GROUSE NEWS

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

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Contents

From the chair

Dear Grousers

The latest update of the IUCN Red List of Threatened Species has just been released. It shows that **17,291 species out of the 47,677 assessed species are threatened with extinction. In 2009,** 21 percent of all known mammals, 30 percent of all known amphibians, 12 percent of all known bird species are threatened with extinction. Among the taxa less completely studied, 28 percent of reptiles, 37 percent of freshwater fishes, 35 percent of invertebrates and 70 percent of plants assessed so far are under threat. *(For more information visit www.iucnredlist.org. There is a lot of excellent material!)*

Of the 9998 bird species currently described, 133 are EX (extinct) and 4 EW (extinct in the wild), and there are 192 bird species listed as CR (critically endangered), 362 EN (endangered), and 669 as VU (vulnerable). An additional 838 bird species is considered NT (near threatened). And how about grouse? With their huge distribution ranges, one would assume grouse to be less threatened that the average bird species. Not quite right: 16% (3 out of 19) are threatened. The Gunnison sage grouse *Centrocercus minimus*, which was recognized as distinct from the greater sage grouse only in 2000, is listed as EN (endangered) and thus, is the most threatened grouse species. The greater *Tympanuchus cupido* and lesser *T. pallidicinctus* prairie chicken are both listed as VU (vulnerable). An additional four grouse species are listed as NT (near threatened), the Chinese grouse *Bonasa sewerzowi*, Siberian grouse *Dendragapus falcipennis*, Caucasian grouse *Tetrao mlokosiewiczi*, and the Greater sage grouse *Centrocercus urophasianus*. The latter species all deserve close attention, because of decreasing populations and ongoing habitat loss and deterioration. The remaining 12 species of grouse are considered safe and are listed as LC (least concern).

Thus, slightly more grouse are considered threatened that the grand mean of all birds (12%). Yet, grouse are better off than most of their closest relatives. In the order Galliformes, 74 out of 288 species are threatened, accounting for a frightening 26% of all species. Many of our new colleagues in the Galliformes SG are looking to us for advice. The grouse are so much better studied than the other Galliformes; so the grouse group might have the recipes for successful conservation. Do we? We are probably fairly good when it comes to conservation science. Regarding our track record in conservation practice, I leave you with a quote from the recent IUCN press release:

*"The scientific evidence of a serious extinction cri*sis is mounting," says Jane Smart, Director of IUCN's Biodiversity Conservation Group. "*January sees the launch of the International Year of Biodiversity. The latest analysis of the IUCN Red List shows the 2010 target to reduce biodiversity loss will not be met. It*'s *time for Governments to start getting serious about saving species and make sure it's high on their agendas for next year, as we're rapidly running out of time."*

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CONSERVATION NEWS

2009-10 Scottish capercaillie survey
Steven Ewing

Population surveys of capercaillie in Scotland are undertaken at 5- to 6-yearly intervals, with previous surveys being conducted during the winters of 1992-94, 1998-99, and 2003-04. Such regular monitoring allows the conservation status of this red-listed species to be tracked. Census estimates derived from these surveys suggest that the population numbered 2200 individuals (95% CI: 1500-3200; Catt *et al*. 1998) in 1992-94, but that it declined substantially (51%) in the period until 1998-99, when the population was estimated at 1073 individuals (95% CI: 549-2041; Wilkinson *et al*. 2002). The most recent survey in 2003-04 implied that the population may have increased subsequently, with a population estimate of 1980 birds (95% CI: 1284-2758) being calculated. A fourth Scottish capercaillie survey is due to be carried out between November 2009 and March 2010.

The forthcoming survey, like those before it, will be conducted during the winter. Capercaillie are more detectable during this period as they forage in the forest canopy and are more readily flushed by observers, while winter surveys also avoid disturbing birds during the breeding season. Sampling of the Scottish capercaillie distribution during the survey will be based on line transect distance sampling. To define the starting point of the transects, a systematic 1.5km grid has been superimposed over the species' range, and a defined proportion of those points that fell within suitable woodland habitat selected. From each of these points, a 2km transect in the shape of an equilateral triangle will be walked along a random bearing, with a qualification being that the full transect should be contained largely within forest. Woodlands in the capercaillie's distribution have been allocated either to a primary or secondary stratum (defined on the basis of different expected densities), within which the sampling intensity differs. Our intention is to try to complete approximately 700 transects distributed across the species' range.

Several large-scale conservation initiatives have been implemented for capercaillie in Scotland in recent years, most notably the EU LIFE project 'Urgent Conservation Management for Scottish Capercaillie'. These have endeavoured to influence the fortunes of the species in Scotland through a combination of management practices, including marking and removal of deer fences, improvement of brood habitat, and targeted predator control. With the completion of the LIFE project in 2007, the forthcoming population survey affords a fantastic opportunity to assess whether such initiatives have been able to deliver any progress towards attaining the UK Biodiversity Action Plan Group target for capercaillie in Scotland.

The 2009-10 Scottish capercaillie survey is funded jointly the RSPB and Scottish Natural Heritage (SNH).

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Steven Ewing is a Conservation Scientist at the RSPB, working within the Species Monitoring and Research Section of the Conservation Science department. His primary role is co-ordinating national surveys of rarer bird species, including Capercaillie. He has worked closely with Tim Poole, the Capercaillie Project Officer, and James Gordon, the Woodland Grouse Project Manager, to set up the 2009-10 Capercaillie survey.

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Gunnison sage grouse reconsidered

The rare Gunnison sage grouse is being reconsidered for protection under the Endangered Species Act after being denied federal protection in 2006. The U.S. Fish and Wildlife Service (FWS) has until 30 June 2010 to decide whether to protect the bird, according to the terms of a settlement agreement with environmental groups and a county in Colorado. The 19 August settlement comes three years after the groups filed a lawsuit protesting the decision not to list the grouse.

The FWS 2010 decision will be an important one in species conservation, as there are only 3,500 breeding adults in the bird's remaining Colorado and Utah ranges, with some populations consisting of few as 10 individuals.

The Gunnison sage grouse is considered to be one of the most endangered birds in the country by the Audubon Society. A recent report, "The State of the Birds," identified sage grouse habitat (high desert grass and sagebrush) as among the most degraded in the country. As sage grouse habitat declines, population size, and dispersal suffer. While experts believe that at one point the bird inhabited much of the interior west, today the species is confined to southwestern Colorado and southeastern Utah. Habitat decline is due in large part to human land use practices such as housing and highway development, oil and gas drilling, livestock grazing and motorized recreation.

Sources: Center for Biological Diversity, Colorado Department of Natural Resources, E&E Publishing, LLC (Land Letter), State of the Birds Report.

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RESEARCH REPORTS

Inter-specific aggression between red grouse, ptarmigan and pheasant

Adam Watson

Fights or other aggressive encounters between grouse species or between grouse and pheasants have seldom been recorded. Below, I describe some encounters between red grouse *Lagopus lagopus scoticus* and ptarmigan *Lagopus muta*, and between red grouse and pheasants *Phasianus colchicus*. They throw light on inter-specific behaviour in relation to habitat.

Red grouse and ptarmigan

In Scotland, Gordon (1912) described red grouse and ptarmigan showing inter-specific aggression over patches of their food plant, ling *Calluna vulgaris*, in deep snow. When both species fed close together on days with deep snow in north-east Scotland, I reported occasional "brief disputes in which one bird avoids another or drives it from a patch of snow-free vegetation" (Watson 1972). These instances occurred when ptarmigan had left their usual alpine habitat above 760 m altitude and moved downhill into typical habitat for red grouse around 600–700 m, and when snow was not so deep as to cause the red grouse to leave. Most disputes were over small patches of ling projecting above the snow.

Out of a total of 33 such encounters that I observed on upper moorland near Braemar in Aberdeenshire (excluding repeated encounters by the same individuals within the observation period), a cock red grouse displaced a cock ptarmigan in 20 cases, both cocks withdrew in three, and a cock ptarmigan displaced a cock red grouse in 10. This suggests a slight advantage to red grouse, but all encounters were in habitat typical for red grouse, though atypical for ptarmigan. Cocks also displaced hens within species, and hens displaced hens within species, but I saw no instance where a cock (or hen) of one species displaced a hen (or cock) of the other species from food.

Each encounter usually lasted 1–2 seconds, during which one bird threatened and the other withdrew. If one was already at the food, it sometimes kept an approaching bird away by threatening, but withdrew if the other showed more aggression. Sometimes the threatened bird did not withdraw and an encounter lasting up to 5–10 seconds resulted, but this was unusual. Seven such brief encounters were on packed snow devoid of food, where birds came within about 0.5 m, and only two of these were won by red grouse. This suggests a slight advantage to ptarmigan, which in such a situation were far less conspicuous in their white winter plumage than red grouse in their dark feathering, and where the packed snow devoid of food bore more resemblance to alpine land than to moorland.

Watson (1972) noted that cocks of both species "sometimes interact when both have territories on the same area, with ground songs, flight songs directed towards a cock of the other species, and occasionally prolonged 'walking-in-line' encounters, facing and fighting". As in territorial interactions within species, encounters were fairly evenly matched, and no cock won in the sense of driving away the cock of the other species. All these territorial inter-specific encounters were in February–May.

An example was on 2 April 1964, when a cock ptarmigan and a cock red grouse 'walked-in-line' for two minutes, with much crowing on the ground and postures of attack intention and escape intention. This was at 750 m on Meall Odhar south of Braemar, where alpine and moorland zones meet. When disturbed by me, the two cocks flew off together but separated a few seconds later. On the nearby hill the Cairnwell at 750 m on 1 May 1965, I saw a cock grouse and a cock ptarmigan giving an aerial song each, in response to one another. The grouse responded to the appearance of the ptarmigan about 50 m away on the hillside below, by flying towards the ptarmigan, whereupon the ptarmigan then flew towards the grouse. After a minute when both stood alert at 9 m apart, they walked away at the same moment. In this case, the territorial cock grouse and the territorial cock ptarmigan occupied the same ground.

An interesting autumn case was at Meall Odhar on 17 September 1988, a year when both species occurred at high density there. Encounters took place on the lower third of the slope, where small patches of tall ling that afforded habitat for red grouse occurred like islands in the midst of short vegetation suitable for ptarmigan habitat. All ground below held tall ling suited to red grouse, and all ground above was entirely ptarmigan habitat. While I watched a loose flock of 14 ptarmigan of both sexes, some feeding and some resting, six standing ptarmigan cocks gave frequent crowing calls indicating attack intention, three of them made brief song flights and then rejoined the flock, and several at times showed 'jumping' (Watson 1972).

A cock red grouse on a ling-covered hillock surrounded by ptarmigan habitat walked up to a hen ptarmigan, which ran out of his way. At once a cock ptarmigan, croaking loudly in a song flight, flew towards the cock red grouse. As soon as the cock ptarmigan started his song flight, the cock red grouse ran off the hillock top into a groove where it crouched submissively. The cock ptarmigan walked away, evidently having not seen the crouching red grouse. Next the cock red grouse rose from the groove and gave a beck on the ground. The ptarmigan immediately ran to the spot, whereupon the cock red grouse walked away without pursuit by the ptarmigan, and did not return.

Red grouse are con-specific with willow grouse. In an Alaskan hill valley where willow grouse and ptarmigan occupied territories on the same area, Moss (1972) recorded interactions between cocks of the two species shortly after they had taken territories in spring. Interactions ranged from a cock responding to a call by another cock, to one case of fighting. On all nine occasions when Moss could decide a clear outcome, a willow grouse dominated a ptarmigan, although on four of them the ptarmigan initiated the dispute. In this case, however, willow grouse could take territories sooner because their habitat at lower altitude became snow-free earlier, whereas ptarmigan tended to take temporary territories close to willow grouse until the snow had melted on the higher ground. Hence it could be argued that ephemeral conditions of habitat caused ptarmigan to be less aggressive than they might have been if the alpine land higher up had been snow-free.

Willow grouse and red grouse are larger and heavier than ptarmigan in the same region. However, although cock and hen black grouse *Tetrao tetrix* exceed the size and weight of cock red grouse, cock red grouse dominated cock and hen black grouse in 11 out of 12 observed encounters in the wild on moorland in north-east Scotland (Parr, Watson & Moss 1993). In Glen Esk I once saw a captive cock red grouse being put into a nearby greyhen's cage in a garden during April 1960. He immediately attacked and pecked the greyhen, which crouched in a submissive posture and died within a minute, presumably of shock.

Red grouse and pheasant

Aggression by a bird displacing a bird of another species from food is fairly common, such as with passerine species at garden bird-tables and other situations with copious food. At Kerloch moor near Banchory, west of Aberdeen, I observed five such encounters between cock red grouse and cock pheasants on oat-ricks in fields adjacent to moorland. The red grouse was victor in four.

Also at Kerloch I observed a prolonged encounter between a cock red grouse and a cock pheasant on 14 April 1964. This was at 150 m altitude on a part of the moor that adjoined fields and that was completely occupied by red grouse territories, but also held two cock pheasants and two hens. The pheasants were usually in two patches of tall ling mixed with tall rushes (*Juncus effusus* and other tall *Juncus* species) or in tall bog myrtle *Myrica gale* with rushes. On this occasion the two cock pheasants had been together in an aggressive encounter on short ling for 20 minutes. They were still showing threat postures, and as they walked stiffly on to a prominent rise in the ground, a back-tabbed cock red grouse which had a territory there flew in, becking loudly as he landed, and at once attacked the cock pheasant that was the nearer of the two. He chased the pheasant for the next 11 minutes, continually attacking it and giving loud calls signifying attack and attack intention. The pheasant ran on, frequently jumping out of range, but five times flew away for 5–10 m after strong attacks.

It also turned to face the red grouse five times, giving a purring call that cock pheasants use in aggressive encounters, and showing a threat posture with its tail raised and body lowered. The two then fought, beating their wings and jumping off the ground, but although the pheasant removed a feather from the red grouse's breast, it withdrew each time. It next flew 50 m towards the centre of the red grouse's territory and was again attacked. Finally it flew 150 m to land at least 100 m outside the red grouse's territory, in the bog where it usually lived. The cock red grouse also flew to land becking loudly near the pheasant, outside the grouse's previously observed territorial boundary. That red grouse clearly had an advantage, even though the cock pheasant was bigger.

Meanwhile the second cock pheasant had crept out of sight in tall ling and crowed loudly when it had gone 100 m away from the other two birds. The first pheasant answered the call immediately, but no further interaction with a red grouse took place, although the two pheasants were now in places within the territories of two cock red grouse.

Moorland is marginal for pheasants, which occur there at low density and only in places with good cover from mires with tall rushes *Juncus* spp., patches of young trees or scrub, or tall ling. Such places are usually little frequented by red grouse in winter and spring, although they are often within the territories of cock red grouse. Red grouse often go to rushy mires with their small young, but rarely show territorial behaviour in summer except at dusk and dawn. Interestingly, two hen pheasants nested in ling swards only 15 cm high, even though taller rushes and ling abounded nearby.

Conclusion

A high proportion of inter-specific aggressive encounters involving grouse species involved the two species not being tested for dominance in a neutral situation, because of differences in habitat. There was interesting evidence suggesting that the outcome of such encounters may be associated with the habitat in which the encounter takes place, rather than by inherent behaviour where one species always dominates another. Of course a bird living in typical habitat for the species is likely to be more dominant or in better physical condition than a bird of the same species in atypical habitat. Likewise this may help explain why it is likely to be at an advantage over an individual of a different species in the same atypical habitat. The hypothesis could be tested by other observations now and in future.

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Ecology and conservation of the Cantabrian capercaillie inhabiting Mediterranean Pyrenean oak forests. A new Ph. D. project.

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Capercaillie *Tetrao urogallus* is usually considered a conifer forests dweller depending on bilberry (Storch 1993, 1995, Selås 2000, 2001). However at the southern limits of its distribution some populations inhabit deciduous forests, with the most representative in the Cantabrian Mountains, northwest Spain. In this area the Cantabrian capercaillie subspecies is found *Tetrao urogallus cantabricus* that is isolated, endangered and listed as the most endangered subspecies according to the IUCN criteria (Storch et al. 2006). As elsewhere Cantabrian capercaillie has been closely related to bilberry (Castroviejo 1975, Martínez 1993, Obeso & Bañuelos 2003) and mainly inhabiting beech *Fagus sylvatica*, birch *Betula pubescens* and sessile oak *Quercus petraea* montane forests (Quevedo et al. 2006). However, in 2000 a remnant nucleus of this subspecies was discovered in the Mediterranean region bordering the Eurosiberian region at the very southern slope of the Cantabrian Mountains (42° 39'N) inhabiting Pyrenean oak *Quercus pyrenaica* forests.

Half of the total area is forested. Dominant forests are natural (more than 50 years old) and post-fire Pyrenean oak interspersed with Scots pine *Pinus sylvestris* plantations (less than 50 years old). Pyrenean oak covers 25,483ha (30%), Scots pine plantations 11,132ha (10%) and heather *Erica australis*, grassland and riparian lowland forest occupy the rest of the natural landscape. Bilberry *Vaccinium myrtillus* is completely absent or too scarce (<0.5% of the total ground cover of the forest) to be considered as a key resource for capercaillie as it is in other populations in the Cantabrian Mountains (Blanco-Fontao et al 2009) and elsewhere (Storch 1993, Selås 2003). This almost complete absence of bilberry may have important consequences for the ecology of this population. However, opposite to the general declining Cantabrian trends (see Bañuelos & Quevedo 2008), this capercaillie nucleus seems to have been relatively stable since it was discovered. It is supposed to constitute close to 10% of the total Cantabrian capercaillie population which makes this population an important conservation target for the Cantabrian capercaillie future. In addition this population could now be the southernmost distribution limit of capercaillie in the Western Palaearctic, since the population of the Greece in Mount Athos might have become extinct (Xirouhakis pers. com.).

However, this Mediterranean capercaillie population may become threatened because of the current wind power projects. Seven wind farms are presently being developed in the area, 3 of them are finished and 4 in working process. No legal protection regulations protect this area and it has not been contemplated in the Recovery Plan for Cantabrian Capercaillie (Junta de Castilla y León) as suitable habitat. Consequently this original habitat is completely unprotected against any threat in the form of big human infrastructures such as wind farms. Because of its peculiar habitat in the Mediterranean region make it will be of great interest to study the ecology of this population to implement locally adapted and effective conservation measures (Blanco-Fontao et al. 2009).

A PhD project is being developed on this Mediterranean capercaillie nucleus focusing on its ecology, population trends, habitat selection and human disturbances, especially related to wind power development in the area.

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Pyrenean oak Quercus pyrenaica *forest with capercaillie presence April 2009*

Capercaillie habitat in the Pyrenean oak forest

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The long-term evolution of Cantabrian mountain landscapes and its possible role in the capercaillie drama.

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Within the Iberian Peninsula, at the south-western boundary of its distribution area, the capercaillie is restricted to the Cantabrian and the Pyrenean Mountains. Cantabrian capercaillie *Tetrao urogallus cantabricus* has undergone a dramatic decline during the last three decades, as reported in the last Iberian Survey (Robles et al. 2006) and in previous issues of Grouse News (Bañuelos et al., 2004, 2008). As a consequence, it is currently the only subspecies of capercaillie critically threatened worldwide.

Although considerable efforts have been made to understand the reasons of this decline, the long-term ecology of this subspecies has received little attention, due probably to the absence of data in the palaeozoological records. Nevertheless, palaeoecological information based on their habitats can provide a useful insight that in the case of the Cantabrian Mountains offers a large body of data that covers the forest history of the last thousands of years.

Cantabrian landscapes over time: the history of pinewoods during the Holocene

It is traditionally assumed that this subspecies is the only one, all over the capercaillie's range, adapted to live during the whole year on non conifer forests, mainly of beech *Fagus sylvatica*, birch *Betula pubescens*, sessile oak *Quercus petraea* and Pyrenean oak *Q pyrenaica*. However, it still persists in the few remaining natural pinewoods and uses regularly recent pine afforestations over the range. Furthermore, accumulating evidence suggests that the role of conifers in the landscape of the Cantabrian range was much more important than today. The compilation of the available palynological data and the analysis of new macrofossil sites support a wider distribution area for pine *Pinus sylvestris* over the Holocene, registering regional and recent extinctions in Cantabrian environments. Today, great difference is shown in precipitation and temperature between the northern and southern slopes of the range, defining the Atlantic-Mediterranean biogeographical boundary in northern Iberia. Oceanic influence is greater in the western areas and in the northern slopes of the cordillera while in the inner slopes submediterranean conditions determine the existence of important differences on vegetation.

Patterns of pine decline were therefore roughly marked by the previous climatic framework. Western and northern deposits reflect changes in vegetation from the onset of the Holocene, when sudden changes occurred and the expansion of hardwoods rapidly affected conifers. However, under drier, subcontinental locations, pines were able to endure until the late Holocene in several areas of the range. During the late Holocene (last 3500 BP) an intense anthropogenic activity (including the extensive use of fire) seems to be the major cause responsible for the regional extinction of pinewoods in different sites of the cordillera. Today, only some stands and scattered pine trees persist over the southern slopes (the best known of them is the Lillo pinewood).

Taking into account the historical information it therefore seems more than plausible that pines and capercaillie were geographically linked at least during part of the Pleistocene and the whole Holocene (last 10000 years) and this fact also fit quite well with the long-isolation model obtained from the genetic analysis of both species that support a coupled history of long term isolation and evolution in the Iberian territories (Chedaddi et al. 2006, Duriez et al. 2007).

Further, beech forests, nowadays the major tree species of the habitat of the capercaillie in the northern slopes of Cantabrian mountains (Quevedo et al. 2006) did not develop in the area until ≈4000 yr BP (Magri et al 2006). It is also surprising that while globally capercaillie prefer (at least during the snow-free season) habitats with open and well-lit spaces and moderate canopy coverage (see e.g. Storch 2007), beech forests offer the shadiest and most dense canopied forests in the cordillera. This could be explained by: i) climatic and physiographic factors and a long-term (millennial scale) anthropogenic disturbance reduce capercaillie's habitat availability to montane environments where beech found the best niche to prosper during the late Holocene; ii) during the last decades, rural depopulation and subsequent abandonment of traditional land use systems are responsible of a severe change in the beech forest structure. The end of an intense anthropogenic activity (including tree-felling, pruning and livestock management) that maintained unusually open beech forests, favoured the densification and disappearance of open areas; iii) in an important part of existing beech forests that are today occupied by capercaillie, forest structure is highly limited by abiotic factors (such as poor soils, high slopes, regular occurrence of snow damages) and permits the existence of open areas with a dense ground cover of bilberry, more typical of a birch forest structure; and iv) in most parts of the beech forests, capercaillie preferentially uses open areas, and when they do not exist, the timberline zone relegating dense forest areas just for refuge. In summary, the arguments cited above can well explain the reasons why capercaillie was so abundant in beech forests and that this fact may not be linked with the species itself.

Pine-capercaillie interactions: do winter diet and tree sheltering counts as key factors for the survival of marginal populations?

Western capercaillie is closely associated in the major part of its range with conifers (Storch 2007). Some authors have explained this connection by the importance of needles in the winter diet and the use of trees as refuge under extremely adverse meteorological events. Early research on capercaillie in Iberian environments already pointed out that winter was a crucial period affecting the survival of the species over time (Castroviejo 1975). Snow cover considerably limits the availability of ground food and consequently alternative food resources are in trees. Rodríguez & Obeso (2000) analysed the peculiarities in the diet of Cantabrian capercaillie. With the exception of the few individuals living close to the relict pine stands of the southern slopes and other pine plantations, capercaillie are forced to include other evergreen trees (such as holly *Ilex aquifolium*) or buds and other parts of deciduous trees (such as beech) in their diet. An interesting conclusion of the study is that their winter diet varies widely depending on the food availability. Secondly, this irregularity may be a limiting factor as predation risk increases for capercaillie feeding in deciduous forests compared to those feeding on coniferous needles.

Tentatively, we focused on the connections between those two species and we presented briefly this association in Rubiales et al (2008). Even if we strongly agree with the main conservation threats and measures already proposed for the Cantabrian populations, we discuss the idea that the absence of conifers in the enclaves best conserved might aggravate the status of capercaillie in these marginal areas of its distribution range.

The consequences of this fact could be far from being trivial. On the one hand, studies of habitat selection have only been achieved on the northern (Asturian) slopes of the range. Although these studies are extremely useful and interesting *per se*, they remain biased since the southern slopes (notably different from northern slopes and more suitable for well restored pine landscapes) were not included. Researchers should therefore be urgently encouraged to continue investigations in that sense. On the other hand, population re-enforcement targets, management focusing habitat amelioration and priorities for conservation related to the capercaillie could include a more open perspective in which pines can be incorporated as precious elements of these mountain ecosystems. As an example of this lack of conscience, the Cantabrian relics of pine are not included as habitats of European interest in the Habitats Directive (although some of them are fortunately protected with regional laws)

Implications for management

During the decades between 1940 and 1970 one of the forest policies that were extensively developed in Spain was the conifer afforestation, which was primarily defended by the administration by their benefits to protect disturbed soils from erosion. This large-scale afforestation policy was certainly accompanied by conflict over the social and environmental effects of plantations. Some prominent people from both the scientific and conservationist communities expressed concerns over the impacts of pine afforestation that took root in social contexts and ended up questioning the autochthonous nature of pines and their role in the forest dynamics of Iberian environments. Fortunately, palaeoecological and historical data are scientifically contributing to solve this debate, but the inertia of the previous ideas certainly exist and part of a misinformed society still shows contempt for pine forests. It would be a misfortune if these prejudices prevented to include and understand the role of the pines in the ecology of Cantabrian capercaillie, and the opportunity that can represent for their recovery.

Theoretical models and ongoing observations on Cantabrian capercaillie are not hopeful, as the extinction of the whole population is envisaged in the near future. Furthermore, the environmental anthropogenic change is now quickly adjusting selection pressures on biological communities and makes predictive forecast even more pessimistic. However, there are still reasons for hope, since surveys does not reflect constant decreasing trends in all of the discrete Cantabrian populations (Robles et al. 2006) and experiences abroad (such as those from Scotland, Kortland 2004) also show that patterns of recovering of populations are possible. It is evident that the decline in Cantabrian capercaillie is not a simple issue and that species-habitat relationships are often highly complex but necessary to assess conservation planning. In our case, the link between pines and capers should not be considered as an attempt to simplify the problem but, on the contrary, to integrate and seek, above all, any of the available solutions that may contribute to the recovery of these populations. What is clear is that the palaeoecological information available proves that pines were an important part of the ecological system in the cordillera during the last millennia and that until present there is no sign proving that capercaillie did not use pinewoods in the past. Further, the scarce data available indicate that pine was probably widely used and that its disappearance could have been a key factor in the long-term.

From the perspective of the management of the species, it would be a mistake to pose the question in the form of whether or not the capercaillie need pinewoods to survive, even at the large-scale. The important question now is whether pine presence ever actually helps southern capercaillie to recover, at least in some of it populations. The experimental information that is being recovered from several areas in León is highly positive in that sense.

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We are grateful to Mario Quevedo and Rolando Rodríguez for contrasting opinions, to Ilse Storch, Siegi Klaus and Tatiana Pavlushchick for their help in obtaining data from other marginal areas and to César Morales for their comments on early versions of the note. Palaeoecological investigations of our team are currently supported by the projects CGL-2006-02956/BOS, CGL-2008-06005/BOS and the Junta de Castilla y León.

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Estimating the stage of incubation for nests of greater prairie-chickens using egg flotation: a float curve for grousers

Lance B. McNew, Andrew J. Gregory, Samantha M. Wisely, & Brett K. Sandercock

Introduction

Researchers often require accurate estimates of incubation stage for back-calculating the timing of nest initiation or predicting the date of hatching to capture young, to determine the durations of egg-laying, incubation and the construction of breeding phenologies, and to calculate nest productivity. Estimates of nest age are also critical for assessment of the influence of temporal variation in nest survival, and to model daily nest survival as a function of individual- or time-specific covariates (Dinsmore et al. 2002). For example, the timing of nest losses is often related to nest success and the probability of renesting (Schroeder 1997, Pitman et al. 2006, McNew et al. in press). Egg flotation is one of the most common methods employed for estimating stage of embryo development with egg flotation-development relationships documented for many species of birds (Hays & LeCroy 1971, Dunn et al. 1979, Fisher and Sengel 1991, Custer et al. 1992, Brua & Machin 2000, Liebezeit et al. 2007). To our knowledge, there are no published techniques to estimate stage of incubation for nests of grouse. Field biologists estimating stage of incubation for eggs of grouse nests have often used a modified version of an egg flotation technique developed for captive ring-neck pheasants *Phasianus colchicus* and gray partridges *Perdix perdix* (Westerskov 1950, Martin & Cooke 1987). It is unknown whether egg flotation can be used to accurately assess age of grouse nests under field conditions. As part of a larger study on the breeding ecology of greater prairie-chickens *Tympanuchus cupido;* (hereafter 'prairie-chickens'), McNew et al. (in press) developed a regression model to accurately predict the stage of incubation for nests from egg flotation angles and egg buoyancy.

Methods

Prairie-chickens were captured with walk-in traps and drop-nets at leks during March–May of 2006–2008 at three study sites in eastern Kansas, USA (Schroeder & Braun 1991, Silvy et al. 1990). Females were fitted with radio transmitters and located via triangulation ≥4 times/week during the nesting period (April–July), and daily once it was determined from movement patterns that a female was nesting. Once a female had localized in an area for 3 successive days, we located and flushed the bird so that the eggs could be counted and the nest location recorded with a GPS unit. Females with nests were monitored daily from a distance of >100 m. Nest sites were revisited during incubation to assess clutch size and incubation stage.

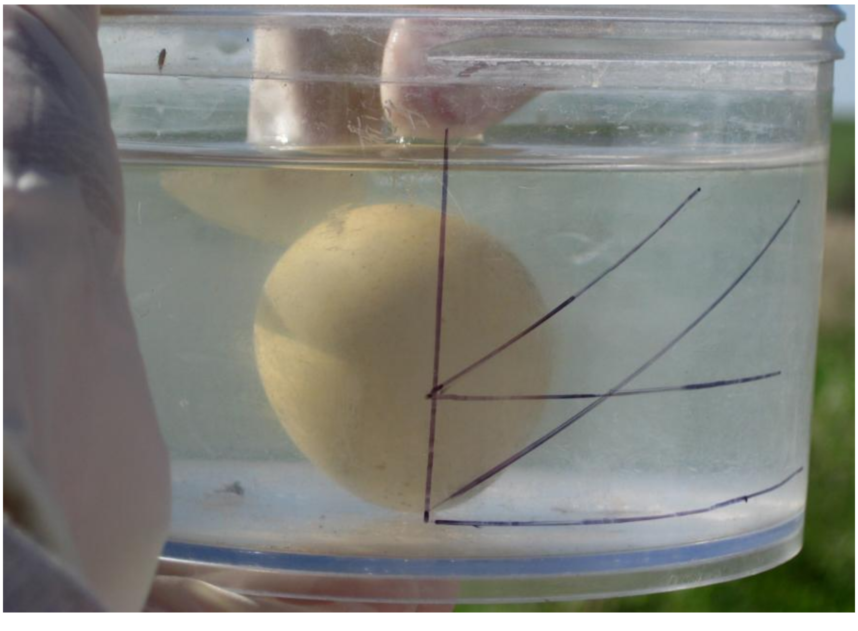

Figure 1. Estimating the float angle or height of a greater prairie-chicken egg. This egg is floating at ~90° and is not yet buoyant.

To evaluate the relationship between egg buoyancy and stage of incubation, we restricted our analysis to nests of known age. Known-age nests included nests discovered during egg-laying and nests that successfully hatched. We collected the clutch from the nestbowl and retreated to a distance of >100 m to float the eggs in a small, clear container of lukewarm water (Figure 1). If an egg touched the bottom of the container, the angle between the bottom of the container and the center axis of the egg was measured. If the eggs floated freely in the water, the distance between the top of the egg and the surface of the water was measured. We used linear regression to evaluate the relationship between float angle and the age of the clutch in days (after Liebezeit et al. 2007). We converted egg angles to proportions (P = angle/90°) before transforming them to the logit scale. Values of 0 and 1 cannot be logit transformed, and we set angles of 0° and 90° to 1° and 89°, respectively, before transformation. Proportional angles were transformed to logits by:

$$\text{logit } P = \ln [P / 1\text{-}P].$$

We then used linear regression to assess the relationship between the logit-transformed proportional float angles and days of incubation. For nests where eggs floated above the bottom of the cup, linear egression was used to predict the day of incubation from float height; measured as the distance between the surface of the water and the top of the egg (in mm). The predictive ability of regression equations was assessed by subtracting the nest age in days of incubation from the predicted age for each nest on a given day. The absolute mean deviation ± SE was used as the statistic of model error. Deviations were plotted against embryo age to illustrate model precision. Finally, interspecific error was compared between float curves developed for prairie-chickens and curves developed for Ringed-neck Pheasants by Westerskov (1950). All statistical analyses were conducted using Program SAS (ver. 9.1, SAS Institute Inc., Cary, NC).

Results

We collected float data from 68 clutches of known age. Mean float angle was estimated for eggs of 62 clutches found early in incubation. Average float height between the top of the egg and the water surface was measured for six clutches where eggs were floated above the cup bottom. Logit-transformed egg angle was a significant predictor of embryo age in early incubation (< 14-d old; r^2 = 0.56, P < 0.001; Figure 2):

$$\textit{Day of Incubation} = 3.25 + 1.19\ (\textit{logit } P).$$

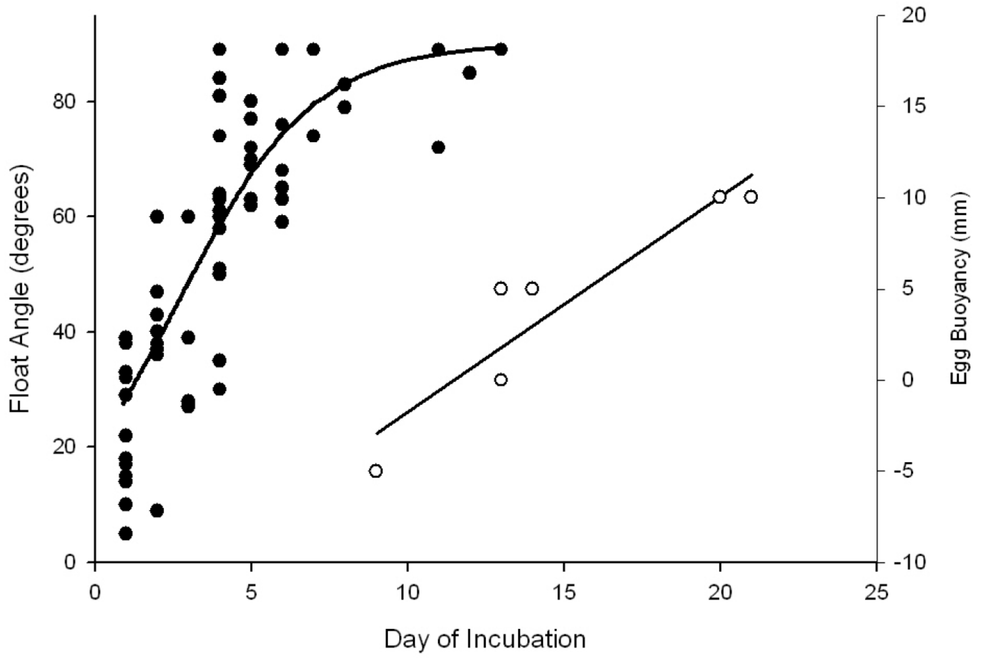

Figure 2. Egg angle (filled circles) and egg buoyancy (open circles) for prairie-chicken nests of known age that were floated during incubation. Egg buoyancy refers to distance from the top of the egg to the surface of the water (in mm).

The mean deviation (± SE) between actual embryo age and predicted embryo age was 0 ± 0.24 days and the 90th percentile of the predicted error for the early-mid incubation period was <9% (± 2 days). Model error was greater for clutches floated during mid-incubation (10-14 days) and was ± 4 days from predicted values. For clutches floated late in incubation (>14 d), linear regression analysis revealed a significant relationship between egg buoyancy and stage of incubation ($r^2 = 0.86$, $P = 0.007$; Figure 2):

Day of Incubation = 12.0 + 0.73 (*Float Height*)

Mean deviation of model predictions for the late incubation period was ± 1 day.

Discussion

Egg floatation was an accurate indicator of stage of incubation for prairie-chicken clutches and had good levels of predictive power. Using data on egg angle and egg buoyancy and regression techniques described by Liebezeit et al. (2007), we found that 90% of prairie-chicken nests could be aged to ±1-2 days if the clutch was floated early or late in incubation (<10 or >14 d). Error was greater (± 4 d) for clutches floated during mid-incubation (10-14 d), due to greater variability in egg buoyancy in a smaller sample of clutches. This study is the first evaluation of egg floatation as a means to estimate the stage of nest incubation for prairie grouse, and extends float curves developed for other species of upland gamebirds (Westerskov 1950). Use of float curves developed for pheasants and partridge consistently overestimated the age of clutches of Greater Prairie-Chickens by an average of ~2 days and the magnitude of the error increased with stage of incubation. We expect that our float curves should provide improved estimates of incubation stage for the nests of other grouse. However, grousers would be prudent to calibrate these float curves by collecting egg flotation data from their own known-age nests to account for potential interspecific variation the effects of egg size on buoyancy and rates of embryonic development.

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Status of Missouri greater prairie-chicken populations and preliminary observations from ongoing translocations and telemetry

Brent E. Jamison & Max R. Alleger

Introduction

Greater prairie-chickens *Tympanuchus cupido* once ranged throughout the native prairies of central North America, from southern Canada to Texas (Schroeder & Robb 1993). Previous work estimated that greater prairie-chickens (prairie-chickens) numbered up to 1 million individuals across Missouri's tallgrass prairie and open savannahs prior to European settlement (Bennitt 1939, Mechlin et al. 1999). Populations peaked following the elimination of bison herds and as newly plowed prairie was converted to agricultural crops that provided a concentrated food source (Bergerud & Gratson 1988). This peak was soon flattened by market hunters and the loss of habitat as additional prairie was eliminated or fragmented by trees.

Missouri's populations followed the continental trend and, in 1907, prairie-chickens became the first Missouri species to be protected from hunting. Since the 1940s, prairie-chicken populations have been monitored by using counts of displaying males on leks during spring. Their decline continued in sync with the decline of prairie habitat. These declines were temporarily ameliorated by grass plantings established under a government cropland set-aside program in the 1960's, but have continued since 1970's. Conversion of tallgrass prairie to other cover types, associated fragmentation, and increases in the amount and distribution of woody cover were assumed to be the primary causes of long-term trends. Additionally, the widespread planting of tall fescue *Schedonorus phoenix* for livestock forage decreased the value of private grazing lands as prairie-chicken habitat. By 1984, Missouri's prairie-chicken population had dropped to an estimated 5000 to 6000 birds (Cannon & Christisen 1984). Just 5 yrs later in 1989, the population had declined to about 3000 birds (Missouri Department of Conservation, unpublished data). These declines led to the development of multiple recovery plans for the species that outlined habitat acquisition and management strategies as well as research needs. Each new species recovery plan received partial implementation. Tracts of existing grassland were acquired from willing sellers and the best available information guided land management. Recent products of research included Master of Science theses from three students (Burger 1988, Jones 1988, McKee 1995). Despite these actions, the population declined to as few as 500 birds by 2006. Extirpation of greater prairie-chickens from Missouri was imminent without immediate, significant and sustained action.

In 2006, we formed a team to develop a 5-yr action plan to stem the decline of prairie-chickens in Missouri (Missouri Department of Conservation 2006). The plan defined priority landscapes for increased habitat management emphasis, established estimated minimum area requirements for habitat conservation and restoration, and identified areas where research could meet information needs. During plan development, the team identified one landscape in west central Missouri that met minimum habitat requirements but was not currently occupied by prairie-chickens. Subsequently, the team developed a strategy for translocating prairie-chickens from stable populations in neighboring states to reestablish birds in that area.

Experienced habitat management staff developed management strategies and identified research needs. Although numbers of active leks and total numbers of displaying males were thought to be useful indices of population change, these metrics were best suited to monitor responses to management at large spatial scales (i.e., landscapes). Monitoring lek populations was not sufficient to inform management at the local scale because effects of local management action are confounded with landscape factors (Svedarsky et al. 2003). Thus, although local management actions were contributing to population growth rates, their effectiveness could not be evaluated solely by using existing data and methods. Subsequently, the team began a telemetry study with the eventual goal of evaluating the impact of patch-burn grazing (Fuhlendorf & Engle 2001) and other management practices on habitat use, nest success, or brood survival. Additionally, we identified the need for documenting the habitat use and fate of translocated birds that we released to establish a breeding sub-population.

Our management goals included acquisition of new land for conservation and improving habitat conditions on existing conservation properties. Additionally, we sought to increase the value of privately owned lands by encouraging and sharing the cost for the removal of woody vegetation, converting invasive cool-season grasslands to cover types more attractive to wildlife, and planting cropland to perennial grasses through government subsidized farm programs. Our monitoring objectives were 1) update the population index for greater prairie-chickens in Missouri, 2) document habitat use and survival of resident and translocated prairie-chickens, and 3) locate and monitor nests of resident and translocated hens.

Methods

Population surveys

Annual counts of birds along standard survey routes were continued to assess state-wide and local populations. In 2008, we continued focused habitat management, began translocations of birds, and initiated monitoring efforts in two landscapes (Figure 1). Patch-burn grazing management units had been established at both the Taberville site and the Wah'Kon-Tah site in 2005 and new units began 3-yr rotations in 2008. These patch-burn grazing treatments were applied to areas that had been traditionally used by prairie-chickens.

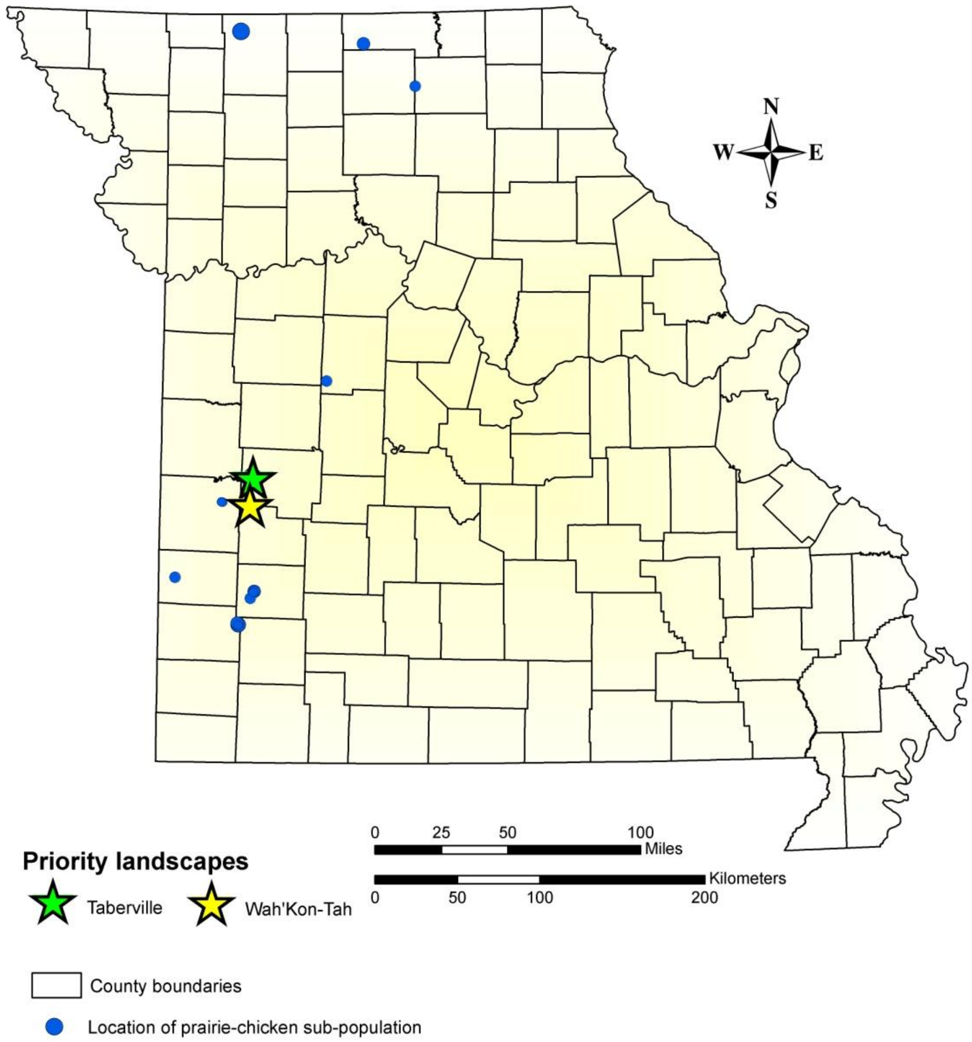

Figure 1. Locations of priority landscapes where management and monitoring were conducted in Missouri during 2008 and 2009.

Habitat use and translocation

At Taberville, we captured and radio-marked native resident birds in a remnant population. Translocated birds were radio-marked prior to their release at Wah' Kon-tah. We located radio-marked birds regularly to assess survival, dispersal and habitat use.

To document habitat use by radio-marked birds, we mapped cover types within about 1.5 km of existing booming grounds at the Taberville site and within a similar distance of release sites at Wah'Kon-Tah. Within each cover type, we delineated management unit boundaries and recorded the management practice(s) that were applied to each unit. We located birds by using truck-mounted null-peak receiving systems. Locations of the receiving unit were determined using GPS and azimuths to transmitters were determined using an electronic compass (Cox et al. 2002). Locations were estimated using Location of a Signal software (LOAS 2004) on a laptop computer as azimuth data were collected in the field.

With the cooperation of the Kansas Department of Wildlife and parks, we captured birds in the Smoky Hills region of central Kansas for translocation to Missouri. Translocations were conducted in two stages each year in 2008 and 2009. Males and females were first captured on booming grounds during spring by using walk-in traps or drop-nets. Males were radio-marked and transported by car (about 4 hours in transit) to the release site (Wah'Kon-Tah) on the day that they were captured. Females were radio-marked and released at the capture site in Kansas. We returned to recapture females and their offspring in late summer. These hens and juveniles were captured at night and transported to the release site the following morning.

Survival and nesting

We divided the year into 2-wk observation intervals and determined counts of individuals at risk and those that died during these intervals. Data for males were analyzed for the period of 1 April 2008 through 31 March 2009. Survival of hens was estimated for 1 August 2008 through July 31 2009. Data were analyzed using the known-fate module in program MARK (White & Burnham 1999).

Nesting hens were located via telemetry. When locations of hens occurred in the same place for three consecutive days, we approached hens on foot and confirmed that they were nesting. We flushed hens from nests once to determine clutch sizes and measure vegetation and did not revisit the nest site until the nest had hatched or failed as indicated by the location of the hen.

Results

Since the writing of the species recovery plan in 2006, MDC and its Missouri Grasslands Coalition Partners have acquired 1800 acres (728 ha) for conservation of grassland plants and wildlife statewide. Partnerships with cooperating private landowners have resulted in habitat improvements on properties adjacent to protected conservation lands across all prairie-chicken recovery geographies identified in the recovery plan. Scattered trees were eliminated from 2700 acres (1093 ha) and 31 miles (50 km) of hedgerows were removed to restore fragmented landscapes. Nearly 1200 lbs of native seed collected from prairies on conservation lands were used to seed 2800 acres (1133 ha) of prairie restoration.

Population surveys

Analyses of survival and habitat use are ongoing. Current population indices, early observations of habitat use, and preliminary results of survival and nest monitoring follow. In 2006, we compiled information from ongoing population surveys. These surveys monitored sub-populations in northwestern and north-central Missouri as well as the majority of the state's population that occurred in isolated flocks associated with the prairie remnants of southwestern and west-central Missouri (MDC unpublished data). By spring of 2009, the estimated statewide population had declined to less than 100 individuals, and the population index derived from counts of birds on booming grounds along standard survey routes had plummeted to all-time lows (Figure 2).

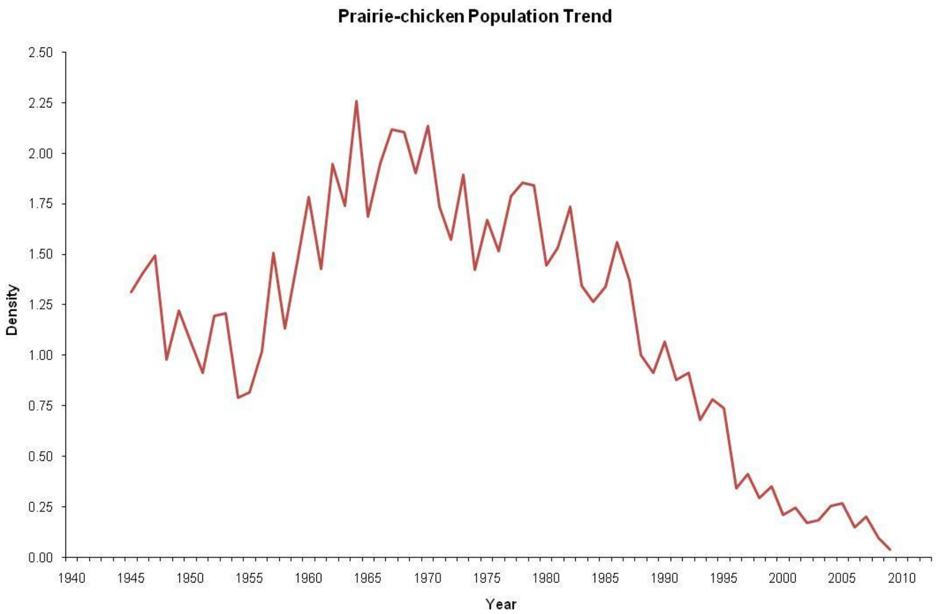

Figure 2. Population index (birds/100 ha) for greater prairie-chickens in Missouri, 1945 through 2009.

Habitat use and translocation

We captured and marked 20 native birds (13 males and 7 females) at Taberville in 2008 and 2009 (Table 1). In those same years, we captured over 400 prairie-chickens in Kansas (Table 2) and translocated 94 males, 48 adult hens, and 54 juveniles. We released 45 males in spring 2008 and then released 24 adult hens and 27 chicks in summer 2008. In 2009, we released 49 translocated males during spring and followed that with an additional 24 hens and 27 chicks in summer. All males and adult hens were radio-marked but juveniles released in summer were too light to carry transmitters sized for adults.

Table 1. Numbers of juvenile (J) and adult (A) greater prairie-chickens captured at Taberville Prairie during the breeding season during March and April, 2008 and 2009.

	Sex				
	Males		Females		
Year	J	A	J	A	Total
2008	3	5	0	5	13
2009	2	3[a]	0	2	7
Total	5	8	0	7	20

[a] Includes 2 recaptures of males first captured in spring 2008 and the capture of 1 male that was translocated from Kansas to Wah'Kon-Tah Prairie in 2009.

Males released at Wah'Kon-Tah in 2008 dispersed up to 42 miles (67 km) from the release site; we documented a maximum dispersal distance of 36 miles (58 km) in 2009. Dispersal distances were shorter for females. Of the 24 hens released in 2008, only 2 dispersed from the Wah'Kon-Tah release site. These individuals joined birds at Taberville 11 miles (6.9 km) from the release site the spring following their release.

Table 2. Numbers of juvenile (J) and adult (A) greater prairie-chickens captured on booming grounds in Kansas during March and April, 2008 and 2009.

	Sex						
	Males			Females			
Year	J	A	U[a]	J	A	U	Total
2008	54	77	6	22	36	4	199[b]
2009	65	77	4	17	43	0	206[c]
Total	119	154	10	39	79	4	405

[a] Age unkown
[b] Includes 45 males translocated to Wah'Kon-Tah Prairie in 2008 and 7 males that died during transport
[c] Includes 49 males translocated to Wah'Kon-Tah Prairie in 2009 and 1 male that died during transport

We mapped cover types and management treatments for over 5927 acres (2399 ha) for 2008 at the Taberville site. Of that area, 1692 acres (685 ha; about 29%) were owned and managed for wildlife and plants by the Missouri Department of Conservation (MDC). The remaining 4235 acres (1714 ha) were privately owned and used for crop production, grazing, hay harvest, or were wooded lands that were primarily idle. We mapped 9304 acres (3765 ha) of habitat at Wah'Kon-Tah. About 3067 acres (1241 ha; about 33%) were owned by either The Nature Conservancy or MDC and were managed by MDC for native wildlife and plants. The remainder was privately owned land that was used similarly to the private lands adjoining Taberville.

We estimated annual survival and documented habitat use only for those birds marked and released in 2008 because less than one year has passed since the 2009 releases. We recorded radio locations most frequently in native tallgrass prairie remnants or diverse native plantings managed for wildlife conservation by MDC. Radio-marked birds used cropland extensively at Taberville (Table 3), but a large number of radio locations were those of males that displayed on a booming ground in a crop field adjacent to native prairie (Figure 3). Similarly, a small planting of alfalfa and clover mowed to a height of 3 to 6 inches (8-15 cm) at Wah'Kon-Tah was used extensively by the translocated males that were released there (Table 4). As expected, radio-marked prairie-chickens made only limited use of tall fescue pasture and hayfields at Taberville and Wah'Kon-Tah (Figures 3 and 4).

Table 3. Major cover types and percentage of the 526 radio locations that occurred in each cover type at Taberville in 2008.

Cover Type	% of total area	% of locations
Prairie	30.1	67.5
Crop	23.3	24.3
Fescue	18.5	4.9
Wooded	10.6	1.3
Pond	0.3	0.6
Brome	0.4	0.4
Tree removal area	1.2	0.4
Prairie trails	1.1	0.2
Prairie/Fescue	9.8	0.2
Native grass planting	3.0	0.2

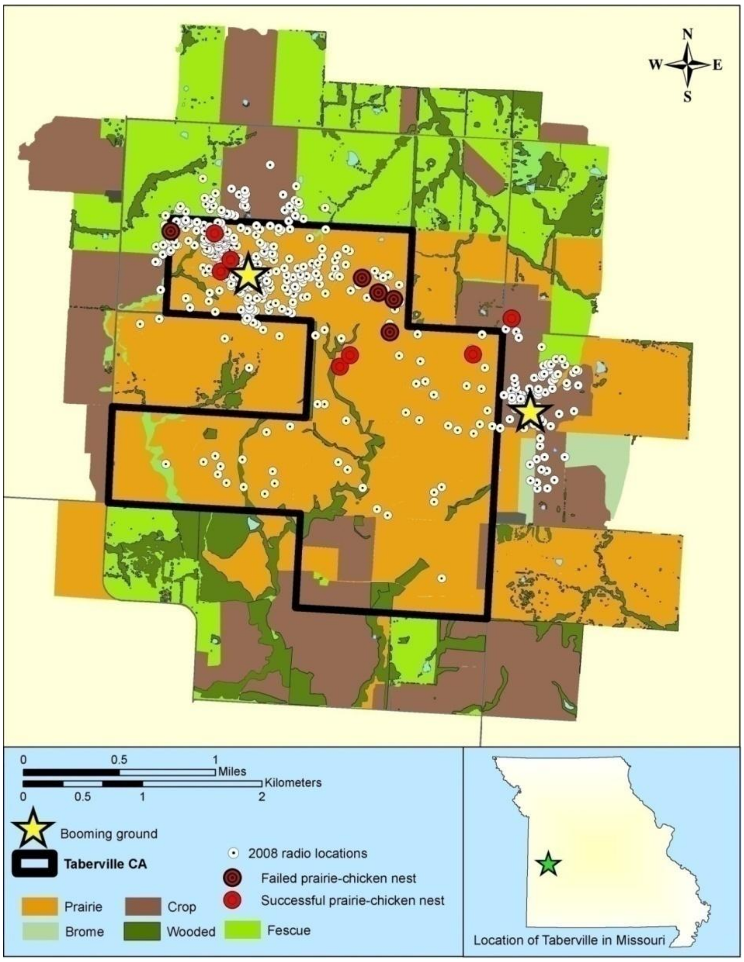

Figure 3. Use of major cover types by native resident prairie-chickens at Taberville during 2008.

Table 4. Major cover types and percentage of the 1888 total radio locations that occurred in that cover type at Wah'Kon-Tah in 2008.

Cover Type	% of total area	% of locations
Prairie	29.0	59.6
Prairie restoration plantings	7.8	13.0
Alfalfa/Clover	0.2	11.4
Fescue	24.0	7.7
Wooded	23.3	3.1
Prairie/Fescue	7.0	3.0
Prairie trails	0.1	0.7
Native grass planting	1.0	0.7
Shrub	3.7	0.3

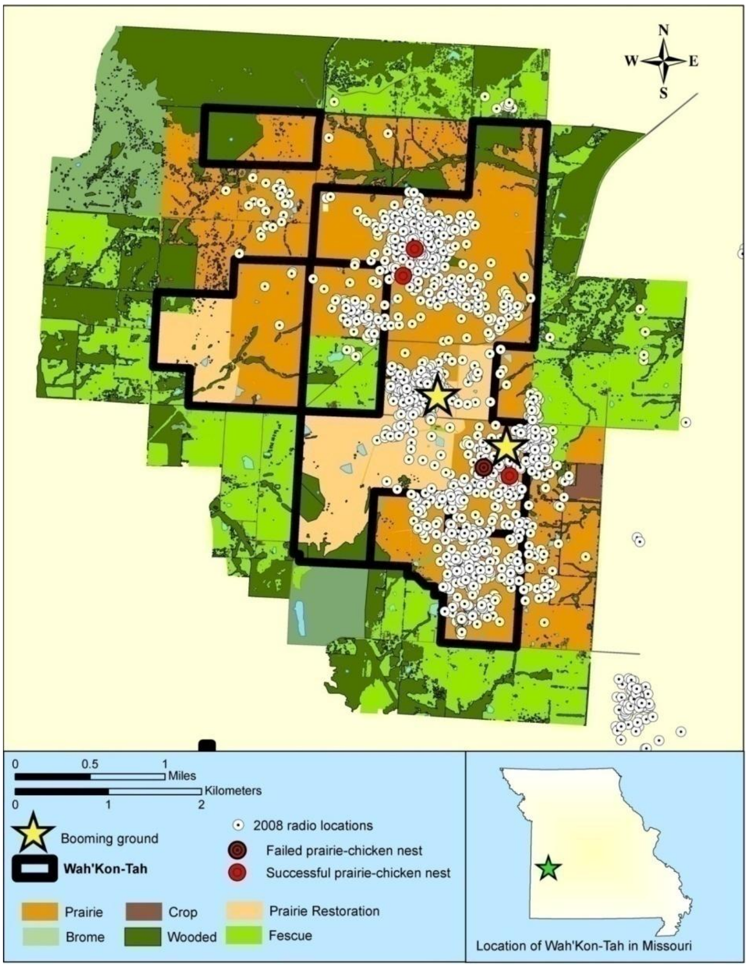

Figure 4. Use of major cover types by translocated prairie-chickens at Wah'Kon-Tah during 2008.

Areas on Taberville and Wah'Kon-Tah that were managed with patch-burn grazing received disproportionately high use. Patch-burn grazing management units at Taberville comprised about 9% of the landscape but accounted for 39% of the radio locations in 2008 (Figure 5). Similarly, translocated birds at Wah'Kon-Tah used patch-burn grazing units about 34% of the time, but these areas comprised only 6% of the landscape (Figure 6). Though these results should not be equated with that from a formal analysis, they serve as meaningful observations on which to base future hypotheses.

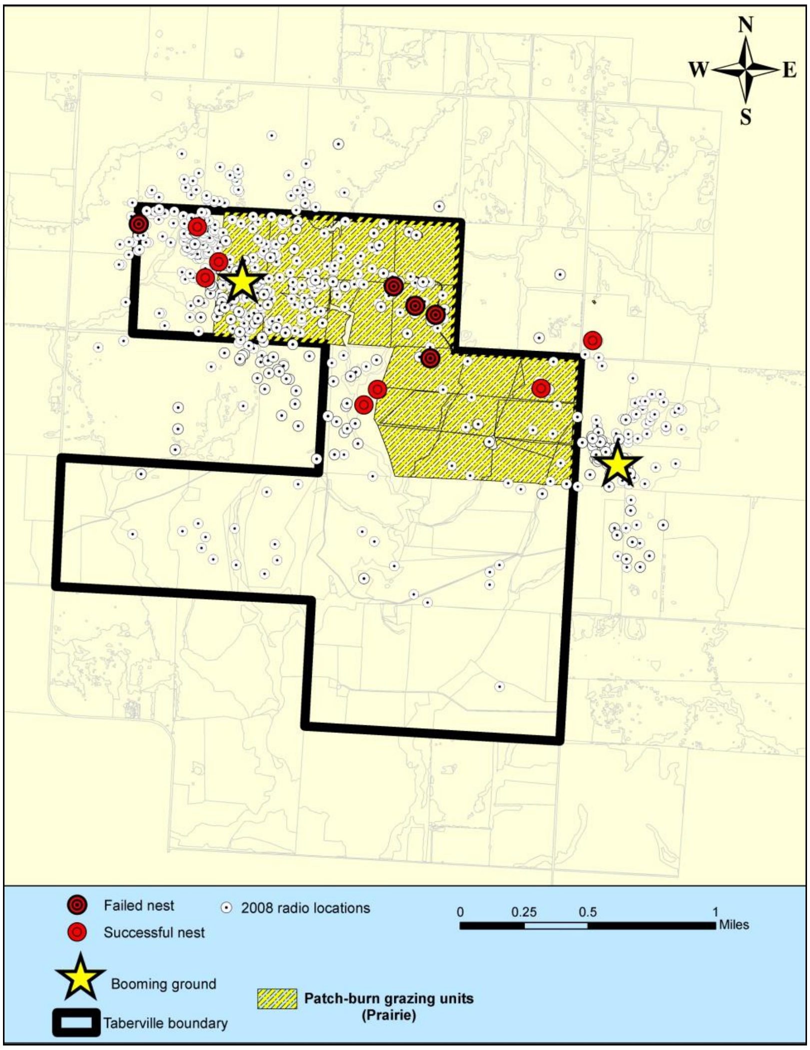

Figure 5. Use by native resident prairie-chickens of native tallgrass prairie remnants managed with patch-burn grazing at Taberville during 2008.

Survival and nesting

Ten of 45 males released in late March of 2008 survived one year following their release. Estimated annual survival of translocated males was 22% (95% CI = 12–39%). Annual survival of native resident birds captured and marked at Taberville was 29% (95% CI = 7-67%). Four of 24 translocated adult hens (17%) released in 2008 survived one year (95% CI not available). Survival of resident hens was only 20% (95% CI = 3-69%). Early observations of males and females released in 2009 suggested that survival was higher and dispersal lower than that in 2008.

In 2008 and 2009, we located and monitored 16 nests of radio-marked hens. Twelve nests (8 first nests and 4 renests) were located at Taberville and 4 nests (all first nests) were found at Wah'Kon-Tah. One of the nests at Taberville and all of the nests at Wah'Kon-Tah were initiated by translocated hens. Ten (63%) of the 16 nests hatched. Half of the first nests and 3 of the 4 renests were successful at Taberville. Three of the 4 nests of translocated hens at Wah'Kon-Tah succeeded and chicks in one brood were known to have survived at least 60 d after hatching. Hens selected nest sites in native prairie remnants in all but one case where a hen initiated a nest in green wheat that was approximately 28 inches (70 cm) tall at the beginning of incubation.

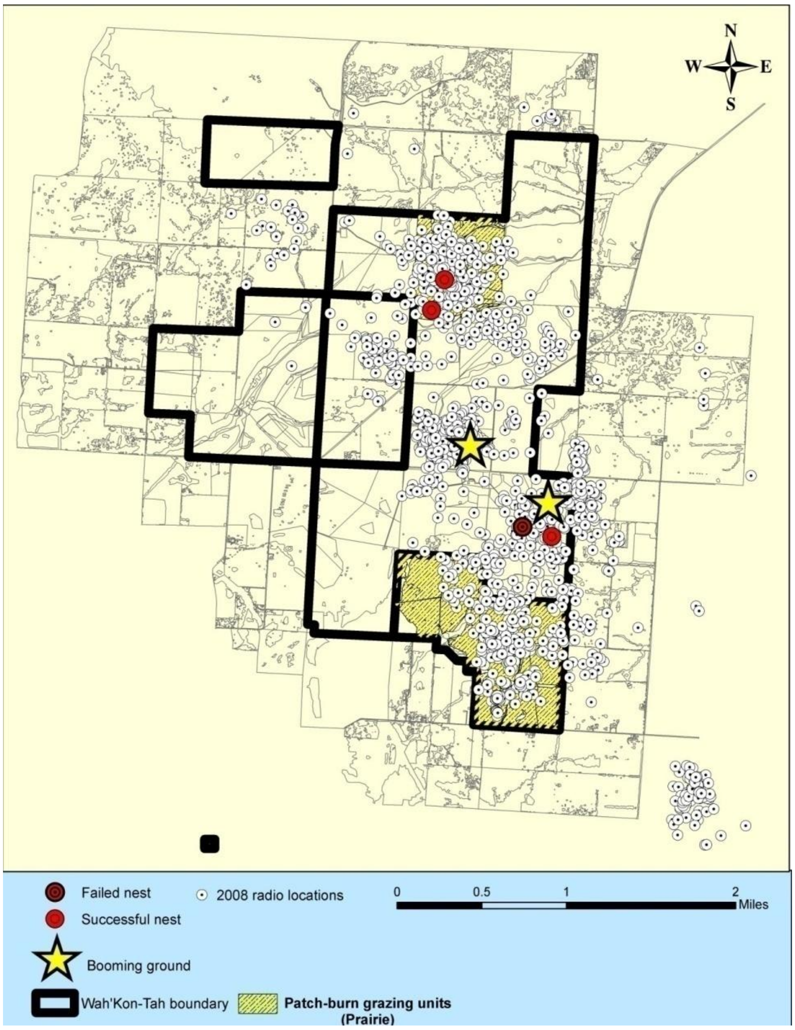

Figure 6. Use by translocated prairie-chickens of native tallgrass prairie remnants managed with patch-burn grazing at Wah'Kon-Tah during 2008.

Discussion and summary

Habitat acquisition, private land habitat improvements, and ongoing prairie reconstruction work have contributed to conservation of open lands and grassland-obligate wildlife species. Efforts to encourage habitat improvement on private lands immediately surrounding Taberville and Wah'Kon-Tah, however, have yielded limited results.

Greater prairie-chicken populations are at record lows in Missouri. The limited suitable habitat currently managed by MDC at Taberville and Wah'Kon-Tah may not be sufficient to sustain a population given the degree of habitat fragmentation, and the isolation of existing sub-populations.

Our observations suggest that birds make limited use of private lands adjacent to intensively managed areas. Native prairie is the only suitable habitat in the Taberville and Wah'Kon-Tah landscapes that is available in sufficient quantity to contribute to population growth. Restoration plantings at Wah'Kon-Tah will add useable space to the landscape and aid in efforts to reestablish a population at that site. Patch-burn grazing units in native prairie are used extensively, but interpretation of this result would be premature because the areas chosen for treatment with this management practice were selected based on their perceived value as traditionally occupied prairie-chicken habitat. In coming years, management staff plan to initiate patch-burn grazing in tracts of native prairie that currently receive little use by prairie-chickens to determine if prairie-chickens respond positively to this management practice. The influence of topography on habitat selection also cannot be ignored. Though low-lying portions of conservation lands were used when populations were greater, the remaining birds have tended to use primarily the highest ridges in the landscape.

Dispersal movements of translocated birds often ended with mortality, but 8 translocated birds settled in suitable habitat with nearby subpopulations. Four translocated birds (2 males and 2 females) were known to have joined native resident birds at Taberville and 4 other translocated males joined a small flock of native resident birds that inhabit a smooth brome *Bromus inermis* planting outside of the mapped area about 10 miles (16 km) west of Wah'Kon-Tah. Survival of translocated birds was not drastically lower than that of resident birds that remained in the landscape where they were captured. However, estimates of annual survival were lower than expected for resident birds and may suggest that poor survival of adult prairie-chickens is playing a larger role in population declines than anticipated.

Though we did not calculate corrected estimates of nesting success, apparent nest success exceeded 60%. We expected much lower nesting success given the abundant and diverse predator community in the small fragments of remnant tallgrass prairie. High nesting success and low survival presents different challenges than the converse. Managing adult mortality may prove more difficult than managing habitat to increase nesting success. Observations of broods conducted at regular intervals after hatching suggest that chick mortality is also substantial.

Intensively managed habitat on conservation lands comprises the majority of habitat supporting remaining birds at Taberville and Wah'Kon-Tah. Efforts to increase the amount of suitable habitat on public conservation lands and through establishment of new grass and forb plantings, and improvement of habitat on private lands will play a large part in determining the fate of the prairie-chicken in Missouri. Translocated birds will likely succeed in reestablishing a population at Wah'Kon-Tah but their long-term security will hinge on connecting that population with Taberville.

Acknowledgement

Prairie-chicken population surveys were completed by dozens of volunteers and employees of MDC and partner conservation organizations. Survey numbers have been compiled annually by a number of grouse biologists in MDC, most recently Larry Mechlin. The 5-yr action plan was developed and implemented by Steve Clubine, Kathy Cooper, Steve Cooper, Len Gilmore, Sharron Gough, Emily Horner, Brent Jamison, Frank Loncarich, and Justin Pepper under the lead of Max Alleger. Current monitoring would not have been possible without the dedicated efforts of nearly 100 individuals in MDC and other organizations who conducted trapping in Missouri and Kansas. Telemetry data were gathered by temporary staff under the supervision of Aimee Wiese and public land management staff. Aimee completed cover type mapping and coordinated the majority of monitoring field activities. Tom Kulowiec wrote database queries for survival analyses. We thank public land management staff including Len Gilmore and his able work crew at Taberville and Wah'Kon-Tah, and Steve Clubine whose influence on grassland habitat management in Missouri has been instrumental in making certain that conservation lands are managed based on the best available information. Steve also coordinated a large portion of the translocation effort. Jim Pitman, Randy Rodgers and other staff of the Kansas Department of Wildlife and Parks allowed the capture and translocation of birds from their fine state. The Nature Conservancy holds ownership of 80% of the Wah'Kon-Tah Prairie and allowed release of translocated birds. This effort was funded, in part, by a Fish and Wildlife Conservation Grant administered by the USDA-Natural Resources Conservation Service.

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Estimating greater sage-grouse fence collision rates in breeding areas: Preliminary results

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Introduction

Collision mortality is a widespread and relatively common phenomenon among European grouse species (Catt et al. 1994, Bevanger 1995b, Moss et al. 2000). Collision with deer fences is a major source of mortality for capercaillie *Tetrao urogallus* in Scotland (Catt et al. 1994, Baines & Summers 1997), and may be contributing to population declines of that species (Moss 2001). Red grouse *Lagopus lagopus scoticus* and black grouse *Tetrao tetrix* appear to be more common collision victims in Scotland than capercaillie, however, the population consequences for these species are not believed to be as severe (Baines & Summers 1997, Baines & Andrew 2003). Similarly, collisions are a common source of mortality for capercaillie, black grouse, and ptarmigan *Lagopus* spp. in Norway (Bevanger 1990, 1995a, Bevanger & Brøseth 2004), and collision mortality may even approach harvest mortality in some areas (Bevanger 1995b).

Research concerning the relative extent and impacts of collision mortality on North American grouse are limited. Wolfe et al. (2007) studied mortality patterns of lesser prairie-chickens *Tympanuchus pallidicinctus* in Oklahoma and New Mexico, and found 39.8% of all mortality in Oklahoma was caused by collisions with fences. Additionally, Beck et al. (2006) found 33% of the mortality of juvenile greater sage-grouse *Centrocercus urophasianus* on an Idaho study area was caused by collisions with power lines.

Existing research into factors influencing avian collision mortality suggests collision may be influenced by biological, landscape, and habitat features (Bevanger 1994), however, results often vary by species or region (Baines & Summers 1997). For example, Bevanger (1995a) suggested male capercaillie and black grouse have a higher probability of collision than females due to their increased size. In contrast, female lesser prairie chickens were more susceptible to collision mortality due to their increased movement patterns during the breeding season (Wolfe et al. 2007). Other biological factors influencing collision risk include high wing loading and heavy body weight (Bevanger 1998, Janss 2000), as well as factors such as vision (Bevanger 1994), crepuscular or nocturnal activity patterns (Avery et al. 1978), and local or migratory movement patterns (Avery et al. 1978, Malcom 1982). In addition to the possible influences of biological factors, collision mortality in grouse may be influenced by the structure, type, and height of surrounding vegetation (Bevanger 1990, Bevanger & Brøseth 2004), season of year (Catt et al. 1994, Bevanger 1995b), topography (Bevanger 1990), and local bird densities (Baines & Andrew 2003, Bevanger & Brøseth 2004). Furthermore, some authors have found evidence for collision "hot spots" where mortality is concentrated (Bevanger & Brøseth 2000, Baines & Andrew 2003), while others have not found evidence for clumped collision distributions (Baines & Summers 1997).

Recent concerns involving the impacts of elevated infrastructure on greater sage-grouse (hereafter sage-grouse) in Idaho have brought to our attention the lack of empirical data concerning collision frequency of most North American grouse species. The spatial extent of fences and other elevated structures has increased dramatically in shrub-steppe habitats during the last 50 years (Connelly et al. 2000, Connelly et al. 2004), and their potential impact on sage-grouse has not gone unnoticed (Braun

1998, Connelly et al. 2004). Few studies on any grouse species have evaluated factors influencing collision rates across multiple spatial scales, and no studies on sage-grouse have estimated fence collision rates or evaluated factors influencing these rates, further limiting our knowledge of what influences collision risk across the landscape. For these reasons, we pursued this research with the following objectives: 1) estimate collision rates of sage-grouse with fences in sage-grouse breeding habitats, and 2) evaluate the influence of biological, topographical, and fence characteristics on collision rates across multiple spatial scales in sage-grouse breeding habitats.

Study Area

Fence collision surveys in sage-grouse breeding habitats occurred across 4 large geographic regions of southern Idaho (Figure 1). The number and distribution of active leks varied among sampling areas, and the sampling areas were spread across approximately 475 km in southern Idaho. Elevations on sampling areas ranged from 1450-2000 meters. Habitat types on the sampling areas varied from large stands of big *Artemisia tridentata*, low *Artemisia arbuscula* or mixed sagebrush types, to large grasslands, and large heavily grazed pasture and burned areas, and therefore were representative of the variety of habitat conditions on southern Idaho rangelands.

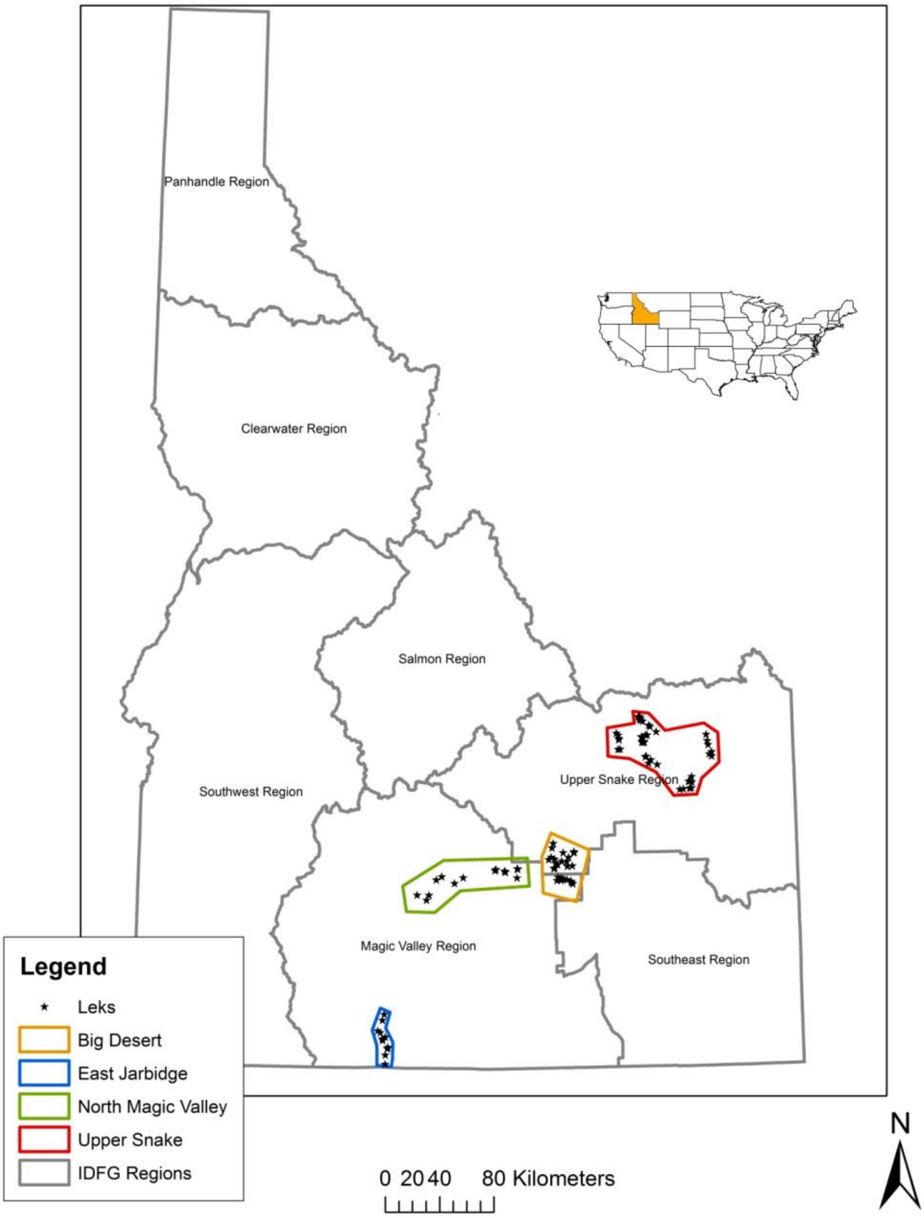

Figure 1. Distribution of sage-grouse lekking areas used in avian fence collision surveys during the 2009 field season.

Methods

We used a cluster sampling approach to estimate collision rates in sage-grouse breeding habitat (Scheaffer et al. 2006). Specifically, 16 lek routes monitored by Idaho Department of Fish and Game were selected for inclusion in the study based on accessibility and known breeding bird use. Once lek routes were selected, global collision rates were estimated using stratified cluster sampling framework (Scheaffer et al. 2006). Specifically, each lek in the route with ≥ 1 displaying male documented the previous year (2008) was buffered by 1.5 km using ArcGIS software. Once each lek on each route was buffered a 1x1 km spatial grid was superimposed over the buffered leks within each route using ArcGIS software, and the grid cells that contained U.S. Bureau of Land Management's (hereafter BLM) pasture boundary layer were used to define the sampling frame. Pasture boundaries were used as our surrogate for fence. Once the sampling frame was defined for each lek route, a stratified cluster sample of 1x1 km grid cells was randomly selected using the Hawthe's Tools (Beyer 2004) extension in ArcGIS. We allocated the sample of 60 grid cells to each stratum in proportion to the number of cells in each stratum. Sixty cells were selected as the overall sample size because we assumed this was the maximum number of cells that could be sampled in a month given time and logistical constraints. A month time period was used to facilitate repeat sampling necessary to incorporate temporal variability in lek dynamics. Furthermore, within each strata collision rates were estimated using a 1-stage cluster sampling framework (Scheaffer et al. 2006), and all collision rates were expressed as the number of collision sites per linear kilometer of fence.

Within randomly selected cells all fence sections (sampling elements) were searched for fence collision victims using 1-2 searchers (1 on each side of the fence, or 1 searcher sampling each side in turn). We digitized fence segments located inside our spatial sampling units but not previously identified with the BLM pasture boundary layer using handheld GPS units and ArcGIS software.

We defined a collision as detection of a whole carcass or a feather pile (> 5 feathers) within 15 m of the fence, or detection of feather tufts stuck in the barbed-wire fence. We were cautious when only feather sign was detected, and if an apparent raptor plucking post was present we did not call these collision locations. Given this definition of a fence collision the only victims not accounted for would involve birds flying into fences and leaving no feathers either in the fence or on the ground, and no carcass, or those where evidence was removed prior to sampling by scavengers or weather. Feather tufts and piles were counted as collisions with no knowledge of the fate of the collision victim. Therefore, our estimates are of the number of collision sites present at the time of the survey, and not of collision mortalities, as we had no way to assess the crippling bias caused by individual birds flying into fences and dying at a later time or in a different area (Bevanger 1999). Furthermore, this estimate is likely biased low due to an unknown detection probability for collision evidence in sagebrush-steppe habitats.

Biological, topographical, and fence characteristics were recorded at each collision site. Random points were selected on each study area for site scale analysis of factors influencing collision, to assess the significance of features recorded at collision locations. Specifically, one spatial location for each collision victim found on each study area was randomly generated within the sampling frame using the Hawthe's Tools extension (Beyer 2004) of ArcGIS software, and the closest fence segment to this location on the study area was used to measure site-scale variables that will be used in modeling.

Preliminary Results

We sampled fence in sage-grouse breeding habitats from approximately 5 March – 19 May 2009. A total of 66.2 km of fence were sampled in 16 lek routes. However, the 6 lek routes in the Upper Snake sampling area were all sampled twice during the breeding season, and the 2 lek routes in the East Jarbidge sampling area were sampled 3 times as they were the only routes accessible early in the breeding season. All other routes were sampled once each due to logistical and time constraints.

We detected 62 avian collision sites, including 36 known sage-grouse, 24 unknown species, and 2 western meadowlarks *Sturnella neglecta*. Additionally, 24 of the 62 collision locations found during the breeding season were not found in randomly selected sampling units but while walking or driving through the study areas, and therefore were not used in collision rate estimation. Thus, estimates were generated with 27 known sage-grouse and 11 unknown species collision sites. Feather samples from all unknown avian collision victims were sent to the feather identification lab at the Smithsonian Institution in attempt to identify these species. Some of these may be from sage-grouse, which will increase collision rate estimates for that species. Lastly, the composition of evidence types found at avian collision sites was dominated by feather piles; however, a large number of sites also contained feathers lodged in the associated fence (Figure 2).

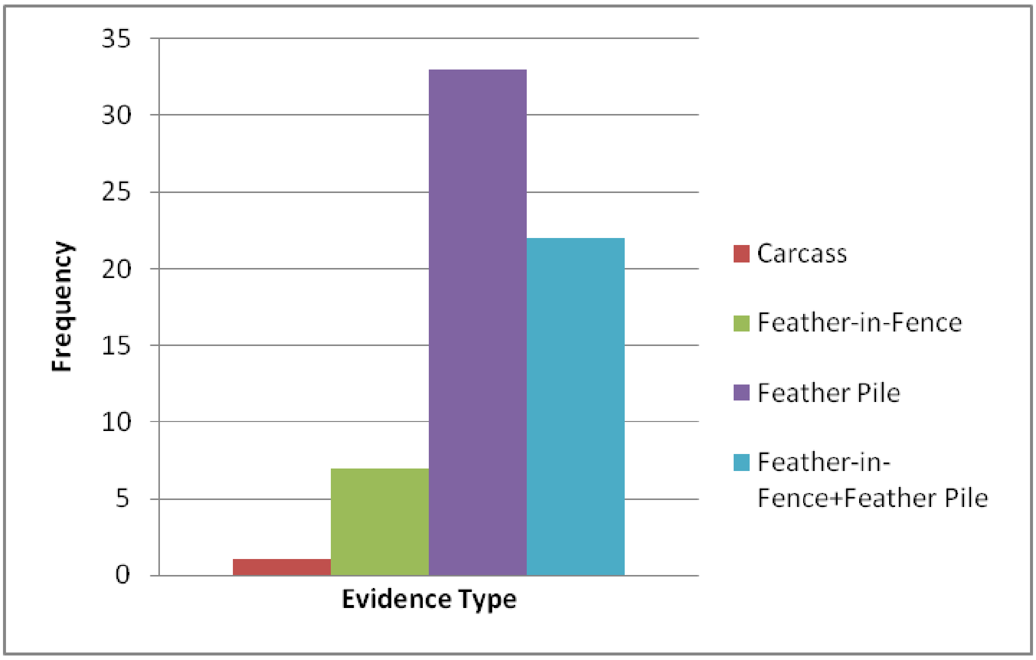

Figure 2. Frequency of each type of collision evidence found at avian fence collision sites in sage-grouse breeding areas in southern Idaho during the 2009 breeding season.

Estimated fence collision rates for individual lek routes were highly variable, ranging from 0-2.94 collisions per linear km of fence. Global collision rate estimates treating lek routes as strata varied by sampling round from 0.062-0.493 per linear km for all species, and 0.062-0.361 per linear km for known sage-grouse (Table 1), and appeared to be less in subsequent sampling rounds.

Table 1. Global estimates for three sampling rounds of breeding season collision rates (per km of fence) for greater sage-grouse in sampling areas in southern Idaho during the 2009 field season.

Sampling Round	**Lek Routes Sampled**	**Collision Rate (All Species)**	**95 % CI**	**Collision Rate (Sage-Grouse)**	**95% CI**
Round 1	16	0.493	(-3.511, 4.497)	0.361	(-3.281, 4.002)
Round 2	8	0.124	(-1.539, 1.787)	0.075	(-1.058, 1.209)
Round 3	2	0.062	(-0.990, 1.115)	0.062	(-0.990, 1.115)

Discussion

Fence collision rates in sage-grouse breeding habitat appeared to vary spatially during the 2009 breeding season. However, sample sizes in some areas were relatively small and not all areas were sampled in subsequent sampling rounds, likely adding to the observed variability. Furthermore, we observed collision sites accumulated over an unknown time period in the first sampling round, and this may have inflated the round 1 estimate relative to later sampling rounds.

Our preliminary results suggest uncorrected collision rates in sage-grouse breeding habitats in Idaho may be slightly higher than those reported for European grouse species. Catt et al. (1994) reported collision rates of 0.25 and 0.03 collisions per linear km of fence per month for capercaillie and black grouse in Scotland. Baines & Summers (1997) calculated collision rates for Scottish grouse over a much larger geographic area, and these ranged from 0.4-1.8 collisions per linear km per year. Uncorrected collision rates for tetraonids in Norway ranged from 0.012-0.176 collisions per linear km of fence, and varied by season (Bevanger 1995b). Unfortunately, differences in sampling methodology and intensity may preclude direct comparison of collision rates with these studies.

Probability sampling methods used in the initial field season of this study provided a way to assess the variability associated with parameter estimates of interest. Approximate confidence intervals on the estimated collision rates often included negative numbers, which is not biologically realistic. However, these intervals were presented as calculated to demonstrate the variability associated with the sampling methodology. Despite the variability, these methods provide a valid tool for statistical inference to a pre-defined population or sampling-frame. Numerous fence collision studies previously reported have often used convenience sampling methods, which provide no way to rigorously assess precision or determine underlying bias in parameter estimates calculated, and no way to rigorously extrapolate results to a population of interest.

Reported fence collision rate estimates are likely biased low by an unknown detection probability. A carcass detectability and longevity study associated with our search methods has also been completed, and will be used to correct for undetected victims at a later date.

Future fence collision surveys in sage-grouse breeding areas are planned for the 2010 field season. Furthermore, data from the 2009 and 2010 field seasons will be used to model the influence of site and landscape features on collision rates at multiple spatial scales. These models will be developed with the goal of providing a tool for managers to assess collision risk in sage-grouse breeding areas, to aide in prioritizing areas for future management actions which could include recommendations for fence removal, or guidelines for placing new fences in sage-grouse habitats.

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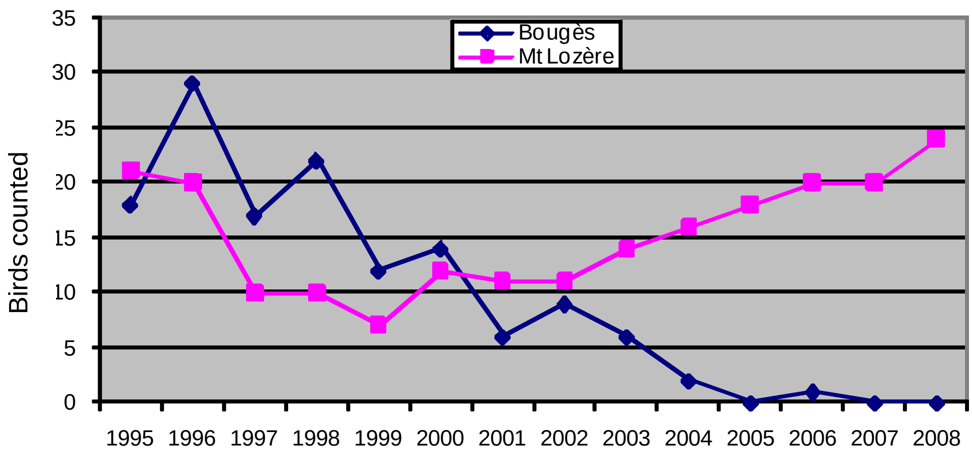
The reintroduced population of capercaillie in the Parc National des Cévennes is still alive!

Christian Nappée

The capercaillie disappeared from the highlands in the south of The Massif Central about three centuries ago when deforestation destroyed its habitat. Following the immense effort of reafforestation undertaken by the Eaux et Forêts authorities from the end of the 19th century onwards, a forest canopy of several thousand hectares has been reformed. The capercaillie habitat reappears here when natural forest restoration is not too greatly affected by commercial forest management practices. In 1976, the Parc National des Cévennes decided to reintroduce this bird into its ecological niche. From 1978 to 1994, 597 young capers produced locally in the Parc's own breeding station, were released in the northern part of its central zone, enabling the establishment of a population of roughly 60 individual birds on the Montagne du Bougès and the Mont Lozère. The demography of this neo-population, estimated yearly by comparing data obtained from counts and occasional sightings, manifestly regressed from the outset until 2002. Releases to reinforce the population, effected between 2002 and 2005 with 43 birds from an Austrian breeding station, may have slightly helped to reduce the genetic drift of the population but were without any real effect on its demography due to the low survival rate of birds bred in captivity (It seems that only three birds, all hens, survived until the next period of reproduction. One of them at least had chicks a year and a half after its release)

Since the extinction of the sub-population on the Mont Bougès, in 2005, the only remaining sub-population is that on the Mont Lozère. It has been progressing from 2002 and has practically doubled according to the annual counts which enable those concerned to establish an estimate called Minimum Summer Numbers.



Evolution between 1995 and 2008 of Minimum Summer Number of the two sub-populations of capercaillie in the central zone of the parc national des Cévennes.

The future of this reintroduced bird population remains, however, very uncertain. Apart from the threat of global climate change which will have a local form and intensity unknown as yet, other obstacles exist which are to be surmounted only by a more forceful policy. Much more intensive protection of the capercaillie habitat is, for instance, necessary in the face of economic pressure from both forestry and pastoral activities in the parc's central zone. A moderate but continuous genetic reinforcement is also essential, first in order to counter the effect of consanguinity and next to give the population enough potential to enable it to grow and assume the size of a meta-population viable in the long term.

Vast potential habitats exist beyond the northern limits of the national park, on the Monts de Margeride and on the Monts du Vivarais. The next important step would be to get those managing these forests to agree to practise a silviculture enabling the capercaillie to colonise them. The Strategy for the Conservation of Capercaillie in France, which is at the moment being elaborated at the request of the Ministry of Ecology and Sustainable Development, could further promote this evolution.

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Does predation affect lekking behaviour in grouse? A summary of field observations.

Bianca Alert & Ilse Storch

Introduction

The evolutionary mechanisms underlying communal display in several grouse species have provoked a lot of controversy among scientists. Many hypotheses have been proposed, ranging from verbal arguments to explicit mathematical models (Höglund & Alatalo 1995). The idea that predation selects towards formation of display groups was established in the 1960's (e.g. Koivisto 1965, Lack 1968) but supporting empirical evidence in lekking bird species is scarce and somewhat ambiguous (e.g. Berger et al. 1963, Hartzler 1974, Trail 1987). A recent discussion in the IUCN Grouse Specialist Group revisited predation as a factor of influence in communal display and was virtually the starting point for this study. Based on anecdotal observations in the field, David Jenkins (*University of Aberdeen, UK*) was wondering about predation frequencies on lekking grouse and on its possible effects on the formation and maintenance of display groups. His thoughts were that lekking males could face a trade-off between having a higher mating success on leks because of female preferences (Bradbury & Gibson 1983) and being exposed to a higher predation risk because of the conspicuousness of leks (De Vos 1979, Wittenberger 1979). In this sense, sexual and natural selection would favour opposing behavioural strategies of displaying males.

The aims of this MSc thesis (of BA under supervision of IS) were to review predation frequencies on grouse leks by collecting field data from members of the IUCN Grouse Specialist Group and to analyse the pooled data. Additionally, we discuss the results on the broader background of evolution of lekking behaviour in grouse.

Results and Discussion

In total, 157 predation events on leks of 6 grouse species were reported of which only 20 % were observed directly. The major part of reports came from indirect evidences like remains of dead grouse in the lekking area. The individual predation frequencies ranged from zero to 0.43 predation events per observation day (Figure 1). The median predation frequency over the whole dataset was 0.01 predation events per observation day. This indicates that predation on leks occurs only rarely. Other studies describe similarly low predation frequencies on leks (Hartzler 1974, Trail 1987). Due to the large amount of indirect observations the computed median could represent an over- or underestimation of the "true" predation frequency on leks. Unfortunately, we could not relate the actual predation events to the number of predator attacks on lekking grouse. Bradbury et al. (1989) reported that golden eagles *Aquila chrysaetos* make on average five attacks on lekking sage grouse *Centrocercus urophasianus* for every successful predation event.

Of the 157 reported predation events, 96 were caused by raptors and 61 by carnivorous mammal species. In the case of direct observations, predation events caused by raptors were more frequent than those caused by carnivores (Figure 2). The total ratio of raptor to carnivore predation on leks is in good concordance with the whole year predation ratio reported in other studies (Angelstam 1984).

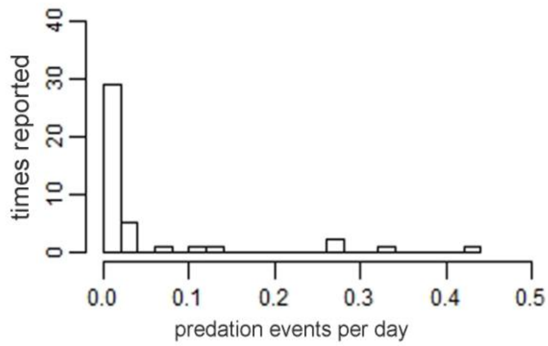

Figure 1. Histogram of the reported predation frequencies (predation events per observation day) over the whole dataset. Bin width is 0.02 units; median predation frequency is 0.01 predation events / day; maximum reported predation frequency is 0.43 events / day.

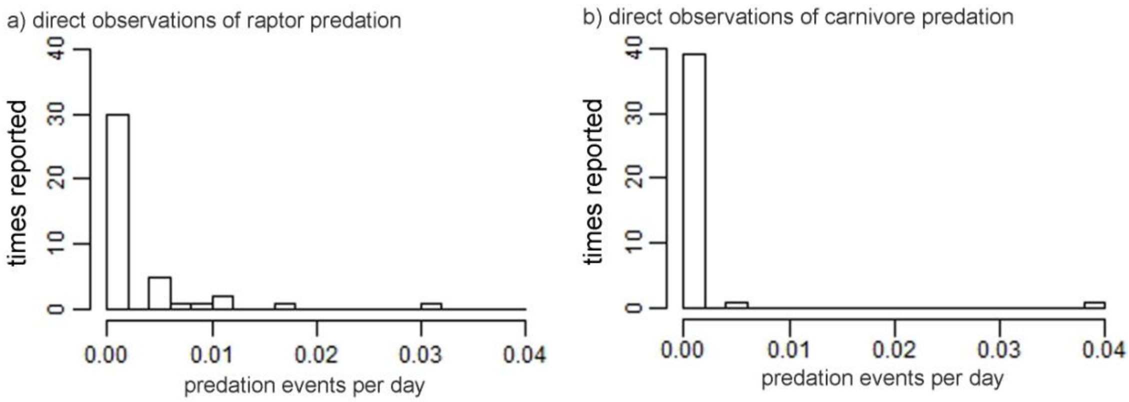

Figure 2. Histograms of the reported frequencies of directly observed a) raptor predation and b) carnivore predation. Bin width is 0.002 units. For direct observations, raptor predation is more frequent than carnivore predation (Wilcoxon signed rank test: $p < 0.05$).

To assess the effect of predation pressure on lek evolution, we linked the spatial variability pattern of lekking black cocks *Tetrao tetrix* with predation frequencies recorded on these leks (Figure 3). In the case of carnivore predation, there may be a relation of no predation at no spatial variability and higher predation at high variability (Figure 3). This pattern suggests that predation by carnivorous mammals may possibly affect the stability of black grouse leks. Because of small sample sizes, this suggestion has to be carefully tested.

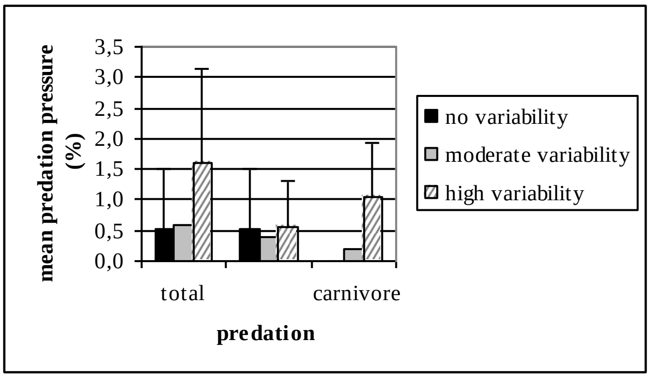

Figure 3. Seasonal predation pressure in % on leks with no, moderate and high spatial variability for the cases of total, raptor and carnivore predation.

Conclusions

Predation frequencies on leks are generally low although, in some cases, predation on leks can be high. Predation on leks caused by raptors is more frequent than predation caused by carnivorous mammal species but there is statistical evidence only for the cases of direct observations. There are a number of factors not considered here that may cause variations in predation frequencies, like local habitat features and lek sizes in terms of numbers of lekking males and in terms of the diameter of the lekking area. We linked different seasonal predation pressures to black grouse leks with different spatial variability. Predation by carnivores possibly has some influence on lek stability but this has to be tested experimentally. From these data, we are not able to conclude that constantly high predation may lead to the subsequent dissolution of leks or that leks as display groups may serve as an anti-predator strategy. Some critical evidence is still missing. For example, we could not compare predation frequencies between leks of different size or between lekking and solitarily displaying males.

Acknowledgements

We would like to thank David Jenkins for inspiring research on a very interesting topic. We would also like to thank the members of the IUCN Grouse Specialist Group for providing their field data and helpful comments.

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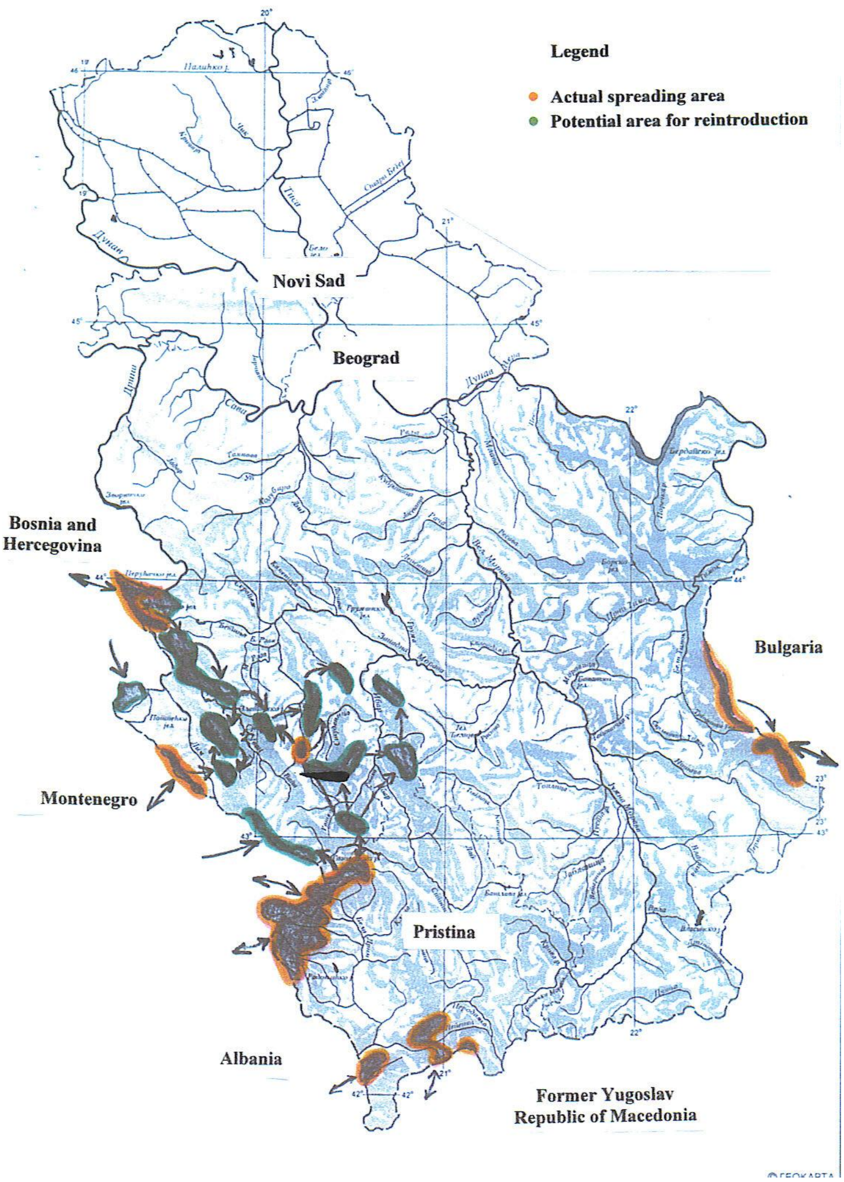
Capercaillie *Tetrao urogallus* in Serbia – principal threats and conservation measures.

Summary

Capercaillie could be found in the mountainous areas of Serbia till the first half of the 20th century, especially in well-conserved coniferous and broadleaf-coniferous forests. The decrease in its range started as a consequence of forest devastation in all possible ways (burning, clearing, felling and excessive pasturage). Forests were destroyed on many mountains and also their altitudinal distribution was decreased. This paper analyses the main threats and protection measures of capercaillie and its sites at the national and global levels.

The most important area of the capercaillie nesting in Serbia is Mt. Prokletije, which is estimated to sustain about 90% of the total national population. Other localities in which the capercaillie was observed are the mountains: Šar Planina, Stara Planina, Tara, Kamena Gora and Golija. The main threats to

capercaillie and its sites in Serbia are: (1) disturbance at the nesting site (presence of tourists, foresters and shepherds, infrastructural opening of the forests, noise of power saws and vehicles); (2) destruction of the belt of coniferous forests, especially of relic pines; (3) forest utilisation (planned and illegal); (4) application of chemicals in agriculture and forestry; (5) poaching; and (6) forest wildfires, especially on Mt. Prokletije. At the national level, some authors classified capercaillie in the category of high risk "**EN**", due to the general state and population trends. Also, the Institute for Nature Protection of Serbia has included the capercaillie in the Action Plan. The Programme of Hunting Development in Serbia 2001-2010 designates capercaillie as the priority species, which require intensive study in the aim of monitoring and undertaking the active measures of protection and the rehabilitation of the national population. The proposed measures of capercaillie protection are: (1) conservation of old coniferous and broadleaf-coniferous forests; (2) prevention of poaching, and reduced disturbance; (3) reduction in the use of biocides and fertilisers in forestry and on mountainous meadows; and (4) reintroduction to the previous sites (Kopaonik, Golija, Zlatar, Tara and Zlatibor).



Distribution map of capercaillie in Serbia

Summary reproduced from Gačić D. P., Puzović S. and Zubić G. 2009. Capercaillie (*Tetrao urogallus*) in Serbia – principal threats and conservation measures. - Forestry, Belgrade 1-2: 155–168. [In Serbian with English summary].

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Black grouse in Perthshire
Matthew Geary

A year ago I began my PhD on the long term viability of black grouse *Tetrao tetrix* populations in a changing upland landscape. The PhD is funded by the World Pheasant Association (WPA) and Manchester Metropolitan University (MMU). My supervisors are Dr Stuart Marsden and Dr Alan Fielding at MMU and Dr Philip McGowan at the WPA. The basis for the work was the worrying decline in black grouse numbers in Britain noted by Hancock *et al.* (1999). This has been linked to land use change in the British uplands especially those involving commercial forestry (Pearce-Higgins *et al.* 2007). In view of the current economic climate, where commercial forestry is becoming less profitable, as well as changes in agricultural and sporting uses of land, this link has become even more important. Because of this I intend to model a black grouse population in Britain in order to assess its long term viability under a variety of land use scenarios.

The study area is 700km^2 of highland Perthshire in Scotland surrounding Loch Tummel (OS Explorer map Sheet 386). The area consists mostly of three land use types: agriculture, grouse-moor and forestry. Farming is a major industry in the area with lower ground being used for cattle and higher ground, stretching up onto high moorland, being used for sheep. Sporting estates are also present across the study area and, along with them; large areas of grouse moor (Figure 1). The level of management by gamekeepers on these moors varies between estates and some moors have been given over to sheep almost completely (Figure 2). As in the rest of the highlands, there is a large red deer *Cervus elaphus* population which provides estates with income from stalking. Forestry is another major industry in the area (Figure 3) with a large amount of land owned by the forestry commission as well as smaller privately managed woodlands on many estates. The most common tree species is Sitka spruce *Picea sitchensis* grown commercially although recently an effort has been made to plant native species to benefit conservation.

Figure 1. Grouse more on the Auchleeks estate with forestry plantation in the background

Figure 2. Grazing land near Schiehallion in the south-west of the study area.

Figure 3. Track inside a private plantation on the Auchleeks estate.

The data I am using have been given to us by the Perthshire Black Grouse Study Group. The dataset consists of counts of the number of males displaying at leks across the study area between 1990 and 2008. Each spring leks are located by listening for calling males and males are counted at a subsequent dawn visit (Hancock *et al.* 1999). This relatively long series of data gives an excellent opportunity to model population changes over time.

Currently I am investigating the anatomy of population change in this black grouse population. This involves looking at the statistical evidence for population trends between 1992 and 2008 as well as how these trends might come about. Using year as a predictor of the number of displaying males per $100km^2$ in a linear regression model I found that there was a statistically significant decline from 1992 to 2000 (df=7, $p<0.001$, Adj. $R^2=0.87$) and a statistically significant increase between 2002 and 2008 (df=5, $p<0.001$, Adj. $R^2=0.93$). This increase is encouraging because, although it is at a slower rate than the decline during the nineties, it was not apparent during the last national census in 2005 (Sim *et al.* 2008).

The number of displaying males in this population is a function of the mean size of leks as well as the number of leks in the study area. Either of these components can change both positively and negatively independently of one another. Both increases and declines in the total population can come about under a number of different scenarios. For example, if the lek size remained the same but the number of leks decreased then the population would decline. On the surface, these components don't seem to change predictably when compared to the overall population trend (Figure 4). I therefore aim to investigate how changes in these components relate to different stages of decline or increase in the using more sophisticated graphical methods.

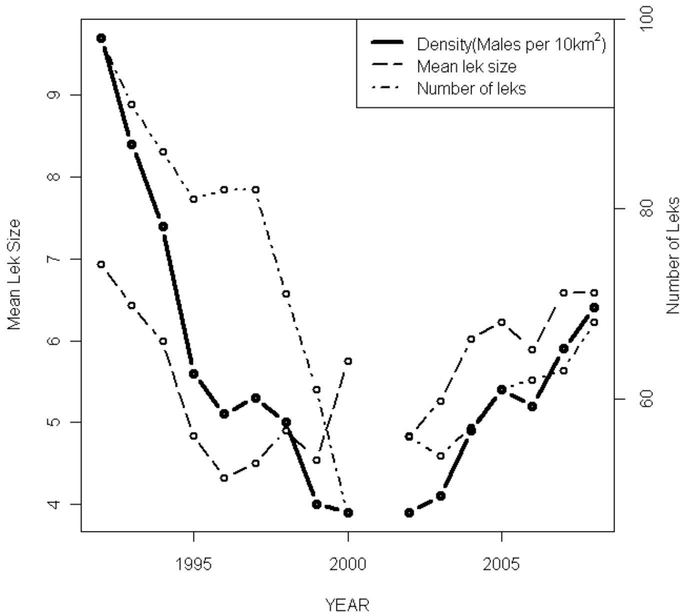

Figure 4. Time series of displaying males per $10km^2$, mean lek size and number of leks from 1992 to 2008

This question leads to further questions about the mechanics of population trends. These include whether the losses or gains in the number of leks from year to year are shared across lek sizes randomly or do they affect some leks more than others. Similarly, I will investigate if losses of leks of certain sizes affect the total population more strongly than others. For example is the loss of a large lek within the population more damaging than the loss of several small leks? Analysis of the size and resilience of leks shows a strong positive relationship between lek size and the number of years in which it was present (df=355, $p<0.001$, Adj. $R^2=0.39$). Therefore I suggest that losses of these large leks might be the most damaging to a population and aim to investigate this with our data. From spatial analysis using Ripley's K we know that leks are clustered spatially in every year of our data. This suggests that certain parts of the study area are more suitable than others but whether there is more pronounced clustering during the decline period of the data resulting from a retreat in range remains to be seen.

Over the course of my PhD I hope to develop a spatially explicit dynamic metapopulation model of black grouse in the study area by combining a number of modelling techniques. These can be divided into three main sections. The first is a model of habitat preference; the second a simulation of habitat change over time and the third a metapopulation model. Two models of habitat preference will be created. The first will attempt to predict lek location based on habitat and land use and the second will focus on lek size. Habitat will be classified from LANDSAT (USGS) satellite images. Two modelling methods will be used for this analysis. One is environmental niche factor analysis (Hirzel *et al.* 2002) which is suited to the presence-only data I have available. The other method will be to use regression modelling which will provide predictions which might be applicable outside of my study area and allow testing of the model in other areas of upland Britain. The simulation of habitat within the study area will focus on succession and management as these have the greatest influence on how the suitability of black grouse habitat changes over time (Pearce-Higgins *et al.* 2007). Using established forest succession models as well as stocking and felling plans from the forestry commission I can simulate how areas of habitat will change. Along with this the moorland habitat can be modelled according to different management regimes and land use change can be simulated. These two models can then be combined to produce a dynamic model of predicted habitat suitability. By keeping this model as flexible as possible I can run simulations of different land use scenarios over long periods and assess the continuing suitability of this area for black grouse. Examples of these scenarios might include increasing or reducing grazing in the area, increased afforestation and changes in burning regimes on moorland.

A metapopulation model of the black grouse population will then be constructed based around leks as individual populations. By combining this with the dynamic habitat preference model I can build a continuous time simulation of a black grouse population in a changing landscape. Productivity and dispersal distance can be scaled according to habitat suitability and, as with the previous model, a large range of land-use scenarios can be predicted for. This will allow me to recommend the most effective management options to ensure the long-term survival of black grouse in both the study area and Britain as a whole.

It would be terrible if future generations could not experience a black grouse lek and black grouse declines during the nineties suggested that this could be a possibility. However, the significant increase shown by this population as well as certain others in Britain is a positive sign and with prudent management black grouse will be present on our hillsides for many generations to come.

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The Per Wegge Jubilee Symposium.

Morten Odden & Erlend B. Nilsen

Introduction

On August 6^{th} – 7^{th} 2009, a group of more than 50 people met at Hedmark University College in southeastern Norway. The purpose was the celebration of the forest grouse, and one of the most dedicated grouse researches - Per Wegge. Wegge is now 70 years old, and he has spent the last 30 years conducting ecological research on capercaillie and black grouse in Varaldskogen, southeastern Norway. In "The Per Wegge Jubilee Symposium", he summarized information obtained during his studies on grouse ecology at Varaldskogen. In addition, invited speakers shared their knowledge of several key topics in forest grouse research, including the effects of forestry and other human activities, the role of predation, grouse population dynamics, and the effect of climate change. The symposium idea was initiated by one of Wegge's former PhD-students - Torstein Storaas, who also served as the main organizer of the Symposium.

Thirty years of capercaillie and black grouse research at Varaldskogen

Per Wegge's research project at Varaldskogen was started in 1979 as a response to a growing concern about negative trends in capercaillie populations in Norway during the preceding two-three decades. The population decrease coincided with a change in forestry practice from selective cutting to clear-cutting and replanting. Evaluating the effects on forest grouse of the ongoing changes in forest composition and fragmentation was a main focus of the project from its initiation. Per Wegge and his team was the first group to use radio telemetry in capercaillie research. At the time, this "state of the art" method produced novel data in a rapid pace, and several aspects of forest grouse ecology were revealed in a short time-span, including habitat selection, spacing behaviour, reproduction and patterns of dispersal and mortality. At the onset of the study, high levels of predation on both black grouse and capercaillie were observed. In particular, it was concluded that mammalian predators on eggs and chicks had a strong impact on annual chick production, and thus the population trajectories. Furthermore, a strong association with old forest was observed among adult capercaillie males during autumn, winter and spring and among broods during summer. As the fragmentation increased and the size of the remaining patches of old forest were depleted,

Per Wegge presenting his talk. Photo Karen Marie Mathisen.

larger capercaillie leks broke up into several smaller units, and availability of prime habitat for broods was markedly reduced. Accordingly, the capercaillie was initially expected to decrease in abundance, whereas an opposite pattern was expected for black grouse due to its preference for younger successional forest stages.

Thirty years later, the Varaldskogen project has accumulated time-series data, which show counter-intuitive results regarding the population developments of the two grouse species. In short, the black grouse has decreased in abundance, whereas the capercaillie density has remained fairly constant. Equally surprising, the trend in annual breeding success has been increasing slightly but significantly in both species. Based on empirical data and indirect evidence, Wegge pointed out several factors that may have created this pattern. Firstly, the composition of the forest gradually changed from being dominated by a sharply contrasting mosaic of clearcuts and old forest to include larger proportions of middle-aged plantations. The capercaillie turned out to be more flexible regarding its use of forests than initially assumed (leks in young forest and broods in bilberry-rich plantations). Regarding the decline in black grouse numbers, Wegge underlined the importance of a change in their pattern of predation. An increase in adult mortality due to a higher predation pressure from goshawk was observed during the latter part of the study, a change that may have been facilitated by a changing forest structure.

Human land-use and predation

Per Wegge's presentation was followed up by several lectures and panel discussions that shed further light on the influence of predation and human land-use on forest grouse. Per Angelstam described the contrasts between natural and man-made forest dynamics, the differences in disturbance regimes and their consequences for the current and future populations of grouse. Janne Miettinen presented an extensive set of data from his PhD thesis on the role of forestry for capercaillie distribution and densities in Finland. Interestingly, some main results concurred with findings from Varaldskogen; the capercaillie has gradually become less associated with mature forests, and it seems to manage well in middle-aged forests. The effects of human hunting on forest grouse was the topic of a presentation by Tomas Willebrand. He showed data suggesting that forest grouse dynamics is not associated with any strong relationship between last year's breeding success and this year's density of breeding birds. His main point was that we need to take into account the spatial configuration of the populations to understand the dynamics of forest grouse.

Olav Hjeljord presented data from an ongoing project in Pinega forest reserve in north-west Russia that illustrated the effect of human land use on the composition of the predator fauna. In contrast to the more intensively managed forests in Fennoscandia where mammalian predators dominate, raptors were the most important predators in the pristine forests of Pinega. A closer look at the importance of raptors was presented by Risto Tornberg. He described how the breeding density of his focal species, the goshawk, tracked the numbers of main prey (grouse) with a time lag of two years. The delayed numerical response of the hawks produced inverse density dependence in their predation on grouse, a pattern suggesting that the goshawk may play a significant role in the generation of multi-annual grouse population cycles.

Per Wegge, Pekka Helle and Kurt Bollmann discussing grouse. Photo Torstein Storaas

In the following panel discussion, there was a general agreement that focus should be aimed on the indirect effects of human alterations of forest grouse habitat through their impacts on ecological processes. The immediate impact on grouse from loss of key resources such as food and cover may be less important than human-induced alterations of the predator regime. Predation on grouse may have increased partially due to elevated predator densities or a changed composition of the predator guild, but also as a result of altered hunting success among predators due to a change in forest structure.

Population dynamics and the role of climate change

Few, if any, match the Finnish researchers' contribution to our current understanding of the spatio-temporal dynamics of grouse populations. Pekka Helle presented a summary of a long-term grouse monitoring scheme where ca 1500 "wildlife triangles" of 12 km each have been monitored twice per year. Currently, more than one million kilometers of transects have been sampled by Finnish volunteer hunters, an effort that has rendered valuable insight into the short-term dynamics of grouse populations, their long-term trends and the underlying ecological processes. Helle talked about the elements needed for producing population cyclicity in grouse, and described how the predictable 6-7 year long cycles that previously characterized the Finnish grouse populations have changed during the last two decades. Short-term population changes have become irregular and the spatial synchrony in grouse population dynamics has been reduced. Similar trends have been documented for small rodent cycles throughout much of the previously cyclic range.

Also the potential role of climate change on grouse population dynamics and distribution was given attention. Robert Moss pointed out that grouse are adapted to cold climate. In general, there has been a warming over the last seven decades, and this warming appeared to have negative effects on grouse in the UK, with capercaillie and black grouse suffering before red grouse and rock ptarmigan. It was argued that although climate change undoubtedly will affect grouse populations, effects are expected to vary among species and with geographical locations.

In summarizing the symposium, Torstein Storaas emphasized the value of long-term population studies - like the Varaldskogen project - where changes in ecological processes and their effects are monitored, combined with shorter-term studies with specific objectives. He thanked all participants for their contributions and hoped they would enjoy the upcoming barbeque banquet dinner – whole-roasted reindeer at the bank of the Glomma River. Which they certainly did!

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The 25th International Ornithological Congress in Brazil.

The 25th International Ornithological Congress will be held in Campos do Jordão - SP, Brazil 22-28 August 2010. This will be the first International Ornithological Congress to be held in Latin America organized under the auspices of the Sociedade Brasileira de Ornitologia. The Congress covers topics from ecology, behavior and evolutionary biology to molecular biology and physiology, not only as individual disciplines but also in highly integrative ways. An important event of the congress will be the initiation of an International Ornithologist's Union. The Congress program will have 48 symposia. One of the symposia has the title: Reintroduction and the restoration of avian populations. The two co-convenors of this program are Christine Steiner São Bernardo and Philip McGowan.

Registration fee before 15 October will be R$ 1050 (396 EUR, 574 USD) and R$1320 (498 EUR, 721 USD) after 15 October. Lower income country residents have reduced registration fees. For further information se the IOC website at http://www.acquaviva.com.br/sisconev/index.asp?Codigo=26.

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Proceedings of the 4th Black Grouse Conference in Vienna

The proceedings of the 2007 black grouse conference are now available. A selection of papers presented at the 4th Black Grouse Conference in Vienna in Sept. 2007 was published in *Folia Zoologica 58(2)* in June 2009. The free pdf-articles are available at the webpage with one year delay: *http://www.ivb.cz/folia/pdf_obsah.htm*

The authors received a pdf-version of the particular paper from the journal. If you are interested in one of the papers please request the authors.

Höglund, J. Genetic studies of black grouse with special reference to conservation biology: a review jacob.hoglund@ebc.uu.se

Krzywinski, A., Keller, M., Krzywinski, K. New methods for preservation of genetic diversity of black grouse (*Tetrao tetrix*): preliminary results, park@kadzidlowo.pl

Merta, D.*, Bobek, B., Furtek, J., Kolecki, M. Distribution and number of black grouse (*Tetrao tetrix*) in southwestern Poland and the potential impact of predators upon nesting success of the species, dorota-zbl@o2.pl

Kurhinen, J., Danilov, P., Gromtsev, A., Helle, P., Linden, H. Patterns of black grouse (*Tetrao tetrix*) distribution in northwestern Russia at the turn of the millennium, juri.kurhinen@rktl.fi

Zeiler, H.P., Grünschachner-Berger, V.* Impact of windpower plants on black grouse (*Lyrurus tetrix*) in Alpine regions, anderkraeuterin@aon.at

Warren, P*., Baines, D., Richardson, M. Mitigation against the impacts of human disturbance on black grouse *Tetrao tetrix* in northern England pwarren@gwct.org.uk

McEwen, K., Warren, P.*, Baines, D. Preliminary results from a translocation trial to stimulate black grouse *Tetrao tetrix* range expansion in northern England, pwarren@gwct.org.uk

Grant, M.C.*, Cowie, N., Donald, C., Dugan, D., Johnstone, I., Lindley, P., Moncreiff, R., Pearce-Higgins, J.W., Thorpe, R., Tomes, D. Black grouse response to dedicated conservation management murray.grant@rspb.org.uk

The 5th European Black Grouse Conference in Poland

Anna Suchowolec

Scientific meetings are a very important part of endangered species conservation programmes. Exchanging information, including the results of new research and the experiences gained from conducting conservation projects, informs others of successful methods and where the gaps in our knowledge remain. The first meeting of the International Black Grouse Conference series was held in Belgium in 2000. Since then, black grouse specialists have met in many different European counties, including the Czech Republic, Great Britain and Austria. Most recently, between 5-9 October 2009, the series reached Bialowieza in Poland. The first black grouse conservation project in northeast Poland started just 10 years ago with great support from the then IUCN-SSC/WPA Grouse Specialist Group, and now The Polish Society for Birds Protection (PTOP) were able to organize the 5th European Conference for Black Grouse Endangered Species and learn much more about this galliform species.

The meeting started with a photograph display prepared by the great Polish nature photographer Grzegorz Leśniewski. The presentation focused on the black grouse's spectacular lekking behaviour, which is compared in Polish tradition to medieval tournaments and black grouse are known as the "knights of spring". Then followed an introduction given by the President of PTOP and by representatives from the Regional Directorate of State Forestry in Bialystok and the Regional Directorate of Environmental Protection in Bialystok - institutions that are involved in black grouse conservation in northeast Poland.

The conference brought together 59 black grouse specialists from 12 countries, including representatives from almost 30 different institutions. During the meeting, participants presented 19 oral presentations, which were divided into 5 sessions, and 10 posters. Michał Kaszuba, as a host of the conference, gave the first talk; a summary of conservation projects in northeast Poland.

The first session was entitled *Black grouse versus habitat changes*. The main issues discussed concerned the sufficiency of black grouse habitat management and the complexity of factors that determine population response, including time scale modeling of habitat suitability for black grouse and how it can be used in current conservation activities.

The next session *Why birds don't ski (tourism impact)* aroused a great deal of interest and one of the subsequent workshop meetings was dedicated to the topic. Presentations chiefly concerned human disturbance caused by winter recreation on the winter refuges of alpine black grouse (Swiss and Bavarian

Alps). Behavioural and physiological responses of black grouse to winter recreation were investigated, as well as the strategies used by grouse to cope with energy losses caused by human disturbance. Another issue discussed was the planning of wildlife winter refuges on the basis of spatially-explicit maps showing conflict zones between wintering black grouse and free-ranging winter sport activities.

A wide range of interesting problems were brought up during the third session, *Management*. Talks discussed the difficulties involved with saving the last black grouse population in the Netherlands, the genetic aspects of black grouse reintroduction projects, management using trial methods in forestry in Scotland, novel ways of bird protection by discouraging predators, and the use of new techniques (such as GPS transmitters) for future research. Much interest was shown in the use of reintroduction as a conservation tool and so another workshop meeting was arranged to enable further discussion on the topic.

The fourth session investigated the *Dynamics of black grouse populations*, looking at projects in the Netherlands, the north-European taiga (Finland, Russian Karelia, Murmansk, Arkhangelsk and Komi regions), and Poland.

The final session, *Mechanism of evolution* concentrated on the predation impact on black grouse. Talks covered how predation may affect the display behaviour of lekking males, and the maternal and environmental covariates of nesting success under variable predator densities. Also, the session looked at the use of appropriate genetic analyses in practical conservation for the species.

The poster session gave a great diversity of interesting issues, from reintroduction, conservation and management, including studies to monitor the impact of new ski-lifts, hiking trails, power lines and overhead cables on black grouse populations.

One day of the conference was set aside for a field excursion. Delegates visited two black grouse refuges - Rabinówka and Krynki – and learnt of the current conservation activities in place. Efforts underway include the restoration of peat bogs and the reestablishment of an ecotone zone. Open areas have been established in black grouse refuges by clearing vegetation and introducing cattle grazing, and predars (such as fox, pine marten, American mink and raccoon) have been reduced. The highlight of the field excursion was observing a group of male black grouse in their natural habitat.

Bialowieza is a unique area with a wonderful primeval forest and delegates were able to visit the Białowieża National Park. This site protects the best preserved fragment of Białowieża Forest – the last natural forest in the European Lowland Area with a primeval character, identical to that which covered vast areas of deciduous and coniferous forest many years ago. The European bison – Europe's largest land mammal - is the flagship species of the Park and a visit was made to the European bison show reserve to meet them eye to eye.

The conference was a great opportunity to discuss the present situation of the black grouse in Europe and further initiatives concerning the protection of the species and its habitats. Abstracts of oral and poster presentations were published and distributed to the authors in Białowieża, and there are plans to produce a further publication exploring the many important issues raised during the meeting (conference attendants will be informed about such plans). Thanks go to the meeting's Scientific Committee (see below) for great support, to the meeting's sponsors, and to the conference attendants for making the meeting very interesting, friendly and highly valuable.

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SNIPPETS

New International Journal of Galliformes Conservation.

WPA has decided to launch a new journal this year. The name of the journal is International journal of Galliformes Conservation. The journal will be published online at www.pheasant.org.uk so the contents are freely available. However, this does not mean that published papers will be below the standard that is required by other journals. Scientific standards will be maintained in each volume. Editor in chief is Stephen Browne. The journal has 3 objectives. 1) To encourage those who are new to the field to communicate their findings. 2) To facilitate the publication of high quality and conservation-relevant information on this group of birds. 3) To make available information on emerging issues and opinions approaches to conservation and research techniques that may enhance the quality of research undertaken on galliformes. For more information on the journal please visit the WPA website, www.pheasant.org.uk.

In memory of Simon Thirgood.

Simon Thirgood was born on 6 December 1962 in Monrovia, the capital of Liberia, but grew up in Vancouver after his father was appointed a professor of Forestry Policy at the University of British Columbia. Simon completed his education in Scotland, reading Zoology at Aberdeen University, where he indulged his love of mountaineering, climbing extensively in the Cairngorms. Among Thirgood's many gifts was his ability to see how scientific inquiry could be developed into pragmatic policy for managing the environment. An example of this approach could be seen in the 1990s with his research for the Game Conservancy Trust into birds of prey and their effect on grouse shooting.

In Britain there has long been a conflict of interest between moorland estates aiming to run profitable shooting and those concerned with the conservation of raptors that prey on the grouse. In *Birds of Prey and Red Grouse* (1997) Thirgood and his colleague Steve Redpath showed that raptors – particularly the hen harrier – could indeed reduce grouse numbers to levels that made the shoots uneconomical. But they also showed that a workable compromise was possible: a research trial in which Thirgood and Redpath put down carrion as alternative food for hen harriers resulted in a marked decline in the destruction of grouse chicks. They also proposed that the numbers of harriers on grouse moors might be reduced by removing their young and rearing them elsewhere.

Thirgood also worked with a wide range of projects in Tanzania, Zambia and Ethiopia. After two years in Africa he returned to Aberdeen to take a senior position at the Macaulay Institute. There he ran a large research group, renewed his interests in Scottish upland ecology. He was noted for bringing more science to conservation, and more conservation to science – a rare and important perspective. He continued to enjoy the mountains of Scotland, and there were few Munros that he had not climbed.

Simon Thirgood died in Ethiopia on August 30 when the building in which he was staying collapsed during a sudden fierce storm. He was in the country as part of a project to study sustainable hunting in Africa. His wife and two daughters survive him. He was only 46 years old.

Tor Kristian Spidsö,
25 November 2009.