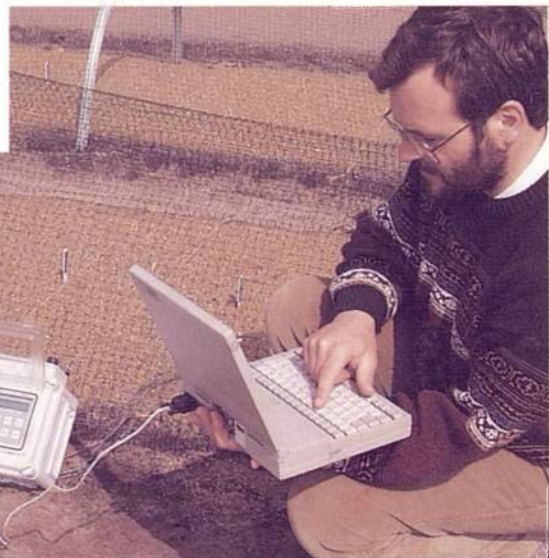




**Forestry Commission**

# **Black Grouse and Forestry: Habitat Requirements and Management**

**John Cayford**





FORESTRY COMMISSION TECHNICAL PAPER 1

# **Black Grouse and Forestry: Habitat Requirements and Management**

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## Summary

The black grouse is a large, sexually dimorphic species found typically in habitats transitional between moorland and forest. Numbers of black grouse have recently declined throughout much of Europe. In Britain, the species is now largely confined to Scotland, the north of England and Wales. Continued loss and fragmentation of habitat represents the most serious threat to black grouse. Research suggests that black grouse would be favoured by sympathetic management practices which conserve existing habitat in forests and on adjacent moorland. Black grouse use forestry plantations prior to canopy closure, resulting in local, short-term increases in numbers and range. This Technical Paper gives recommendations for the management of black grouse in coniferous forests together with a description of the species, its current distribution, status and critical habitat requirements.

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# Black Grouse and Forestry: Habitat Requirements and Management

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## Description

Black grouse *Tetrao tetrix* L., or blackgame, are striking birds best known for the elaborate displays of males on communal 'leks' in spring (Lack, 1939; Johnstone, 1969; Vos, 1983). The male (blackcock) weighs approximately 1250 g, is roughly the size of a domestic fowl and is larger than the red grouse (*Lagopus lagopus* L.) but smaller than the capercaillie (*Tetrao urogallus* L.). From a distance the plumage of males appears black, but close-up the upper parts are a glossy blue-black with a scarlet wattle over the eye. A distinct white wing bar is best seen when the bird flies. The underside of the lyre-shaped tail is pure white and is particularly striking when males display. In summer, males moult their feathers and the partial eclipse plumage is more mottled with brown.

The female black grouse (greyhen) is smaller than the male (weighing approximately 950 g), but is larger than the red grouse. The plumage is variable but generally a mottled fawnish and chestnut brown, barred with black on the head. This gives a greyer-brown appearance compared to the red grouse. The two species can sometimes be distinguished in flight by the profile of the tail which is forked in the black grouse, but rounded in the red grouse. The greyhen also has a wing bar, although this is not as prominent as in the male. The flight action of a greyhen is quite different too, with deeper continuous wing beats compared to the shorter beats of red grouse which are interspersed with glides. Female capercaillie are 35% larger than female black grouse and have no pale wing bar.

## Distribution and population density

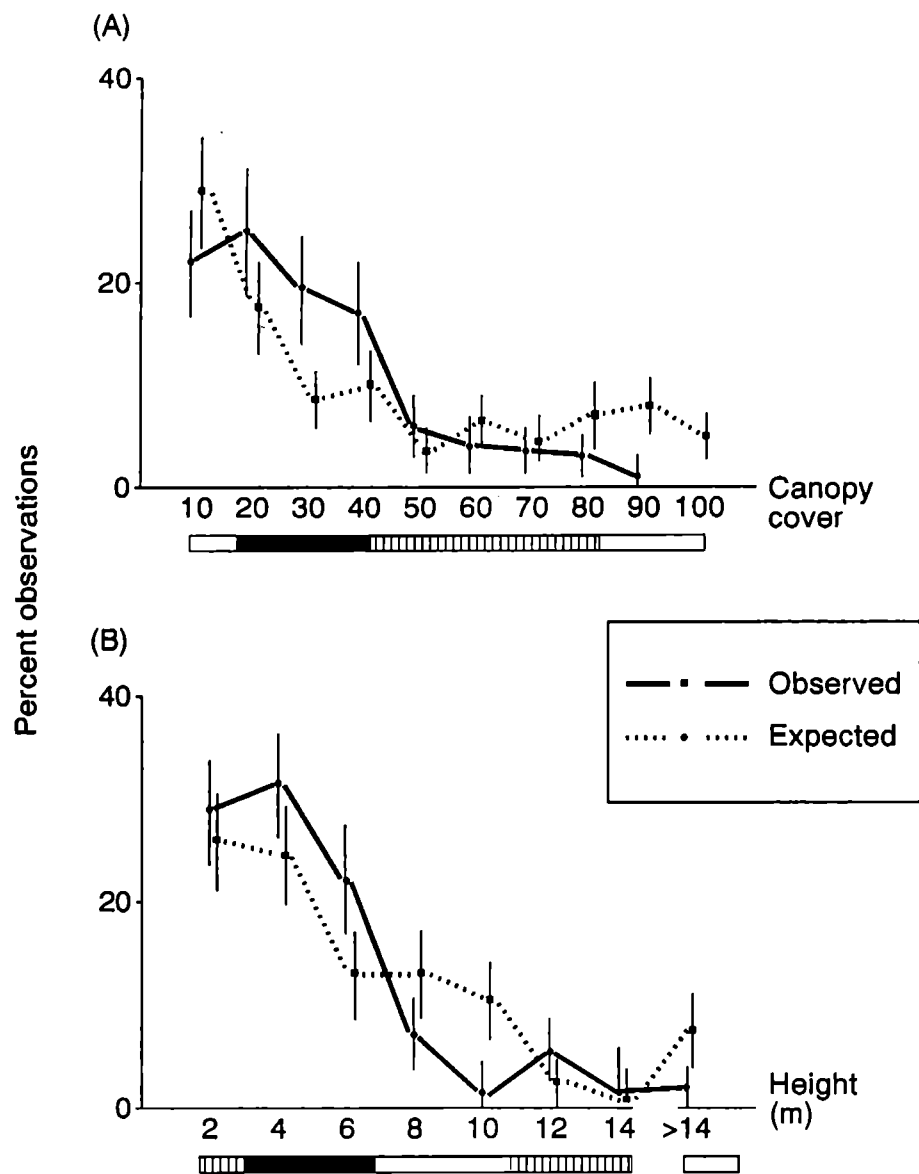
Black grouse are widely distributed throughout continental Europe and Siberia, but numbers are declining over much of this range. In Britain they occur in the more remote, upland parts of North Wales (Grove *et al.*, 1988), the moorlands and rough grazings of northern England (Garson and Starling, 1990) and the Peak District (Sharrock, 1976; Lovenbury *et al.*, 1978; Yalden, 1986), but only in Scotland are black grouse numerous over large areas (Thom, 1986; Picozzi and Catt, 1988; Hudson, 1990; Baines, 1990). The total British population was estimated by Parslow (1973) to be between 10 000 and 100 000 pairs. Both Sharrock (1976) and Picozzi (1986b) consider the true figure to lie at the lower end of this range.

The black grouse has declined in many parts of Britain over the last 100 years. Formerly widespread in

south-west England and in the east to Lincolnshire and Norfolk it is now extinct in these areas. Less than 20 males remain in the Peak District (Yalden, 1986). In northern England the population has undergone some fluctuation and at present is thought to be stable in County Durham and parts of Northumberland but may be declining in parts of North Yorkshire (Garson and Starling, 1990). The population in Wales partially recovered, probably due to afforestation, after a decline in the early part of this century when black grouse became extinct in Glamorgan, Monmouth and Flint. Recent surveys in Wales showed a contraction of range and a fall in numbers to less than 300 males by 1986 (Grove *et al.*, 1988) with some evidence of continued declines on leks in forests (Cayford and Walker, 1991). In Scotland, shooting-bag returns from estates show a 75% reduction in the numbers of black grouse shot since the 1930s and marked differences in the magnitude and timing of this decline between regions (Hudson, 1990). Numbers have shown both short- and long-term fluctuations, but are now thought to be relatively stable after a substantial decline in the early part of this century (Barnes, 1984). Recolonisation and colonisation is apparent in some recently afforested areas and may account for local population increases (Thom, 1986).

In common with other grouse species, some black grouse populations undergo short-term fluctuations in numbers. Tapper (1988) presents evidence based on bag records in Scotland for population cycles with a peak at about 5-year intervals but this may be an artefact because most black grouse are shot on red grouse drives, and some red grouse numbers show cyclical fluctuations. Various intrinsic (self-regulatory) and extrinsic (predation, parasites, weather conditions, habitat deterioration, etc.) factors have been proposed to account for cyclical changes in other grouse species. For example, in northern and central Scandinavia and Finland short-term fluctuations of grouse populations have opposite trends to those of small mammals. When vole populations 'crash', predators switch their attention to ground nesting birds such as grouse (Angelstam, 1984).

The main threat to black grouse appears to be loss and fragmentation of habitat with resulting isolation of populations (Cayford, 1990b). Other factors which have been shown to suppress numbers include egg and chick predation, disturbance (especially during the breeding season), shooting pressure and possible cold wet weather during the early fledging period which reduces the availability of insects to chicks.

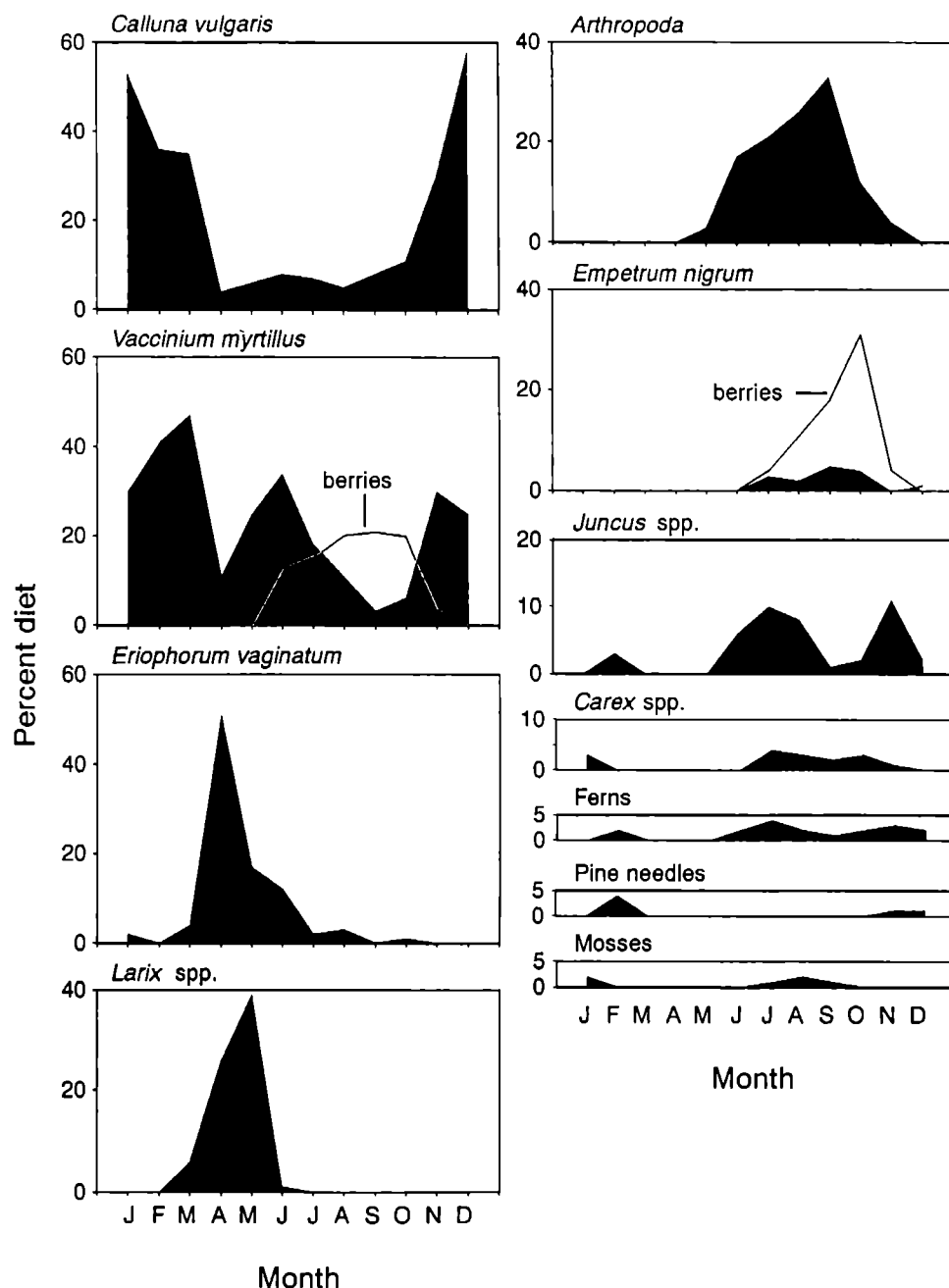


**Figure 1.** Habitat use and preferences of radio-tagged male black grouse at Penaran in Wales. Values shown are percentage of observations  $\pm$  95% confidence limits in forest stands of different canopy cover (A) and height (B) compared with expected values based on random samples observed (n=252 A), (n=226 B), and expected (n=330 A), (n=333 B). Horizontal bar: closed = significant preference, hatched = no preference, open = significant avoidance. (Redrawn from Cayford *et al.*, 1989).

## Habitat requirements

The ancestral habitats of black grouse were probably in the boreal and sub-arctic forests of the northern hemisphere where fire and wind damage created a mosaic of openings and young successional stages which the birds could colonise. These natural forests provided food in the form of dwarf shrubs, birch buds and catkins and berries together with shelter, nest sites and undisturbed lekking arenas. Similar conditions exist today in some native Scots pine (*Pinus sylvestris*) forests in Scotland, but most habitats of black grouse in Britain are of more recent origin and greatly influenced by man's activity.

The presence of trees is generally believed to be essential for black grouse (Johnsgard, 1983). However, some populations in northern England and Scotland survive in relatively treeless areas. Studies in northern Sweden have shown that black grouse prefer stands of 5-8 m in height and avoid those <4 m or >12 m high (Marcstrom *et al.*, 1982). However, tree density is often more critical than height because this affects the speed of canopy closure and the shading out of important ericaceous food plants (Cayford *et al.*, 1989). Most forests in upland Britain are comprised largely of fast-growing, coniferous species, particularly Sitka spruce (*Picea sitchensis*), planted at high density in uniform stands. Research in Wales revealed that black grouse



**Figure 2.** Seasonal changes in the diet of adult black grouse in coniferous forests in Wales. Values shown are means. (Redrawn from Cayford, 1990c).

showed the greatest preference for plantations with 15-40% canopy cover which persisted in small patches where the planted crop had failed (Cayford, 1990c). Birds generally avoided thickets where canopy cover exceeded 70% (Figure 1).

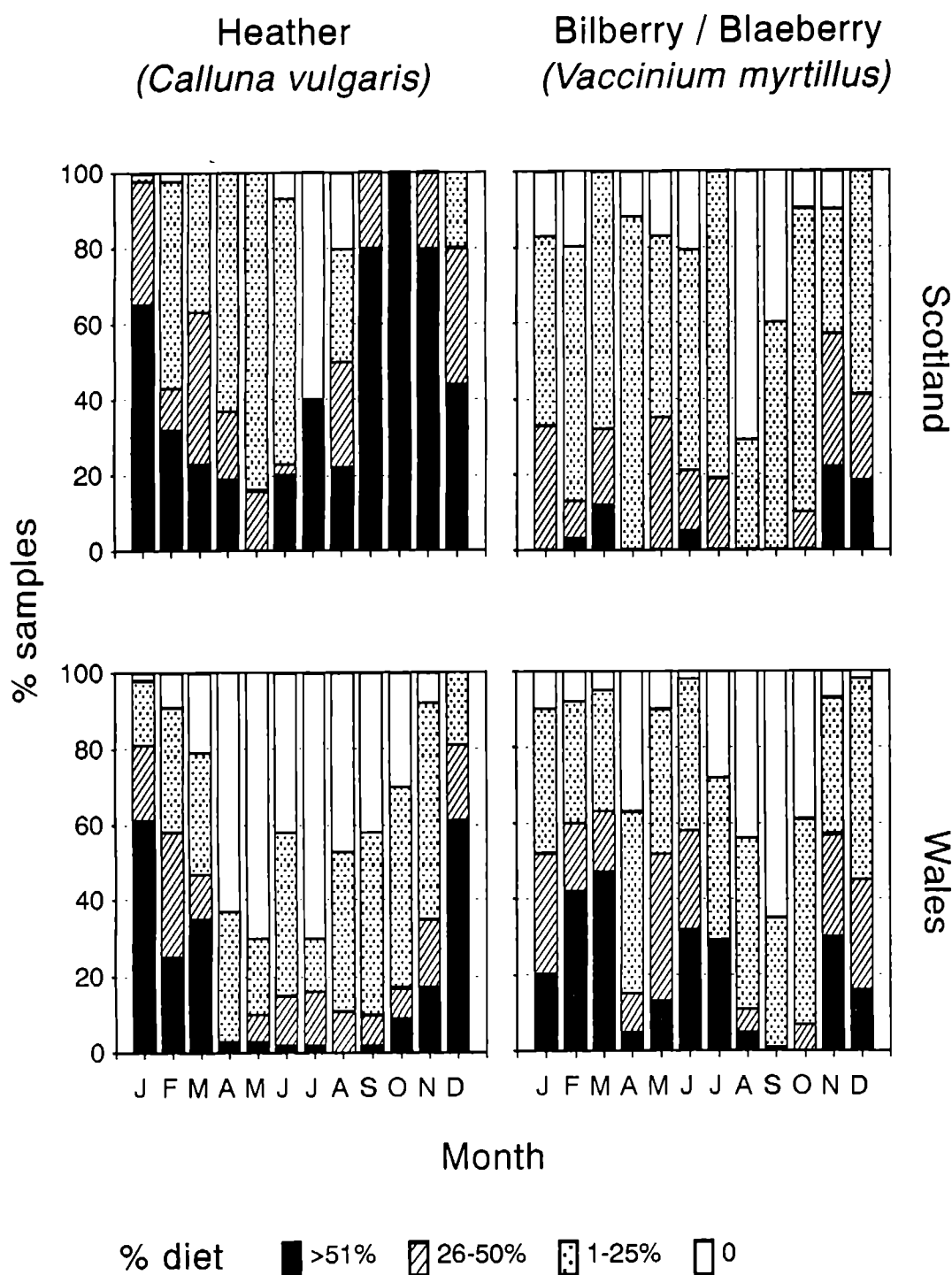
Throughout the year black grouse require a succession of different habitats for activities such as feeding, displaying, nesting, roosting and moulting. The number of males at a lek reflects the availability of these different habitat components within a radius of approximately 2 km of the lek.

### Display areas

Black grouse males are polygamous (mate with several females) and play no part in rearing young. Males display communally and mate on traditional arenas

(leks) where they advertise their social status through ceremonial defence of a small area of the lek. Dominant males tend to occupy a central court on the lek and attract more females (Johnstone, 1969; Kruijt *et al.*, 1972). Males attend leks throughout the year except when moulting, but the main period of activity is between March and June, and in some areas, in late September and October (Koivisto, 1965; Hjorth, 1968). Arrival times at the lek can vary but in Wales males arrive approximately 90 minutes before sunrise in mid-March and leave the lek an hour after sunrise. By the end of May in Wales, the first males arrived as early as 0300 hrs, but most birds had left the lek by 0430 hrs (Cayford and Walker, 1991). It is quite common for birds to return at dusk, particularly in April and May.

The bubbling, dove-like 'cooing' or 'rookoo' sounds made by several males as they display can often be



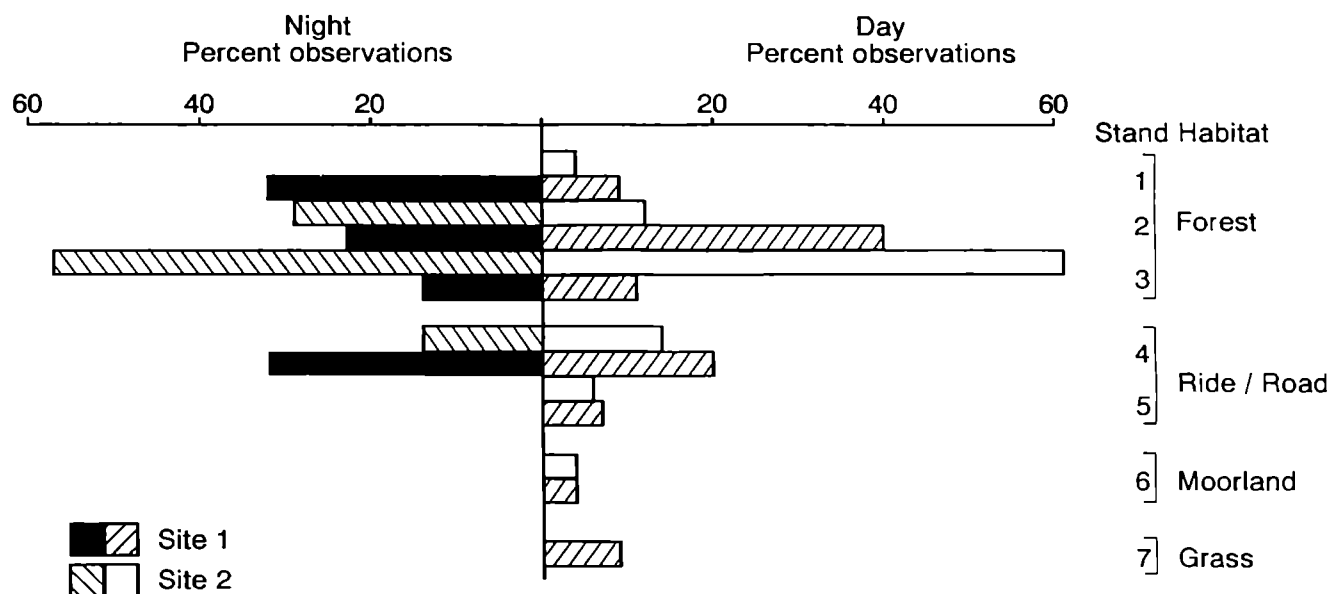
**Figure 3.** Seasonal changes in the percentage composition of heather and blaeberry in the diets of black grouse in Scotland (upper) and Wales (lower). (Redrawn from Cayford *et al.*, 1989 and Picozzi and Hepburn, 1984).

heard 1-2 km from the lek on a still morning and can be used to locate leks. The lek usually consists of an area of relatively flat, open ground with short vegetation (less than 5 cm in height) and good all round visibility. The total area used for display rarely covers more than about 0.5 ha, but the lek is always sited in a much larger expanse of open ground. Peat bogs, pasture, moorland adjoining forest, open glades, forest rides and roads, and clear felled areas can all be used. Leks tend to be on the same sites year after year, but may move if vegetation encroaches or there is sustained disturbance.

#### *Diet and feeding areas*

In Britain the diet of black grouse has largely been determined by faecal analysis. Adult black grouse feed on a variety of seasonally available vegetation and also take some insects in summer (Figure 2). Leaves, stems, buds, flowers, seeds and fruits of several dwarf shrub species are eaten, depending on locality, season and availability. The buds of larch, Scots pine, birch, juniper, rowan and hawthorn, together with fruits of rowan and hawthorn are also taken. Most feeding is done on the ground but birds will feed on larch buds in





**Figure 4.** Habitats utilised by ratio-tagged broods at two sites in North Wales during the day (site 1 n=45, site 2 n=5) and at night (site 1 n=22, site 2 n=14). Habitat categories: 1 = young conifers (height 0.5-1.3 m), 2 = young conifers (height 1.3-3 m), 3 = thinned middle-aged stand (average stem diameter of 10-20 cm at breast height), 4 = forest ride, 5 = forest road-side verge, 6 = wet moorland (damp, heather dominant but including *Nardus*, *Scirpus*, *Eriophorum*, *Molinia* and *Sphagnum*), 7 = grass (>50% cover), *Nardus/Molinia* dominant. (Redrawn from Cayford *et al.*, 1989.)

spring and birch catkins and the buds of Scots pine in late winter. During periods of prolonged snow cover the availability of tree buds may be critical to the condition of the bird and may thus influence breeding success and in some instances survival (Picozzi, 1986a).

Ericaceous shrubs, particularly heather (*Calluna vulgaris*) and blaeberry (bilberry) (*Vaccinium myrtillus*) are important food plants throughout the year and formed the bulk of the diet of black grouse in Scotland (Picozzi, and Hepburn, 1984) and Wales (Cayford, 1990c). Heather predominates over blaeberry in the diet of moorland black grouse studied in Scotland (Picozzi, 1986a), whereas blaeberry is favoured by birds in Wales (Figure 3). From March to May, both sexes may feed almost exclusively on larch buds and the newly emergent flower heads of the cotton grass (*Eriophorum vaginatum*). In northern England, herbs such as *Trifolium* spp., *Rumex* spp. and *Ranunculus* spp. are important spring foods (Baines, 1990). In summer, berries, insects and seeds of grasses and sedges are taken.

Chicks less than 3 weeks old are fed almost exclusively on arthropods (see Kastdalen and Wegge, 1986; Picozzi, 1986a; Cayford *et al.*, 1989; Cayford, 1990c). A wide range of insects and spiders were taken according to local abundance and ease of capture, but ants and the larvae of Lepidoptera and sawflies are numerically the most important items (Picozzi, 1986a; Cayford *et al.*, 1989). Other insect orders which were taken include harvestmen, beetles, spiders and flies.

Chicks older than 3 weeks take fewer insects and more berries and heather leaves.

Radio telemetry studies in Scotland (Robel, 1969a; Picozzi and Hepburn, 1986) and Wales (Cayford *et al.*, 1989; Cayford, 1990c) have shown that black grouse select a variety of open, semi-natural habitats for feeding, but generally prefer an open patchwork of young, or widely spaced older trees with a well developed understorey of young heather, blaeberry or cotton grass. In Scotland, males were found mainly in open mature woodlands in winter, whereas hens favoured very small clumps of regenerating pine on moorland and both sexes were found on open ground in the summer and autumn (Picozzi, 1986a; Baines, 1990). In coniferous forests in Wales the preferred foraging habitats were young plantations, thinned older stands, open enclaves, forest rides and exposed ridges with a patchwork of uneven-aged trees and open glades (Cayford *et al.*, 1989; Cayford, 1990c). Comparisons of habitats in the vicinity of leks in northern England suggest that sheepwalk and young coniferous forest were preferred habitats (Garson and Starling, 1990).

### Chick rearing areas

The habitat of hens in summer is determined by requirements for nesting and rearing young. Eggs hatch synchronously usually in mid-June and young are led from the nest within 24 hours of hatching. Broods travel successively further from the nest site during the first 2-3 weeks before settling into home ranges of 30-60 ha (Wegge *et al.*, 1982). The first 10 days after hatching are

the most critical for chick survival. The condition of hens may influence chick survival, but wet weather and the availability of food are more important. The quality of the brood habitat can be of paramount importance in influencing brood survival.

Hens with broods avoid thickets, dry heather moorland and heavily grazed farmland, but prefer a variety of habitats which support high densities of insect foods and provide cover from predators (mustelids, foxes and raptors). Wet, rushy mires (ungrazed by sheep) were preferred by chicks less than 3 weeks old on heather moorland in Scotland (Parr and Watson, 1988) whereas stream margins, sunny rides, verges and young plantations supporting a mixture of tall grasses, heather and blaeberry were favoured habitats in broods in forests in Scotland and Wales (Picozzi, 1986a; Cayford *et al.*, 1989; Cayford, 1990c) (Figure 4).

### *Nesting and roosting sites*

Mating occurs on the lek and the females usually nest within a 2 km radius (Willebrand, 1988). The 6-11 eggs (8 is average) are larger, but less heavily marked than those of the red grouse and are laid on alternate days in a shallow scrape, lined with grass or moss. Eggs are laid in late April-early June and hatch in approximately 26 days (Cramp and Simmons, 1980). The female selects a dry, nest site with tall (greater than 35 cm and up to 54 cm), dense vegetation or some other form of shelter such as an uprooted tree, which offers protection from weather and concealment from predators during incubation. Tall, rank heather, dense blaeberry, rushes and bracken are particularly favoured as nesting and roosting sites (Cayford *et al.*, 1989).

### *Habitat scale*

Little information exists on the area of suitable habitat needed to support a self-sustaining population of black grouse. Estimation of the area used by individual birds is an important prerequisite to a better understanding of habitat use and management. Johnstone (1969) found that home ranges of lekking males in north-east Scotland were about 500 ha. Robel (1969a) reported ranges of 303-689 ha with a mean of  $458 \pm 126$  (SD) ha and Picozzi (1986a) obtained ranges of  $355 \pm 178$  ha for males,  $85.8 \pm 37.3$  ha for moorland females and  $44.9 \pm 28.3$  ha for woodland females. It appears that once a hen has bred it seldom moves far from that general area (Picozzi, 1986a). In coniferous plantations in Wales home ranges of radio-tagged males averaged  $325 \pm 71$  ha (Cayford, 1990c). Home ranges of males attending the same lek overlapped considerably and were discrete from males attending adjacent leks. Males did not appear to move between leks. These data confirm that black grouse are largely sedentary and suggest that an area of 500-700 ha of suitable forest and moorland habitat may be enough to sustain one lek.

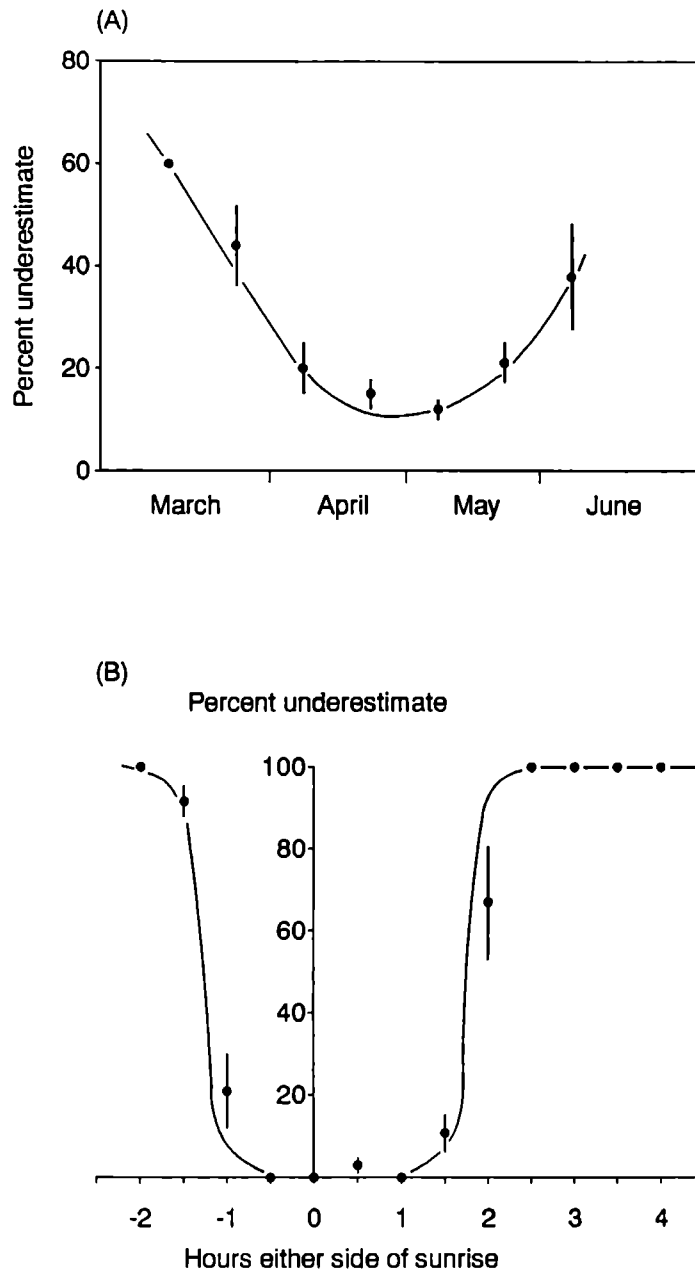
## **Black grouse in British forests**

Black grouse occupy some semi-natural forests in Scotland, particularly of pine and birch (Gladstone, 1924; Johnstone, 1969; Robel, 1969a, 1969b; Picozzi, 1986a, 1986b; Parr and Watson, 1988) but in most other areas they are mainly associated with coniferous plantations, as in Wales (Grove *et al.*, 1988; Cayford *et al.*, 1989), and patchworks of semi-natural vegetation such as heather moorland and unimproved pasture interspersed with woods, hedgerows or groups of broadleaved trees. Post-war afforestation in the uplands has reduced the range of some birds dependent on moorland (Avery and Leslie, 1990; Petty and Avery, 1990), but black grouse often benefit, in the short-term, following planting. Under relaxation from grazing and burning, dwarf shrubs such as heather and blaeberry spread and become luxuriant, so providing food and nesting cover. Moreover the young trees and the developing ground vegetation provide shelter, cover from predators, and in some cases winter food until the canopy closes.

### *Effects of changes in the age-class of forests*

In the early growth stages after afforestation there is an increasing amount of semi-natural vegetation which black grouse can exploit. After 10-15 years conditions rapidly deteriorate for black grouse as the trees close canopy and suppress the growth of understorey shrubs. Loss of ground vegetation due to shading is more pronounced in spruce as opposed to pine plantations (Hill, 1979). By the time the canopy has closed (thicket-stage), these young plantations are largely unsuitable for black grouse, although they may still be used in winter or as a refuge following disturbance and black grouse may feed on larch buds in the spring. By the thicket stage, suitable habitat is mainly confined to unplanted rocky outcrops and moorland patches, areas of windthrow, stream margins, rides, road-side verges and the interface between forest and moorland (Cayford and Hope Jones, 1989). In upland Britain large areas have been afforested during a short time span, resulting in the habitat quality for black grouse deteriorating quickly over extensive areas as crops pass into the thicket stage.

Clear felling recreates open space in the forest which black grouse can exploit if a dwarf shrub layer develops. In the long-term, clear felling can create a mosaic of different-aged crops which may provide a constant supply of suitable habitat. In Wales, black grouse feed and roost in felled and replanted (restocked) areas where heather and blaeberry have re-established, but avoid those which have become choked with grass and bramble. Heather seed persists in the soil through the first rotation and at clear felling it can regenerate over large areas. However, when trees are planted within a year of felling, heather may not have time to regenerate from seed and reach a suitable height



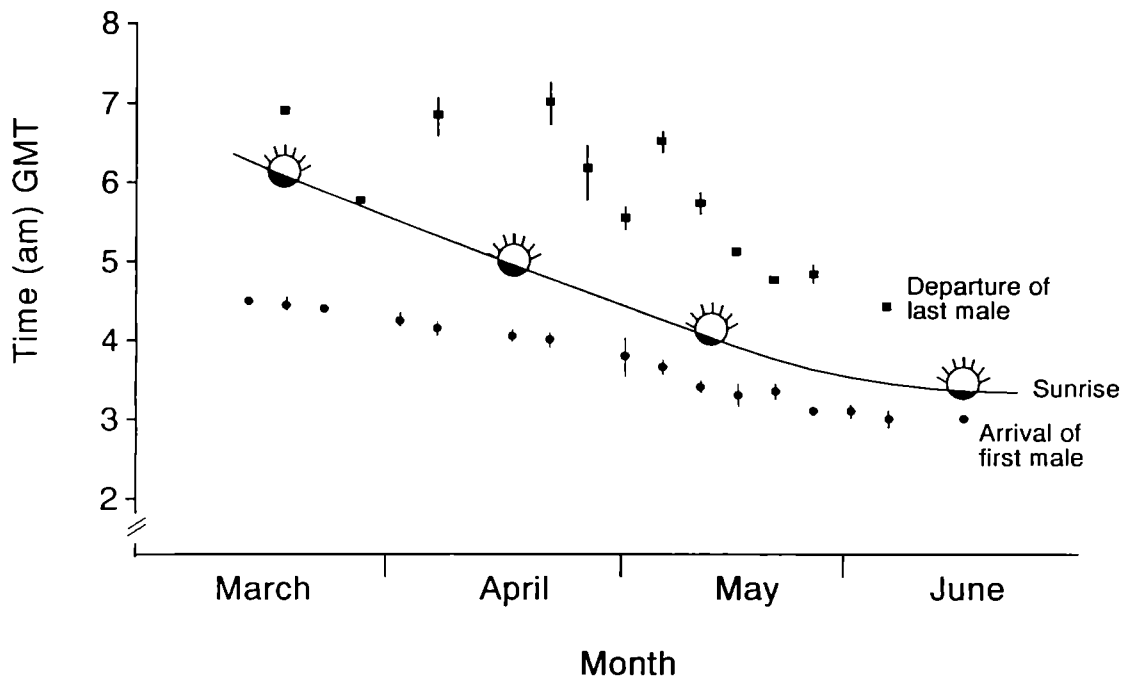
**Figure 5.** Deviations in the numbers of male black grouse counted on individual leks in Wales by (a) season and (b) time in April-May. Values shown are the average extent to which a single count deviated from the seasonal maximum count. (Redrawn from Cayford and Walker, 1991.)

to provide both cover and food for black grouse. Clear felling should not be seen as a substitute for, but as an addition to, the provision of more permanent black grouse habitats within forests. Diversifying the age structure of a forest at the end of the first rotation by patchwork clear felling will improve the area for black grouse providing heather is allowed to regenerate on restocked sites. However, other measures will also be required.

### Surveying and monitoring black grouse populations in forests

Annual counts of black grouse give the forest manager data on distribution and density over time, against

which the effectiveness of management practices can be gauged. Two main census techniques are used for black grouse, these involve either counting males on leks (Grove *et al.*, 1988; Cayford and Walker, 1991) or counting birds along transects using pointing dogs (Baines, 1990). The latter requires highly trained dogs which limits the use of this technique to forests where suitable dogs are available. Lek counts provide the simplest way of counting black grouse in a forest. Not all males display communally, so it is important that birds displaying solitarily are also located. Solitary display sites may be used for just one or two years compared to the regular use of traditional leks. However, coniferous forests are dynamic habitats, so new lek sites can be established and used over a few years when the habitat is suitable.



**Figure 6.** Seasonal changes in lek attendance by male grouse in Wales. Values shown are means  $\pm$  1 S.E. (Redrawn from Cayford and Walker, 1991.)

The diurnal timing of lek counts should be standardised because numbers vary with time and season (Figure 5) with males arriving on leks earlier as the season progresses (Figure 6) (Hjorth, 1968; Cayford and Walker, 1991). Counts should ideally take place one hour either side of sunrise, no earlier than the second week in April and no later than the second week in May. As an example, a three-tier monitoring programme has been proposed for black grouse in Wales. This involves an extensive survey every sixth year, biannual monitoring of all leks and solitary display sites in the highest density area, and annual surveys by Forestry Commission rangers in selected forest blocks (Cayford and Walker, 1991). Willebrand (1988) noted that females arrived on leks for mating during a 6-8 day period, usually in the first 2 weeks of May, while in Scotland they visited leks from mid-April onwards (Picozzi, personal communication).

### Improving forests for black grouse

The future of black grouse in Britain depends largely on the availability of suitable habitat. Forests can play an important part. The primary objective of management for black grouse is to ensure that all their habitat requirements are met throughout the forest rotation. The following recommendations aim to produce a mosaic of vegetation types by conserving existing habitat and creating areas of semi-permanent habitat. Emphasis has been placed on management of existing open areas and the creation of new ones.

### *Management areas centred on leks*

Both male and female black grouse remain in the same general locality throughout the year and rarely move more than a few kilometres from the lek they attend in spring. Therefore, it is recommended that management improvements should first be targeted within a 1.5 km (707 ha) radius of known leks and largely concentrate on:

1. the edges of forests which border moorland;
2. clear felled and restocked sites;
3. recently afforested sites;
4. unplanted moorland remnants within the forest.

Consideration may also be given to creating suitable conditions for colonisation or re-colonisation by black grouse in forests less than 15 km from existing populations. However, this is of lower priority than developing a management strategy based on existing strongholds.

Forests should be ranked in order of importance for black grouse on the basis of sound survey data from leks. Areas with leks should be ranked on the size (number of cocks) and number of leks and the best areas designated as Black Grouse Management Areas and incorporated into Conservation Plans. A large-scale

map showing the management requirements within the designated area and the time-scale of operations will ensure continuity in the event of personnel changes.

The following sections give advice on how to improve the quality of various habitats for black grouse within Black Grouse Management Areas.

### *Lek sites*

The area of the lek needs to be kept open. On some sites this may require periodic mowing or clearing of invading vegetation while others may be developed as deer glades or grazed by domestic stock. Mowing or cutting-back should take place between November and January when attendance at leks is infrequent. To provide adequate flight paths and security from predators, no trees should be planted within 50 m of the lek and it may be necessary to fell trees within the distance to retain the openness of the lek. All forms of disturbance should be minimised, particularly during the April/May period. The location of lek sites should not be made widely available. However, at some well known leks disturbance from people could be reduced by providing an observation hide with sheltered access.

### *Young plantations*

New forests should be designed with many open areas consisting of ericaceous vegetation and damp, boggy areas which greatly benefit black grouse. These areas should be linked by wide rides or riparian zones. In forests in the pre-thicket stage, management should be directed towards maintaining habitats that are preferred by black grouse. For example, sunny river margins, rides, road-side verges, boggy areas and open areas, rocky outcrops and respacing crops with good ericaceous vegetation. In forests in the thicket stage and beyond, where much of the suitable black grouse habitat has disappeared, the emphasis should be on preserving nesting and chick-rearing habitats and creating new habitat, by premature clear felling or respacing.

### *Forest edges adjacent to moorland and marginal farmland*

Forest/moorland edges could be dramatically improved for black grouse by providing a graded interface instead of a hard division between close-spaced trees and moorland. This can be achieved in a number of ways. First, do not plant up to the perimeter fence for all its length. Leave unplanted large areas of ericaceous vegetation and wet flushes on the forest side of the fence. Second, use variable spacing to grade the forest into the adjacent moorland. The aim should be to create at the end of the first rotation a mixture of trees interspersed with a variable patchwork of open areas where the existing ground vegetation persists. This grading should extend up to 200 m into the forest on areas that have been carefully selected to benefit black grouse. Third, by the wider use of other trees such as Scots pine, larch and birch to provide alternative species

to browse during periods of heavy snow cover. Scots pine and birch are very useful species, as they cast a much lighter shade than spruce or larch and often allow ericaceous vegetation to survive even during the thicket stage, particularly when the initial planting distances are increased.

A number of management practices could favour black grouse on moorland and marginal farmland adjacent to forests. In northern England black grouse select improved in-bye fields in spring, rough grazings in summer and hay meadows in autumn, emphasising the importance of low-intensity agricultural land adjacent to forests. Drainage and re-seeding has led to a reduction in the amount of traditionally managed herb and sedge rich meadows and associated flushes favoured by adults prior to breeding and broods (Parr and Watson, 1988). In Scotland, black grouse feed in fields of rape, clover, grass and herbs and up to the early 1970s flocks of both sexes fed on oats on stubbles (Parr and Watson, 1988). Agricultural intensification has reduced the amount of marginal habitat suitable for black grouse, but if some of the practices were re-established on a small scale, it could provide additional food for black grouse.

A feature of heather is that the green shoots preferred by grouse become less nutritious as the plant ages and more of the plant becomes woody. To improve food quality for red grouse, heather has been burnt in strips and patches when the plants are 15-20 cm high, to produce fresh new growth. This practice will almost certainly benefit black grouse, so long as some areas are burnt less regularly to provide older plants for cover, roosting, moulting and nesting. Blaeberry will also thrive in areas of older heather or under trees which cast a light shade.

Burning heather is often too risky along the edge of forests, but mechanical cutting provides an alternative means of regenerating heather. Black grouse and red grouse used cut strips of moorland more than uncut areas throughout the year in Wales (Cayford *et al.*, 1989). Cutting is best done in late autumn or early spring along the edge of forests holding good stocks of birds and the cut stems should be removed or they will inhibit regeneration.

### *Riparian zones*

The margins of rivers and streams, mires and wet flushes where heather, blaeberry and grasses are present, are good feeding areas for adults and broods. It is important to maintain wide margins around these areas to prevent the shading out of food plants and give easy access to the birds. For example, where the vegetation is suitable, at least 25-30 m should be left unplanted on either side of watercourses, but the wider the better. Mires and wet flushes should not be drained and wet insect-rich areas can be created by blocking drains. It is desirable to vary the width of these unplanted areas and to provide a graded interface between the tree crop and the open area.

Where good chick rearing habitat is localised in narrow strips, predation can be more severe than in more extensive open areas (Picozzi, 1986a). A mosaic of wet flushes incorporated into wide stream margins with good cover and no trees offers the best chance of survival. In areas less important for broods, a scattering of birch, hawthorn, Scots pine or larch may be beneficial as a source of spring and winter food, but all trees should be sufficiently well spaced or planted in groups to reduce shading of the ground vegetation.

### *Roads, rides and fire breaks*

These features can be treated in a similar way to riparian zones. Identify areas with the best ericaceous vegetation and wet flushes and design wide open areas around them. Ride junctions can be improved for black grouse by felling trees back from each corner to create open enclaves and respacing trees further back into the crop to create a 'graded edge'. Wide rides can be planted with a scattering or groups of larch and birch to create spring forage. Wide rides can be used to 'link-up' isolated patches of suitable black grouse habitat and act as corridors down which hens with broods can move and feed.

### *Clear felled and replanted sites*

Felling of mature stands introduces spatial diversity into even-aged forests and creates open areas which black grouse exploit. In much of Wales and Scotland, extensive felling of post-war plantations has just started and will increase dramatically in the 1990s and the next century. This will create much potentially suitable habitat for black grouse, and may well result in some populations increasing.

Very little is known about the suitability of clear felled and replanted habitats for black grouse, but so long as heather regenerates in quantity, these areas will provide ideal feeding conditions for adults for up to 10-15 years before the tree canopy closes. No information exists on the optimum size of clear felled areas for black grouse. In Wales black grouse used areas smaller than 5 ha as well as larger areas, suggesting that size may be unimportant. Deer often became established in forests during the first rotation. On restocked sites they may preferentially graze many of the food plants important to black grouse.

The use of herbicides and insecticides may in time be detrimental to black grouse. Minimum use should be made of broad-spectrum herbicides such as glyphosate (Roundup) in restocked areas with vegetation suitable for black grouse because this will reduce the food supply and the availability of nest sites (Cayford, 1988). Similarly, insecticides should not be used on restocked areas within Black Grouse Management Areas during the breeding season as this is likely to deplete the insect food essential for chick survival. Treatment of young planting stock against attack by *Hylobius* is unlikely to cause problems so long as insecticide is applied only to the young trees.

It is important that all wet flushes, particularly those with rushes and cotton grass, should not be replanted

during restocking as these habitats are much less common after the extensive drainage undertaken during the first rotation. Natural regeneration of conifers may need to be cleared from wet flushes periodically.

### *Monitoring the use of Black Grouse Management Areas*

It is important that habitat manipulations within Black Grouse Management Areas are documented and progress reviewed at least every 2 years. Fixed-point photographic records of sites at various stages of management will provide a useful, qualitative record of habitat changes over time. In most forests it will not be possible to measure directly the use of sites by black grouse. The presence of fresh droppings are a useful indicator that black grouse are present in an area and a record of casual sightings of birds can be useful too. But, the long-term success of management prescriptions should be measured by increases in the density or range of black grouse within a geographical area. Counts of displaying males provide the easiest yard-stick against which success can be measured.

### **Sporting**

The black grouse is a game species, covered by the Game Acts with an open season from 20 August-10 December. Small, fragmented populations at low density are the most vulnerable to the effects of hunting and a voluntary moratorium on shooting in such areas is wise, at least until populations have recovered to something approaching their former numbers.

### **ADDRESSES FOR ADVICE**

Royal Society for the Protection of Birds, Conservation Management Advisory Service, The Lodge, Sandy, Bedfordshire, SG19 2DL.

Game Conservancy, Crubenimore Lodge, Newtonmore, Inverness-shire, PH20 1BE.

The Forestry Authority, Wildlife and Conservation Research Branch, Ardentinny, Dunoon, Argyll, PA23 8TS.

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