

Behaviour and Conservation : habitat, population, territorial and social dynamics of Black Grouse (*Tetrao tetrix*) at the arenas during a long term study in the Hautes-Fagnes of Belgium (*)

by
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SUMMARY

In the wild, an animal has to find food and shelter, avoid predators, select a partner with whom to copulate. All these necessities are modulated by the habitats scale and structure and by the population density.

Black Grouse is an endangered species in Western and Central Europe. Social units are scattered, often small with few individuals. The Belgian Hautes-Fagnes Nature Reserve is probably the most western sanctuary of the species on the continent. Over years, the original landscape convenient for Black Grouse has been reduced to one third (5,000 ha most under protection now). The Black Grouse numbers have fluctuated since the mid-sixties between 198 (1971) and 18 (2000) cocks. Censuses have been organized annually on 30 arenas. Some have been under daily control in spring for years.

Three types of arenas structures can be seen: 1) on natural habitats (bogs, small patches of heather, mowed moorland), arenas look like tight clusters of small territories where competition is high between the more central males who rarely are allowed to develop their courting behaviour; 2) arenas in line where territories equivalent in space and situation follow each other on the grassy strip of a one kilometer long firebreak; important

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differences appear in courting and copulation success between apparently equal landowners; 3) extended arenas with larger territories on artificial meadows where even the most central males have sufficient space to court with success. On such an arena, a long term study from 1971 to 1979 allowed to record the courting skill and copulation success of colour ringed individuals. On this respect, they are quite unequal. Nevertheless, independently of their copulation success, they all contribute in attracting the hens to the arena, and sometimes old surviving individuals signal to youngers where to join the arena. The success of the group relies on all of them. A population is not only the sum of a given number of anonymous consumers or reproducers. It is built of individuals each with its personality. Behaviour is necessary to elucidate the social network of interactions between individuals with personal profiles, life histories, skills and experience. Conservation requests informations from behavioural studies.

Introduction : Behaviour is a prerequisite to conservation

Behaviour is important to consider when someone tries to understand the success or the failure of an individual, a social group, or a population. Behaviour is indeed the way and the mean by which an animal resolves the problems it has to deal with in its environment. This animal has to live, survive and reproduce. He has to find food, he has to find shelter and avoid predators, and he has to meet and choose a mate with whom to copulate, which will determine their contribution to the next generation and its genetic composition and fitness.

As far as Black Grouses are concerned, the most spectacular and crucial event is the lekking behaviour, when cocks settle early in the morning and in the late afternoon, on precise sites where each defends a territory for hours, days, weeks, and months, waiting for the passage of matured hens from mid-April to mid-May. These sites are also the very places where to count individuals, either territorial cocks or young intruders.

The level and nature of interactions between individuals on these arenas depend : firstly, on the location and extent of these sites as well as on the nature and structure of their vegetation; secondly, on the population density, itself depending on the available extent of the home range and on the quality of the habitats . We have therefore studied the past and recent evolutions of the nature and extent of landscapes and habitats as well as the fluctuations of Black Grouse populations in the Hautes-Fagnes for the three past decades (see RUWET *et al.*, 1998).

Evolution of Black Grouse habitats and populations in the Hautes-Fagnes

Black Grouse is a most endangered species in Central and Western Europe and the Hautes-Fagnes Plateau in the Belgian Ardenne - with the Sallandse Heuvelrug in the Netherlands — (HERINGA 2000, DE RODER F. 2000, TEN DEN P.G.A. & F.J.J. NIEWOLD 2000) — is probably its most western sanctuary on the continent.

Past Evolution of landscapes and habitats in the Hautes-Fagnes

The original landscape of the Hautes-Fagnes (summit of Belgium : 694 m) was a mixture of peat bogs and large forests. During the first millenium, the Highlands - over five hundred meters (500 m) over sea level - were covered by forests (beeches on the well drained crests; oaks and birches on less well drained slopes, peaty moorland down the slopes and peat bogs on the saddles between watersheds.

During the second millenium, agricultural practices adapted to the local climate led to an afforestation, for charcoal production, extensive pastoralism which means also grazing and mowing, cultivation of some parts of the moorland with a succession of rye, oat and potatoes, which means also burning the vegetation to enrich the soil with ashes, and finally peat exploitation. They created a new open landscape dominated by moorlands. The open lanscape of peat bogs and moorlands created by man reached its largest extent at the end of the eighteenth century. It covered fifteen thousands ha (15,000).

In the middle of the nineteenth century, new economic needs requested the improvement of wastelands e.g. peatlands, marshes, moorlands, which led to the drainage of wetty areas, and reforestation with cultures of spruce trees. From that period to the middle of the twentieth century (1962), it was reduced to one third of its previous extent, i.e. some five thousands (5,000) ha of witch most are now under protection. Nevertheless, habitats had been cut apart and isolated from each other. We can now distinguish two main areas, plus the military domain of Elsenborn. So, the extent of the Black Grouse home range has been cristallized and its characteristics have been determined (RUWET *et al.*, 1997).

Evolution of Black Grouse populations since the mid-sixties

In the Belgian Hautes-Fagnes, Black Grouse numbers have been censused since 1966. Inventories have been conducted on the thirty known arenas.

Thanks to important recruitments in the late 1960s, the population of displaying males grew up to 198 individuals in 1971, then it collapsed to 42 in 1976. During the next 20 years, it fluctuated between about 80 (e.g. 1977, 1987), and less than 40 (e.g. 1982, 1983, 1995, 1997) (details in RUWET *et al.* 1997). The present situation (28 in 1999 and 18 only in 2000) is thus more critical than in the mid 1970s, and even made worse by the spontaneous evolution of some parts of the Nature Reserve from attractive moorlands to less attractive woodlands (LONEUX *et al.* 1997, KEULEN *et al.* 1997).

Structure of arenas, dynamics of lekking behaviour and mating success.

Considering the situation of the three past decades — both extent of valuable habitats and Black Grouse population fluctuations —, it is possible to classify arenas on a structural basis (RUWET *et al.*, *op. cit.*).

First, the most usual situation is to be seen on natural (e.g. raised peat-bogs) or semi-natural habitats (mowed moorland). On such sites, small territories cluster on a small surface; the eldest males defend central territories whereas the younger ones settle in the periphery; the level of agonistic interactions between males is high, specially with central cocks, who appear as if they were the most active ones. This collective activity attracts hens, who settle on the arena and cross territories before choosing one cock with whom to copulate. In this intrasexual competition between cocks, the more central and eldest males are not the most successful, females being sometimes repelled by some aggressive components in these males courtship behaviour.

Secondly, a particular situation is an elongated type of arena established on a firebreak bordering the Nature Reserve, and perfectly matching the well named «Hahnstreck» or «the cocks mall». In 1971, when the Hautes-Fagnes population was at its highest level, never seen again, 23 cocks defended elongated territories in line on the 1,500 m long lawny strip of the firebreak. Cocks were regularly spaced and defended territories most of which equal in space and situation. In such a case, it appears that copulation success is unequal : some cocks are successful, others not at all. Success depends on personal gifts and appropriate tactics.

Finally, a more enlarged site-type occurs, where territories are larger, e.g. on pastures and meadows. Important recruitments of young cocks in the late 1960s were indeed the starting point of the building up of an important arena on recent pastures created at the expense of the Nature Reserve. One such situation was the occasion to follow the evolution of both the territories and the copulation success of cocks during a complete turn over of the population of the arena. This allowed a long term case-study on territoriality, annual income of cocks and individual copulation success.

	A	B	C	D	E	F	G	H	I	J	K	L	M	U	W																																			
1970																																																		
1971	4	0	4	1	0	2	1	0	1	0	0	1	0	0	0	M'	Y	Z																																
1972		1	3			3		0	0		1	1			0	2	0	0	Q	R																														
1973		0	2			0	0				1	1			0	5	3	0	2	0	A'																													
1974		0				1	0					5			0	5	1	1	8	6	0																													
1975		0													0	0	0	0	2	5	9	G'	H'	K'																										
1976																													11	5	1	1	0	B'	T	I'	J'	O	Y'	P	Z'									
1977																													9	1					0	0	0	0	1	0	0	0	D	H''						
1978																																							1	3	1	0		4	1	1	S			
1979																																							2	8	0	0		1		0	0	X	X	
1980																																												?	?	?		?	?	X
1981																																												?	?	?				
1982																																													?	?	?			
Copulation succes																12	4	1	12	31	15	1	1	0	0	0	3	11	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	?	?	?				
Territorial persistence																4	4	4	3	5	4	1	1	1	1	1	3	3	3	5	1	5	1	3	1										?	?	?			

Territorial stability, annual income of new cocks on the arena and copulation success: a case study

Important recruitments of young cocks in the last 1960s were the starting point of the building up of an important arena on pastures created recently in the immediate vicinity of the Grande Fange in Jalhay. From 1971 to 1979, the cocks were under daily control in spring ! Males caught before or after the copulation period were individually recognizable thanks to colour rings and wing marks. Exact ages of cocks present on the arena in 1971 were not known ; they were born from 1966 to 1970. Afterwards, the first attempt of any new young cock to settle was under control and recorded. Each letter personalizes one individual and indicates the duration of its attendance over years. Maximum duration is five years (R and Z' ; perhaps more for B and

W...). The copulation success is quite unequal. Some cocks are successful (31 for R) others less successful (1 for B) and not at all (0 for W) in five years. The long living cocks are important to attract younger ones at the right place, and to ensure the transition between generations. An arena is indeed a well-balanced association, at a proper place, of competitors of different ages. The gentle replacement of old experienced cocks by the rising generation and the persistence of the arena itself depend on recruitment, mortality, disturbance ; in past, present and weather to come ; in the satisfaction of the birds' requirements.

From 1971 to 1979 (see **Table**), cocks of this peculiar arena were under daily control in spring. Males caught before or after the copulation period were individually recognizable thanks to colour rings and wing marks. Exact age of cocks defending a territory on the arena in 1971 was not known ; they were born from 1966 to 1970. Afterwards, the first attempt of any new young cock to settle was under control and recorded. These observations are a confirmation of personal characteristics of each male. The duration of each cock attendance on the arena over years as well as its annual and global contribution to copulations are known. Some cocks accumulate copulations, others are less or not at all successful. Of course, copulation success does not necessarily means reproductive success. Assessment of reproductive success urges genetic analysis (see SCHREIBER, 2000; SEGELBACHER & HÖGLUNG, 2000). At the time when Black Grouse populations were healthy, this perspective was a dream. Meanwhile, genetics have undergone rapid progress. But now that populations are scattered and endangered, we have to be cautious and rely on non invasive techniques (see HERZOG, 2000). It is worth to notice that maximum attendance duration on the arena was five years.

From 1980 onwards, observation continued but without ringing (RUWET J.C. & L. HANON).

Conclusions

Long living cocks are important to attract younger ones at the right place where to gather for lekking, and to ensure the transition between generations.

An arena is indeed a well-balanced association, at a proper place, of competitors of different ages.

The gentle replacement of old experienced cocks by the rising generation and the persistence of the arena itself depend on recruitment, mortality and disturbance levels, and on the satisfaction elsewhere of the birds requirements.

It appears also clearly that if all territorial cocks contribute to the attractiveness of the arenas where lekking takes places, the copulation success is quite unequal.

A population is not only a sum of or the average of a number of consumers or reproducers; it is a social group of individuals, each with its personality, life history, experience, natural and acquired gifts and skills. One individual is not the other, and they are not interchangeable. All deserve consideration and protection.

Finally, it shows that the understanding of animal life requires long term behavioural studies combined with genetic analysis.

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RESUME : **Comportement et Conservation : habitat, population, dynamique territoriale et sociale des tétras lyres (*Tetrao tetrix*) au cours d'une étude à long terme dans les Hautes-Fagnes de Belgique.**

La connaissance du comportement est indispensable à une conception correcte d'une politique de conservation. Le comportement est en effet le moyen par lequel un animal résout les problèmes que lui pose son environnement : trouver sa nourriture, éviter les prédateurs, choisir un partenaire avec qui s'accoupler. Du succès de ces nécessités dépend la génération suivante, et sa juste adaptation au milieu. S'agissant des tétras lyres, le point le plus délicat est l'organisation des oiseaux sur et dans le voisinage des arènes de parade où les coqs s'affrontent au printemps sur des petits territoires individuels en attendant le passage des poules. La localisation et la structure des arènes ainsi que la dynamique sociale y sont déterminées par la densité de la population et par l'étendue et de la qualité de l'habitat.

On esquisse ici l'évolution des paysages et habitats du tétras lyre dans les Hautes-Fagnes de Belgique, ainsi que les fluctuations de ses populations, les coqs ayant été recensés pendant plus de 30 ans sur 30 arènes de parade; ces problèmes ont fait l'objet d'exposés exhaustifs dans un numéro spécial «Tétras lyre». A côté de cet aperçu, et alors que l'analyse de la masse des données accumulées sur les comportements est encore en chantier, nous soulignons les différences structurales, selon le site, des arènes de parade :

1) Grappes de petits territoires concentrés sur les sites naturels (tourbières) ou semi-naturels (bruyères basses, landes fauchées) où la compétition est forte entre coqs, les plus centraux subissant une pression centripète les empêchant souvent de développer une parade de cour, tout bénéfique pour des coqs périphériques considérés à tort comme marginaux ;

2) Territoires alignés à la file sur le ruban enherbé d'un coupe-feu en bordure de la Fagne, où chaque coq dispose d'un territoire équivalent aux autres en surface et visibilité; néanmoins, les succès vis-à-vis des poules sont inégalement répartis ;

3) Arènes étalées sur les grandes surfaces des prairies artificielles, enclavées ou en bordure de la Fagne; les territoires disposés en grappes lâches y sont plus vastes, même au centre, où la pression est moins forte qu'en site naturel ; le suivi individuel de 1971 à 1979, sur une telle arène, du comportement et du succès d'appariement des coqs, tous marqués de combinaisons de bagues colorées et identifiables individuellement, a permis de mettre en évidence la personnalité de chacun, et d'en préciser les rôles et succès. Certes, le succès d'un coq quant au nombre de ses copulations n'est pas nécessairement synonyme de succès reproducteur. Celui-ci doit être vérifié par des analyses génétiques. A l'époque où les populations étaient florissantes, cette perspective n'était encore qu'un rêve. Aujourd'hui que les populations sont émiettées et fragilisées, nous ne pourrions déontologiquement recourir qu'à des techniques non invasives.

On insiste in fine sur le fait qu'un coq, quels que soient son âge et son expérience vécue, présente des aptitudes personnelles utiles au groupe : assiduité sur l'arène contribuant à l'attraction globale de celle-ci sur les poules; aptitude à courtiser et accumuler les succès; coqs âgés qui, quel que soit leur passé reproducteur, restent les sentinelles de l'arène traditionnelle où ils attirent les jeunes sujets, assurant ainsi l'enchaînement des générations. Une population n'est pas assimilable uniquement à une somme de consommateurs et de reproducteurs; c'est un groupe social composé d'individus, ayant chacun sa personnalité, son histoire de vie, son expérience et ses aptitudes propres, innées ou acquises. Ils ne sont pas interchangeables, tous méritent considération et protection.

Cela montre que la compréhension de la vie animale requiert des études comportementales de longue durée, nécessaires aux politiques de gestion et de conservation.

Mots-clés: *Tetrao tetrix*, Tétras lyre, Hautes-Fagnes, Belgique, Evolution des habitats, Population, Arènes de parade, Dynamique sociale, Conservation.