in Washington, Oregon, Idaho, Montana, North Dakota, eastern California, Nevada, Utah, western Colorado, South Dakota and Wyoming and the Canadian provinces of Alberta and Saskatchewan. They currently occupy approximately 56 percent of their historical range.

If trends since the mid-1960s persist, many local populations may disappear within the next 30 to 100 years, with remaining fragmented populations more vulnerable to extinction in the long-term. However, the sage-grouse population as a whole remains large enough and is distributed across such a large portion of the western United States that Fish and Wildlife Service biologists determined the needs of other species facing more immediate and severe threat of extinction must take priority for listing actions.

The Service will review the status of the species annually, as it does with all candidate species, and will propose the species for protection when funding and workload priorities for other listing actions allow. Should the status of the greater sage-grouse sufficiently improve as a result of the efforts to be undertaken, the Service could determine that the protection of the Endangered Species Act is not needed.

For more information about the Service's finding on the greater sage-grouse, visit <http://www.fws.gov/mountain-prairie/species/birds/sagegrouse/>. [or <http://tinyurl.com/yjnsq71>].

For more information about the BLM's efforts to conserve sage-grouse habitat, visit http://www.blm.gov/wo/st/en/info/regulations/Instruction_Memos_and_Bulletins/national_instruction/2010/im2009-071.html. [or <http://tinyurl.com/ykrrq13>].

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Sage Grouse Listing Warranted but Precluded

On 5 March 2010 the Department of Interior (DOI) listed the sage grouse (*Centrocercus urophasianus*) as a candidate species for federal protection under the Endangered Species Act (ESA). The species is now designated as “warranted but precluded,” meaning that it meets the qualifications for listing under ESA but is outranked by species with more pressing conservation needs. The bird joins 249 other species with the same designation. “Warranted but precluded” species are assigned a ranking between one and 12; lower numbers indicate higher conservation concern. The sage grouse was assigned an eight. Under this status, Bureau of Land Management and the Forest Service can opt to treat the bird as endangered and consult the US Fish and Wildlife Service about potential projects in sage grouse habitat.

Soon after the announcement, the Western Watersheds Project (WWP) filed a legal complaint challenging the “precluded” finding. The complaint, filed in the U.S. District Court in Boise, claims that by determining other priorities outrank the sage grouse, DOI is in violation of the Administrative Procedure Act and the ESA. They claim that the decision is not based on science but is political and arbitrary.

The listing of the sage grouse as an endangered species could restrict development of traditional oil and gas, as well as alternative energy, in the west by increasing restrictions for projects on sage grouse habitat. The sage grouse is found in several western states but it is estimated that 54% of the population resides in Wyoming. The listing would protect large areas of the steppe ecosystem where the birds live and reproduce, including lekking grounds, considered core breeding areas essential to sage grouse survival.

Reprinted from: The Wildlife Society, Wildlife Policy News, Volume 20, Issue 2, April 2010, **Editor:** Laura M. Bies, **Reporters:** Emily Boehm, Joshua Kurtz, and Grant Sizemore
Sources: E&E Publishing, LLC (Greenwire)

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Comments to Sage Grouse Listing Warranted but Precluded.

"Although not all understand it, this decision means that the status of greater sage-grouse has changed, at least with respect to many decisions by federal management agencies. It also means that the U.S. Fish and Wildlife Service will annually assess the status of greater sage-grouse throughout the species' range, leading to greater federal oversight of the species and its habitats. This increased oversight strongly suggests that management decisions that affect greater sage-grouse will be more critical and must be more carefully considered than in the past with respect to sage-grouse conservation. If not, the end result could be another listed species. We expect this decision to at least maintain, if not increase, the relatively high level of interest by both resource professionals and the general public in sage-grouse conservation issues."

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Webmaster for Galliformes Specialist Group

Grouse Group member Michéle Loneux has agreed to act as the webmaster not only for the Grouse Group, but for the entire Galliformes SG. She is currently setting up the site. The domain name is galliformes-sg.org, the url will be www.galliformes-sg.org. The Grouse Group site that you are familiar with will be moved and will be available via the new website shortly.



Probably the largest Black Grouse *Tetrao tetrix* lek in Europe!

The Slītere National Park is located in the north-western part of Latvia and stretches along the coast of the Baltic Sea. Relief genesis in this territory is determined by the development and dynamics of the Baltic Sea at different stages – the Baltic Ice Lake, the Ancylus Lake and the Litorina Sea. Slītere National park is specially protected nature territory and is included in the Natura 2000 network of Special Areas of Conservation of European Union. The park covers 16360ha of land and 10130ha of the sea.

In 1992 the open part of the largest bog in Slītere, Bažu Bog (1880ha), burned out almost completely (the total area of burn was more than 3000ha), making the landscape more open than before. Black grouse *Tetrao tetrix* lek in Bažu Bog has been known since 1960s, when there was over 20 males, years later the number was constant – about 30 males. After burning in the 1992 the lek was not visited.

Only in year 2006, when I started to work in Slītere National Park, I visited the lek for the first time and on 17 April 2006 counted 29 males.

On 19 April 2007 28 males was counted, and 27 April 2008 there were 40 males, on 1 May 2008 – 30 males. On 19 April 2009 there were 66 males, and on 1 May 2009 – 62 males. When visiting the lek 16 April 2010 there were 35 males, 20 April 2010 43 males were counted, but in the evening of 26 April 2010 only 26 males were counted.

There are no difficulties of counting birds on the lek because it is possible to go up close to the lek along the open part of the bog without disturbing the birds and count them using binoculars. It should be pointed out that this year the number of birds counted in black grouse and capercaillie *Tetrao urogallus* leks has been smaller than in recent years. It is possible that the long and cold winter has affected grouse more than we can imagine!?

Taking into account that in Europe the number of black grouse is declining and leks of this size are not known, it may be of value if other observers could share the information about the largest leks of your countries.



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Review article on trends in grouse research.

In the last issue of *Wildlife Biology* (volume 16 2010) Robert Moss, Ilse Storch and Martin Müller published a paper on trends in grouse research. They have analysed the representation of species and topics in the titles of 2,788 papers published since 1930. The most frequently studied species before 1960 ruffed grouse *Bonasa umbellus*, willow ptarmigan *Lagopus lagopus* in the 1970s, changing gradually to black grouse *Tetrao tetrix* and capercaillie *Tetrao urogallus* became increasingly popular until they were the most-studied species in the 2000s. Biological research of the grouse family has become increasingly related to conservation. Going back to the 1990ties and earlier papers on disease, diet, behaviour and reproduction was dominating while more recent papers have more focus on conservation ecology. There is evidence that grouse are good umbrella species, meaning that good grouse management should benefit many other species and their habitats. As umbrella species, grouse would stand for an entire community, and so be much more likely to get political support for their conservation. To read the full article you may see:

Moss, R., Storch, I. & Müller, M. 2010. Trends in grouse research. – *Wildlife Biology* 16: 1-11.

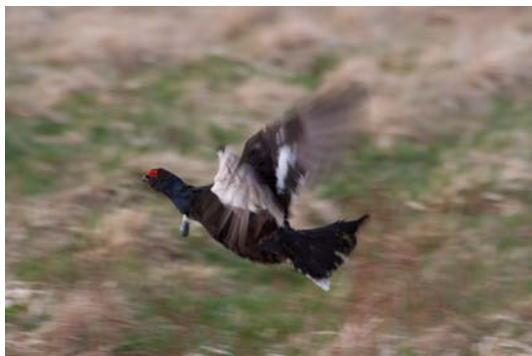
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Translocation under way to prevent extinction of the Röhn black grouse, Germany

With increased awareness of low genetic variability and potential inbreeding depression in remnant populations, release is currently re-gaining attention as a grouse population restoration measure: introduction of a few successful breeders might eliminate inbreeding depression, normalize hatching rates, and enable population growth.

In the Rhön mountains, a 3300 ha low mountain range in central Germany renowned for its open cultural landscape, black grouse have long been a symbol of nature conservation. As elsewhere in central Europe, the population crashed in the 1970s from several hundred to a few dozens of birds. Over the years, major efforts went into measures such as habitat improvement, predator control, and reduction of human disturbance. When in 2008 numbers of displaying cocks were down to <10 and genetic variability



of the population was shown to be reduced, conservation authorities considered translocation as last resort to prevent extinction. A feasibility study, however, came to the conclusion that the current extent of suitable habitat will not be able to sustain a viable population. Therefore, a translocation would only be justifiable according to the IUCN (International Union for Conservation of Nature) Guidelines for Re-introductions if a significant extension of suitable habitat to at least 5000 ha was guaranteed (Storch 2009, unpublished report for Government of Unterfranken District).

By now, efforts are under way to reach the 5000 ha goal. Authorities decided for a translocation of black grouse from Sweden. This April, the remnant population counted 4 cocks and 12 hens. On April 29 and May 1, 2010, an additional 9 cocks and 2 hens caught on a lek in Sweden were released; all but one were equipped with 16g VHF radio-transmitters. Torsten Kirchner, the black grouse biologist in charge, reported that the Swedish birds had stayed in the release area so far. There is hope that the first “international” black grouse chicks will hatch already this year, and strengthen the next generation of black grouse in the Rhön mountains.

The project is conducted by the „Wildland-Stiftung Bayern“, a Foundation of the Bavarian Hunters Association, and supported by the Government of the Unterfranken District (Regierung von Unterfranken). Permission has been granted for capture and release of 15 Swedish black grouse annually over a period of 5 years.

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The Mediterranean *Quercus pyrenaica* oak forest: a new habitat for the Capercaillie?

In late April 2010 an article describing an extension of the known distribution range of the Cantabrian Capercaillie *Tetrao urogallus cantabricus* into an atypical area and habitat for the species was published. Nine Capercaillie leks were found in Mediterranean *Quercus pyrenaica* forests with a total of 14 cocks. This population represents both the southern-most distribution for Capercaillie and the only one inhabiting Mediterranean *Q. pyrenaica* forests. The results suggest a wider adaptation of this (sub) species than previously thought. The full article is published online in Journal of Ornithology 25 April 2010.

González, M.A., Olea, P.P., Robles L. & Ena, V. 2010. The Mediterranean *Quercus pyrenaica* oak forest: a new habitat for the Capercaillie? – Journal of Ornithology. Online First. DOI 10.1007/s10336-010-0528-6.

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