GROUSE NEWS

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

Galliformes Specialist Group

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Contents

From the editor

The first Grouse Symposium was held at Culloden House in Inverness in Scotland in 1978. At the conference in Elverum, Norway, in 1990 David Jenkins put forward an idea of a newsletter for grouse researchers and other grouse lovers. The result was the first Grouse News printed in March 1991 with Diana and Tim Lovel as the first editors. This means that we may celebrate 20 years of Grouse News with this issue 40. All the issues may be found at our web page http://www.galliformes-sg.org/gsgindex.html.

The last three issues have been larger than for many years. This issue with more than 50 pages is the largest containing much interesting stuff. One important reason is that many of you have sent contributions to Grouse News. All kind of contributions are welcome, from research stuff to short notes about new things that happen, like change in employment and so on. It would be very nice if you could send a short note when you move telling about your new position. And it is very important that you send us your new e-mail if you still want to receive Grouse News. Each time we are sending a new issue we get many replies of address unknown.

In this issue you will find interesting readings about capercaillie, black grouse in Scotland, and capercaillie in the Italian Alps. Also information about Cantabrian capercaillie is found and a comment on the article in the last issue of Grouse News on the impact on grouse of ice crust formation. Articles dealing with Japanese rock ptarmigan and Svalbard rock ptarmigan are also represented. Abstracts of theses and dissertations and a long list of recent grouse literature are presented. In snippets you will find a press release dealing with sage grouse and a short note of a publication on Caucasian black grouse.

After a wonderful stay in Whitehorse in Canada at the 11th International Grouse Symposium hosted by Kathy Martin, the next conference is coming up very soon. It is less than one year to the 12th International Grouse Symposium in Japan hosted by Hiroshi Nakamura. The conference will be held 19th to 23rd July in Matsumoto. Be sure you set aside this time to attend this conference. There are also other conferences next year. A conference on Gyrfalcons and Ptarmigan in a Changing World will be held at Boise State University in Boise, Idaho, USA, 1st – 3rd February. The 29th Biennial Prairie Grouse Technical Council meeting will be held at Hays Kansas, USA, 3rd – 6th October and the XXXth IUGB and Perdix XIII Congress will be held 5th to 9th September 2011 in Barcelona, Spain

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From the Chair

Congratulations, grousers, to 20 years and 40 unintermitted issues of Grouse News! You have kept your network growing and your newsletter going; and this issue in fact is the most voluminous ever. It is particularly encouraging to see so many contributions from North America. Thanks to our active Co-Editor Don Wolfe, GN left behind the last bits of the, however unintended, European bias it long appeared to have.

Also the grouse that will soon be featured as the "Species of the Day" will be North American: the Gunnison Sage Grouse. To coincide with the International Year of Biodiversity 2010, to increase awareness of the huge variety of life, and raise the profile of threatened species, the IUCN Species Survival Commission launched The IUCN Red List of Threatened Species™ "Species of the Day". Each day in 2010, a different species is featured on a range of websites and through other media channels. The species will be selected from the entire range of taxonomic groups, representing all regions and detailing the threats to their existence. The GSG was invited to nominate a grouse species to be featured as the "Species of the Day". Why did we decide for the Gunnison sage grouse? Many of the species featured will be threatened by growing human populations and their hunger for land and natural resources; threats that are common in developing and newly industrialized countries. Thus, we wanted to make the point that even a species in the rich western world, that is extensively studied, and its threats well described, may still not receive the attention it deserves because of significant economic and political interests. The Gunnison sage grouse is an excellent example. Here is its profile, provided by our colleague Jessica Young:

The Gunnison Sage-grouse, *Centrocercus miminus*, is listed as 'Endangered' on the IUCN Red List of Threatened species. This bird species was once found in the United States in shrubsteppe habitat in Colorado and Utah; however, it is currently located in less than 9% of its historical range in eight populations, several of which have estimates of less than a hundred individuals remaining and with a global population of less than 5,000 in the wild. Potential causes of the species decline are varied and numerous and include habitat loss, degradation and fragmentation, and may include loss of genetic diversity due to genetic drift from small population sizes and the species lek mating system. Current threats include continued conversion of sagebrush habitat for agricultural purposes, urbanization, and increased recreation; all of which may result in greater predation and habitat loss. The species has been recognized by the American Ornithological Union as one of the ten most endangered species of birds in North America and has recently been listed as a candidate for consideration of future listing under the Endangered Species Act (ESA). Numerous local and range-wide groups have developed conservation plans and actions to recover the species; however, the species continues to be at significant risk and lacks federal protection under the ESA.

Watch out for "our" species of the day at http://www.iucnredlist.org/species-of-the-day.

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NEWS FROM GSG

5th International Galliformes Symposium Thailand 2010

The World Pheasant Association (WPA), with considerable support from King Mongkut's University of Technology, Thornburi (KMUTT), have just held a symposium on the conservation and sustainable management of all species of pheasant, partridge, quail, francolin and guineafowl, with special emphasis on Asia, threatened species and their habitats. It was jointly organised by WPA, KMUTT and the IUCN-SSC/WPA Galliformes Specialist Group.

Outline

The first part of the symposium was held at the 4-star Imperial Mae Ping Hotel (www.imperialmaeping.com) in Chiang Mai. The programme consisted of short talks, poster sessions and open debates for three days. Day trips to local sites of interest were available for those wishing to spend time away from the meeting and before the formal sessions closed on Thursday 11 November. Excellent pre- and post-symposium tours were arranged for birdwatchers, naturalists, aviculturalists and people with cultural and other interests.

Itinerary

Wednesday 3 November: Arrived in Bangkok for the pre-symposium tour.
Thursday 4 November: Pre-symposium tour started
Sunday 7 November: All delegates gathered at the Imperial Mae Ping Hotel in Chiang Mai
Monday 8 -Wednesday 10 November: 3-day Symposium with a formal programme of talks and posters.
Thursday 11 November: Day visit to Chiang Mai Zoo and other local attractions.
Friday 12 - Saturday 13 November: Stay at Imperial Mae Ping and travel as two groups to Dio Inthanon NP & Dio Su Thep.
Sunday 14 November: Depart for post-symposium tours or return home.
More information will be published in forthcoming Specialist Group newsletter.

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RESEARCH REPORTS

Population ecology of black grouse on north-east Scottish moorland in 1956–82

Adam Watson

Summary

Black grouse (*Tetrao tetrix*) were trapped in autumn and studied throughout the year in 1956–77 at two moors in succession (Glen Esk and Kerloch), using study areas chosen for intensive team research on red grouse (*Lagopus lagopus scoticus*). On these two main areas and on other areas studied with less effort, the numbers, breeding success, adult deaths and movement of black grouse were recorded. On each of the two main areas, traps in oat fields caught more young birds than old, more hens than cocks, and more young hens than all others. Afternoon weights exceeded morning ones, cocks outweighed hens, and young and old at the same time of day weighed much the same. No birds were found freshly dead in June–August, but many in September–May, mostly due to predators, though a few to flying into wires. Most birds found dead showed good body condition, but a few birds in poor condition had parasites or other disease. Most trapped birds were not seen again, and it was inferred that the adults counted on about 500 ha of moorland near each trapping site formed part of a larger population living in a larger area. Some young birds, especially young hens, moved, the furthest straight distances recorded being 14 km in a cock and 28 km in a hen. Yearly breeding success at Glen Esk was 0.6–2.0 young reared per hen, with a mean of 1.4. It was strongly correlated positively with total June rainfall. Breeding success at Glen Esk was not related to that of red grouse in the same year. The proportionate change in number of cocks or of hens from spring to spring was only very weakly associated positively with breeding success in the intervening summer.

Introduction

This was not a defined study of black grouse, and the observations presented below were incidental, having been made in the course of intensive team research aimed at testing hypotheses about red grouse. Nonetheless, because the data came from decades before the recent large declines of black grouse, they offer a useful comparison with recent data from many studies on black grouse internationally.

During catches of red grouse for the above intensive study, black grouse were caught on oat-fields after harvest, in traps baited with oats. They were then weighed and marked. Here I present data on their age, sex, weight, movement and survival.

Furthermore, in the course of fortnightly counts of red grouse on the two main areas and other frequent observations on their behaviour, black grouse were counted too, and notes made on their deaths and breeding success. One can therefore compare spring to spring change in numbers with breeding success in the intervening summer. Such data help provide better understanding of a species that is hard to study because of low density and big home ranges (e.g. Robel 1968).

Figure 1. The Low study area at Glen Esk, Angus, in October 1959. It shows heather-dominated moorland with small woods of natural birch and planted Scots pines, small arable fields at the edge, and higher moorland hills behind rising to 750 m. The Glen Esk High study area is on the plateau on the left.

Study areas

These lay on moorland west of Aberdeen. The area at Glen Esk (Figure 1) covered 508 ha (parts I-VI of the 460-ha Low area of Jenkins *et al.* 1963, plus the 48-ha part VII), and c.500 ha of low moorland at Kerloch (Figure2) (Jenkins *et al.* 1967; Moss *et al.* 1984; Watson *et al.* 1984). Adjacent to both areas there were fields and small woods. Parr & Watson (1988) reported the use of habitat by black grouse on the two main areas, and Parr, Watson & Moss (1993) their changes in numbers in relation to those of red grouse. Both papers described the main study areas in detail. Other red grouse study areas where black grouse occurred and were counted less frequently than on the main areas were the Punchbowl in lower Glen Esk, Glen Muick, Corndavon and 'Lochnagar' (really Glen Girnock of Abergeldie) in Deeside, Glen Isla in west Angus and Glen Tarken in Perthshire, described by Jenkins *et al.* (1963). The main lek was in a field, at both places. In the Glen Esk photo, the cocks often sat in the trees in the small wood beside the fields, after the morning lek was over.

Figure 2. Garrol Hill on the main Kerloch study area in July 1966, heather-dominated moorland with woodland and fields beyond. It also shows the effect of applying calcium ammonium nitrate fertiliser in May 1965 to the far section of Garrol Hill, with spectacular flowering of heather compared with the unfertilised control in the near foreground.

Methods

Caught birds were weighed, ringed, and marked with plastic back-tabs as in red grouse (Watson *et al.* 1984). At Kerloch, their body condition was assessed by feeling the breast muscles, using a method where 1 scores as very poor, 2 poor, 3 fair, 4 good, and 5 very good (Savory 1983). Because all birds caught at Kerloch were in good or very good condition, we subdivided into 3+, 4–, 4+, 5–, and 5. The fullness of crop in Kerloch birds was assessed in six categories 0–5, where 0 was empty, 1 was 20% full, 2 was 40% full, 3 was 60%, 4 was 80%, and 5 was full or 100%. Because full crops in shot birds held about 180 g of fresh material each, I could use this and the above percentages to estimate the crop-weight in each bird caught. This estimate was then subtracted from the gross weight, to obtain a net weight without crop contents. I also give gross weights of Kerloch birds, for comparison with data from Glen Esk.

Some tabbed and un-tabbed birds were found dead on study areas, and some died by shooting elsewhere. Young birds in their first year could be told from old ones by their pointed outermost two primary tips with pale freckles, as in red grouse (Watson & Miller 1976). Almost all adult red grouse that died on study areas were found during counts with dogs (Watson *et al.* 1984), so the dogs should have readily found the much larger and more conspicuous black grouse. Staff at Lasswade Veterinary Laboratory carried out autopsies on freshly dead birds, as in Macdonald (1962).

Results

Proportion of different ages and sexes caught

Traps caught more young than old in four out of five years at Glen Esk (both equal in the fifth), and in six out of seven at Kerloch (binomial test on the hypothesis of equal age ratio, NS at each area). More hens than cocks were caught in four out of five years at Glen Esk and in all years at Kerloch (binomial test, *NS* at Glen Esk, $P = 0.016$ at Kerloch, combined $P < 0.05$). The 92 young hens that were caught outnumbered the 59 of all other age/sex categories combined, as was also the case with red grouse caught in the same traps at both moors. The high proportions of young hens were proportions coming to baited traps, not proportions in the population. This indicated differential movement of age/sex categories to the traps. The proportion of trapped birds not seen again was high, except in old cocks, and was broadly similar in other age/sex categories (Table 1).

Table 1. Number (Glen Esk and Kerloch combined) tabbed in autumn/early winter, and columns to the right show the number of them known to have been alive in autumn/early winter during each of four later years (i.e. the number re-trapped or seen alive or found recently dead).

		n	*t + 1*	*t + 2*	*t + 3*	*t + 4*
Old	Cock	11	4	3	3	0
	Hen	23	7	4	0	0
Young	Cock	25	13	6	0	0
	Hen	92	31	15	4	3

Survival

A preliminary exploration of the data shows rough estimates of return rates to study areas (Table 1). This was minimal survival, because any birds that moved off study areas would be far less likely to be seen alive again or found dead. Estimates for old cocks at 0.60 exceeded the 0.36 for old hens, 0.44 for young hens, and 0.32 for young cocks. Morten Frederiksen has the raw data and is interested in a detailed analysis.

Table 2. Number of trapped birds, mean weight in g, lowest and highest weight (parentheses).

		Glen Esk		Kerloch*
		Morning	Afternoon	Afternoon
Old	Cock	5, 1328 (1238–1350)	3, 1370 (1296–1493)	4, 1395 (1380–1425)
	Hen	3, 977 (900–1053)	8, 1019 (900–1053)	6, 1045 (1000–1100)
Young	Cock	11, 1259 (1125–1463)	9, 1398 (1125–1575)	5, 1355 (1195–1510)
	Hen	9, 1010 (900–1125)	6, 976 (846–1125)	26, 1040 (890–1150))

** No trapping in mornings.*

Weight and condition

Birds caught in afternoons weighed more than in mornings (Table 2). This applied also to the same re-caught individuals (whose crops, empty in the morning, had largely filled by afternoon). Within sexes, young and old differed little in weight. Within ages, cocks outweighed hens. No trapped bird was in poor condition, and hens seemed in better condition than cocks (Table 3).

Table 3. Scores for body condition of trapped birds at Kerloch (scores below Table 4).

			4-	4	4+	5-	5
		n					
Old	Cock	4	1	2	1	0	0
	Hen	7	0	3	3	1	0
Young	Cock	5	0	4	1	0	0
	Hen	29	3	4	14	4	4

Deaths of adults

This section excludes shot birds and a few killed by stoats (*Mustela erminea*) in the traps. At Glen Esk, no adult was found to have died in June–August, but 57 in November-May, all but 3 of them on the study area. On the hypothesis of equal expected numbers of deaths in equal periods, the summer result was far lower than expected (one-sample $\chi^2 = 14$, $P < 0.001$). Numbers dying in September–December were 9,

15, 4, and 10, and from January–May 2, 1, 4, 0, and 4. The only four Kerloch birds found dead (apart from shooting and stoats in traps) died in September–March.

Numbers found dead at Glen Esk were relatively high in autumn 1959 (7 in September and 9 in October), and in autumn 1960 (2 in September, 6 in October and 4 in November). Yet only one was found dead in November 1959–February 1960, and none in December 1960–February 1961. Numbers found dead were fairly high again in springs after the autumns of 1959 and 1960, with four each in May 1960 and March 1961.

Predators were the immediate cause of most deaths. Usually the predator was unidentified, but foxes (*Vulpes vulpes*) killed at least four, hawks or falcons four, a golden eagle (*Aquila chrysaetos*) one, and a stoat one. Two big chicks and in November two cocks died flying into wires.

Ten found dead at Glen Esk and one at Glen Dye near Kerloch were sent for autopsy (Table 4). All four that died on wires were in good condition, all three found dead without sign of violence in poor condition. In no bird did the analyst report threadworms as the cause of death.

A greyhen in August had buttercup flowers and seed-heads in her crop and another in March a crop full of oats. Two birds in May and September had eaten many heather-tips.

Table 4. Autopsy of 10 birds from Glen Esk and a 1964 bird from Glen Dye.

Year	Month	Sex	Age	Condition	Weight (g)	Worms		Coccidia	Cause of death
						Thread	Tape		
1958	Aug	Cock	Chick	5	544	1 (90)	0	0”	wire
	Nov	Cock	Old	4	1526	0	0	0	suffocated^
1959	May		Young	1	845	2 (1520)	1	0	tuberculosis
	Aug	Hen	Chick	3	484	2	0	0	dog
	Sep		Old	1	441	0	2	1 #	shot wound
1960	May	Cock	Young	2	1109	0	0	0	liver necrosis
	Aug		Chick	4	553	0	0	2	suffocated ^
	Aug	Hen		4	509	1	0	0	wire
	Nov	Cock	Young	4	1049	0	0	0	wire ##
1961	Mar	Hen		5	900	0	0	1	dog
1964	Nov	Cock		4		0	0	1”	wire

Condition 1 very poor, 2 poor, 3 fair, 4 good, 5 very good.
Scores for worms and coccidia are 0 - none, 1 - a few, 2 - moderate, 3 - numerous, with parentheses around estimates from counts.
^ Accidentally, while being ringed.
” Some Escherichia coli.
 # Also some Capillaria. A diverticulum in the crop wall was probably due to the wound. All internal organs were small.
‘ Suggestive of blackhead.
External lice identified at British Museum (Natural History) as Lagopoecus lyrurus.

Movement and emigration

Most birds caught were not seen again (Table 5), as in red grouse caught at the same traps. Flocks of black grouse were often seen flying right across the red grouse study areas at Glen Esk or Kerloch and landing up to 1 km outside, and on a few occasions flying at least 4 km and in the end going out of sight. On 3 August 1957, two groups of eight and three blackcocks at Glen Isla were watched flying 150 m above the ground for at least 8 km until they went out of sight. During mild snow-free conditions, I saw three singleton greyhens in late March on high ground where I had seen none on fortnightly counts with dogs in the months beforehand and later. One was a tabbed young hen at 500 m altitude on the lowest

section of the high Glen Esk study area, one an un-tabbed hen on a nearby higher section at 570 m, and thirdly a tabbed young hen high on Kerloch at 450 m. None of these was seen on subsequent counts with dogs over the next few months, so the birds had probably been on the move when seen. Some August–September counts revealed no blackgame on study areas for red grouse, although many were there before and after (next section). So, it was inferred that blackgame numbers seen on the two main study areas for red grouse on low ground at Glen Esk or Kerloch formed only part of a larger population on and also around each of these two areas.

Table 5. Distances (km) moved by Glen Esk and Kerloch tabbed birds that were later found dead.

		0-1	1-2	6	10	12	14	17	18	21
Old	Cock	1	0	0	0	0	0	0	0	0
	Hen	1	0	0	0	0	0	0	0	0
Young	Cock	2	0	0	0	0	1	0	0	0
	Hen	5	2	1	1	1	1	1	1	1

Returns of shot birds showed that some young moved, up to 14 km in a cock and 28 km in a hen, in straight lines as the crow flies. A Glen Esk young hen was recovered 5 km down Glen Esk near a different lek. Another went near Aboyne in Deeside, on the other side of the range of hills between the river North Esk and the river Dee. Shooting killed two Kerloch young greyhens on hills with moorland and woods beyond the Dee's north watershed, separated from the southerly Kerloch by valley farmland and woods. One was seen on 28 October in the same place as where it was later shot in December. In July 1971, foresters at Drumtochty often saw a young hen that had been tabbed in October 1970 on Kerloch 6 km to the north.

Four young hens tabbed at the Glen Esk area stayed on it during the next breeding season, and two at Kerloch had nests on the study area during the May after their tabbing. In England, Warren & Baines (2003) found no young hen staying on the area where they had marked her.

Changes in adult numbers between spring and autumn

Counts on the Glen Esk study area revealed big changes in adult numbers between spring and the ensuing summer. Spring numbers exceeded summer ones in all years except 1959 (Table 6). Successive counts also showed that some adults moved into the study area in late summer or in autumn–early winter, with hens moving in during late August 1960, October 1958 and late November 1957, and cocks in September–October 1960, November 1958 and December 1957.

Table 6. Number of cocks, and hens after comma, on Low area at Glen Esk.

Year	Apr	July	Aug	Sept	Oct	Nov	Dec
1957	7, 10	3, 8	3, 8	1, 8	1, 0	1, 13	7, 13
1958	12, 15	3, 14	0, 0	0, 0	0, 14	4, 17	11, 16
1959	15, 12	10, 12	10, 11	12, 7	5, 13	10, 10	10, 10
1960	16, 14	0, 13	0, 23	9, 17	14, 14	15, 17	17, 19
1961	17, 15	1, 13	1, 12	-	-	-	-

So, hens within years preceded cocks in such immigration, but between years the cocks immigrated at about the same season as hens. These periods of movement coincided broadly with periods when observers found most deaths on the moor (above).

Breeding success

At Glen Esk, greyhens generally bred more poorly than red grouse in the same summers (Table 7). The six-year mean number of young reared per greyhen was 1.45, compared with 3.32 in red grouse. It exceeded that of red grouse in only one of the six years.

Table 7. Number of young reared by black and red grouse at Glen Esk.

	n greyhens	Greyhen brood sizes	Young per greyhen	Young per hen red grouse
1957	3	1	0.3	4.4
1958	13	1,1,1,1,1,1,2,5	1.0	2.1
1959	10	1,3,3,3,5	1.5	0.9
1960	9	1,2,3,4,5	1.7	4.9
1961	12	1,2,4	0.6	3.9
1964	1	3,4	3.5	3.7

Breeding success of greyhens was strongly correlated negatively with total June rainfall (n = 5, r = –0.973, P = 0.0054, adjusted R^2= 0.928). The incorporation of June mean temperature or the number of June rain days reduced the proportion of variation accounted for in a multiple regression.

The greyhens' breeding success was negatively associated with the number of rain days in June, though only weakly. Brood size, on the other hand, was significantly correlated, negatively, with the number of rain days in June (n = 5, r = –0.913, P = 0.030).

Data on breeding success at Kerloch were too fragmentary for annual analysis. At all study areas combined other than Glen Esk, 12 hens had 26 young and 8 hens none, or a mean of 1.30 young reared per hen.

Change in numbers in relation to breeding success

I compared the proportionate change in spring number (the number in spring *t+1* divided by the number in spring *t*), with breeding success in year *t*. At Glen Esk, change in number of cocks was highly correlated negatively with the number of young reared per hen (r = –0.976, n = 4 years, P = 0.024). Change in hens was associated negatively with this measure (r = –0.52), but far from significantly (but note n only 4 years). When I used the proportion of hens with young, relationships were again negative for cock change (r = –0.787, P = 0.2), and strong and significant for hen change (r = –0.979, P = 0.021). Hence proportionate change in the spring number of cocks or hens was strongly and negatively related to one or the other measure of breeding success.

The possibility of breeding success showing a density-dependent tendency at Glen Esk (i.e. low when adult numbers were high) was rejected. Each measure of breeding success was associated positively with the number of cocks or hens in spring of the same year (r = 0.070–0.595), though far from significantly. The sign would be negative if density were adversely affecting breeding success.

Change in the number of cocks relative to hens

Proportionate change in spring number of cocks at Glen Esk was associated with that of hens (r = 0.659), though not significantly (P = 0.3, but note n only 4 years). The sign was positive, as one would expect.

Flocking

Cocks were seen in flocks and singly during all months of the year, and hens likewise. All nesting hens and hens with broods were solitary. Flock size in September–May exceeded that in summer. Many winter flocks held both cocks and hens, but some had only one or the other. The largest flock seen was of 50 greyhens in Glen Esk, on moorland near the trapping site on a mild snowless day in January 1961. This far exceeded the number of hens seen during regular counts on that area. On flushing, the 50 flew at least 4 km right out of the area, down Glen Esk.

At very low densities on Kerloch in 1977 and 1978, observers on four occasions in late March–early April and on different parts of Kerloch saw a cock and hen flushing as a loose pair 10–20 m apart. Unlike red grouse pairs in spring, however, the two were much further apart, did not stay together in flight, and landed apart.

Discussion

Young birds weighed much the same as old birds of the same sex. This was quite like Finnish birds, where young in autumn and early winter weighed almost as much as old ones of the same sex (Koskimies 1958). By contrast, young birds in the Swiss Alps entered the winter at a considerably lower weight than old ones (Marti & Pauli 1985).

Most deaths of adults occurred in autumn–spring, with very few in summer. This was also the case in the French Alps (Caizergues & Ellison 1997).

By inference, black grouse on study areas at Glen Esk and at Kerloch formed only a part of a larger population. Undisturbed birds often rose to fly right across a study area. Robel's (1968) study at Glen Dye near Kerloch showed that each radio-tagged blackcock had a home range far bigger than the main study area for red grouse at Glen Esk or at Kerloch.

Greater movement of young hens than cocks (Table 5) fits with conclusions from a recent study with radio-tagged birds in northern England (Warren & Baines 2002).. Likewise the sightings on the two Scottish areas of young hens moving to new ground in March fits with the intensive data from radio-tagging.

A strong positive correlation at Glen Esk between breeding success and June rainfall was the opposite of what I expected. However, all greyhens seen with downy chicks were in moorland flushes from groundwater seepage, often in the wettest parts of them. The flushes remain wetter in Junes with a large total rainfall. In this dry sunny eastern part of Scotland, summer precipitation is usually small, evapo-transpiration large, and soils mostly freely drained, so a large total rainfall in June may be of benefit. This might well not be the case in the far wetter climate of western Scotland where flushes very seldom dry out on the surface in summer.

The number of rain days in June was negatively associated with breeding success. Though this association was very weak, the marked difference from the strong positive correlation with total rainfall is notable. Perhaps a rain day may restrict feeding activity of the chicks, whereas some heavy rainfalls occur at night when hens are brooding chicks, or in brief daytime periods such as thundery rain when a hen can brood her chicks until the rain ceases.

At Glen Esk, the proportionate change in number from one spring to the next was associated positively with breeding success in the intervening summer, but only very weakly. The lack of a correlation suggests that change in number may have depended more on net immigration or emigration than on breeding success. Another possibility is that the study area, which had been chosen for research on red grouse, formed too small a proportion of the area used by the population of black grouse that were using it.

Despite hens rearing few young and a high proportion of hens rearing none, adult numbers increased during the study years at Glen Esk. Research during the last three decades in several European countries including Scotland shows that the mean number of young reared per greyhen (Baines 1990, 1991; Warren & Baines 2002) has generally exceeded that at Glen Esk. This was also the case at Glen Tanar (Moss 1986), to the north of the study area at Glen Esk. However, poorer breeding success of 1.2 young reared per greyhen has been recorded on moorland in northern England (Calladine *et al*. 2000), and 0.5 at Feughside (Picozzi 1986) east of Glen Tanar and north-east of Glen Esk. Perhaps there was more adult mortality or emigration in recent years than formerly. Alternatively, adult numbers of black grouse on the red grouse study areas at Glen Esk and at the other five moors noted above may have been topped up by immigrants from nearby. This, however, may seem more unlikely when one is considering six areas as here.

Acknowledgements

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The reintroduction of black grouse to the Isle of Arran, Scotland

Andy Walker

Arran is an island of approximately 432 square kilometres in the Firth of Clyde in the south-west of Scotland. Records – particularly shooting bag records – indicate that black grouse (*Tetrao tetrix*) were widespread and common on Arran throughout the 19th and early 20th centuries. However, by the early 1950s, the population had crashed to a very low level. Numbers then continued to fall and only occasional birds, probably visitors, have been recorded in the last 30 years; the last being in 2000. The possible reasons for the extinction on Arran are complex and varied, but two main reasons are likely to be overgrazing by sheep and over-burning of moorland, both of which resulted in widespread deterioration of habitat. Over-shooting when the population was declining and extensive hill drainage, leading to the loss of wet flushes, were probably also contributory factors to the extinction.

However, since the first half of the 20th century there have been many land management changes on Arran, which have had a positive effect on the habitat from the perspective of black grouse. Sheep numbers have reduced from 35,000 to 6000 and this has resulted in an increase in the quantity and quality of ericaceous vegetation. During the same period, 10,000ha of commercial forests were planted, comprising mainly non-native conifers, with sheep being excluding from 3000ha of this area. The commercial forestry now provides transitional habitat during the replanting phase, following the start of harvesting by clear fell in the early 1990s. Finally, the notification in 2003 of 10,737ha of Arran Moors Special Protection Area (SPA), designated for hen harriers (*Circus cyaneus*), has resulted in major positive changes in moorland management practices.

There are populations of black grouse on the Scottish mainland near to Arran, in Kintyre to the west (c. 6km away), Cowal and Isle of Bute to the north (c. 10km away) and Renfrew and Kyle to the east (c. 15km away). However all of these populations are at a low level, and declining, and natural recolonization is probably very unlikely.

In 1999 the Arran Black Grouse Group (ABGG) was formed with the aim of reintroducing the bird back onto the island. The group members believe that there is now sufficient suitable habitat on Arran to support a population of black grouse. There are over 10,000ha of interspersed and well connected habitat of two main types: 1. managed heather (*Calluna vulgaris*) moorland with good mosaics of wet flushes, bilberry (*Vaccinium myrtillus*), bog myrtle (*Myrica gale*) and willow (Salix spp.); and 2. forest restocks with regenerating heather, bilberry, birch (*Betula* spp.), rowan (*Sorbus aucuparia*) and willow together with planted Scots pine (*Pinus sylvestris*) and larch (*Larix* spp.). Photographs 1-3 show examples of the habitat on Arran.

Photo 1: Heather (Calluna vulgaris) moorland in the southern half of Arran. Note the rotational burning, willow (Salix spp.) scrub and abundant cotton grass (Eriophorum spp.).

Of particular significance on Arran is the limited number of predator species. There are no foxes (*Vulpes vulpes*), pine martens (*Martes martes*), stoats (*Mustela erminea*) or weasels (*Mustela nivalis*), and goshawk (*Accipiter gentilis*) has not established itself as a breeding species. The main potential predators are therefore limited only to hen harriers, golden eagles (*Aquila chrysaetos*) and feral cats (*Felis catus*).

Photo 2: Woodland site with 60% open space providing high quality habitat.

Photo 3: General view of SPA habitat in the southern part of Arran. A landscape with a variety of suitable black grouse habitats that are interspersed in a way that fits with the known seasonal movements and dispersal behaviour of black grouse.

In October 2009, forty-two captive-bred black grouse (32 males and 10 females) were obtained opportunistically and released after six weeks in a hill pen. See Photograph 4 for an overview of the release site habitat. The pen was situated on the forest edge in heather and bilberry, and the bilberry was eaten to ground level by the grouse. A grain feeder was provided in the pen and after the release a second grain feeder was provided on the outside of the pen. The feeders were used regularly throughout the winter. Prior to release, five cocks and five hens were fitted with radio tags and weighed. Eight of the released birds died by the second week and a number of these were picked up for examination. No diseases or significant parasite burdens were discovered, but the birds were 25-33% below their release weights and their stomachs and crops were completely empty. This indicated that the birds were not eating, despite apparently feeding well on wild food and feeders whilst in the pen. Reasons for this outcome are not yet clear, but may be stress responses to the combination of radio-tagging and release. Another possibility, based on previous experience with captive-bred grouse (R Moss *pers comm.*), is that the birds simply didn't recognise the feeder outside the pen as a source of food. However, some of the birds survived this initial period and in mid April 2010 one female and up to six males were still alive. Cocks were observed lekking alone or in twos in April and May 2010, but no subsequent nesting attempts were discovered. The Arran Grouse Group is now focussing on monitoring the remaining released birds and on developing a captive breeding programme on the island for planned future releases.

Grouse Group members Robert Moss and Kenny Kortland visited the island and met the ABGG in October 2009. Both were impressed by the dedication of the group and by the amount of high quality habitat. They calculated that Arran had the capacity to support a population of at least 500 black grouse. They also concluded that, because of its location, Arran was a good place to attempt a black grouse reintroduction, and that the project offers an opportunity to learn about the factors that influence such projects. However, the ABGG would benefit from advice from other Grouse Group members who have direct experience of captive breeding of black grouse, so please get in touch!

Photo 4: Overview of 2009 release site in northern part of Arran. This area comprises a few hundred hectares of mixed-age forestry, willow scrub, heather moorland and wet, grassy flushes.

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Two capercaillie leks in novel habitat in Scotland

Kenny Kortland & Graeme Findlay

In Scotland, semi-natural pinewoods are very limited in extent and commercial plantations are the most extensive habitat available to capercaillie. Of 114 known lek locations recorded as being active in at least one year between 1999 and 2009, 70% were in plantation habitat. Most of these plantation leks were in forests, or parts of forests, with a high proportion of thinned Scots pine (*Pinus sylvestris*). Typically the stands around the display sites were over forty years old. However, two leks are located in habitat that is novel in terms of the composition of the surrounding stands and, in one case, the age of the surrounding stands. The way in which capercaillie are seen to use the habitat at both of these leks in spring is also interesting.

Lek 1 is situated on a reasonably flat area of approximately 50ha at the top of a gently sloping hill, at around 300m altitude. Approximately 60% of the woodland within 500m of the usual display area comprises one continuous block of unthinned Sitka spruce (*Picea sitchensis*) and Lodgepole pine (*Pinus contorta*), which are North American conifer species known to be eaten by capercaillie in Scotland (Picozzi *et al* 1995). The remaining 40% is one block of Scots pine. All of the trees were planted between 1954 and 1956. The Sitka spruce and Lodgepole pine stands seem impenetrable to flying capercaillie, but the Scots pine stands have been thinned and capercaillie can fly through them.

Lek 1 has been counted since 1999 and three or four cocks have usually been found. Up until 2006, when there was some small-scale clear felling near the lek, the cocks displayed along three rides that radiated from a central point. (Rides are linear, unplanted gaps about 10m wide that separate some stands, and which serve various management purposes.) The central point where the rides converged was usually occupied by the alpha male (based on observations of copulations). Careful searches of the rides, and the adjacent spruce and Lodgepole pine stands, for capercaillie signs indicated that the cocks were living along the rides and roosting in branches overhanging the rides. At a few locations, droppings indicated that cocks were spending time on the ground within the unthinned stands, but such droppings were all within 10m of the rides. So, in spring time at this lek, the alpha cock appeared to have a small territory where the rides converged, and the other two or three cocks had linear territories several hundred metres long that radiated from this central point. At dawn in April, the alpha male would start singing at the central point. The two or three other males would then gradually make their way along their 'ride territories' towards the alpha male.

Interestingly, beyond 500m from lek 1, there is abundant 'normal' lekking habitat of well-thinned Scots pine over forty years old. But this was apparently never seen to be used for display or mating purposes, and there were very limited signs in this area. In 2006, the Scots pine within 500m of the

display area received another thinning and two coupes of the unthinned Sitka spruce and Lodgepole pine were clear felled near the central point where the rides converged. The clear felled coupes were approximately 3 and 1.5 hectares. Following this thinning and felling, the distribution of displaying cocks changed a little and most display activity is now (2010) within the Scots pine stand next to the former central point – although this is only about 100m away and there is still much activity on the rides.

Goshawks are now present in this forest and have been observed hunting along the rides. On two occasions, a female goshawk was seen swooping down towards a capercaillie cock displaying on the ground. The cocks reacted by simply running a few metres into the unthinned spruce where they were completely safe.

Lek 2 is situated on a reasonably flat area of approximately 50ha at the top of a gently sloping hill, at around 370m altitude. The forest within 500m of the known display area comprises unthinned stands and mixtures of Sitka spruce, Lodgepole pine, and Scots pine. All of the trees were planted between 1984 and 1985 (see Diagram 1 and Photo 1). Beyond 500m, the stands are the same and the nearest thinned pine is over 3km away, although there is a small semi-natural pinewood approximately 2km away.

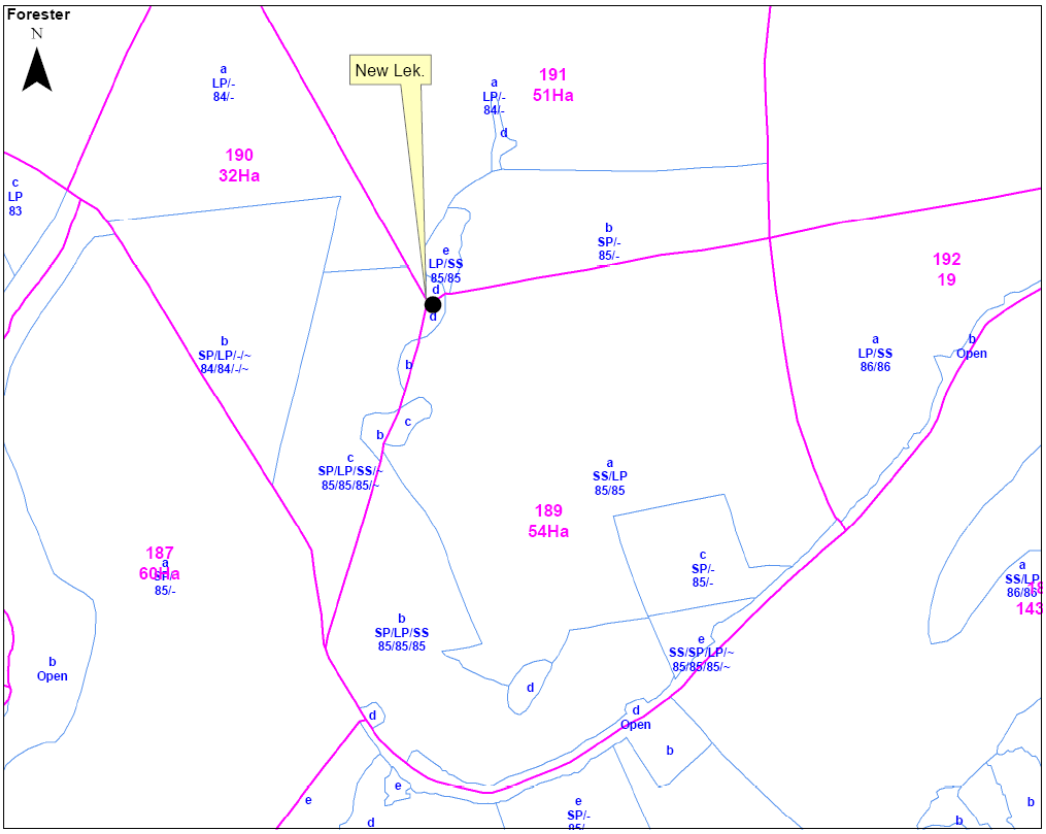

Diagram 1: Forest stock map showing details of crop and the location of the new lek (lek 2) at the junction of three rides (pink lines). SP is Scots pine, LP is Lodgepole pine, SS is Sitka spruce. The numbers equate to the year the trees were planted, so SP84 is Scots pine planted in 1984.

A cock was first seen on the ground at the lek in spring 2009, though there had been several records for the general area prior to that. In 2010, at least two cocks were at the lek and cocks were seen there by Forestry Commission Scotland staff on numerous occasions during April. Hens have been seen regularly in the rides near the lek for the last three years. In spring 2010, hens were present in the rides constantly during spring and there were abundant signs of cocks and hens throughout the rides near the lek. It should be noted that more effort was made to survey the site in 2010. Searching of the unthinned stands next to the rides for sign revealed that cocks and hens had been using the edges of the stands.

One common feature that leks 1 and 2 share is that the trees have been planted on mire and therefore the rides are dominated by tussocks of hare's-tail cotton grass (*Eriophorum vaginatum*) (see Photo 2). Cotton grass appears to be a significant part of the spring diet of hens in Scotland, and hens are probably attracted to these rides because of this food and because of the cover offered by the unthinned stands.

We speculate that once trees in new plantations planted on mire reach a threshold height that provides sufficient cover (at age 23 years based on the information available for lek 2) hens are attracted to the rides to feed. Subsequently, cocks are attracted to the site by the hens, and a lek is formed. It is worth noting that lek 2 is situated in a forest of over 3000ha in the north-east of Scotland and there are other active leks within 2.2, 4.5, 5, 5.5 and 5.7km of lek 2. Therefore, there are nearby sources of capercaillie and the cocks attending lek 2 may be young, although this has not yet been confirmed.

Photo 1: Looking SSW down the southern ride from the new lek (lek 2) site. Capercaillie feed in this ride and others around the lek and utilise the edges of the unthinned stands for cover. A large number of cock droppings were found in the Scots pine stand on the left, which had a number of small gaps. Many droppings were not fresh and were full of pine needles, suggesting that at least one cock had been present all winter in these small trees (c. 5m tall).

These observations concur with those of Rolstad *et al.* (2007) who found that leks formed in young (26-46 years old) plantations because cocks were attracted by the hens feeding there in winter. All of these findings support the hotspot theory of lek formation presented by Gjerde *et al.* (2000).

On the national forest estate in Scotland, which is managed by the state forestry organisation, Forestry Commission Scotland (FCS), capercaillie conservation is a major management objective. See www.forestry.gov.uk for details of their action plan for the species. Therefore, efforts are being made to enhance and retain these two unusual leks. However, the main constraint to thinning the trees around the lek to create space for more cocks is wind. This is particularly the case for lek 1, where most of the trees have not been thinned and are now too tall to thin. This is because the site was designed for a simple plant and clear fell rotation, with no thinning. This has now been changed to suit capercaillie and the plan now is to fell and replant a series of small (<2ha), linear areas within the lek range, on an ongoing basis, to create a mosaic of age classes. At lek 2, management may be easier because the trees are younger and thinning may be possible in some of the areas around the lek. However, the site is exposed and thinning opportunities may be limited because of the very strong winds that occur here. One management activity that is being carried out already is cutting of the vegetation within the rides. This is carried out in autumn and is done using a cutter towed behind a tractor. This treatment results in a large increase in cotton grass.

Photo 2: Close up of vegetation in ride of lek 2 showing Eriophorum vaginatum tussocks. Hen capercaillie droppings are also visible. Like all hen droppings found in the rides at both leks, the droppings are full of undigested cotton grass glumes.

In Scotland, black grouse (*Tetrao tetrix*) colonise new, planted woodlands as soon as they are planted. As the trees grow, lekking activity is increasingly restricted to the rides – until the trees reach approximately 25 years old (K Kortland *pers obs*). At this stage, most lekking occurs out with the woodland, although a few cocks may continue to lek in very wide rides, at the junction of rides, or in other open areas within the woodland. Black grouse occur in the vicinity of lek 2 and still use the rides there, but capercaillie are now seen more frequently. So, in Scotland, it seems that when new commercial woods, comprising non-native tree species, are planted on upland mires, they become instantly attractive to black grouse. Then, as they grow, they become less attractive to black grouse but become suitable for capercaillie, even at an early stage of growth (23 years old). Even if they are not thinned, capercaillies are able to continue to use this novel woodland habitat. The fact that capercaillie and black grouse can adapt to such man-made habitat makes the long-term conservation of these species in Scotland a slightly more realistic possibility.

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Habitat selection and spacing behaviour of capercaillie in the Italian Alps: a project in progress

Michael Berchtold, Luca Rotelli & Ilse Storch

Throughout central Europe capercaillie have become rare and population densities are just a fraction of what they used to be some 50-100 years ago. Habitat loss and habitat degradation due to changes in forestry and other human land-use practices are commonly seen as the major explanation of the species' decline. Consequently, capercaillie conservation is dominated by the "habitat paradigm": quality and quantity of available habitat are believed to explain variation in capercaillie numbers.

Work in the Bavarian Alps (STORCH 2002) indicated that although capercaillie show pronounced preferences for certain forest types, parameters of forest structure can explain only a minor proportion of the variation seen in capercaillie density at the landscape scale. Similarly, colleagues in Finland found that changes in forest age structure cannot be blamed for observed capercaillie declines (SIRKIÄ ET AL. 2010). Are we wrong, or at least partly wrong, when we believe in forest structure as the best predictor of capercaillie populations?

Photo: The study area is a high mountain range in the eastern part of the Trentino province, Italy, with altitudes between 1100 and 3200 m above sea level. The landscape is characterised by extended spruce dominated coniferous forests with ground vegetation rich in ericaceous shrubs. Besides forestry, human influences are ski-tourism and alpine pasturing.

In 2009, we started an interesting new case study in the south-eastern part of the Italian Alps. Extended spruce-dominated mountain forests, shaped by careful single-stem and group felling practices, appear to offer optimal capercaillie habitat structures. Yet, capercaillie population density is clearly less than what one would expect compared to other parts of the Alps. Habitat availability appears not to be a limiting factor. Suitable structures occur on thousands of hectares. Other limiting factors, such as insect food for chicks, predation, competition with ungulates, and tourism, are likely at work.

The research project is conducted by the Nature Park "Parco Naturale Paneveggio - Pale di San Martino" in cooperation with the Department of Wildlife Ecology and Management of the University of

Freiburg, Germany. Until now eight birds have been captured and equipped with 19g VHF radio-transmitters. Major study question is the role of "habitat" in capercaillie range use and demography.

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First note about radio-tracking of Cantabrian capercaillie *Tetrao urogallus cantabricus* in the southern slope of the Cantabrian Mountains, León, NW Spain

C.J. Pollo, F.J. Ezquerra, L. Robles & M.A. Osorio.

Introduction

Since 2006, a study based on radio-tagging of capercaillies (*Tetrao urogallus cantabricus*) is being developed in the province of León (Castilla y León, Northwest Spain). The project is framed within the "Program for Ex-situ Conservation of the Cantabrian Capercaillie", funded by the Biodiversity Foundation (depending on National Government, Ministry of Environment) with the participation of the Junta de Castilla y León and the Principado de Asturias (Regional Governments). Throughout this period three individuals have been captured and tagged, two of them in 2006 (one male and one female) and another female in 2007, in two different areas. The capture zones are located in the southern edge of the capercaillie range in the province, which is also the southern extent of the range of the species in south-western Europe.

The radio-tracking effort has continued through 2010, funded jointly by the Natural Heritage Trust of Castilla y León, the Biodiversity Foundation and the Junta de Castilla y León.

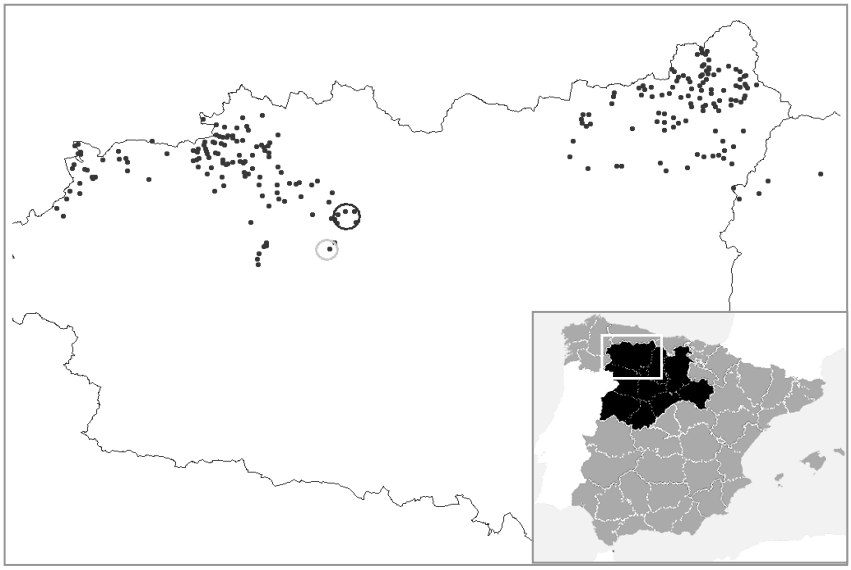

Figure 1. Location of capture areas (circles) in the Leon province, NW Spain. Points mark main capercaillie nucleus in it.

Study area

Two close study areas (Omaña and Cepeda) are both located in a transition zone between the Eurasian and Mediterranean bioclimatic regions in central-northwest portions of the province of León. They are

near the border of the most southernmost chains of the Cantabrian range, characterized by hot dry summers and wet winters. The topography of the site is a mid-mountain area, with gently slopes and slightly pronounced sides, and peaks less than 1500 m a.s.l.

The vegetation is heavily modified by the traditional use of fire to maintain pastures for livestock use. North-facing slopes are usually covered by the dominant tree species Pyrenean oak (*Quercus pyrenaica*), which forms clumps, mostly root re-sprouted and less than 30 years old, except for some small remnant mature stands. During recent decades, this kind of forest has developed primarily from the abandonment of farming, grazing and firewood harvesting. Sunny slopes are occupied by large continuous scrubland with red heather (*Erica australis ssp. aragonensis*) and other shrubs. There are also several reforestation plots dominated by pine (*Pinus sylvestris*), 30 years old or younger, several of them having developed naturally mixed stands of pine and oak. Pine woods dominate the southern study area (Cepeda) while oak forests dominate the northern one (Omaña), although both forest types are represented in each study area. Bilberry (*Vaccinium myrtillus*), which has been identified as being of major importance for Cantabrian capercaillie, is quite scarce and appears only in small patches with poor fruit harvest in the higher slopes of northern area.

Regular presence of capercaillie in these areas has only recently been noted. Presence in the northern area of Omaña was known a couple of decades ago, but existence of birds in some of the sites where we have captured them was unknown, even by biologists, until recent years. Populations in the southern area (Cepeda) have been discovered even more recently by scientists, and in fact several previously unknown core occupied sites and evidence of breeding have been found during the study years.

Methodology

Marking and location of birds

The birds were captured in autumm using steel trap-boxes. Captured birds were equipped with radio-collar transmitters (Biotrack mod. TW3, 21 grs. weight), fitted with mortality sensors, with a battery life of 2-3 years. During 2006 one adult male and a 4-month old female were so tagged in the Omaña area, while in 2007 one 15-month old female was captured in the Cepeda area. The monitoring program established a minimum frequency of one location per week, except during critical times of the year (estrus, breeding and wintering), when location frequency increased. An ICOM RI-20 receiver and a Telonics 2-element antenna were used for tracking. Whenever possible we tried to obtain a signal with high attenuation, for better precision in marking the exact position of the birds.

Once the bird was located, its position was determined by triangulation, marking it on a map to obtain the UTM coordinates. Once per month we tried to visually locate the birds to check their status, integration into a group or activity (heat or incubation), or to confirm their exact location.

Data processing

We have selected only one location (noon) per day in order to achieve a good distribution of data and avoid autocorrelation bias from multiple location sessions that may not be representative of the entire study period.

For data processing we used the GIS program ArcView 3.2 and Animal Movement software that allows determination of areas of probability of presence (equivalents to home ranges) from locations with different degrees of probability. The Minimum Convex Polygon (MCP) has been determined by joining the most extreme locations, and on the other hand areas with different Kernel probabilities (95%, 75% and 50%) have been calculated (Worton, 1989). We have considered the home range of the individuals as the polygon formed by the union of the locations on the periphery of the point cloud of all annual observations (MCP). This operation has been carried out using the Kernel software, as an extension of ArcView 3.2.

Kernel 95 seems very similar to MCP, but eliminates less common values, which gives us a definition of the territory perhaps more accurately, but could leave out area infrequently used by the bird. It also excludes displacements buffer zones between ends or results of the union of two extreme points, which can give an unreal image of the range.

In order to determine the habitat of the birds in a certain period, we used the Kernel estimators 75 and 50, which better represent the most frequently used areas of the home range during that period. These Kernel areas are important for more detailed studies of habitat characterization. In our case we considered the Kernel 50 to be more accurate to determine occupation by seasons.

Annual period has been divided into four phases, which correspond to a mixture of stages in life cycle of capercaillies (heat and incubation and mute) and / or meteorological seasons (summer, autumn and winter), and delimit their behaviour and the use of habitat they can do. All of them have been determined over extensive information collected in the literature, data from other areas and our own observations or collected by other observers.

The periods for data analysis were as follows:

Mating season: Determined by the first exhibition of males displaying on the leks. Period between 15 March and 1 June.

Summer season: From the cessation of mating up to the time of rising temperatures, withering of vegetation and water shortages, which lasted until mid-September. This period matches two phases of the life cycle of grouse: hatching and raising chicks, and the complete change of plumage. The latter begins for the male when they finish mating displays (June) and for females varies depending on the development of incubation and rearing, starting when chicks are a few weeks old (July-August) or coinciding with the males if nesting fails or is the bird did not nest.

Fall season: In work areas may correspond to an extension of the summer, but it starts with berry fruit (blackberries and blueberries) and other seeds (hazelnuts and acorns) and extends until mid-November.

Winter season: Marked by snow, low temperatures, reduced daylight hours and dormancy of vegetative plants.

Some preliminary results

Between November 2006 and October 2007 269 locations were recorded, with 561 locations recorded in 2008 and 98 locations recorded in 2009 (Table 1). The two transmitters deployed in Omaña ceased transmitting precisely at the end of 2008; although they have allowed some localizations until mid-2009 with very low intensity signals; these data have not been analyzed. The female 2 was depredated in September 2009. We are now working with the collected data in several ways, the determination of home ranges being the first. Here we present our preliminary results.

*Table 1. Number of locations in each year for radio-tagged birds. * Non-analysed data.*

Year	Male	Female 1	Female 2	Sum
2006	31	30	--	61
2007	99	99	10	208
2008	228	230	103	561
2009	23*	31*	44	98
Total	**381**	**390**	**157**	**928**

a) Home ranges

Male

The forest type occupied by the male has always been the oak forest. Surprisingly it has not used the pine plots in the vicinity, which are commonly used by other capercaillie, nor has it used a patch of birch whose structure at the top of a hillside with bilberry understory is typical of Euro-Siberian woods (Storch, 1993) with presence of other individuals also. Its home range was larger in 2008 (1177.63 ha) than in the previous period (779.28 ha) (Table 2).

Table 2. Home range (ha) in one year (November 2006 - October 2007)

	MCP	Kernel 95	Kernel 75	Kernel 50
MALE	779,28	765,85	330,23	127,65
FEMALE 1 (young)	1272,28	1273,61	519,20	177,30

Female 1

This bird has allowed us to observe the change from being a juvenile in 2006-2007 to becoming an adult in 2008. In 2007 it took a displacement of about 5km in the core of the mating season, to a distant oak wood which seemed to be not occupied by other capercaillie, where silvicultural works had been recently developed, and where there had been no records of capercaillie for the last decade. This movement was interpreted as a juvenile dispersal behaviour, which could be expected in a bird with an age of about 10 months, perhaps in order to colonize new ranges.

In April 2008, it returned to the place of birth and capture, where he remained during the breeding and nesting seasons until August, when it moved back to the wood colonized in 2007, and finally returned again in October to its natal area, which could due to phylopatric behaviour.

As a result of succession of journeys, the habitat occupied by this capercaillie was very different between 2007 and 2008, with much lower values of Kernel 95, 75 and 50 in 2008 as an adult, than in 2007 as a juvenile. The habitat occupied by this bird has always been oak woods.

Table 3. Home range (ha) in one year (2008)

	Mínimo polígono convexo	**Kernel 95**	**Kernel 75**	**Kernel 50**
MALE	1177,63	687,50	254,22	86,95
FEMALE 1 (adult)	1735,3	736,5	186,54	98,1
FEMALE 2 (2008)	122,29	128,34	40,96	8,33
FEMALE 2 (2009)	107,66	144,64	28,80	13,40

Female 2

The area used by this capercaillie was much smaller than the others we observed. The home range was less than one tenth the size of that of female 1 (Table 3), due to no large displacements, but only short movements throughout the year and seasons; even when changing main areas, distance between the outermost points has been 1,200 m.

The dominant forests in its home range are young woods, about 30-40 years old, both reforestation stands of *Pinus sylvestris* and natural after fire re-sprouted stands of *Quercus pyrenaica*, and the tagged bird has used both depending on season, but mostly pine woods. Absence of bilberry is remarkable in this area, where the understory is composed of red heather and *Halimium alyssoides*, a short shrub that has been known to be of great dietary value for the grouse.

b) Annual change in the use of space (habitat)

Thus far, the analysis has been completed for only the male and female 1, for which two full years of study have been completed (Table 4).

Table 4. Comparing results between seasons for 2007 and 2008, for male and female 1.

	Male 2007 (adult)	***2008 (adult)***	***Female 1 2007 (joung)***	***2008 (adult)***
Annual (Kernel 95)	765,85	687,50	1.273,61	736,50
Winter (Kernel 50)	78,97	122,37	14,09	98,55
Mating (Kernel 50)	59,72	41,75	594,39	125,99
Summer (Kernel 50)	211,29	135,21	18,98	122,68
Fall (Kernel 50)	69,19	38,63	73,33	135,22

In 2007 and 2008 the male stayed in the same areas during the mating season, autumn, and most of the summer, varying only in the winter, although the areas occupied in the latter period during both years have been very near, in a north-facing slope with some holly (*Ilex aquifolium*). The area occupied during the mating season follows the same trend, while in summer and autumn it settled in areas facing west, southwest and northwest. In both years the male used a larger area in the summer than during the mating season and autumn.

As previously mentioned, female 1 has used many different areas, the natal area being a north-facing slope and the colonized wood a northeast-facing one. In both periods, it was during the winter when a smaller area was used, while areas used in mating season vary a lot depending on large displacements.

c) Other facts

Other studies are being developed regarding the presented data. Besides what we have presented here, we are working on modelling capercaillie habitat in this area, which is quite different from other parts of the Cantabrian range where some habitat analysis (Quevedo *et al*. 2006, Bañuelos *et al*. 2008) have been developed and whose conclusions are clearly not valid for this site (for instance, those which point out the beech woods as the optimum for capercaillie, while here there are no beech and the grouse uses submediterranean oak woods and pine stands). We are further investigating the relationship between forest structure and use of habitat, a question that preliminarily seems to fits quite well. Effects of silvicultural practices (to prevent forest fires or thought to be of management practices for capercaillie) are being also analysed.

Conclusions

As previously mentioned, this note is intended as a preliminary report in order to share our experience and to present the information we are acquiring. The main conclusion is the remarkable difference in home ranges, and the use of habitat and displacement patterns between the three studied birds, which was not easily predictable in such a small area. This enables us to further understand the need long term research in this manner in order to achieve valid conclusions. On the other hand, notable observations, like capability of large displacements (even of "go-and-return"), the different use of "man-made" pine stands or the absence of bilberry should be taken into account by researchers and managers involved in the conservation of this species.

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Cantabrian capercaillie through time: a further comment

Juan M. Rubiales, Francisco J. Ezquerra, Fernando Gómez-Manzaneque, Salvia García Álvarez, Ignacio García Amorena & Carlos Morla

In a recent note published in this journal (Rubiales et al. 2009) we discuss the role the long-term environmental history of the Cantabrian Mountains may have played in the dynamics of the Cantabrian capercaillie *Tetrao urogallus cantabricus*, the only subspecies of capercaillie at risk of extinction worldwide. Three key conclusions, in the light of the available palaeoecological data were that: 1) the vegetation occurring within the range of the Cantabrian capercaillie has heavily changed during the last three millennia, due primarily to anthropogenic activity; 2) the extensive distribution of pinewoods until the historical period is coherent with the pattern of association of capercaillie and conifers occurring in the rest of its range; and 3) in the light of the distinct current patterns of decline and persistence of the capercaillie, it could be expected that the demise of pinewoods (becoming locally extinct at the western part of the Cantabrian mountains) would have had implications in the capercaillie persistence in the long term.

In this respect, although the Rodriguez-Muñoz et al.'s (2010) note in the last issue of Grouse News purports to be a reply to our communication, it does not respond to any of our arguments, but rather reproduces a misleading debate devoid of any scientific basis. Further, they seem to question the validity of our conclusions by arguing that: 1) genetic and fossil evidence supports that Cantabrian capercaillie has remained confined to the Cantabrian area since, at least, the beginning of the last glacial cycle, and 2) the current decline of capercaillie may not be explained by a long-term ecological process spanning centennials.

Here, we show that the arguments provided by Rodríguez-Muñoz et al (2010) have no scientific relevance to refute our hypothesis. Firstly, they present an unfortunate string of wrong assumptions on the geographical and palaeoecological setting of the Cantabrian areas. A relevant point argued is that human activities have not had a major influence in the shaping of the vegetation (and particularly of pinewoods) during the Holocene. However, accumulating evidence from palaeoecology (including pollen and macrofossils) are showing that pinewoods extensively survived up to the historical period and that anthropogenic activity has been the major driver of change during the last two millennia. Moreover, historical data reinforce that the intense deforestation owed to human action spanned centennials (and not only some decades of the 20th century). These arguments are already detailed in Rubiales et al. (2008, 2009) and in some of the works cited in their own note, as in García Antón et al. (1997); but readers can also check, for further discussions (Manuel et al. 2003, Ezquerra & Gil 2004, Gil & Torre 2006, Sevilla 2008, López Merino et al. 2010, Carrión et al. in press, Jalut et al. in press). Furthermore, niche modelling studies (cited wrongly in the note) such as the examples of Benito et al. (2006, 2008) show that the simulated maps of presence include the Cantabrian Mountains, both for the mid-Holocene and the present, as potential distribution areas for *Pinus sylvestris*, reinforcing the weak role of climate in explaining its recent natural distribution.

Regarding the long term, geographical confinement of Cantabrian capercaillie in the Iberian mountains, we consider that this model is fully compatible with a coupled history with pinewoods (i.e. *Pinus sylvestris*) in the mountains of western Iberia, that also show a long history of isolation as shown from their genetic data (e.g. Soranzo et al. 2000, Chedaddi et al. 2006) and from that of other pine dependent species, (e.g. *Thaumetopoea pityocampa*, Rousselet et al. 2010).

It seems evident that Cantabrian capercaillie has been able to persist without conifers in wide areas during a considerable amount of time and that its present demise is very probably due to a mixture of factors and that the absence of pines is probably not among the most important. However, the question that still remains open is whether or not, under critical adverse situations for the capercaillie, the existence of conifers (pinewoods in the case of Iberia) may confer additional advantages for their survival. It is true that the lack of long-term animal data-sets hamper the precise reconstruction of population trends at the centennial to millennial scale, but in the absence of an empirical approach, there is no theoretical reason to doubt on the existence of long time-lags between habitat deterioration and species losses (e.g. Diamond 1972, Tilman et al 1994). Now more than ever, long-term processes such as resilience and thresholds are major topics of research in the field of ecology (e.g. Willis et al. 2010) that will probably deserve more attention that they have so far received from experimental ecologists. Although increasingly threatened, ongoing research on Cantabrian capercaillie could still help us to deepen in these questions and it thus makes sense to investigate these points by tracking the history of their habitat and the current use of non-natural pinewoods.

In the last paragraphs, Rodríguez-Muñoz and co-workers attempt to discredit our work by attacking questions that we have not addressed (i.e. that “pine afforestation is likely to improve its recovery more than the natural restoration of deciduous forests”) or by using demagogic assumptions (i.e. that our

argument encourage "forest managers to keep replacing the natural hardwoods with pine plantations"). We believe that a more careful reading of our original note would have obviated this spurious criticism. Contrasting opinions are always welcomed, but instead of using provocative arguments to distort the debate, researchers should rely on objective data to prove their own assumptions. We certainly still believe that those reflections on the role of natural conifers over the long-term history of the Cantabrian capercaillie bring a fresh and open perspective to biogeographers and managers that watch over the conservation of the last capercaillies in the Cantabrian range.

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On the impact of ice crust above snow burrows of grouse

Roald Potapov

Menoni et al. (2010) discussed the problems of impact of ice crust formation on grouse and partridges in the winter and its possible relations to climate change. The paper presented two instances of deaths of two Tetraonid birds, ptarmigan *Lagopus muta* and black grouse *Tetrao tetrix*, both with transmitters. The ptarmigan was found in June, whereas the photograph shows the bird in winter plumage without any signs of spring moult. The Black grouse was found in buried in snow. The diagram shows the bird covered with snow on a slope. The bird was located next to a large stone. The paper deals with the issues of ice coating and the combination of conditions which might burry grouse alive in their snow burrow, which the authors tried to demonstrate on the example of two findings mentioned above. Ice coating indeed might appear throughout the grouse range during periods of freezing rain. These conditions of ice coating ("ledyanaya kukhta") are well known in old literature. It is not new that it makes food of grouse inaccessible for several days, and in some cases might cause severe decline of local populations of grouse and even local extinctions (see Formozov 1946, 2010, Novikov 1981, Potapov 1974, 1985, 1992 and references therein). This factor indeed might affect populations of wild grouse, however I found no direct indications that the probability of ice rain significantly increased in the recent global warming episode. The authors did not make any specific indication to that too. In this short communication I address only the issue of 'buried in snow chamber' phenomenon and its impact on the grouse.

The Grouse, or Tetraonidae birds, are the youngest family of the order Galliformes. Its origin and evolution is based on an old and deep adaptation to survival during the winter season while staying in one place, i.e. survival as a non-migrant. Among these adaptations, both morphological and behavioral, are the habits of the birds to roost under snow, and to move on snow cover. The birds developed unique morphological structures on their toes, represented by pectination on both sides of the phalanges. This trait appears in all species of grouse (except all species of the genus *Lagopus* and Chinese grouse *Bonasa severzowi* at the beginning of the winter. These pectination is very important in the process of digging into snow during preparing the snow burrows (Potapov 1969, 1992). The birds loose this pectination during spring. In *Lagopus* species the pectination is replaced by thick feathering. Another important morphological adaptation for roosting in snow burrows is the thick feathering of the nostrils. The purpose of this adaption is not only to protect the respiration system from the snow crystals while the bird is digging through snow, but to condensate moisture from the exhaled air in order to prevent a formation of icing on the walls of under snow burrows and tunnels. I mention these well known characters here only to stress the importance of snow burrows in which the grouse spend not only long winter nights, but also significant parts of the daytime. The ambient temperature in such snow burrows is optimal for birds, and ranges between -1 and - 3 C. The temperature in snow burrows is not correlated with the ambient temperature above snow level, which often reaches extreme levels of -50 C and below. In other words, the regular roosting in snow burrows (i.e. thermal refuges) is one of the main adaptations of grouse for survival during the winter season. Other important adaptations are the ability to live on twigs, buds, catkins, needles etc of trees and shrubs with low nutritional content throughout all of the winter months.

These adaptations are of a prime importance in the areas with severe winter conditions: Scandinavian countries, most parts of Russia, Alaska (USA), Greenland (Denmark) and Canada. In other countries, especially in Western Europe, where the snowy winters are frequent only in high mountains, the situation is very different. Snow cover appears for a comparatively short time and irregularly. Because of frequent thaws and little thickness this snow cover is not suitable for preparing snow burrows. In such conditions there is no strong need for a thermal shelter for the grouse. This need appears only during the strong and prolonged winter frosts accompanied by the sufficient decrease of the day's longevity. In such cases only two reasons may prevent grouse from preparing a thermal refuge (snow burrow): 1. little quantities or

lack of snow cover or 2. impossibility to dig into it because of a hard crust covering it. In the first case which is not at all rare N.E. Siberia at the beginning of winter (end of November), the local populations of grouse (black-billed capercaillie, hazel grouse, willow grouse) survive on significant fat layers. Grouse in such cases roost mostly on the ground, hide in tree canopies or dig small holes in the thin cover of snow. When a hard snow (not ice) crust is formed on the surface after alternating strong frost/thaws cycles, the grouse indeed suffer a higher mortality. All the information about possible disastrous cases of grouse captured under the snow by a powerful "nast" (a Russian word meaning a hard crust of frozen wet snow atop of normal snow layer) that is found in Russian literature is connected to such cases. The crust begins to form every morning above the thick snow layers from the middle or end of March throughout all of the Taiga. That crust may reach extremely hardness so that it can support the weight of a human without skies. However such a kind of spring crust is not so dangerous for grouse. The increased longevity of the day and wormer air temperatures permits grouse to roost both in the thick canopies of trees, as well as in the open holes at the snow surface.

The "records" of the death of grouse in winters under the snow crust appeared in Russian literature from the beginning of the 20th Century. The main sources of this information were the reports of laymen (hunters, nature-lovers etc.). No direct records of this kind are known to me from professional ornithologists. In all of the reports the bodies of dead grouse were found during the snow melt in spring (and yes, the snow crust was above the bodies) and were never analyzed professionally (there is only one exception, see below). Because of this, the opinion that the reason for these deaths was the hard crust on the snow surface was quickly established in many popular literature publications as the main explanation of these events. One good example is the information from Dementev et al.(1967) cited in the article of Menoni et al (2010). The original Russian text was describing the disappearance of black grouse flocks of 20-40 birds each in the Moscow region in 1944 (based on information received from "hunters"). After the appearance of the hard snow crust the black grouse stayed not less than 2 weeks. "Vanished", the true translation, is not "perished" (translation in E. Menoni et al. 2010). The next sentence explained that during the winter the flocks of Black grouse had a nomadic way of life. The author of this text, Dr. A. Micheev (1967), decided for an unknown reason that disappearance of birds in this case meant their ultimate death. Following this Menoni et al. (2010) said that when a flock of 5-6 hand reared young male black grouse suddenly disappeared after a night of freezing rain; the authors thought that these birds were "trapped by the ice at their night roost, and died, even though they were never found". The simple idea that the birds might have moved elsewhere was never addressed.

I found in Russian sources only one case when one grouse perished in the winter (a male black grouse) (Formozov 1946, 1970, 2010). He found the body of male black grouse in a good condition without any damage, in the melting snow in the beginning of May. The dead bird was sitting in a sleeping position, with the head pulled to shoulders, with the legs closed to the belly between the feathers, and with the crop full of birch catkins, but only a few droppings. All this proved that this bird died calmly and painlessly (in sleep – R.P.). The author had no doubts that it was killed by frost (Formozov 1970). Black grouse feathers differ from that of other palaearctic grouse by a very high thermal conductivity which is twice the theoretical conductivity (Hissa et al. 1982). This fact explains the absence of this species in the most continental parts of Siberia despite an abundance of its main winter food – birch's catkins, buds and twigs (Potapov 1986). In other words, the black grouse is the more heat-loving among Eurasian grouse and this is the reason why the reports about the death of grouse during winters mainly concerns black grouse. This circumstance explained other published information about the finding of black grouse bodies ice-bounded in the Sosva river, Northern Ural, Russia, after the strong January frost of -50 C. As was explained by Formozov (1970), it was because the thin snow cover in the river where Black grouse roosted in its snow burrows was not thick enough to protect birds from such a strong frost. The water in the ice appeared much later and the dead bodies were ice –bounded after they died.

There is another vulnerable moment for grouse during long spells of strong frosty weather. Under these conditions the grouse tend to fill up their crop as quickly as possible. The large quantity of food in the crop has the same temperature as surrounding air, and the grouse must warm it up to the body temperature. In anticipation of this energy expenditure the grouse rush to dig a snow burrow as soon as possible in order to offset such a demand. If the snow condition is not favorable, or the bird is weakened by parasites or other reasons, the situation could result in the bird's death.

I heard several stories about the findings of black grouse bodies during the spring snow melting. The bodies were in sleeping positions and with food in its crops. However, I never found such birds myself despite 40 years of regular winter field work. During this period, together with my colleagues, I inspected hundreds of snow burrows of black grouse, capercaillie and hazel grouse, both with birds, as well as just flushed, but never found the fresh snow burrows, especially with the birds in its, during the thaw or under the fresh crust. This suggests that the events described above are not common.

Sometimes I heard fantastic stories, all of them "Hunting Stories" where some real facts are slightly visible across the clouds of an author's fantasy. When I read to my colleagues the story about one game keeper who rescued a black grouse flock (not less than 10 birds) from frost traps in one day in late winter (Borchtchvski written com.), cited in this article (Menoni et al. 2010), this produced the burst of Homeric laughter. Maybe the story was produced from the fact that sometimes grouse in a snow burrow let the person on skies approach so close that they were touched by a ski stick. This will trigger a vertical take-off from a snow burrow like an exploding bomb. I had such cases in my experience. In this case the rescue is problematic as the bird now faces a night in an ill-prepared snow burrow, and increased energy expenditure because of the explosive take-off with a filled crop. Formozov (1970) described a similar case when he studied the snow burrows just being left by black grouse several seconds after his shot. He began to measure the temperature in the snow burrows. To his surprise, in the second snow burrow the thermometer stumbled on a female that did not leave despite of the shots. Push of thermometer was too much for it and it flew up straight into Formozov's face.

It has long been known that grouse never dig its snow burrows during the thaw in wet and compact snow. It is clear that wet feathers are dangerous to any bird during the winter. Because of this reason some authors deny any chances for grouse birds to be found entrapped under snow/icy crust. At the same time other authors are opposed to this point of view. They explained that in the middle of the winter grouse spent a long time in its snow burrows from the beginning of the dark up to sunrise, i.e. nearly 14 – 15 hours. This time may be enough for a harsh change of weather, like a thaw with sleet or rain in late evening and a strong frost in early morning. This is very rare, but possible. And even during this possible situation grouse have a good possibility to avoid the danger of being entrapped under the snow/ice crust because of its ability to sense the changes of snow cover, and to change the place of roosting during the night. During the last 30 years it was established that hazel grouse, capercaillie and black grouse can leave the snow burrow in any dangerous case such as at the beginning of thaw, and during the heavy snow falls when the thickness of the snow roof above the burrow increases quickly. During this change grouse finds the new place for the roosting and dig the new snow burrow or, during the thaw, roosts at the snow surface under the cover of low branches of trees (Potapov 1982, Potapov 1986). It was clear for a professional that a dead grouse appearing from the snow during melting in spring is not the victim of snow/ice crust. There are many other reasons that grouse may die during the winter. This may be long absence of normal conditions of the snow cover which in turn increase overall energy expenditure, or heavy parasite infections.

Menoni et al. (2010) found a female rock ptarmigan and a young black grouse male in the snow. I cannot see real evidence that the cause of its death was the ice crust formation. In the first case the female ptarmigan (radio-tagged!) was found 8 June. However, it had a white winter plumage. This shows that the bird died before the beginning of spring molt, sometime before the end of March. The dead bird was in a position usual for the grouse, sleeping on the ground in the snow surface. After its death (at least 2 months) the bird was exposed to several snowfalls and snow melts. After the snow melted enough to expose the bird, it was in its snow burrow, i.e. under the snow, as authors supposed. The authors suggested only two reasons why the birds died, either a rapid hardening of snow (i. e. formation of the ice crust), or a slide of the upper snow layer. The latter assumption has no relation to the process of ice crust formation. It depends on slope declination, which was not given in the paper. In any case the death of the grouse in both situations is certain. Authors mentioned that there are nearly 20 droppings under the bird's bodies. Given that the average time to produce 1 dropping is 12 minutes (Potapov 1985), we estimate that the total time to produce such quantity of droppings is nearly 3 hours. Menoni et al (2010) give no information about the content of the crop, gizzard and intestines, especially the caecum (guts), no information on the weight of the dead body and the level of its exhaustion, or the presence of parasites. Another valid question is why was this bird was alone. It is well known that rock ptarmigan in the Alps stay in small groups, not alone (Couturier 1964, Blotzheim et al.1973). It is real to suppose that this bird was not in good health, hence it died. It is clear that the death of any grouse because of age and problems with its health is more possible in winter. I suppose that this was the case for the bird described by Menoni et al. (2010). I guess that if they came across the Otzi, the 5300 year old Iceman found frozen in the Alps, or corpses of mountaineers found in abundance at mount Everest, all thawing out from the snow, following their logic would conclude that these individuals suffocated in the snow burrows. A simple thought that these individuals were covered by snow layers after their deaths would not be part of the discussions.

The second dead bird was a young male black grouse (also radio-tagged). This situation is more clear, but again as it seems to me it has no relation to the ice crust formation. The authors gave a clear picture (vertical cross-section) which indicates that the cause of entrapment was a slipped snow layer from above the place where the bird rested. In connection with this I have to mention that the Caucasian black grouse, the species that lives only in mountains, tend not to select burrowing places close to stones or rocks.

These birds prefer gentle slopes with minimal probability of avalanches. I suppose that in Menoni's black grouse case the bird changed the suitable warm place for the day's resting after the cold night and morning feeding. This bird selected a place of southern exposition close to the vertical surface of the stone which absorbs lots of sun energy. But the upper snow layers warmed up by the sun slipped down, locking the bird in its place of the day's resting (not in the burrow, as authors wrote). The captured bird used all the food in its crop from the morning feeding, and was alive till all the food in the caecum was used (guts). Menoni et al (2010) mentioned a large quantity of droppings, but they did not count them. If the droppings had been counted, it would have been possible to calculate not only the time of this digestive process, but also the quantity of the food that was in the crop and gizzard. They mentioned the good health of this bird, but it was not confirmed by the data about the body weight. However, Menoni et al (2010) are addressing the importance of more studies of all the cases of winter death of grouse. Such studies should be supplemented by full autopsies and careful records of all surroundings.

Of course, many such cases are connected to constant climatic oscillations. However it is important to keep in mind that grouse, as a very young family of birds, was naturally selected from the beginning of global cooling nearly 6 million years ago by adaptations to life in winter conditions. This was a gradual and long process which resulted in the grouse surviving the Pleistocene Period with its constant and deep climatic changes during the glacial and interglacial epochs. The current climatic oscillations are by far inferior to that of the Pleistocene, and are not dangerous for grouse in general. Nevertheless nowadays all grouse have to face a new factor that was not in place before. They face human civilization. This factor already created a critical situation for the existence for many local populations of different species of grouse and especially for species with limited distribution. Frankly speaking, the existence of all grouse nowadays depends more or less on mankind, as the existence of all wild nature of the Globe.

In short, the paper by Menoni et al (2010) fails to provide direct evidence that the two discussed birds died because of being locked up in snow by ice crust. The chances that the birds die well before they were covered by snow were not addressed. The possible impact of radio transmitters which might have caused overcooling of birds prior to their deaths was not considered. The paper also cite Russian sources in wrong translation (e.g. "Perished" instead of "vanished"), and fail to cite key references on the subject (Formozov 1946, 1970, 2010, Novikov 1981).

I thank prof. E. Potapov for his help with preparing this report, and N. Potapov (student) for his help with the language.

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Why Japanese Rock Ptarmigan never fear humans?

Hiroshi Nakamura

Japanese Rock Ptarmigan *Lagopus mutus japonicus* is a subspecies of Rock Ptarmigan with the southernmost distribution of the species. Its habitat is alpine zone of central Honshu, Japan. The ptarmigan is relic population after the ice age and isolated on the mountain tops. The population is separated into 5 mountain groups: Mt. Hiuchi, North Alps, Mt. Norikura, Mt. Ontake and South Alps (Nakamura 2007, see Figure 1). Thirty years ago, the total population size was estimated to be about 3,000 birds by the research of territory distributions (Haneda 1985). The population size has decreased in recent years, and it was recently estimated at about 1,700 birds from the research by the same method (Nakamura 2009).

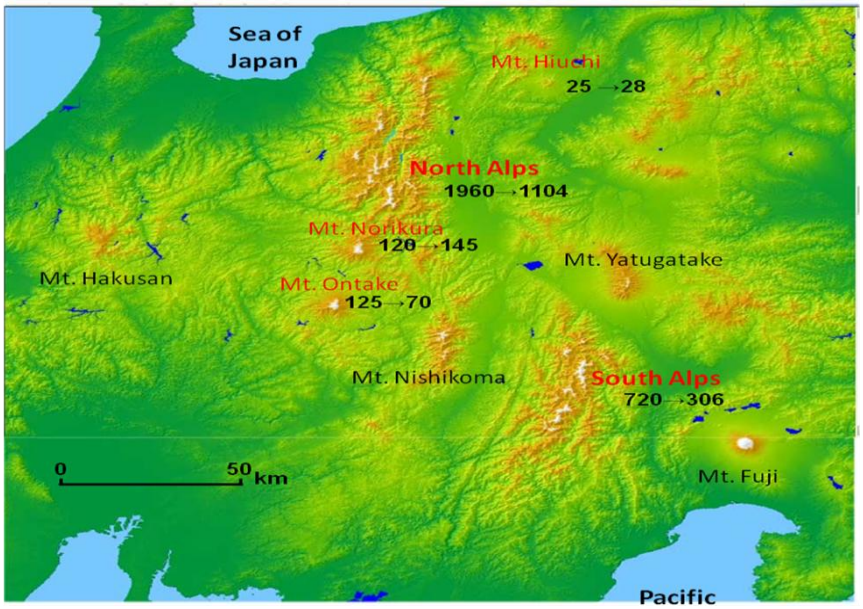

Figure 1. Distribution of high mountains in central Honshu and the change of estimated number of Japanese rock ptarmigan in this thirty years.

The Rock ptarmigan in Japan shows no fear of humans

Figure 2 shows a person who is approaching a ptarmigan that is watching his territory on the rock, and taking pictures within 1 m from the bird. Because ptarmigan can be approached so closely, pictures can be taken without a telescope. It is also very easy to capture them, because they never fear humans. They can be captured easily by using a fishing pole with a wire loop, on the top, and hung it on the neck. Once I could capture two fighting males with my bare hands at once. Strangely enough, they never run away even if other ptarmigans are captured in front of them. So it is possible to capture all the members of a flock one after another, and it is possible to capture the same bird two or three times. About 200 ptarmigan on Mt. Norikura, located at the south of the North Alps have been marked individually, and our laboratory at Shinshu University has been continuing the study of their behavior, ecology and population.

Figure 2. Japanese rock ptarmigan never fear humans.

Rock Ptarmigan in other parts of the world do fear humans!

It was 17 years ago that I first learned the fact that rock ptarmigan in other populations do fear humans. In the summer in 1993, I visited the Aleutian Islands (Alaska, USA) for a month. I was surprised to see the behavior of rock ptarmigan there, because they took flight as soon as they saw humans. So, their behavior could not be observed from a short distance as can be done in Japan. On my return trip, I visited continental Alaska and observed that the ptarmigan in Alaska showed the same wariness. Later, I had a chance to stay at Cambridge University in Great Britain, and in 1995, had the opportunity to observe ptarmigan in Scotland. These ptarmigan were also very wary of humans, so I could not observe them from a short distance. In late October, 2003, I visited Norway and had a chance to watch rock ptarmigan being hunted. Yet another opportunity to observe a different population of rock ptarmigan came in September 2005, when I attended the International Grouse Symposium in France. The ptarmigan which were observed in the Pyrenees at that time also showed the same wariness as those of Scotland and Alaska.

The reason for the behavioural differences shown by European and American rock ptarmigan may be due to the long history of being hunted by humans. One question, then, is why did the Japanese rock ptarmigan did not become a desired quarry for hunting in Japan?

Why Japanese Rock Ptarmigan never fear humans?

In Japan, there is another species of bird which shows no fear of humans like the ptarmigan. The species is Short-tailed albatross *Diomedea albatrus* which is breeding on Torishima, an uninhabited island in the Pacific Ocean. From the end of 18 century to the beginning of 19 century, over 5,000,000 individuals of this species were clubbed to death for their feathers and it was believed that they became extinct in 1949 (Austin 1949).

The reason that the albatross never feared humans may be because they adapted to the breeding at isolated islands far from land and had no contact with humans throughout their evolution. The same explanation, however, does not apply to the Japanese rock ptarmigan, because the habitat of the ptarmigan is close to human habitations (Figure 3). From old literature remaining in Japan, we understand that the existence of contact between human and the ptarmigan has occurred for a long time (Nakamura 2006).

Figure 3. The habitat of Japanese rock ptarmigan is close to human habitations.

In spite of the contact with humans, why did the ptarmigan not become a hunted bird? It cannot be because of lack of interest in hunting game birds in Japan. The Pheasant *Phasianus colchicus* and Copper pheasant *Syrmaticus soemmerringii* have been hunted regularly until the present time in Japan. There is also another one grouse species, Hazel Grouse *Tetrastes bonasia*, which lives in Hokkaido, Japan. They have been a hunted species from a long time ago. We believe, as a result of examination of all the literature, that the reason rock ptarmigan has not been hunted is closely related with Japanese culture.

Japanese mountain worship

In Japan, there has been mountain worship since ancient times. People believed that gods lived in the high mountains. The most typical mountain worship has been mountaineering asceticism (Japanese name is Shugendo). The mountaineering asceticism is a religion that assimilates Japanese ancient mountain worship with introduced Buddhism from continental Asia. The religion had always been closely related with mountains. The monks secluded themselves in the high mountains and led an ascetic life, and by that

they were spiritually awakened. The religion began from the 7th century and continued until the Edo period (1603-1868).

When we climbed the high mountains for the purpose of studying the rock ptarmigan, we often found remnants such a small shrine and a stone image of the Buddha (Figure 4). These remnants tell us that people of those days had climbed high mountains based on piety. So they could not kill animals at high mountains. For the people in those days, the rock ptarmigan inhabited on the top of the high mountain was a god's bird that lived in a god's area.

Figure 4. Some remnants of mountain worship.

Why did the hazel grouse become a hunted species? The reason is likely because the hazel grouse lives in low elevation areas which are not the range of gods. One other reason that the rock ptarmigan is praised with being a bird of gods and were not target of hunting is that the ptarmigan changes to the white form in winter.

The domain of Kaga (present Ishikawa prefecture) strictly protected the rock ptarmigan that inhabited within the domain, such as Mt. Hakusan and Mt. Tateyama. In Edo period, some talismans that were written portray the rock ptarmigan as amulets against the evils of fire and thunder.

Japanese culture based on rice farming

It is closely related with Japanese nature and culture that the rock ptarmigan was a god's bird in Japan (Nakamura, 2006). Japan was covered widely by forest until the end of Jyoumon period (BC 3,000 ~ 300) cultivation had not yet begun. After that time, rice production culture came into Japan from Continental Asia. The forests of lowland areas were cut down and converted into paddy fields. The rice farming needed a lot of cooperation, so the people lived in village and their lifestyle changed into settlement. The forests around paddy fields and villages were used extensively as sites to get natural manure, fuel, and timber for houses. But, the high mountain forests distant from village were not used. This is because secure water supply was most important for rice farming. Therefore gods were enshrined at the high mountains and climbing the high mountains without reason was under taboo. The base of Japanese culture is the proper use of habitation areas (it's called Sato), its adjacent forest areas (Satoyama) and high mountain areas (Okuyama). The base was established through rice farming.

Thus it seems that Japanese mountain worship was practices a long time closely jointed to Japanese culture that related with rice farming. As the result, native nature was left alone in the high mountain areas in Japan until present times. We can see, even now, native beech forests and subalpine coniferous forests in high mountain areas, and native alpine vegetations were left in an almost untouched state (Figure 5).

Figure 5. Native vegetations were left almost untouched state in the alpine areas in Japan.

Under the protection of the law

In the Meiji period (1868-1912), however, social circumstances changed completely. To advance the modernization, the Meiji Restoration Government advanced the policy to deny the old native piety, and prohibited the mountaineering asceticism. As the result, a feeling of awe for nature and piety gradually dissipated. People without fear of the divine punishment started to climb the high mountains. Some of these people started to club the rock ptarmigans to death and to eat them. The Meiji Government was anxious about this situation and designated the rock ptarmigan as a protected bird and capture was prohibited in 1910. Later, the gods' bird was designated as a natural monument in 1923 and as a special natural monument in 1955. At the present time the rock ptarmigan is strictly protected by law.

The rock ptarmigan was not the only animal hunted excessively in the Meiji period. As the result of hunting becoming possible for ordinary people, a lot of wildlife was hunted and experienced population declines. But, most large animals like bear, wild boar, antelope, deer and Japanese monkey have persisted until now in Japan. Among large animals in Japan, only the wolf became extinct, which occurred during the Meiji period. The reason that many large species of wild animals continue to persist without extinction in Japan may be that they live in the gods' area and have lived separately from humans for a long time.

There are some hypotheses on why wildlife is afraid of humans. The major theory is relates to perceived predation risk. As pointed out, seems that Japanese rock ptarmigan persisted on Japanese mountain tops until now without severe hunting history except during a short period, thus they never developed a fear of humans. Therefore, it may be possible to say in this sense that the Japanese rock ptarmigan's lack of fear of humans is a product of Japanese culture.

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Habitat modelling of Svalbard rock ptarmigan: - Development of GIS-based tools for adaptive management

Åshild Ønvik Pedersen, Eva Fuglei & Jane U. Jepsen

The endemic Svalbard rock ptarmigan *Lagopus muta hyperborea* is the only resident terrestrial bird species in Svalbard. Currently the pre-breeding population is monitored by annual surveys of calling territorial males. In this article we present our predictive habitat model, which is based on the monitoring data, for presence of territorial ptarmigan males. We also give some perspectives on how predictive habitat models serve as useful tools for management and conservation of ptarmigan species.

I. Habitat models

Predictive habitat models provide spatial information on use and suitability of habitat for the species in question. Such models are important tools to evaluate possible consequences of changes in land use, climate and other environmental conditions on species distribution and abundance (i.e. Boyce 1999, Pearce and Ferrier 2000, Jepsen et al. 2005, Pedersen et al. 2007, Speed et al. 2009, Booms et al. 2010). Predictions based on a habitat model may serve to extrapolate results from a limited survey area to a larger region and to delineate the potential range of the species in question. Further, predictive habitat models may form the basis for assessing the relative sensitivity of the species' range to various environmental factors, hence, aiding in identifying key habitats or conflict areas (see references above). In Pedersen et al. (2007) we developed statistical habitat models, based on 5 years of pre-breeding monitoring data, to predict presence of Svalbard rock ptarmigan males in spring. Our complementary goals were to: (1) determine habitat suitability for territorial rock ptarmigan males by assessing the relative importance of a suite of environmental variables; (2) assess the accuracy and utility of the habitat model; (3) extrapolate the best model predictions to a larger region to evaluate the regional availability of suitable rock ptarmigan habitat; and (4) provide habitat suitability maps to guide management and conservation agencies to plan future directions for both conservation and harvest management.

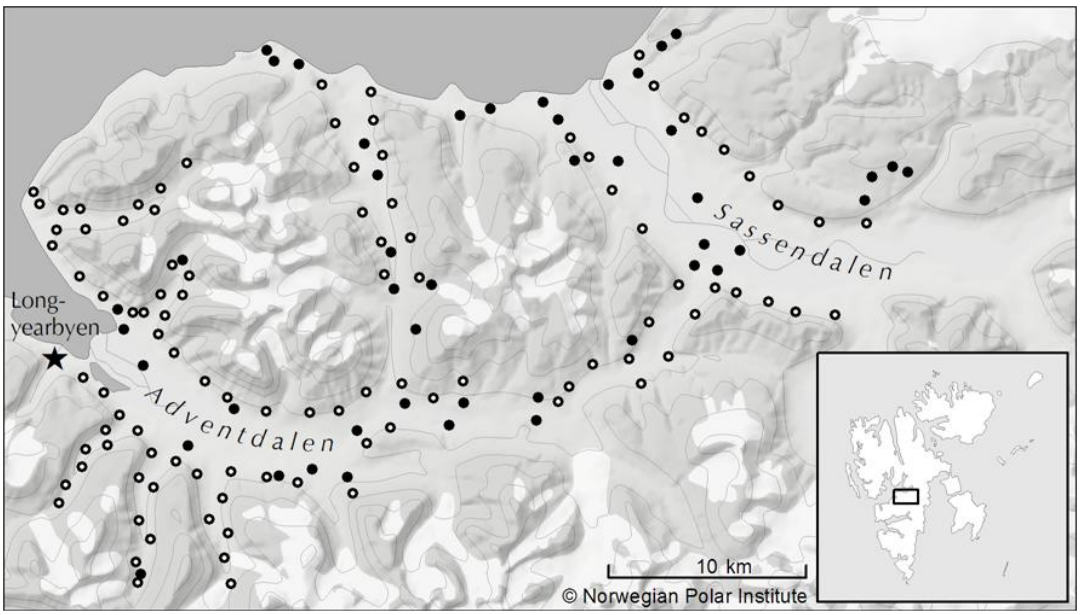

Figure 1. Map showing the Svalbard Archipelago, Norway, and the location of the study area for monitoring of territorial males (total N = 147 survey points; non-random survey points (N = 101 [◉]); random survey points (N = 46 [●])).

II. Ptarmigan survey data

The spring monitoring survey of calling territorial males was initiated as a pilot project in 2000 by the Norwegian Polar institute (http://mosj.npolar.no/). We have established a total of 147 survey sites where we survey calling territorial males in April to estimate the pre-breeding population (Figure 1). At this time of the year males establish territories and show territorial behaviour throughout the 24 h day (Unander and Steen 1985). One of 3-4 trained observers visited each survey point for 15 minutes 2-3 times per

season in a rotating manner (Mackenzie and Royle, 2005) by means of snowmobiles. Males were often detected from look-out points (i.e. small hills, rocks or other elevated features) where they usually advertised their presence using body displays and characteristic territorial calls (Unander and Steen 1985; Figure 2).

Figure 2. Svalbard rock ptarmigan males return from the wintering grounds in April and establish territories shortly after arrival. They stay territorial until hatching in July (Unander and Steen 1985). Photo: Nicolas Lecomte.

III. Spatial environmental data

Based on Svalbard rock ptarmigan ecology we hypothesised that habitat selection was primarily affected by terrain and vegetation characteristics. We extracted terrain variables from digital elevation models (DEM) (altitude, slope, aspect and terrain ruggedness index [SARI]; Pedersen et al. 2007) at different scales from the survey points. Variables were extracted from local (i.e. 100 m from the survey site) to landscape scale (i.e. > 1000 m from the survey site), way above a ptarmigan territory (range = 3-50 ha; Unander and Steen 1985). Then, we combined these variables with relevant vegetation data expressed by composition of habitat type and NDVI data [Normalized difference vegetation index]) extracted at similar scales. NDVI data was extracted from Landsat satellite imagery (30 x 30 m) based on one scene from mid August (Pedersen et al. 2007).

IV. Data analysis

In a use-availability study design the used sites, in our case sites with presence of territorial males, was assumed to be a sub-sample of the available sites (i.e. randomly allocated sites representing available ptarmigan habitats). First, we used Ecological Niche Factor Analysis (ENFA; Hirzel et al. 2002) to explore the differences between the sites with ptarmigan presence and available sites in the study area. ENFA is a multivariate method that investigates the difference between used and available sites in both the average (called marginalization) and the range of variation (called specialization) of the different environmental variables. Second, we used logistic regression models to derive resource selection functions (RSFs) (Johnson et al. 2006). Models were fitted by adding one variable at a time until all possible combinations, including interactions, were tested. All explanatory variables were examined for co linearity using Pearson's correlation coefficient (*r*) and variance inflation factor (VIF). We assessed the linearity of relationships between the response variable (probability of use versus availability, on a logit scale) and the predictor variables using partial residual plots and generalized additive models (Wood 2006). Model selection was performed using the Akaike's Information Criterion corrected for small sample size (AIC_c, Burnham and Anderson 2004). Third, the predictive performance of the best model was assessed by following the protocols of Boyce et al. (2002) and Nielsen et al. (2004). For further details see Pedersen et al. (2007).

V. Habitat model results

The environmental cues used by birds when selecting habitat are rarely known, and the ecologically most relevant scale for the different environmental variables are difficult to determine in advance. Our results showed that males used survey sites characterised by a lower altitude, a higher degree of terrain heterogeneity and denser vegetation cover than the overall availability of habitat in the study area. The variables related to vegetation (i.e. habitat composition and NDVI) and terrain heterogeneity identify two different scales important in male territory choice. Vegetation variables seem to be most important at a finer scale (i.e. 200 m from survey site) which likely corresponds to selection of foraging areas (Unander

et al., 1985; Unander and Steen, 1985). The same scale was identified both using habitat type composition and NDVI variable in the model. The preferred habitat type, vegetated xeric sloping areas, was predominant on south-facing slopes and contains some of the most important foraging plants (e.g., *Salix polaris*, *Saxifraga* spp.) for ptarmigan at this time of the year (Unander et al. 1985, L.B. Jakobsen and R. Elven, unpublished data). Terrain characteristics, however, seems most important on a larger scale (i.e. 1000 m around count sites) which is well above the reported size for Svalbard rock ptarmigan territories (Unander and Steen 1985). One likely explanation is that terrain heterogeneity is a good indicator of the overall suitability of an area for supporting the requirements of a breeding ptarmigan pair. Rugged and sloping terrain contain look-out points favoured by males for territorial display and offer good shelter for nesting birds both from weather and predators. In addition good drainage conditions and high quality food plants are important for nesting females (Unander and Steen 1985). The habitat model indicates that medium-high quality (predicted value ≥ 0.5) breeding habitat for males constitutes just below 5 % of the total land area in the extrapolation region. The breeding habitat was mostly confined to a narrow strip along the coast and along low altitude areas on both sides of the numerous valleys in the study area (Figure 3). Owing to lack of data on habitat types we were only able to extrapolate the model to a limited region. Our results showed that it was possible to obtain a model with a high ability to rank habitats using a low number of map-derived variables related to terrain and vegetation characteristics.

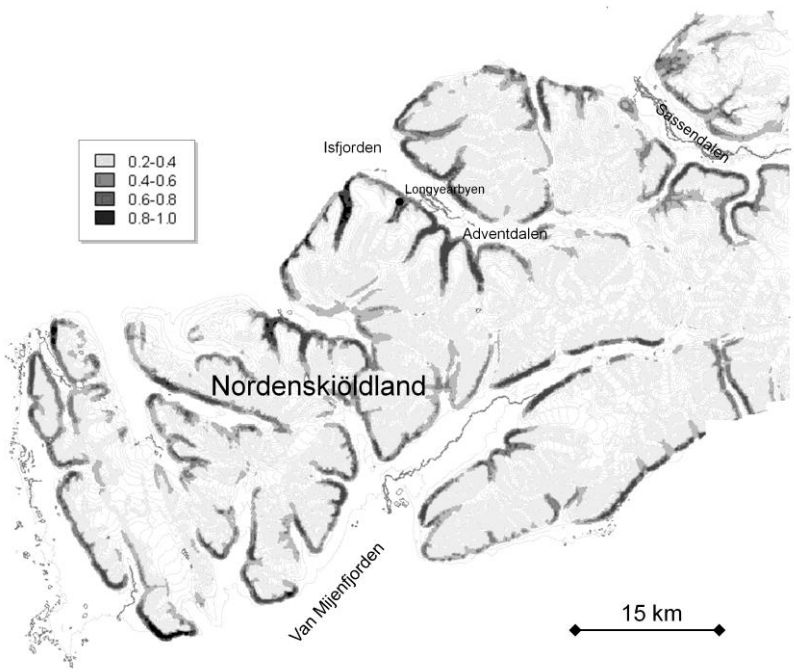

Figure 3. Relative habitat suitability for territorial Svalbard rock ptarmigan males in the extrapolation region (Nordenskiöld Land) as predicted by the best habitat model. The legend indicate from low (0.2-0.4) to high (0.8-1.0) relative habitat suitability (from Pedersen et al. 2007).

VI. Updated habitat model

Recently a new vegetation map, based on Landsat satellite imagery, covering the entire Svalbard archipelago was published (Johansen et al., 2009). Therefore we are now updating the habitat model using 10 years of spring monitoring data (Pedersen et al., submitted 2010), the new vegetation map and new data mapping the onset of greening based on MODIS imagery (S.R. Karlsen, unpublished data). Onset of greening is expected to correspond to time of snow-melt which is an important predictor for high quality ptarmigan habitats (Unander and Steen 1985). The new data sets allow us to extrapolate the relative habitat suitability for ptarmigan males to the entire Svalbard archipelago. The upcoming habitat suitability map will be an important contribution to evidence-based management of Svalbard rock ptarmigan habitats at a large spatial scale. The project is scheduled to be finished by February 2011.

VII. Relevance to management and future perspectives

In arctic and sub-arctic areas rock ptarmigan species live in the most extreme and remote places. Basic knowledge of rock ptarmigan ecology is lacking in most Nordic countries (except Iceland), and there are

urgent needs for robust management tools to insure sustainable harvests and protection of species and habitats. Based on harvest statistics from Nordic countries population declines of rock ptarmigans have been documented (i.e. Storch 2007, www.ssb.no, www.rktl.fi, www.smavilt.se, www.ust.is). The species is also under risk of range contractions due to anthropogenic impacts and therefore a potential indicator of arctic and alpine ecosystems (Storch 2007, Post et al. 2009).

Changes in climate and land-use may occur more rapidly than biological adaptations can respond and species may not be able to adapt fast enough to meet the new conditions (Post et al., 2009). The impacts of climate change are difficult to assess because other stressors that drive population changes could be present. Such stressors can be habitat loss and fragmentation, increased human access to arctic and sub-arctic regions, increased predation pressure from generalist predators etc. (i.e. Storch 2007). By identifying key habitats (measured as habitat suitability) at a large spatial scale, we make an important contribution to the knowledgebase on habitat use and spatial distribution of ptarmigans. By looking at past population trends and present land-use practices, managers can plan actions and construct programs to protect rock ptarmigan habitat. Further, information about habitat use and suitability creates a solid platform to implement sustainable harvest management strategies and actions. Predictive models of ptarmigan habitat suitability can provide valuable and cost-effective tools for conservation planning, biodiversity management and harvest management, especially in poorly surveyed regions that are under accelerating anthropogenic pressure as in Svalbard (Storch 2007). The spatially explicit output of a habitat model represented in a Geographic Information System (GIS) environment serves as an important visual aid to communicate results (i.e. Pedersen et al. 2007, Jensen et al. 2008, Speed et al. 2009, Booms et al. 2010).

We encourage researchers to use our habitat modelling framework to make predictive habitat models for ptarmigan species in other parts of the distribution range, and to use these models actively in conservation and management of species and habitats. In this respect we have initiated a Nordic collaborative network aiming to conduct similar habitat modelling for rock ptarmigan populations in Arctic, sub-Arctic and alpine areas of the Nordic countries. The proposal is currently under evaluation for funding.

Acknowledgements

We would like to thank the following organizations for funding of the study: Svalbard Environmental Protection Fund, the Governor of Svalbard, the Norwegian Polar Institute, and the Norwegian Institute for Nature Research and the University of Tromsø.

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Box 1. Facts about the study area and the Svalbard rock ptarmigan

Study area

The high-Arctic archipelago of Svalbard (62 700 km^2) is covered with 85 % glaciers, barren rocks and non-vegetated areas (Johansen et al., 2009). The study area (approx. 1 200 km^2) for annual spring monitoring is located on the largest island, Spitsbergen, in the north-eastern part of the peninsula of Nordenskiöld Land. It encompasses two main valleys, Adventdalen and Sassendalen, surrounded by peaks reaching 1 200 m a. s. l. (78°15' N, 17°20' E; Figure 1). The area is situated in the middle Arctic tundra zone, dominated by rivers and open valleys with wetland, ridge, and heath vegetation which never reaches up to more than 5-10 cm above ground (Elvebakk 1989).

Svalbard rock ptarmigan *Lagopus muta hyperborea*

The endemic Svalbard rock ptarmigan is the only resident herbivorous terrestrial bird on Svalbard (Løvenskiold 1964). Knowledge of long-term population trends and population dynamics of the Svalbard rock ptarmigan is limited (Unander and Steen 1985, Steen and Unander 1985, Pedersen et al. 2005, 2007). Spring population sizes of territorial males vary between 1.5-3.6 males/km^2 and annual variations are limited (Pedersen et al. submitted). The species is a popular small game bird and annual harvest varies between 486-2069 per year (Pedersen et al. 2005, Governor of Svalbard 2010).

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Recent theses and dissertations on prairie-chickens

Behney, A. C. 2009. Predation and reproductive behavior of Lesser Prairie-Chickens at leks in the Texas Southern Great Plains.

M. Sc. Thesis. Texas Tech University, Lubbock, TX. 110pp.

Abstract: While avoidance of anthropogenic vertical structures by lesser prairie-chickens (*Tympanuchus pallidicintus*, LEPC) has been shown, the ultimate cause of this avoidance is unknown. An increased risk of predation due to raptors perching on these structures has been hypothesized as a reason for avoidance and even as a contributing factor in the observed decline of the species.

I evaluated the effects of vertical structures at lek sites where LEPCs are seemingly very exposed and vulnerable, conducted raptor surveys throughout the study area to assess the raptor community throughout the year, and monitored nesting Swainson's hawk (*Buteo swainsoni*) prey deliveries for LEPC presence. In addition, I studied sexual selection and the reproductive behavior of LEPCs at leks to gain a better understanding of the life history of the species.

I used video recording systems and direct observations to monitor leks a total of 650 hours while LEPCs were present. I observed 63 raptors at leks (0.10 raptors per hour of monitoring). I did not detect a difference in raptor encounter rates between leks with adjacent structures and leks with no adjacent structures (P = 0.32). Northern harrier (*Circus cyaneus*) was the most common raptor observed at leks followed by Swainson's hawk, other buteos (*Buteo* spp.), falcons (*Falco* spp.), and accipiters (*Accipiter* spp.). Reactions of LEPCs varied with the hunting strategy of approaching raptor. Northern harriers and buteos elicited flushing responses whereas falcons elicited squatting/hiding responses. Mean time for at least a total of two LEPCs to return to lekking behavior following a raptor encounter was 4.22 ± 5.55 (SD) minutes. Mean LEPC return to lekking times differed between the species of raptor encountered with falcons eliciting longest interruptions in lekking behavior.

I placed 38 survey points throughout the study area in areas that supported and did not support LEPCs. Five minute point counts were conducted monthly from each point. I used a double observer sampling scheme during 303 out of 907 total surveys to correct for detectability. During the summer period corresponding to LEPC nesting/brood rearing, Swainson's hawk was found in greatest densities and, practically, the only raptor species present. During the lekking and overwintering period there was much greater diversity in the raptor community. Overall raptor densities for the LEPC lekking, nesting/brood rearing, and overwintering periods were 0.34, 0.42, and 0.62 raptors/point, respectively. Power utility structures were a significant predictor of raptor density at survey points while vegetation community was not found to effect raptor density.

I used video-recording systems to monitor four Swainson's hawk nests in areas that support LEPC populations. No LEPCs were detected as delivered to Swainson's hawk nests. Amphibians, birds, mammals, and reptiles made up 3%, 1%, 86%, and 10% of identifiable prey species delivered to nest, respectively. The most common mammal observed was spotted ground squirrel (*Spermophilis spilosoma*). Other species observed as prey at least three times included Great Plains toad (*Bufo cognatus*), quail (*Callipepla squamata*, *Colinus virginianus*), Ord's kangaroo rat (*Dipodomys ordii*), Great Plains skink (*Eumeces obsoletus*), and Texas horned lizard (*Phrynosoma cornutum*).

I collected data on male LEPC territory, behavior, and morphology characteristics in 2008 and 2009. Territory characteristics, generally, exhibited the greatest coefficients of variation. Using logistic regression models, I did not find a consistent predictor of male mating success. Although not statistically significant, it appeared that morphological characteristics exhibited weak effects (mean absolute value β= 0.24 ± 0.24) on male mating, while territory (0.50 ± 1.12) and behavior (1.82 ± 1.18) characteristics exhibited slightly greater effects. Peak female attendance at leks occurred during the one-week interval starting 13 April during both years of the study. I found significant turnover of males at leks early in the lekking season as 13 of 19 males banded early in the lekking season departed the lek of capture and were not seen again despite monitoring other leks in area.

Bell, L. A. 2005. Habitat use and growth and development of juvenile Lesser Prairie-Chickens in southeastern New Mexico.

M. Sc. Thesis. Oklahoma State University, Stillwater.
Thesis Advisor: Sam D. Fuhlendorf

Chapter 1 Abstract – The structural attributes of shrubland plant communities may provide thermal refugia and protective cover necessary for wild animals to survive. We evaluated the wide spread effects of herbicide use on sand shinnery oak plant communities to determine what impact herbicides might have on the thermal environment for lesser prairie-chicken broods in southeast New Mexico during the summers of 2002 and 2003. Based on data from 257 brood locations and 53 random locations, lesser prairie-chicken broods selected locations on sand shinnery oak dominance with taller plant heights and more over head cover when temperatures exceeded 26.4 °C than what was available at random. Temperatures did not differ between random sites in presence or absence of herbicide applications. Habitat selection was more dependent on the structural attributes contained within areas not treated with herbicide and these sites were often selected at a fine spatial scale. Habitat management that seeks to conserve native shrublands may increase the abundance or help to sustain populations of lesser prairie-chickens in semiarid environments.

Chapter 2 Abstract - The ability to describe or compare growth rates across a species distribution, especially for a species of concern that has isolated populations separated by hundreds of kilometers, is essential baseline information for captive breeding efforts or examining genetic influences on adjacent populations of the same genus (i.e. potential to hybridize), respectively. We examined growth rates and the physical development of four body characteristics (mass, wing chord length, bill length, and head width) of lesser prairie-chickens (*Tympanuchus pallidicinctus*) <120 days post hatch in southeast New Mexico. New Mexico juvenile lesser prairie-chickens achieved 90% of their asymptotic body mass faster than lesser prairie-chickens in Kansas. However, growth rates, inflection points, and growth patterns (logistic and Gompertz) were the same in New Mexico as in Kansas for juvenile lesser prairie-chickens for body mass and wing growth.

Bohls, R. L. 2006. Extensive investigation of reticuloendotheliosis virus in the endangered Attwater's Prairie Chicken.

Ph. D. Dissertation. Texas A&M University, College Station.
Chair of Advisory Committee: Dr. Ellen Collisson

Abstract: Reticuloendotheliosis virus (REV) is a retrovirus that causes a neoplastic disease in a wide range of avian hosts including chickens, turkeys, and ducks. In 1993, REV was detected in the endangered Attwater's prairie chicken (*Tympanachus cupido attwateri*), a subspecies of *Tympanachus cupido*. Subsequent infections of this prairie chicken have been identified at captive breeding facilities throughout Texas. The implications of these infections have severely hindered repopulation efforts by these facilities. This study focused on investigating REV infection of captive Attwater's prairie chicken in order to better understand the disease affecting these endangered birds. The overall objective was to develop a means of eliminating this threat to the repopulation of the Attwater's prairie chicken. Several aspects of virus infection were investigated. Reagents capable of recognizing prairie chicken IgY and viral gag polypeptides were developed for use in assays for detection of antibody responses and titration of viral concentrations. Sequencing data of genomes collected from isolates of Texas prairie chickens and domestic chickens, as well as three REV prototype viruses, were compared to determine relationships among strains and identify the potential origin of the REV infecting Attwater's prairie chicken. Additionally, a flow cytometry technique of segregating the lymphocyte population from peripheral blood mononuclear cells (PBMC) using a pan leukocyte monoclonal antibody was developed to more accurately measure changes within lymphocyte populations. This technique combined with intracellular labeling was used to deduce the target cells of REV infection. A nested polymerase chain reaction (PCR) test was developed for greater sensitivity in detecting infection in birds than the previous method of single amplification PCR. This greater sensitivity results in earlier identification of the virus in infected birds, which allows for earlier removal of infected birds to minimize transmission of the virus throughout the flock. The sensitivity of the nested PCR diagnostic test was determined in a dose response pathogenesis study, which was conducted on hybrid greater/Attwater's prairie chicken to observe the experimental development of disease in these birds. Finally, a vaccine was developed using plasmid DNA with REV encoded genes and tested on naturally infected prairie chickens to determine its efficacy in reducing viral load. Although no reduction in viral load was detected, the vaccine may be effective in providing prophylactic protection in future studies.

Jones, R. S. 2009. Seasonal survival, reproduction, and use of wildfire areas by Lesser Prairie-Chickens in the northeastern Texas Panhandle.

M. Sc. Thesis. Texas A&M University.
Committee Chair: N. J. Silvy

Abstract: Lesser prairie chicken (Tympanuchus pallidicinctus) numbers have declined considerably in Texas since the early 1900s. Conversion of native prairie to cropland has been the major cause of the decline. I trapped and monitored 115 (66 males, 49 females) lesser prairie chickens in the Rolling Plains of the Texas Panhandle from 2001 through 2003. I used an information-theoretic approach to model selection as implemented in program MARK to evaluate factors contributing to variation in survival and differences in nest success. I found breeding season survival of both males and females was lower compared to non-breeding season survival. Annual survival was 0.52 (95% CI: 0.32–0.71). Model selection indicated higher nest success (70%) in the sand sagebrush (*Artemisia filifolia*) vegetation type as compared to the shinnery oak (*Quercus harvardi*i) type (40%). I also evaluated post-burn habitat alterations and plant succession (1 year and 2 years after burning) as potential lesser prairie chicken habitat. After spring rainfalls stimulated re-growth of herbaceous plants, male lesser prairie chickens moved to the site, feeding on new-emerging forbs throughout the summer. A female lesser prairie chicken with a brood used the burned site during the first summer after the burn. A year later, males established a lek on the burned site. Two female lesser prairie chickens with broods used the burned site during the second summer. Burned sites had more forbs than nonburned sites and probably had more insects available which are an important food source for chicks during their first 4–5 weeks of age.

McNew, L. B. 2010. An analysis of Greater Prairie-Chicken demography in Kansas: the effects of human land use on the population ecology of an obligate grassland species.

Ph. D. Dissertation. Kansas State University.
Major Professor: Brett K. Sandercock

Abstract: Greater prairie-chicken (*Tympanuchus cupido*) populations have been reduced by >70% since the turn of the 20th century due to large-scale conversion of native prairie habitats to cultivated agriculture and other human development. Although Kansas is considered a stronghold for greater prairie-chickens, statewide populations have declined >30% in the last 30 years. Goals of this dissertation were to determine the demographic mechanisms for apparent population declines and evaluate how regional variations in landscape composition and grassland management affect the demography, habitat use, life-history, and population viability of three populations of greater prairie-chickens. First, I found that, despite high reproductive potential, poor reproductive success prevented populations from being self-sustaining. All three populations were projected to decline but finite rates of population declines were different among populations (λ = 0.49, 0.54, and 0.74). I found that grassland fragmentation and rangeland management practices influence nearly every aspect of greater prairie-chicken population ecology and dynamics. A population in a contiguous prairie landscape managed with annual spring burning and intensive early stocking of cattle (South) was characterized by delayed breeding, low nest and brood survival (0.08–0.18 and 0.27, respectively), high annual survival of mature females (0.64–0.71), projected age-ratios heavily skewed toward adults, and longer generation times. Conversely, a population in grasslands heavily fragmented by cultivation and managed with longer fire-return intervals and moderate grazing (Smoky) initiated nests earlier, had higher nest and brood survival rates (0.16–0.31 and 0.34, respectively), produced significantly larger eggs, and had low annual survival (0.34–0.42) and shorter generation times. A site with intermediate levels of fragmentation, burning and grazing (North) had intermediate demography. Finite population change was more sensitive to changes in adult survival at all sites, but the relative influence of fecundity parameters on projected population change was not similar among study populations. Data indicate that differences in rates of decline among populations were largely due to variation in adult survival mediated by human landscape alteration. Human-mediated changes to grasslands impact the demography and viability of prairie-chicken populations, influence population sensitivities to changes in vital rates, and mediate changes in the life-history strategies of a grassland-sensitive species.

McRoberts, J. T. 2009. Aerial surveys for Lesser Prairie-Chicken leks: detectability and disturbance response.

M. Sc. Thesis. Texas Tech University. 139pp.
Committee Chariperson: Warren B. Ballard

Abstract: The lesser prairie-chicken (*Tympanuchus pallidicinctus* [LPC]) is a prairie grouse species that attends leks (areas where male LPCs assemble and compete for breeding opportunities) during the spring reproductive season. Lesser prairie-chickens inhabit Texas, New Mexico, Colorado, Oklahoma, and Kansas and are a species of conservation concern. The LPC is also a candidate species for listing as threatened or endangered under the Endangered Species Act because of substantial reductions in population size and occupied range. Historically, LPC populations have been monitored by groundbased lek surveys and counts of birds attending leks, but these methods are labor intensive, limited by access, often restricted to roads, and may be a poor index of abundance. These drawbacks created the need to test and apply innovative conservation ideas crucial to the survival and management of LPC populations. We believe aerial surveys may alleviate the drawbacks of traditional monitoring methods. Our study objectives were to evaluate aerial survey techniques, estimate lek detectability, assess LPC response to aircraft disturbance, and create predictive models to explain lek detectability and disturbance response.

We flew aerial surveys using 3 aircraft platforms: a Cessna 172 fixed-wing aircraft, a Robinson R-22 Beta II helicopter, and a Robinson R-44 Raven II helicopter (hereon C172, R-22, and R-44, respectively). We conducted surveys in Texas and New Mexico. Ground observers and remote cameras were stationed on known leks during aerial surveys to assess lek activity and potential behavioral disturbance to LPCs, thus enabling us to model lek detectability and LPC flush response to aerial surveys. We created *a priori* models and used logistic regression to develop predictive models of lek detectability and LPC disturbance response. We used Akaike's Information Criterion corrected for small sample size (AICc) to rank the models within the model sets.

We conducted a total of 58 flights during spring 2007–2008. From remote camera data, we determined that 305 active leks were available for detection. We found that detectability was 89.8% (82.0–95.0%; 95% CI) from the R-44, 72.3% (64.5–79.1%) from the R-22, and 32.7% (20.3–47.1%) from the C172. Variables that influenced lek detection were aircraft type, distance to the lek, lek type (man-made or natural lek), and survey date. Model weights suggested that aircraft platform, distance to the lek, and lek type were important predictors of detectability.

We collected 49 ground observations of the response of LPCs on leks to aerial surveys during spring 2007–2009. We did not observe LPCs flushing in response to the C172. We found no difference in flush response between helicopters (P = 0.33; Fisher's exact test) and observed a flush response of 43.2% (28.4–59.0%) from helicopters. When LPCs flushed from a lek, the mean return time was 7.0 + 2.6 min (mean + 95% CI). Modeling of disturbance response was limited to the helicopter platforms and we found that distance to the lek had the greatest impact on flush response, with a decreased flush response as distance to the lek increased. We concluded that aircraft disturbance did not adversely affect the lekking behavior of LPCs.

Aerial surveys can provide an efficient and effective technique for monitoring and detecting LPC leks. Lek density is an important population parameter and it is possible to estimate lek density through aerial surveys. Furthermore, aerial surveys alleviate the drawbacks associated with ground-based lek surveys by providing rapid survey coverage of large tracts of land. We also feel aerial surveys can be conducted without harm to the LPC lek dynamic. This methodology could be applied to other prairie grouse species, though additional testing of the technique is suggested.

Nooker, J. K. 2007. Factors affecting the demography of a lek-mating bird: the Greater Prairie-Chicken.

Ph. D. Dissertation. Kansas State University.
Major Professor: Brett K. Sandercock

Abstract: Sexual selection via female choice and male-male aggression leads to elaboration of male traits. If male traits correlated with reproductive success are honest signals of male quality, survival costs may be associated with the expression of those traits. Testosterone (hereafter 'T') may enhance male breeding success, but T can also reduce immunocompetence and survival. Socially monogamous male birds with higher circulating T experience reproductive advantages, but the role of T in lek mating systems is largely unknown. To address these issues, I individually marked and conducted focal behavioral observations of greater prairie-chickens (*Tympanuchus cupido*) at five lek sites over a 5-year period. Females were fitted with radio-telemetry to monitor nesting success and survival. I examined the

relationship between male traits and mating success using multinomial discrete choice models, a statistical method not previously applied to studies of sexual selection. Male mating success was highly skewed at greater prairie-chicken leks with 18.5% of males obtaining 87.2% of all successful copulations (n = 108 males; 85 copulations). Mating success was influenced most by male behavior, followed by several morphological attributes. The role of T was quantified using blood samples and by experimentally implanting a subset of males with T. T did not consistently affect mating success.

Non-territorial males had lower T levels than territorial males. Among territory holders, T was unexpectedly negatively correlated with mating success. However, the odds of receiving a copulation were 4.3 times (0.42 to 45.3) greater for T-implanted males than males with sham implants. Future work should explore the interactions among the immune system, parasite load, and mating success of prairie-chickens. Annual survival of male prairie-chickens was not related to mating success, behavior, age or T level, suggesting there is no cost of increased male mating success. Like males, reproductive success of females was also highly skewed because < 10% of nests successfully hatched young. Comparisons of seasonal and annual survival rates indicate that females experience increased mortality during the breeding season relative to the nonbreeding season. Synthesis of field estimates of demographic parameters indicates prairie-chicken populations will decline without changes in rangeland management to reduce predator numbers or provide more nesting cover.

Pratt, A. C. 2010. Evaluation of the reintroduction of Attwater's Prairie-Chickens in Goliad County, Texas.

M. Sc. Thesis. Texas A&M University-Kingsville.
Chairman of Advisory Committee: Dr. Leonard Brennan

Abstract: The reintroduction of Attwater's prairie-chickens (APC, *Tympanuchus cupido attwateri*) raised in captive-breeding facilities has prevented extinction but has only maintained the population at low levels. Post-release survival and brood survival for the first private-lands reintroduction in Goliad County, Texas during 2007 and 2008 were within the variation observed from releases of pen-reared birds at the Attwater Prairie Chicken National Wildlife Refuge and the Texas City Prairie Preserve from 1996-2008. All 3 release sites had lower post-release survival and brood survival than past estimates for wild APCs and contemporary greater prairie-chickens (*T.c. pinnatus*) in Minnesota suggesting that both are contributing limiting factors in the successful reintroduction of APCs in Goliad County and in the recovery program as a whole. However, simulation results from a population model found that brood survival was the only variable that could be increased independently and have a successful recovery of 6,000 APCs in 50 years. Sensitivity of population size was constant and identical for the number of birds released and post-release survival, but exponentially increasing for brood survival. Releasing more birds with higher survival will help recover the APC faster but a successful recovery will not be possible without improved brood survival.

CONFERENCES

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

Second announcement

The Japan Rock Ptarmigan Meeting, the Institute of Mountain Science, Shinshu University, and the Mountain City Matsumoto are pleased to invite you to the twelfth International Grouse Symposium to be held in Matsumoto, Nagano prefecture, Japan, 19th to 23rd July 2011. The official language will be English. **The c**onference starts on Tuesday, 19th July, at 6 pm with an opening reception and ends on Saturday, 23rd July at night, followed by three kinds of field trip options from Sunday morning.

Logo by Teruo Nakamura

Scientific program

The congress will focus on all aspects of grouse biology, research and management. The Special themes will be:

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

Pre-conference Field trip options 19th July

This field trip is prepared for the participants who could not attend post-conference field trips and the participants who will attend the Hazel Grouse observation in Hokkaido after the Grouse Symposium. Leaving Matsumoto in the early morning, participants visit to Mt. Norikura to observe the Ptarmigan, other alpine and sub-alpine birds and flowers. Capacity of the participants is 25, Minimum is 15.

Post-conference Field trip options 24-26th July

We are planning the following three field trips. Each of them is a three days' trip. Trip 2 is normal Mountain climbing by lodging at a hut.

Trip 1. Rock Ptarmigan observation by bus tour

Trip 2. Rock Ptarmigan observation and mountain climbing

Trip 3. Hazel Grouse observation in Hokkaido

Early deadline for registration is 31st January 2011. The latest registration deadline is 30th April. Deadline for submitting abstracts is 31st March 2011.

For more information, preliminary program, other information and registration please see http://cert.shinshu-u.ac.jp/eco_lab/modules/tinyD4/.

For general conference details contact:

Hiroshi Nakamura, Faculty of Education Shinshu University, 6-Ro, Nagano city, Nagano,#380-8544, Japan, Tel & FAX: +81-26-238-4115, hnakamu@shinshu-u.ac.jp, seitajm@shinshu-u.ac.jp (Secretary's mail).

Gyrfalcons and Ptarmigan in a Changing World

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

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

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

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

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

Registration fees: Early registration $200 per person (on or before 1 November 2011). **Regular registration** $300 per person (after 1 November 2011 and throughout the conference, as long as space is available). **Closing Banquet** on 3 February 2011 (optional) $25 per person.
For more information see the conference website at http://www.peregrinefund.org/gyr_conference/

The XXXth IUGB and Perdix XIII Congress 5th to 9th September 2011 in Barcelona

The Organizing Committee of the XXXth IUGB and Perdix XIII Congress to be held from 5th to 9th September 2011 in Barcelona with the topic: *"**Human-wildlife conflicts and peace-building strategies",*** is very pleased to announce that, after the last joint Conference of Quail VI and Perdix XII, as Gamebird 2006 in Athens (USA), Perdix XIII will, for the third time, be held jointly with the IUBG Congress series. The first Conference on Grey Partridge *(Perdix perdix)* was held in Prague in 1965 to address the declining numbers of this species across Europe. In 1992 a conference hosted by the Game Conservancy Trust (now renamed to Game and Wildlife Conservation Trust) combined the American-founded Quail series with the Perdix series at Fordingbridge (UK). It is for those historic reasons that the Perdix series currently seeks to provide a scientific platform for Partridge, Quail and Francolin researchers and conservationists, mainly across Europe and North America. In order to make the Perdix series even more attractive to ga! mebird biologists, we would like to welcome any other galliform specialist, be it pheasant, cracid, megapode or grouse from anywhere in the world. This joint Congress will provide an excellent opportunity to share current developments in gamebird and other wildlife research and management, identify research gaps and conservation action needs, and encourage potential cross-country research projects.

Given the expectation of leaders in game or wildlife biology fields, IUGB provides an interesting forum to discuss the following topics:

- Wildlife biology, behaviour and game species management.
- Veterinary aspects of wildlife and conservation.
- Interactions humans-wildlife.
- Methodologies, models and techniques.
- Population dynamics.
- Human dimensions of game wildlife management
- Wildlife law and policy.
- Conservation and management of migratory game species.

Do not miss this wonderful opportunity to listen in live version worldwide leaders attending the Conference. For more information do not hesitate to contact with Aloha Congress or visit the conference official website: www.iugb2011.com

XXXth IUGB Congress and Perdix XIII Chaired by: Dr. Manel Puigcerver. Website: www.iugb2011.com Contact details: Noemí de Villasante Lahoz , Aloha Congress Project Manager, Tel. (0034) 93 363 39 54, congresos@alohacongress.com , www.alohacongress.com

The 29th Prairie Grouse Technical Council meetings in Hays, KS

Kansas Department of Wildlife and Parks (KDWP) will be hosting the 29th Prairie Grouse Technical Council meetings in Hays, KS. This conference will be held October 4-6, 2011, at the Robbins Center, Fort Hays State University. We plan on 2 days of presentations and one day in the field looking at lesser prairie chicken habitat is western Kansas. A call for abstracts will be sent out in the spring of 2011. Please be thinking of interesting presentations that would be of interest to prairie grouse biologists. We look forward to these meetings.

FYI: Kansas has an open greater prairie chicken season during these meetings (http://www.kdwp.state.ks.us/)

Contact: David Dahlgren, Small Game Specialist, Kansas Dept. of Wildlife and Parks, 785-628-8614, dave.dahlgren@ksoutdoors.com.

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SNIPPETS

New address for Grouse Group web page.

From 2009, 'GSG' stands for a single IUCN/SSC WPA 'Galliformes Specialist Group' and no longer for 'Grouse Specialist Group' alone and is found at http://www.galliformes-sg.org/gsgindex.html. The new website for Grouse Group (Former Grouse Specialist Group) is found under the Galliformes Specialist Group web page. The Grouse Group web page is still a construction site. Michele might send you a few lines asking for contributions / corrections.

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Governor Freudenthal issues Executive Order on sage-grouse core area strategy to protect bird and allow development

Cheyenne, Wyo. - Governor Dave Freudenthal has issued a revised executive order on Wyoming's sage-grouse Core Population Area strategy, aimed at protecting the bird to prevent an Endangered Species Act listing while offering opportunities for resource development.

Executive Order 2010-4 includes maps with new boundaries of protected sage-grouse Core Area habitat where development is prohibited. It replaces Executive Order 2008-2 and allows for development in non-Core Areas, even where sage-grouse are present.

"We need to protect what truly needs protecting and provide flexibility and opportunity outside core areas," Freudenthal said. "Sage-grouse management, as outlined in this executive order, is driven by the best data we have regarding sage-grouse habitats, populations and impacts to the species. It is clear there will be specific cases where the application of habitat protections will require site-specific variation, and the process to determine that flexibility is clear and fair," Freudenthal said.

The executive order includes a map of the sage-grouse Core Areas, which was revisited using new data developed from a $500,000 study funded by the Wyoming Legislature. The listing of the greater sage-grouse would have a significant, adverse effect on the economy of the state of Wyoming, including the ability to generate revenue from state lands, the executive order noted. It suggests that the Core Population Areas not be altered for at least five years, although the Governor indicated that he would be open to a more immediate review if new data becomes available.

"The State of Wyoming has emerged as the leader in the effort to conserve sage-grouse in North America, and it is my intent that we will accomplish that goal, while at the same time, maintaining a strong and vibrant economy in our state," Gov. Freudenthal said. "Our actions to date, specifically the creation of the Core Area strategy, are a framework for conservation, and allow us to move forward in a responsible manner," he said.

Executive Order 2010-4 reiterates that wind development will not be permitted in Core Areas. On two separate occasions the U.S. Fish & Wildlife Service has stated that the best available science indicates that wind development is incompatible with Core Area protection. Research outside of Core Areas is ongoing, according to the Governor's Deputy Chief of Staff Ryan Lance, to evaluate sage-grouse reaction to wind development to inform a more flexible approach in the future.

Lance said that the Governor recently asked the U.S. Fish & Wildlife Service, again, if wind energy development could be permitted in the core areas. "The response was that it would call into question the sufficiency of the core area strategy, thereby leading to a possible listing of the sage-grouse, so it's critical that we maintain the bird and its habitat, consistent with the best available science," Lance said.

The Executive Order lists 17 provisions and addresses three issues not fully developed in the 2008 Executive Order, due mainly to a lack of data and information; these include: mapping, connectivity zones and development outside of Core Areas.

In an effort that relied heavily on the involvement of sage-grouse local working groups comprised of industry, conservation and land owner interests, the remapping was a public process that consisted of the local groups making recommendations to the Governor's Sage Grouse Implementation Team. The Team adopted the vast majority of the local groups' recommendations.

Also affected by the executive order are connectivity zones, which help ensure genetic mixing of sage-grouse population, a key issue in the U.S. Fish &Wildlife Service's recent decision that sage-grouse warrant listing under the Endangered Species Act. Stipulations inside the connectivity zones have been defined and the order makes clear the zones are not to be managed as Core Areas.

Outside of Core Areas, the executive order clarifies that stipulations are to be relaxed, so that there are enhanced resource development opportunities. The entire Executive Order can be downloaded from: http://gf.state.wy.us/wildlife/wildlife_management/sagegrouse/Executive%20Order%202010-4.pdf .

Caucasian grouse (*Lyrurus mlokosiewiczi* Taczanowski, 1875: chronology of investigations and problems of today

An article about Caucasian black grouse has been published in Russian Journal of Ornithology volume 18 in 2009 by Roald Potapov and E. Pavlova. This paper is published in Russian, but a full text translation is made in English and is found on the webpage of Roald Potapov. Below is the abstract from the original paper reprinted. http://sites.google.com/site/roaldpotapov/home/publications/Caucasian-grouse1.pdf.

Abstract.
The paper is devoted to the history of studies of a relic species and Caucasian endemic, the Caucasian Grouse *Lyrurus mlokosiewiczi*, starting from the appearance of the first zoologists in the Caucasus (1770-1773), discovery and description of the species, and its subsequent studies till the present time. The paper comprises the data on 128 works obtaining data on this species. Many of these publications are hardly available not only to foreign, but even to Russian specialists. In the conclusion, the authors determine the most important tasks in future studies of this species. They include clarification of the range borders, the detailed study of the biology of southern populations of the grouse, the further study of the structure of local populations and the degree of bird's mobility with the use of modern technique (radio tracking, ringing), elaboration of methods for the cultivation of this species in capture in order to obtain hybrids between the Caucasian and the Black Grouses, for further expose of ancestral features, appeared usually in the hybrid offspring, and also for the study of the degree of stability of species characters, first of all, morphological and behavioral (voice) ones. And, at last, the further activation of paleontological investigations that can result in new findings of the fossils of this species, which now are very scarce.

*Potapov, R. and Pavlova, E. 2009. Caucasian grouse (*Lyrurus mlokosiewiczi *Taczanowski, 1875: chronology of investigations and problems of today. Russian Journal of Ornithology 18 (487): 887-923 (English translation).*

Combining radio-telemetry and random observations to model the habitat of Near Threatened Caucasian grouse *Tetrao mlokosiewiczi*

The distribution of the Near Threatened Caucasian grouse *Tetrao mlokosiewiczi*, endemic to the Caucasus, has been studied by Alexander Gavashelishvili and Zura Javakhishvili. The species' occurrence was defined by field surveys and radio-telemetry. Data were analyzed using a geographical information system and various modeling techniques to develop models. The final best-fit model suggested that Caucasian grouse prefer open habitat, and the most important independent variables accounting for the species' distribution were annual mean temperature, mean temperature of warmest quarter, precipitation and proximity to deciduous broad-leaf forest. This model provides a tool to improve search effectiveness for Caucasian grouse in the Caucasus and for the conservation and management of the species. The Ministry of Environmental Protection and Natural Resources of Georgia is going to use the results of this study to reshape existing protected areas and identify new ones.

Gavashelishvili, A. and Javakhishvili, Z. 2010. Combining radio-telemetry and random observations to model the habitat of Near Threatened Caucasian grouse Tetrao mlokosiewiczi. - *Fauna & Flora International, Oryx, 44(4): 491–500. doi:10.1017/S0030605310000979*

Species of the day

Gunnison sage grouse *Centrocercus minimus (Photo: Noppadol Paothong)*