Nature's gain

How gamebird management has influenced wildlife conservation

A report from The Game Conservancy Trust

July 2005

www.gct.org.uk

THE GAME CONSERVANCY TRUST

Credits

Author:
Stephen Tapper BSc, PhD

Editorial assistance:
Louise Shervington

Design & layout:
Sophia Miles
Natterjack Publications Limited
Hansel Cottage
Woodcutts
Salisbury
SP5 5RP
01725 552685
smiles@natterjackpublications.co.uk

Printing:
Friary Press
Bridport Road
Dorchester
DT1 1JL
01305 265656

JUBILEE YEAR 2005/6

25 YEARS AS A WILDLIFE CONSERVATION CHARITY
75 YEARS OF GAME MANAGEMENT

The Game Conservancy Trust
Fordingbridge
Hampshire
SP6 1EF
01425 652381

www.gct.org.uk

Contents

The Game Conservancy Trust

The Game Conservancy Trust conducts scientific research into Britain's game and wildlife. We advise farmers and landowners on improving wildlife habitat and we lobby for agricultural and conservation policies based on science.

Many of our supporters take part in field sports. They invest in managing wildlife habitat in the countryside. This improves biodiversity and represents a philosophy of "Conservation through wise use".

The Game Conservancy Trust charitable objects are:

- to promote for the public benefit the conservation and study of game species, their habitats and the other species associated with those habitats;
- to conduct research into the ecology and biology of game species and their environmental requirements and to publish the useful results of such research;
- to advance the education of the public in game biology and the conservation of game (especially, but not exclusively, in the conservation of game as a sustainable resource).

We employ some 14 post-doctoral scientists and 50 other research staff with expertise in such areas as ornithology, entomology, biometrics, mammalogy, agronomics and fisheries science. We undertake our own research as well as projects funded by contract and grant-aid from Government and private bodies. In 2004 we spent £2 million on research.

Burgate Manor, Fordingbridge – headquarters of The Game Conservancy Trust. (Stephen Tapper)

Executive summary

Cotton grass on Pennine blanket bog.
(Stephen Tapper)

- Conservation is not about protecting nature from the hand of man, it is about managing our fauna and flora so that it sustains us physically and spiritually.

Moorland issues

- The scale of upland forest planting at the expense of heath and blanket bog would have been far longer had it not been for grouse shooting. This has been acknowledged by Scottish Natural Heritage.
- On a landscape scale, grouse moors and deer forests are doing better than elsewhere at maintaining upland heath and mire.
- Moors managed for grouse typically have five times as many golden plovers and lapwings as other nearby moors and about twice as many curlews.
- Curlews are about 18 times more abundant in the North Pennines Special Protection Area, which is managed for grouse shooting, than they are in the Berwyn Special Protection Area, a large part of which is managed as a bird reserve.
- Breeding golden plovers, dunlins, lapwings and curlews are disappearing throughout much of England and Wales. Only on grouse moors do breeding distributions remain relatively stable.
- The merlin, Britain's smallest bird of prey, is almost twice as common on grouse moors as it is on other upland moors.

Hazel coppice with oak standards.
(Sophia Miles/Natterjack Publications Limited)

Woodland issues

- During the century from about 1870 to 1970, pheasant shooting was a key motive for retaining and managing woods in lowland Britain. This motivation was at its height in Edwardian England when around 25,000 professional gamekeepers were in full time employment (roughly five times as many as today). Without this motivation there is little doubt that the economic pressure exerted by governments through grants and tax concessions for forestry would have turned most decent sized lowland woods into conifer plantations.
- 61% of properties that released pheasants also undertook new woodland plantings.
- One case study showed that woodland managed by coppicing and ride cutting had a richer ground flora and butterfly fauna than woodland that had been neglected

or managed solely for timber. Such management is typical of woodland kept for pheasant shooting.
- The management of woods for pheasant shooting results in higher numbers of songbirds and woodland butterflies. Even the large numbers of pheasants put into release pens seem to only have a short-lived effect on the local ground flora.

Farmland issues
- Game biologists were pioneers of wildlife research on arable land and were first to recognise the repercussions of the indirect effects of herbicides on the invertebrate and bird fauna.
- Thousands of hectares of game crop and thousands of tonnes of grain put out for pheasants and partridges help many songbirds over winter.
- Conservations headlands, invented to improve the survival of gamebirds, now offer the last hope for saving the ancient Neolithic flora of cereal fields on a wide scale. Thankfully they are now part of the Environmental Stewardship.
- Our demonstration farm in Leicestershire, where modern farming is combined with conservation and game management, has shown the following in 10 years:
    - Autumn numbers of wild pheasants increased from less than 150 to over 600.
    - Numbers of brown hares increased by more than 10 times.
    - Overall songbird numbers more than doubled, while the trend in numbers on nearby farms continued to decline. As examples, between 1992 and 2001 the following increases in numbers of breeding pairs were recorded: wren 47 to 141; dunnock 46 to 144; robin 54 to 110; blackbird 66 to 143; song thrush 14 to 64; whitethroat 25 to 45; blackcap 19 to 38; chiffchaff two to 10; willow warbler 28 to 45; spotted flycatcher eight to 14; chaffinch 135 to 229.
    - Harvest mice have thrived in the field margins and especially in the beetle banks planted with the long-stemmed grass, cock's-foot.
- The Game Conservancy Trust's Allerton project at Loddington illustrates how the abundance of nationally-declining farmland bird species can be doubled in less than five years. Farms that adopt this game management strategy will be able to deliver Defra's Public Service Agreement on a local scale.

Mixed arable land at Loddington in Leicestershire. (Sophia Miles/Natterjack Publications Limited)

Introduction – the world agenda

Beavers, now abundant throughout Canada, are harvested in a highly regulated and sustainable fashion. (Stephen Tapper)

Any nature conservation that game management provides is, of course, largely incidental to the business of making sure that there are enough birds around for the shooting season. That said, shooting people are not oblivious to the wildlife that flourishes on their properties and most will do everything possible to encourage it. In reality the deepest pleasure that one takes from any field sport is a sense of being there, participating in life, and not being a spectator.

The concept of *conservation through wise use*, that we shall explain, is not a trumped up idea to justify shooting – it has strong international conservation roots. Developed in the early 1970s in an effort to conserve world biodiversity in the face of industrialisation and population growth, the first global initiative was the *World Conservation Strategy*[1]. This was published in 1980 by the International Union for the Conservation of Nature and Natural Resources (IUCN) in collaboration with United Nations Environment Programme (UNEP), the World Wildlife Fund (WWF), the Food and Agriculture Organisation of the United Nations (FAO) and the United Nations Educational, Scientific and Cultural Organisation (Unesco). This set out three objectives:

1 ***To maintain essential ecological process and life-support systems***. Clean air, water and soil – allowing biological systems to function and nutrients to re-cycle.
2 ***To preserve genetic diversity***. Natural diversity like rain forests and coral reefs – but also the many varieties of crop and livestock that man has developed over millennia.
3 ***To ensure the sustainable utilisation of species and ecosystems***. Fisheries, wildlife, forest and grazing resources - which are maintained and not depleted.

This strategy was built into the Rio *Convention on Biological Diversity* (1992) which included in Article 6 a requirement to develop national strategies for the *"conservation and sustainable use of biological resources"*. Actions were drawn up under a protocol called *Agenda 21*, and as in the convention, where wildlife conservation is referred to, it is accompanied by the phrase *"sustainable use"*. Thus the sustainable use of wildlife has been internationally recognised as a conservation principle for over a generation. It has gained acceptance because, fundamentally, all life on the planet is interdependent, and because giving wildlife a value can encourage its preservation – provided the uses are well defined through regulation or property rights. *Wildlife stays if wildlife pays*. Non-consumptive uses, like bird watching, are promoted by some as being more benign than consumptive uses, such as gamebird shooting. However, sometimes the reverse is the case because consumptive uses may have a higher value to local communities and leave a smaller environmental foot-print that non-consumptive uses.

Poorly regulated fishing has led to the chronic over-harvesting of many species. (Laurie Campbell)

Grouse shooting is sustained because of good management and a carefully calculated harvest for each moor annually. (Keith Sykes)

For instance, a study by IUCN showed that trapping for furs by native Americans in Canada was a more sustainable use of wildlife than were monkey-watching tours in tropical rainforest[2].

Although the Government has acknowledged that game management does contribute to conservation[3], it has yet to embrace it as mainstream. This was evident in its progress report on *Agenda 21* for the Johannesburg Summit in 2002, which makes no mention of sustainable use[4]. This was a lost opportunity. In this report, we will show that:

- Upland heather moor (a habitat of international importance) has been better conserved on properties that manage grouse for shooting than it has elsewhere.
- Upland wading birds breed in much higher numbers on grouse moors than on other upland moors.
- The EU Birds Directive, which requires the Government to designate Special Protection Areas (SPA) for important bird species, has resulted in all the main English grouse moor areas being designated as SPAs. Big national parks, on the other hand, like Dartmoor and the Lake District, where there is virtually no game management, simply don't have enough birds.
- Pheasant shooting has been a key incentive for managing and retaining lowland woods over the last 100 years, and has prevented many from being ripped out for agriculture or replaced by conifer plantations.
- The management of woods for shooting, with rides and glades, improves the numbers of butterflies and some songbirds.
- Game crops planted for pheasants and partridges help sustain many farmland songbirds in winter as well.
- Field margins managed for gamebirds provide a refuge for butterflies in the countryside, and help to conserve the last relics of an ancient Neolithic weed flora.

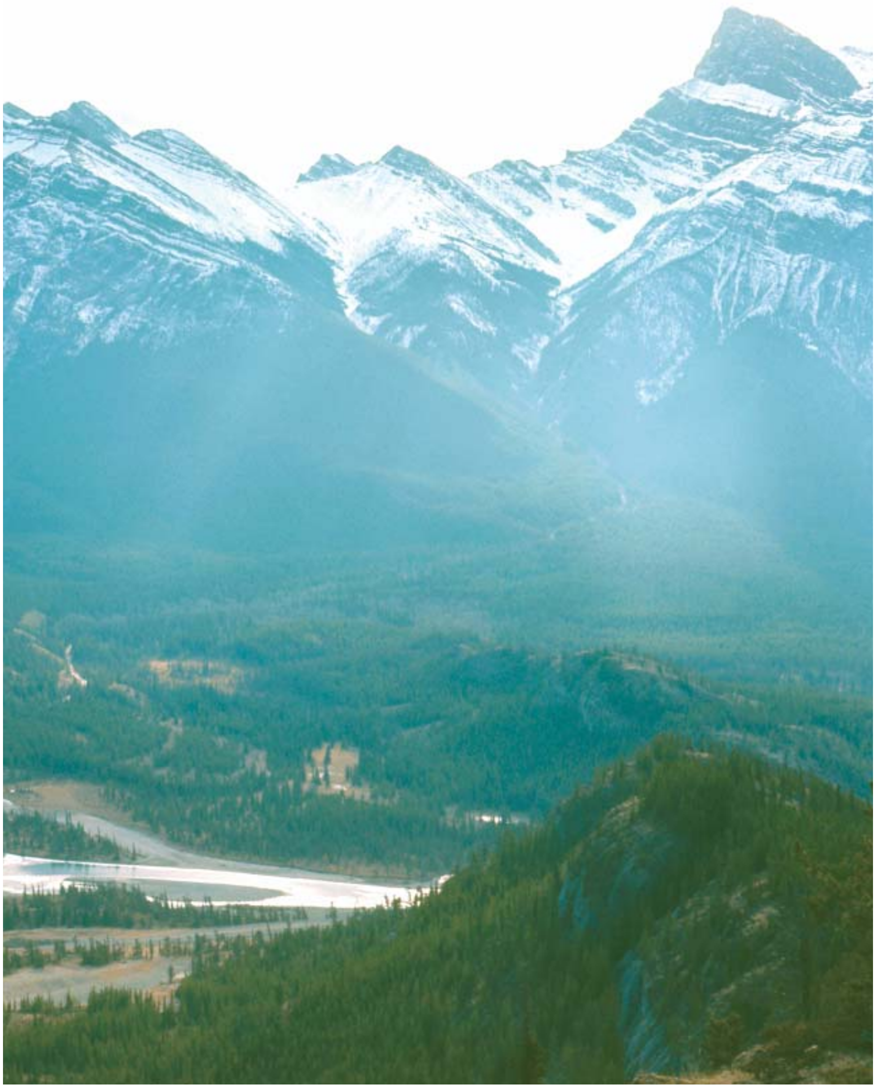
Although opportunities are lost, others present themselves. The new integrated agency *Natural England* gives the Government this new opportunity. We hope it will work with game interests to provide better conservation and not regard shooting as a land-use at odds with its objectives. Field sports get no government help, nor do they seek it. In the main they would prefer to be left alone. Regulations designed to protect wildlife sites and species must be framed with good reason and based on science. For the first time, probably since the war, a more benign agricultural policy, based on area payments and enhanced agri-environment schemes, is in place which does not reward unrealistic production. Farm payments and stewardship schemes are not there to support gamebirds – nor should they be. They are there for land management and nature conservation for the public good. The fact that prescriptions for nature conservation and game management often coincide is unsurprising as they are built on the same ecological principles.

Conservation or protection – good taste but poor insight

In 1868, John Muir, a native Scot whose family had immigrated to Wisconsin when he was a child, set out to see the frontier lands of the American west. Travelling from the west coast of California across the Sierra Nevada and eventually into Yosemite, he was overawed by the landscape and the wildlife. This began a career of writing and travelling into many other wilderness areas, both in the United States and other parts of the world. For him, like Thoreau before him, the mountains of the American far west were a pristine world where Indians lived in balance with their natural surroundings. Through his writing he championed the cause of saving remnants of this wilderness before they were lost forever to encroaching civilisation. John Muir thus became the first conservation hero of modern times.

Although, without doubt, the setting up of national parks – especially in the sparsely inhabited regions of Africa and America – has been a conservation triumph in retaining diverse and spectacular fauna and flora, John Muir's essential premise that these parks are examples of pristine wilderness has turned out to be flat wrong.

This error has been explored by Stephen Budiansky[5], who pointed out that in Yellowstone the park authorities are coming to the conclusion that their wildlife needs to be properly managed – something one wouldn't have expected if it were in a primeval natural balance. Actually John Muir should have been more perceptive. 65



The Rocky Mountain continental divide west of the Big Horn River. Was this a pristine wilderness that white man discovered or a region that had lost its native people? (Stephen Tapper) years earlier, in 1803-5, when Lewis and Clarke led the first expedition into the Rocky Mountains, they made the first white contact with Shoshone Indians to secure horses for their portage across the continental divide[6]. As it was already known that the endemic American horses became extinct in the Pleistocene[7]; the horses in question were, of course, stock derived from Spanish settlers two and half centuries previously. Later Lewis and Clarke's encounters with the aggressive Blackfoot tribe were with natives armed with muskets that they had obtained from the Canadian North West Company. Thus trading between neighbouring tribes certainly changed Indian cultures generations before they met their first white men – and certainly long before John Muir encountered them.

The effect of trade, however, is of small consequence compared with the effect of disease. Archaeology in recent decades has revolutionised our understanding of aboriginal American cultures. Until recently it was thought that the aboriginal peoples of North America numbered some one million prior to Christopher Columbus. This implied a thinly dispersed human population with a very light imprint on the landscape – fitting entirely with John Muir's perception of the noble savage. Now we recognise that, for example, the lower Mississippi held a densely populated, extensively farmed, and sophisticated kingdom similar to that of the Inca or the Aztec. It now seems that 20 million is a more likely population figure for pre-Columbian North America[8].

The largely unnoticed disappearance of some 19 million North American Indians clearly needs some explanation. Jared Diamond[8] in reviewing this evidence concludes that it was primarily European diseases like smallpox, that triggered the pandemics that swept through the Indian tribes of North and South America, sometimes years before their existence was even recorded for the western world. Although the exploits of Pizarro and Cortez are notorious, the effect of Spanish germs was far more deadly. In short, America was not a pristine wilderness before Columbus, but a developed land, supporting a substantial population.

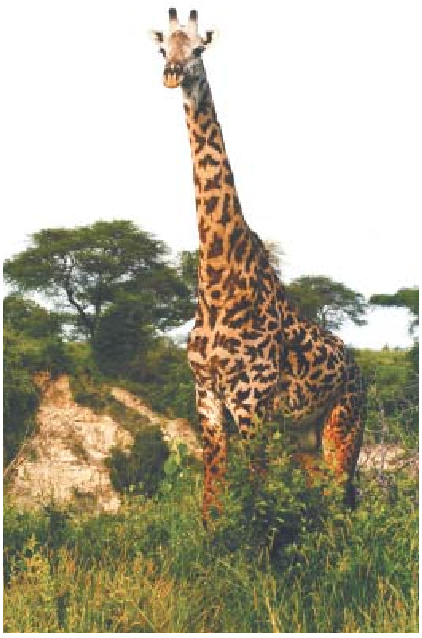
America is not the only case. The fabulous East African game reserves and national parks of the Masai Mara, Serengeti and Ngorongoro are not the unaltered relics of a vast original savannah – the cradle of mankind as a hunter gatherer. They, too, appear to have once been more densely populated by Bantu tribes. Catastrophe befell these people in the 1890s when their livestock was wiped out by the viral disease, rinderpest, introduced in cattle imported from India into Somalia[9]. The disease swept southwards reaching the Cape after a few years. Throughout Africa, rinderpest decimated native wildlife and livestock leaving the tribes that depended on them starving to death. Some 5.3 million cattle died in South Africa alone – 90% of Kenya's buffalo were wiped out and the bongo nearly became extinct. The wide open plains of East Africa encountered by early 20th century white hunters and pioneer African conservationists like Bernhard & Michael Grzimek[10] were not therefore a pristine landscape left largely to nature, but one from which its native people had been recently decimated.

Wherever we look we find increasingly that the hand of man has been writ large on the landscape. More than this, it now seems likely that our farming activities have been altering world climate for at least the last 8,000 years, and to such an extent that if it hadn't been for our agriculture we would now be coping with a new ice age[11].

More than 70 years ago, Aldo Leopold, the American father of game management as a science, tried to explain this idea to people who thought game stocks would look after themselves and all one needed to do was exercise care when hunting them. Leopold, as ever, was polite and to the point…

> *"There are those who shy at the prospect of a man-made game crop as something artificial and therefore repugnant. This attitude shows good taste but poor insight. Every head of wildlife still alive in this country is already artificialised, in that its existence is conditioned by economic forces. Game management merely proposes that their impact shall not remain merely fortuitous. The hope for the future lies not in curbing the influence of human occupancy - it is already too late for that - but in creating a better understanding of the extent of that influence and a new ethic for its governance."*

Aldo Leopold (1933). In: *Game Management*[12]



Giraffe at Tarangire. Rinderpest wiped out the livestock in East Africa in the 1890s leaving a savannah deserted of native people and their cattle. (Stephen Tapper)

The point of all this is that conservation is not about protecting nature from the hand of man, it is about managing our fauna and flora so that it sustains us physically and spiritually.

Following Leopold's thought, one such ethic is that of ***conservation through wise use***. As it relates to game shooting in Britain, this ethic contains two essential elements.

The first element, expressed in the phrase ***wise use***, is the idea that a harvest of wildlife can only be taken wisely if it is done in an optimum sustainable way. This is not an empty phrase, but a sound concept based on the science of population ecology. The theory is explained in *Wise use*, below, which shows why it is that wild populations can be culled year after year without harming their numbers, and also why managed game populations are often more abundant, even after they have been culled, than populations that are not managed and never culled.

The second element is embodied in the two words ***conservation through***. This is an assertion that the game management put in place to support wise use acts to conserve not just the game, but elements of the wider environment too.

It is this second element, the game management link to the conservation of wildlife, that we explore in this report.

WISE USE

The term *wise use* when applied to harvesting game populations for shooting should be based on the concept of the *optimum sustainable yield*. This is derived as follows:

- Many animal populations are stable over time and have reproduction and death rates that exactly balance each other. This happens because natural resources (eg. food supply, nesting habitat) are limited and as these resources are used up and competition for them intensifies, the mortality rate increases (*density dependent mortality*) and fecundity reduces (*density dependent natality*). This *density dependence* maintains the population around a stable equilibrium level.

- If such a population is subjected to regular hunting its numbers will be reduced, but this reduction will in turn free-up resources that either lower the natural mortality rate or increase birth rate. Thus, a regularly hunted population will also be stable, but at a lower level than otherwise would be the case.

- As the proportion of the population that is killed by hunting is increased, the level at which the population stabilises becomes lower. With a lower population the number of breeding individuals is reduced – even though they may be breeding at a faster rate. Thus there are two opposing tendencies in operation, a shrinking breeding stock and rising productivity, which together determine the number of animals that can be killed sustainably at a given level of hunting.

- Clearly the maximum number that can be hunted each year will be achieved when the largest number of birds is breeding at the fastest possible rate. This is termed the *maximum sustainable yield* and is most elegantly presented as one of the points on the curve in Figure 1.

- Because of vagaries in ecological systems, culling and harvesting strategies are usually set at a rate somewhat lower than the maximum sustainable yield – this is the *optimum sustainable yield*.

The above explanation applies to most harvesting of wildlife populations whether they are fish, birds or mammals. It should also be noted in passing that other similar relationships also apply. For example it is common, especially in relation to fisheries, to relate the catch rate to fishing effort. Here, exceeding the maximum sustainable yield is termed *over-fishing* and is characterised by an increasing effort, a declining catch per unit of effort and a low and even declining stock.

Managed and unmanaged populations
When populations are subject to game management some additional factors also apply.

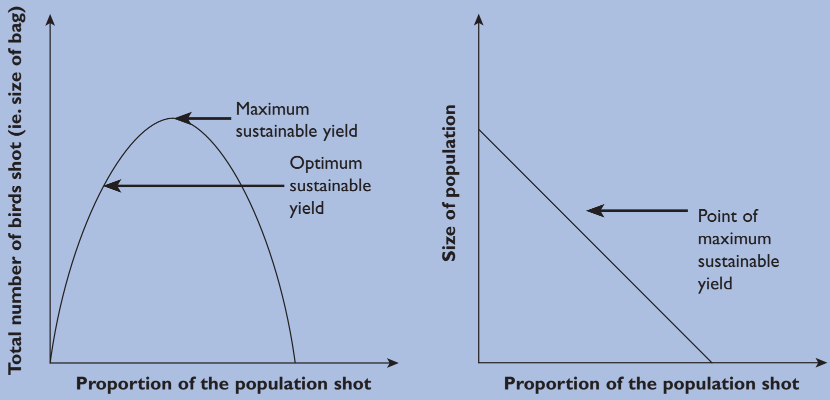
- Game managers (gamekeepers and others) try both to enhance the productivity by providing better breeding habitat and more food, and reduce the natural mortality due to predators and disease.

- In Europe this has worked best with the resident game species, as a gamekeeper can protect his local population year round and because the economic benefits of a higher bag are also local.

Red grouse hen. Grouse on managed moors, where shooting takes place, are much more abundant than where they are not managed and not shot. (Laurie Campbell)

Figure 1

Graphs showing the relationship between the average annual bag and the proportion that is shot each year (left) and the same population showing the relationship of the breeding stock to the proportion shot (right).

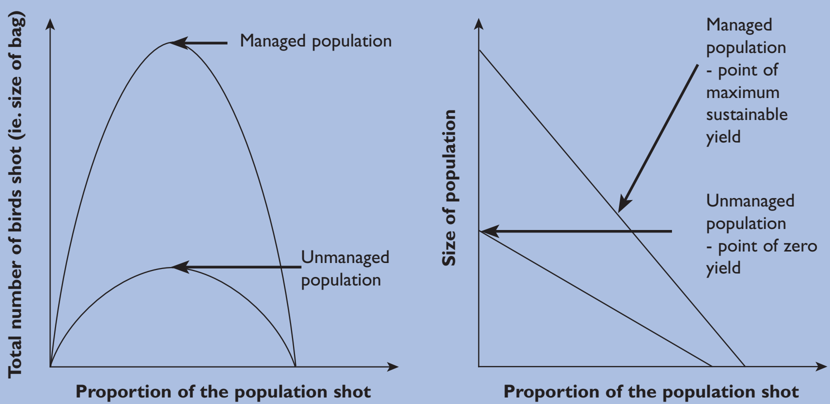


In the left-hand graph the left side of the curve shooting a higher proportion of the population produces a higher bag. However, on the right side, beyond the point of maximum sustainable yield, increasing the proportion of the population shot leads to diminishing returns as the breeding stock is reduced further. Note however, that shooting beyond the maximum sustainable yield leads to low bags and low stocks – it does not necessarily lead to declining stocks, although it may. In the right-hand graph the stock is at maximum when none are shot and declines steadily with increased shooting until it is reduced to zero. This relationship is not always linear and the maximum sustainable yield not always at the mid point.

*These graphs represent averages over years; they are not time series. So a population can remain stable at all points along the curve on the left and the straight line on the right – it is just that on the right-hand side of these graphs harvesting is very inefficient. Over shooting will only endanger the population if the **proportion** that is shot increases each year. Note that this will occur if the same **number** of birds are being killed annually while the breeding stock is declining.*

Figure 2

Graphs showing how the maximum sustainable yield differs between managed and unmanaged populations in relation to bag (left) and size of population (right)



In the left-hand graph increased productivity and reduced (non-hunting) mortality mean that yields of managed populations are much higher than unmanaged ones. The right-hand graph shows that further, in many instances, the managed bird populations are maintained at much higher densities – even after hunting – than are unmanaged ones with no hunting at all.

Upland moor – a cultural landscape

The bulk of Britain's uplands are treeless. This contrasts with other parts of the world at similar latitudes where, with increasing elevation, mountains are generally forested up to a point where exposure, cold and wind hamper tree growth and forest gives way to alpine tundra. Although such habitats do exist in parts of the Cairngorms and are inhabited by typical alpine birds like ptarmigan and dotterel, the rest of our upland is mostly an ancient de-forested zone.

Deforestation by burning probably began in the uplands as early as the Mesolithic (9,000 to 4,500 years BC) and then may have included natural fires caused by lightening as well as those set by man[13]. So it is possible that fires were started by hunting people, rather than farmers, much in the way that Indians throughout North America set fires to improve accessibility for game hunting and to protect themselves from ambush[5,14]. Later, farming communities cleared the forest for grazing and many areas that are now entirely unsuited to anything other than extensive rough grazing were enclosed as farmland. The ancient 'Reeve field' systems of Dartmoor run though land that is now heather-dominated moor. There, it seems, that following forest clearance, a period of heavy livestock farming led to erosion, leaching soils and the formation of iron pans giving the acid podzols typical of this bare landscape[14].

Thus our uplands became dominated by moorland plant communities of heath and mire[15]. Many of the characteristic plants such as heather (*Calluna*) are probably part of former shrub communities that are adapted to the forest floor or forest glades rather than open ground[16]. This open landscape has been largely maintained by grazing and burning for sheep and cattle. But, over the last century, most of the burning has been done by gamekeepers improving the habitat for grouse.

Professor Charles Gimingham of Aberdeen University, and a leading authority on moorland ecology, has described moorland as a "cultural landscape"[16] – emphasising the role of man in its creation and maintenance. Floristically interesting, it has become one of the most widely studied habitats in Britain – no doubt because it has been subject to less agricultural change than some of the others. The moorland plant communities and their associated fauna are now habitats of high nature conservation value. There are two main conservation issues in relation to moorland:

1 Preservation in the face of alternative land uses.
2 Appropriate management to prevent deterioration.

From Grinton moor looking across Swaledale. In the foreground is a typical patchwork of heather stands produced by muirburn for red grouse. (Stephen Tapper)

Preserving moorland

Since the Second World War, both upland and lowland moors have been eroded because they have been undervalued and, indeed, often regarded as virtually derelict land. Thus areas were fertilised for grazing, planted for forestry, stripped of their peat, built-on, or destroyed by excavation. Gimingham[17] shows as an example how the Dorset heaths have been whittled away to a fragment over the last 150 years. This loss has been pan-European. Some 60-70% of moorland has been lost in Denmark and Sweden[17], and the Netherlands now has only 5% of the heather it had in 1835. Britain, almost alone, has been able to retain a substantial proportion of its moorland because of its importance for grouse shooting. Gimingham summarised it thus:

> *"Only in regions where there was still a use for heathlands as grazing land or for sport (particularly Scotland and upland England) or where climate or terrain preclude conversion (for example in coastal regions of northern France) do extensive tracts of heathland survive."*

Charles Gimingham (1981) in *Conservation: European heathlands*[17]

What there has been of moorland preservation owes little thanks to government. Indeed up to the 1980s, successive governments were encouraging a switch in upland land-use, away from moorland managed for sheep and grouse, to one dominated by forestry. This was done both directly through the Forestry Commission and indirectly with tax-breaks to land-owners. Against this pressure, grouse shooting remained as the main economic alternative. Further, unlike farming and forestry, game management received no subsidy or public funding. Without subsidy, switching land from grouse moor to forestry was clearly uneconomic. It required high capital investment (nearly £1,000 per hectare at 1974 values) and produced a rate of return on capital of only 5.6% – very low in relation to interest rates at the time[18]. On the other hand, maintaining land as grouse moor not only provided annual rent, but an accruing capital value as well. This is because grouse moors are valued on the average number of grouse that can be shot annually expressed in pounds per brace. In 1974 these values were increasing at roughly 12.5% per annum[18].

Because of subsidy, by the 1980s large areas of upland moor were being enclosed for forestry. Over a 30-year period, Scotland lost 18% of its heathland and 8% of blanket mire – some 62% of this to forestry[19].

This loss can be illustrated by landscape changes that show up in aerial photographs. Figure 3 shows changes to the extent of heather in Scotland on land that has been retained as grouse moor and land that hasn't.

In the end, however, it was the proposal to plant massive areas of the Sutherland flow country that caused conservation groups to begin mounting serious resistance. The reaction of the Forestry Commission has been to promote a more bio-diverse and more landscape-sensitive approach to planting – even though it continues to seek government support. However, the rationale for this support has shifted from an argument based on economic investment, to one based on amenity, and on the curious notion that because most countries in central Europe have a lot of forest, Britain should too.

There is little doubt that the scale of upland forest planting at the expense of heath and blanket bog would have been far worse had it not been for grouse shooting. This has been acknowledged by Scottish Natural Heritage[21].

> *"Without grouse-moor managers, most of our 'better' moorland areas would perish. Heather – and the very heaths and moors which we now cherish – would peter away."*

Magnus Magnusson (1995), then Chairman of Scottish Natural Heritage. In: *Foreword to Heaths and Moorland: Cultural landscapes*[21]

Figure 3

An analysis of aerial photographs from the National Countryside Monitoring Scheme in Scotland. A random sample of sites photographed in 1940 showed that 49% were being managed as grouse moors, of these, 57 sites remained as active grouse moors and 46 had given up grouse management by the 1980s. Over this 40 year period the grouse moors lost 24% of their heather cover, whereas where the grouse shooting was lost, the heather cover had been reduced by 41%. From a study by Robertson, Park & Barton[20].

Preventing deterioration

The increasing ecological interest in moorland plant communities followed Sir Arthur Tansley's classic work on Britain's vegetation[15]. These studies culminated in 1991 with the completion of a detailed national classification of plant communities financed by the Nature Conservancy Council and later by the Joint Nature Conservation Committee (JNCC). This classification, edited by John Rodwell, recognised two basic types of moorland plant community; mires and heaths[22]. The former are water-logged areas and characterised by the accumulation of peat over time. The latter are dry, typically have little or no peat, and have grey leached podzols usually with an iron pan some inches down the soil profile. Within these broad categories there are 38 different communities of mire and 22 communities of heath. By no means all of these are found in the uplands – but many are. Communities are given names based on the predominant plant species they contain; thus a common heath community is *H9 Calluna vulgaris – Deschampsia flexuosa* – taking its name from heather and the wavy hair grass. Among the mires *M19 Calluna vulgaris – Eriophorum vaginatum* is basic blanket bog where water-logged peat is covered by heather and cotton grass. This large range of plant communities not only encouraged concern about their potential loss, especially to forestry, but also how they should be managed in future. As a consequence the *Upland Heathland – Habitat Action Plan* was launched in 2000.

The Action Plan identified two factors particularly, which would cause the deterioration of existing shrub heath; over-grazing and poor burning.

Over-grazing

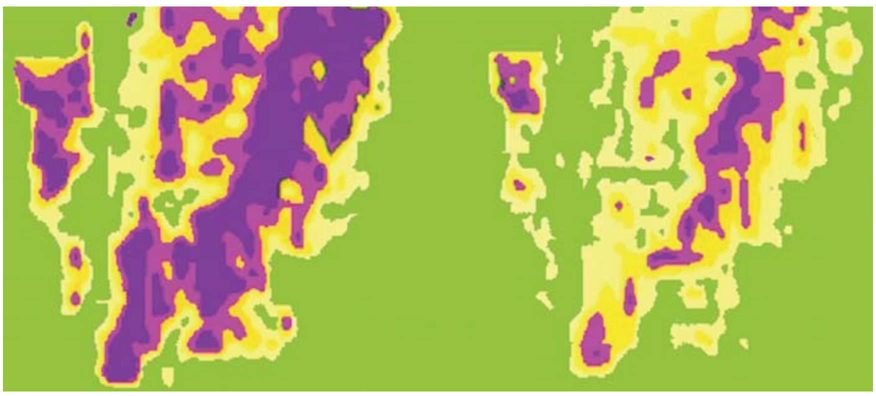
This typically causes a shift from shrub-dominated heath to grass-heath often dominated by mainly unpalatable matt grasses such as *Nardus*. This not only reduces the moor's wildlife interest but the farming use as well. Steve Redpath and Simon Thirgood show a good illustration of this at Langholm Moor in south Scotland[23]. Heavy grazing by sheep, especially during winter when they were fed with hay along the lower hillside slopes, killed off the heather so that, over time, the line between grass and heather gradually retreats up the hill. At Langholm this caused a 48% loss of heather over a 40-year period (see Figure 4).

Poor burning

The Action Plan claims that too large and too frequent burning causes a loss of habitat structure and lower plant species (mosses and lichens) that can lead to peat erosion. Although some burning is done by graziers, most heather burning – called muirburn – is done as part of grouse moor management. Gamekeepers burn heather in small (25-metre wide) strips every few years so that the moor takes on a patchwork of different aged stands of heather[24]. A gamekeeper will aim to burn heather stands before they reach knee height and before the plants become old and woody. This burning rotation ensures that there is always enough of different ages of heather for grouse to feed on and nest in. There are two main reasons for not allowing plants to become old. Firstly, when they are eventually burnt they fail to regenerate from the root stock and so the burnt area must grow again from seed – which can take some time. Secondly, because old plants are woody they carry a high fuel load and any fire will be very hot and could set alight and destroy the peat substrate. Stands of long

Figure 4

Heather cover on Langholm moor in 1948 (left) and 1988 (right) assessed from aerial photographs. Purple colours represent more than 50% heather cover, yellow to green less than 50%. Adapted from Redpath & Thirgood[23].



Most burning takes place in a short spring season when conditions become just dry enough to burn safely. (Laurie Campbell)

Heather will regenerate from seed or from the root stock, provided the plant is not too old or the burn has not been too hot. (Laurie Campbell)

heather therefore represent a fire hazard, especially in areas with public access, and are best avoided through regular cool burns.

Currently English Nature has classified over 30% of the upland Sites of Special Scientific Interest as being in unfavourable condition because of poor burning[25]. Most of this land is owned and managed for grouse. Thus, at present, there is a genuine difference of view between what the statutory conservation agency wants and what the grouse moor manager is seeking to achieve.

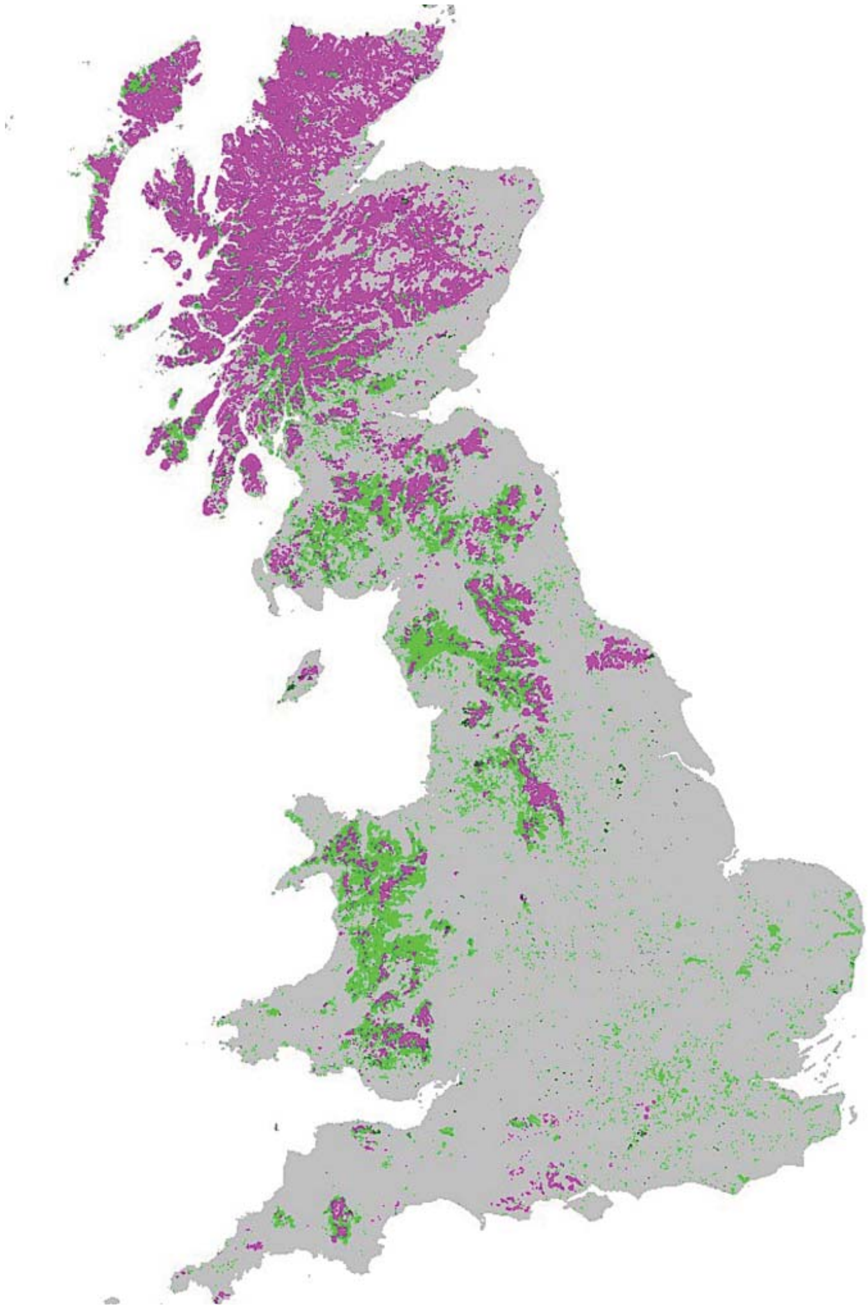
Maintaining habitat

In broad terms grouse moors are retaining upland shrub heath better than upland areas elsewhere. The Habitat Action Plan calls for dwarf shrub cover to be increased to at least 25% cover where it has previously been reduced or eliminated. Figure 5 shows the distribution of this habitat based on land cover maps published in the Government's Countryside Information System[26]. This illustration shows shrub-dominated montane heath (mainly heather) compared with rough grass. All the important grouse-producing, and, in Scotland, deer stalking areas, are mostly dominated by the shrub heath, whereas in other districts this shrub heath remains only in small fragments or has otherwise degenerated to rough grass sheep-walk. Peter Hudson[27] obtained data from 206 properties that shot grouse in the Scottish Highlands, 51 in the Southern Uplands, 80 along the Pennine chain including the Peak District and Bowland fells, 12 on the North York Moors, but only five in the whole of Wales and none at all in the Lake District or South West England. A more recent survey of upland grouse moor and deer forests, led by Julie Ewald[28], included 229 in Scotland, 139 in England and only three in Wales. In considering the Habitat Action Plan objective of retaining 25% cover of shrub heath it is worth comparing in Figure 5 the Lake District National Park, where this is no grouse shooting, with the North York Moors National Park, which is almost entirely made up of grouse shoots.

On a landscape scale, grouse moors and deer forests are doing better than elsewhere at maintaining upland heath and mire.

Figure 5

Montane heath that has been maintained at more than 25% cover (purple) compared with rough unimproved grass. Map calculated from the Countryside Information System using the 2000 land cover map and habitat classification[26].



Cotton grass – a typical plant of wet blanket bog. (Laurie Campbell)

Bird life on grouse moors

Although advocates of grouse moors have long argued that the uplands provide habitat for a range of bird species, this is not a universal view. In a review of the evidence available up to the early 1990s, Andy Brown and Ian Bainbridge suggested that the evidence, at best, seemed to be equivocal[29]. They acknowledged that although grouse shooting had certainly been instrumental in retaining moorland, they could find no species that depended uniquely on grouse management. Indeed some birds like the hen harrier clearly fared less well on grouse moors. They concluded that the view *"…grouse-moor management maintains the internationally important upland breeding bird interests in Britain may be misplaced"*[29]. This is a conclusion that seemed to be almost immediately negated by the actions of the conservation agencies which, when selecting the best areas for upland birds as EU Special Protection Areas, chose most of the English grouse moors. Brown and Bainbridge did, however, acknowledge the lack of studies on the issue.

Since then, a systematic field study led by Andy Tharme[30] (see *Grouse moor bird survey*, page 17) has demonstrated that waders are distinctly more abundant on grouse moors than on nearby unmanaged moor. None of the waders can be described as common and some have undergone significant national population

GROUSE MOOR BIRD SURVEY

In 1995 and 1996 Andy Tharme of the RSPB, in collaboration with The Game Conservancy Trust and grouse moor owners, conducted a series of breeding bird counts in upland areas where grouse shooting was the dominant land-use[30]. He visited 122 properties in the north-eastern Highlands, the Cheviot Hills, the North Pennines and the North York Moors. He then surveyed 320 kilometre squares of upland habitat both on and off grouse moors.

The raw counts of birds on and off grouse moors are shown in Figure 6. Many of the differences are not very large and not significant. However, there are some big differences – unsurprisingly red grouse are more numerous and crows less numerous on grouse moors. Some of the species, like meadow pipit and skylark, were less abundant on grouse moors – perhaps because of subtle habitat differences due to grouse moor management not picked up in the analysis. The fewer whinchats may be related to the taller shrubs on some of the unmanaged moors. However, three of the four wader species (golden plover, curlew and lapwing) were all much more abundant on grouse moors. Of the raptors only the hen harrier was significantly less frequent on grouse moors, indeed buzzards were seen more frequently. The lower number of hen harriers is likely to be related to their breeding success and survival being reduced by grouse moor keepers as shown by RSPB in an earlier study[31].

The analysis was complicated by the fact that some regions (like the North York Moors) were so dominated by grouse management that it was difficult to find comparative sites within the region.

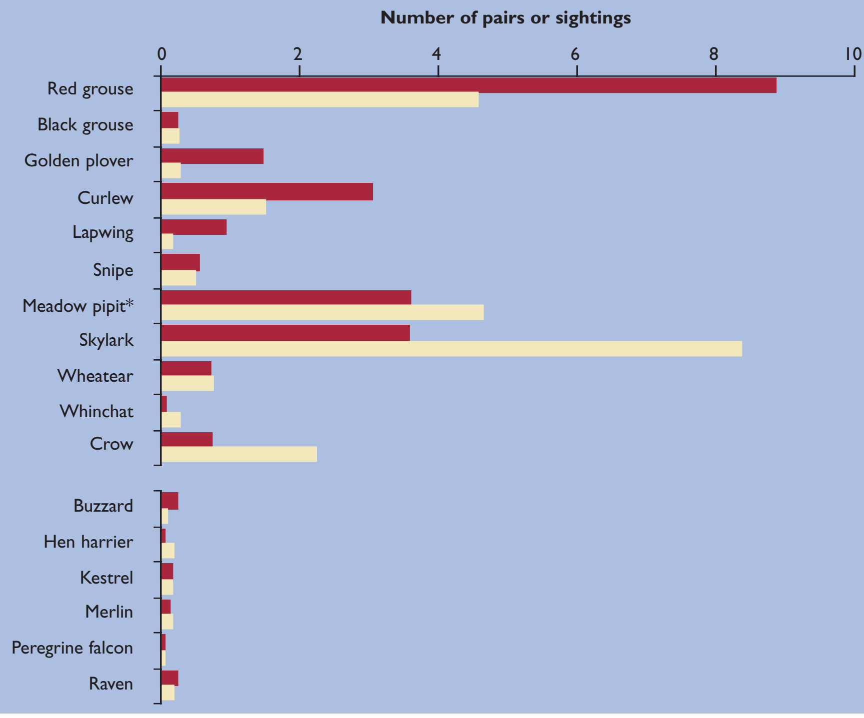


Figure 6

Overall numbers of pairs or sightings of birds seen on 320 upland kilometre squares. Squares were chosen to have similar vegetation types but are separated into those managed for grouse with a full-time gamekeeper and those not. Only the larger differences are significant.

*NB. Meadow pipits were very numerous and have been divided by 10 on this graph. Data from Tharme *et al* (2001)[30].

declines; so this finding is important. Apart from the rare hen harrier, which we consider in *Birds of prey and red grouse* (page 21), most of the other species that are less abundant on grouse moors, such as crows, meadow pipits and skylarks are very common anyway. Tharme's study raises two important questions:

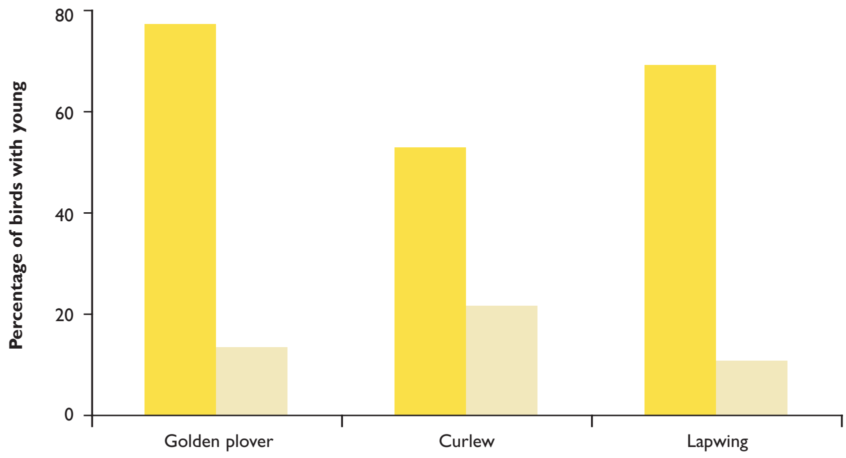
1 What causes the difference? Is it habitat management or predator control?
2 Because the study was confined to sites within regions where grouse shooting was widespread, and because we know predator control by gamekeepers can have a regional impact as well as a local one[32], is the true effect on waders not larger than the one shown by Tharme?

Tharme believed the answer to the first question was predator control, but because his study compared sites with different habitat, he could not prove it. A more definite answer will only come by experiment. Such experiments are expensive and time consuming. However, they are essential to a proper understanding, so The Game Conservancy Trust is conducting one at Otterburn in Northumberland. This experiment, which began in 2000, will run for nine years and involve four gamekeepers' beats – two with predator control and two without. No firm conclusions can yet be drawn, but at the half way stage in 2005 the waders on the beats with predator control are certainly breeding more successfully than on those without (see Figure 7).

Moors managed for grouse typically have five times as many golden plovers and lapwings as other nearby moors and, about twice as many curlews.

Figure 7

Experiment at Otterburn. The percentage of waders that successfully rear at least one chick on beats with and without predator control. Average of four areas over four and five years. See Fletcher[33] for details of the study so far.



To answer the second question we need to look at how waders are doing on a much wider scale. Some of these waders are listed within the EU Birds Directive and the UK is required to take special measures to protect them, including the designation of special sites where they are conserved. These sites are what the Commission refers to as Natura 2000 sites and in Britain they are the Special Protection Areas (SPA) for birds. The Joint Nature Conservation Committee (JNCC) chose these areas on the basis that they had the highest concentrations of birds of conservation concern.

Table 1 shows a list of all the main upland SPAs in Britain. What stands out is that the key areas for waders are all along the Pennines and the North York Moors. As it happens, most of this is privately owned grouse moor, not owned by English Nature, public bodies or conservation organisations.

In Julie Ewald's survey 17 out of 22 properties on the North York Moors SPA shoot grouse and they employ 43 gamekeepers. On the much larger North Pennines SPA 67 of 73 properties shoot grouse and employ 149 grouse keepers. As all the properties in Ewald's survey were mapped into a Geographical Information System it is possible to calculate the area of SPAs that are managed in this way. In England 74% of the overall area of the four upland SPAs is managed as grouse moor. In some, like the North York Moors and the North Pennines, this proportion is higher (see Figure 8).

A comparison between the upland SPAs managed for grouse and those that are not is instructive. In the North Pennines, dominated by grouse shooting, there are some 3,930 pairs of curlews. Although there are no recent data on curlew numbers in the Welsh Berwyn SPA where there is no driven grouse shooting, numbers can be roughly calculated using the data from the Lake Vyrnwy reserve, which represents some 26% of this SPA[34]. From these data, it seems that the Berwyn may have only

Figure 8

The North Pennines Special Protection Area for birds and the numbers of pairs of birds listed in the designation. The two largest pieces of moor not managed for grouse are the RSPB reserve at Geltsdale in the north west and the English Nature owned moor of Moorhouse. Data from Julie Ewald's (unpublished) survey conducted in collaboration with the National Gamekeepers' Organisation.

North Pennines SPA	
Curlew	3,930 pairs
Golden plover	1,400 pairs
Dunlin	330 pairs
Merlin	136 pairs
Peregrine	15 pairs
Hen harrier	11 pairs

Table 1

The main upland Special Protection Areas for birds in Britain and the bird numbers on which the designation is based. Small SPAs and candidate SPAs have been omitted.

Special Protection Area	Listed birds	Number of pairs
Wales		
Elenydd Mallaen	Merlin	7
	Peregrine	15
	Red kite	15
Berwyn	Hen harrier	14
	Merlin	14
	Peregrine	18
England		
Bowland fells	Hen harrier	13
	Merlin	20
	Lesser black-backed gull	13,900
South Pennines	Merlin	77
	Peregrine	16
	Short-eared owl	25
	Golden plover	752
	Dunlin	140
North Pennines	Merlin	136
	Peregrine	15
	Hen harrier	11
	Golden plover	1,400
	Curlew	3,930
	Dunlin	330
North York Moors	Merlin	40
	Golden plover	526
Scotland		
Drumochter Hills	Merlin	7
	Dotterel	70
Cairngorms	Golden eagle	12
	Osprey	2
	Peregrine	12
	Merlin	14
	Capercaillie	125
	Crossbill	50
	Dotterel	240
Ben Wyvis	Dotterel	20
Bein Dearg	Dotterel	22

Golden plover, curlew and lapwing. These birds breed in large numbers on grouse moors, but are declining elsewhere. (Laurie Campbell)

about 35 pairs of curlews. Even correcting for the fact that the North Pennines SPA is six times the size of the Berwyn, it still means that curlews are more than 18 times as common in the Pennines as in the Berwyn. Although not an SPA, the Dartmoor National Park appears now to have only about five pairs of curlews left[35]. For golden plover the comparison is more difficult to calculate because the birds are so uncommon away from the grouse moors. The two Pennine SPAs have between them some 2,152 pairs of golden plovers. In the whole of Wales – everywhere, not just the SPAs – there appear to be only some 80 pairs left[34].

It is sometimes argued that bird abundance is less important than the compliment of bird species – the so called 'bird assemblage'. In other words what is important is whether the bird is present.

The simplest way to check this is with the British Trust for Ornithology's bird atlases[36,37]. Each species is mapped into a 10 by 10 kilometre Ordinance Survey grid. Two atlases have been published – the first covering the 1970s and the second the 1990s. In the second atlas, the BTO has also mapped the gains and losses for each

Curlews are about 18 times more abundant in the North Pennines Special Protection Area, which is managed for grouse shooting, than they are in the Berwyn Special Protection Area, a large part of which is managed as a bird reserve.

Table 2

Percentage losses in breeding range of three moorland birds in different regions where grouse shooting has been retained (N England) compared with areas where it has been lost (Wales and SW England). Data from BTO Bird Atlases for 1970s & 1990s[36,37].

	N England	Wales	SW England
Red grouse	-13	-36	-66
Dunlin	-7	-25	-75
Golden plover	-8	-32	-50

species. So, it is simple to tally up the losses and gains and work out the balance. Table 2 shows this for the red grouse and the two wader species that confine their breeding to upland areas. This shows that the loss of range (or loss of this species from the local bird assemblage) has been small in the North of England compared with the South West of England or Wales where the losses have been huge. The tie up between the fate of the grouse and the two waders is striking.

For waders that breed in upland and lowland habitats, such analysis is more difficult. However, a recent BTO study of lapwings[38] found that the highest regional percentage declines were in Wales and the South West (-77% and -64%) whereas the lowest was in the Yorkshire Humberside region (-28%) – a region which includes the North York Moors and the bulk of the Pennine chain.

A recent study of the lapwing decline in Scottish uplands associated the decline with agricultural change, but also noted that other studies had found much higher predation rates in areas with more foxes[39] – something that had previously been illustrated in the North of England[40].

Breeding golden plover, dunlin, lapwing and curlew are disappearing throughout much of England and Wales. Only on grouse moors do breeding distributions remain relatively stable.

In summary

The financial investment in grouse shooting makes a huge contribution to nature conservation in the uplands. It has protected and conserved the plant communities, and it has produced the best areas for upland waders in mainland Britain. On any criterion, grouse shooting provides a highly sustainable form of land use. By contrast what we might question is the lack of management on upland areas that are not grouse moors. In some of the National Parks, where emphasis is placed on outdoor recreation, it may be at the expense of nature conservation.

In the spring grouse moors are alive with peeping waders and displaying grouse, birds that are disappearing fast from the rest of the country.

The Joint Raptor Study (1992-1997) showed that hen harriers can reduce grouse stocks to such an extent than driven grouse shooting becomes impossible. (Laurie Campbell)

BIRDS OF PREY AND GROUSE

The UK Raptor Working Group[41], in seeking to find solutions to raptor predation problems, noted that most birds of prey had expanded in range and numbers over the last 30 years. The buzzard, which was reduced to the western fringes in the 19th century, had now spread back into most English counties. The red kite, for so long just holding on in mid-Wales, now has substantial populations thanks to a translocation and re-introduction programme. Peregrine falcons have probably never been so numerous, and the numbers of sparrowhawks have bounced back to such an extent that they may be running out of food in some areas. This has come about because of legal protection and the banning of organo-chlorine pesticides, which decimated many species in the 1950s.

In most situations gamekeepers find that they can tolerate losses to raptors, but one species, the hen harrier does represent a serious threat to grouse shooting. Harriers were wiped out from most of Britain in the 19th century and the population recovery since the 1970s has brought them into increasing conflict with grouse moor interests. Currently the harrier population seems to be increasing and spreading except, noticeably, on English grouse moors, where they are mostly absent.

To determine the effect of raptors on grouse stocks, several organisations set up the Joint Raptor Study, which was conducted mainly on Langholm moor between 1992 and 1997.

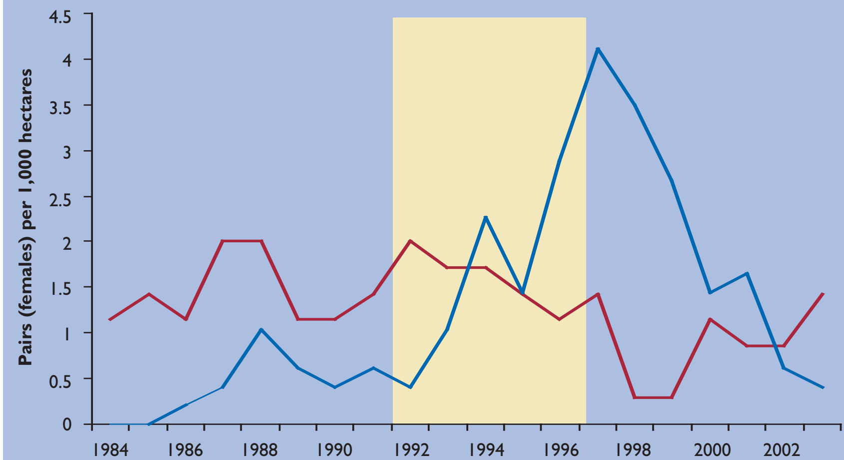
By watching bird of prey nests and counting the grouse chicks killed by harriers and brought back to nest, Steve Redpath and Simon Thirgood were able to assess the extent of predation by raptors on the grouse stock. By monitoring the grouse population at the same time, they could work out the proportion of grouse being killed and calculate the effect. For the years 1995 and 1996 they calculated that about half of the autumn stock was being killed by birds of prey and this had a knock-on effect to the next year so that the difference was compounded in successive years. During the study the harrier population was building up and the grouse population going though a cyclic low. The combination meant that the grouse population was unable to withstand this loss, it continued to decline instead of recovering, grouse shooting was suspended and the gamekeeping effort largely stopped[42,43,44].

Work carried out by Adam Smith and others confirmed that many grouse moors had similar characteristics to Langholm and about half of all grouse moors would face the same demise if harriers built up in numbers the way they had at Langholm[45].

The Game Conservancy Trust argued that grouse moors should be able to cope with a limited number of hen harriers and, in fact, probably as many as would occur on unmanaged moor without gamekeepers[46,47]. Figure 9 shows that when the harrier breeding density at Langholm reached its peak it was about four times the density on the RSPB bird reserve at Lake Vyrnwy – part of which is an SPA designated for hen harriers. It is also worth noting that before 1992 Langholm was a highly productive grouse moor even with a limited population of harriers. Now there is no grouse shooting, no gamekeeping and certainly no more hen harriers.

Not all raptors do badly on grouse moors. Some, like the merlin, actually do a lot better. Table 1 on page 19 shows merlin designations for the SPAs. Taking account of the different sizes of these SPAs there are about five pairs of merlin for every 10,000 hectares on the unkeepered Berwyn, whereas there are about nine for every 10,000 hectares on the intensively keepered North York Moors and North Pennines SPAs.

Ground-nesting merlins benefit from the fox control carried out by grouse keepers. (Laurie Campbell)



Merlins are almost twice as common on grouse moors as on other upland moors.

Figure 9

Contrasting changes in hen harriers.

- Changes in breeding harriers at Langholm moor
- Changes in breeding harriers at the RSPB reserve at Lake Vyrnwy
- Period of the Joint Raptor Study

Woodland – new life for an ancient asset

If we gave up managing the land, most of Britain would become inexorably covered in forest. The process would not necessarily be slow – much of New England's pioneer farmland reverted back to trees following the American Civil War and the opening up of the Mid-West[5]. So, for Britain, forest is what is termed the climax vegetation and many of our other plant communities are really seral stages that are maintained by grazing, cutting, cultivating or burning and would otherwise return to this climax forest. The nature of this climax is determined by climate and it was the gradual amelioration of our climate at the end of the Ice Age that allowed forest to dominate.

The development of Britain's vegetation has been tracked by analysing pollen from sediment and peat deposits that have accumulated since then. A classic series, illustrated by Sir Arthur Tansley[15], shows data from core samples taken from the peat in Hockham Mere, East Anglia. At greatest depth, equivalent to the post glacial period or the Palaeolithic, the pollen samples in the peat are a mixture of birch and grasses – suggesting that the landscape was open and thinly treed during a cold period. Further up the core, in more recent times, the grass pollen dies out as does the birch and is

Bialowieza forest in Eastern Poland is thought to be the only vestige of original forest in lowland Europe that has remained largely unmanaged and in a more or less primeval state. (Stephen Tapper)

Typical English ancient semi-natural woodland. The underwood here has been coppiced and the large timber trees (the standards) are left. (Sophia Miles/Natterjack Publications Limited)

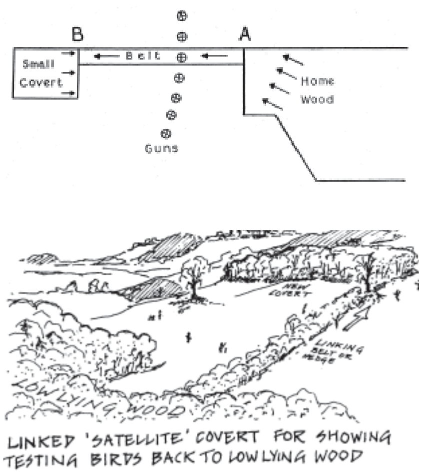
replaced mainly by pine. During this boreal phase, Britain was drier than today, but this pine forest was short-lived and replaced, during a following wetter Atlantic phase, by broadleaves like oak, elm, alder and lime. The dominance of tree pollen suggests that at this time (the Mesolithic) there was little or no open ground and Britain was wooded almost everywhere. It wasn't until later, during the Neolithic period, that pollen from grass, cereals and herbaceous plants became common – suggesting a landscape opened up by cultivation and grazing.

Thus our native woodlands are the remaining fragments of this climax deciduous forest – what is popularly known as the original wildwood[48,49]. These woods vary in nature and species composition mainly because of soil type and climate – but also, of course, they reflect how they have been managed. Rodwell's classification[50] recognises 19 woodland communities and a further six types of scrub which are seral stages leading to woodland. Some woodland types, such yew woodland (*W13 Taxus baccata*) are very scarce and found only in a few localities; others, like the woodlands dominated by oak or ash, are widespread. Some, like beech woods, are mainly southern, whereas pine woods are mainly northern.

The history of British woodland has been chronicled by Oliver Rackham[48,49]. He emphasises that Britain's woods are managed ones, and have been a vital part of the rural economy since pre-history – of equal value to farmland. Rackham distinguishes timber, which is cut from mature trees, from wood, which is the product of coppice or under-wood. Coppice was cut in rotation (around seven years) and used for poles, hurdles and fuel. The timber was for buildings and ships. From at least Anglo Saxon times, woods were owned and managed. Early written records included inventories of what could be cut from particular woods. Rackham argues that the basic pattern of woodland today is probably much as it was in the Iron Age and probably was not much changed by Roman, Anglo Saxon, Dane or Norman invasions. Typically these ancient woods are bounded by a ditch to keep out livestock and surrounded by trees that were pollarded. Pollarding served the same function as coppicing but it kept the new shoots out of reach of the livestock that grazed around the wood. The longevity of ancient woodland is a testament to its resilience. Rackham points out that you don't destroy a wood simply by cutting down the trees; it regenerates from stumps, stools and seedlings – in the absence of browsing rabbits and deer, it should be added. Two

Figure 10

Using woodland to show pheasants for shooting. The birds live in the home wood but on the morning of the shoot are gently driven out of it, along the shelter belt and into the small game covert. Finally the birds are flushed out of the covert and then fly back to the home wood over the waiting guns. Illustration at top is from the ICI Game Services guide in 1954[55] and, below, from a Game Conservancy guide published in 1988[56].



major things that have destroyed ancient woodland have been farming and, ironically, forestry. Many old woods have been killed by plantations of conifer. The dense shade and deep bed of acid needles snuffs out all the pre-existing flora.

The woodland economy that helped sustain the nation for millennia fell into decline in the industrial age. Coal replaced wood and charcoal, and concrete and iron took over from wattle and timber. Probably more critical, however, was the effect of world trade. The lands opening up in the New World and the steady flow of timber from Baltic and Canadian forests caused most estate incomes to go into a steady decline in the latter half of the 19th century. Thus, although timber was still in demand, it did not increase in value. The old hazel coppice with oak standards system, where the spreading oaks produced the important knee timbers for wooden ships, fell into disuse. By the start of the 20th century advocates were recommending that traditional systems be abandoned in favour of dense, even-aged plantings of timber trees – especially non-native conifers like Douglas fir[51]. A principle of this new system was dense planting that reduced light to such an extent that the lower branches died off leaving tall growing trees that are essentially self trimming.

The First World War drastically reduced the remaining timber stock so there was a national imperative to invest in forestry. Thus in 1919 the Forestry Commission was created, both to encourage private investment in forestry through tax breaks and forest dedication schemes, as well as to create entirely new forests owned by the state. It was rationalised that, because forest rotations were so long, landowners could not be trusted to make sensible investment decisions that spanned several generations[51,52]. Such logic partly stemmed from the fact that these new forests did not have any short cycle coppice to bring in more regular income as they were mostly planted in uniform stands. These advocates focused entirely on trees and overlooked or ignored the regular income that could be generated from game shooting.

This was a blinkered approach as game shooting was becoming increasingly important in the latter half of the 19th century[53] and reached an apogee in Edwardian Britain just prior to the First World War. Paradoxically the opening up of world trade, which triggered an agricultural depression and a decline in woodland management, also fostered interest in game management for shooting. The big estates of the late 19th century, faced with lowering revenues from tenant farmers and poor income from the their woods, increasingly nurtured the sporting value of their properties. Some estates were divided and a new class of landowner, with wealth from commerce and industry, was able to buy land, build grand country houses, and develop the woods as pheasant shoots. Such woods were both old and newly-planted.

The main gun deck on HMS Warrior – the first iron warship. Up until this point commercial and naval fleets had depended on timber from Britain's oak woods. (Stephen Tapper)

The key idea was to manage these new woods in a way that would hold pheasants as well as 'show' them in front of a line of guns. A leading proponent was Sir Ralph Payne Gallwey[54].

Briefly in the late 1930s and again in the 1950s, Payne Gallwey's ideas where discovered afresh by the Ely Game Advisory Station (see Figure 10). These centred on managing existing farm woodland for game shooting, ameliorating forestry schemes so that they hold pheasants as well as trees, and planting new small game spinneys as pheasant holding coverts. The principal features of woodland managed for pheasants are:

- A broad shrubby edge to keep it sheltered and warm.
- A mixed planting scheme with some evergreens, that provides shelter in winter. The deciduous trees let in light, allowing a shrub or underwood layer and ground flora to develop.
- A tree canopy with gaps, beneath which low thicket shrubs are planted to act as flushing points. This allows birds to be gathered and flushed out over the underwood and the high trees.
- A layout with rides. Some may be narrow for access, others wide to let in the light making them suitable as pheasant feed rides, and in bigger woods very wide rides for shooting.

In the 1950s and 1960s the Ely Game Advisory Station had a small team of full-time field staff who visited shoots across Britain promoting these ideas. They were visiting over 500,000 acres of property annually and giving advice on game management – much of it on woodland plans for improving pheasant shooting[57].

> *"A multitude of groves is maintained for shooting or fox-hunting, without which they would vanish almost overnight (a point which opponents of these activities would do well to remember)."*
>
> **Oliver Rackham** (1976) in *Trees and Woodland in the British Landscape*[48]

During the century from about 1870 to 1970, pheasant shooting was a key motive for retaining and managing woods in lowland Britain. This motivation was at its height in Edwardian England when around 25,000 professional gamekeepers were in full-time employment (roughly five times as many as today)[53]. Without this motivation there is little doubt that the economic pressure exerted by Government through grants and tax concessions for forestry would have turned most decent sized lowland woods into conifer plantations.

Pheasant woods today

Since the Second World War, the Forestry Commission has been gradually shifting its policy to be less concerned with efficient timber production and more with the idea of promoting forests and woods that are multipurpose, and have landscape and amenity value. No doubt it was stung by the outspoken criticism of Sir Arthur Tansley, first chairman of the Nature Conservancy Council, who dismissed "plantations of alien trees" as not being worthy of consideration[15]. By 1985 the Forestry Commission was planning new schemes to promote broadleaves and in 1988 it launched the Woodland Grant Scheme as well as phasing out tax concessions for plantations. By 1999 the strategic rationale had widened to include recreation, conservation, rural development, and economic regeneration – especially on derelict industrial sites[58]. However, even

61% of properties that released pheasants also undertook new woodland plantings[60].

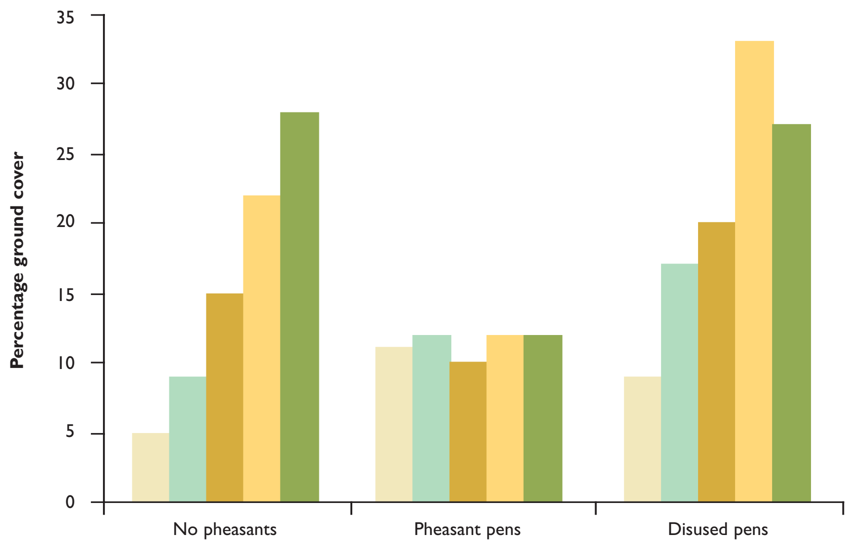


Figure 11

The abundance of five groupings of ground plants inside and outside pheasant release pens[59].

- Annual plants
- Perennials of light and fertile conditions
- Perennials propagated by seed
- Perennials of shade and infertile conditions
- Winter-green perennials

Songbirds like this wren do very well in woods managed for pheasants. (Laurie Campbell)

under these new planting schemes, pheasant shooting still provides a key motivation for entering a scheme in the first place.

Woodlands that are used for pheasant shooting are, of course, not only managed for driving pheasants out of, but they are also used for releasing pheasants into, in preparation for the shooting season. So, for much of the autumn and winter such woods contain a lot of birds that are fed by the gamekeeper either by hand or with food hoppers which dispense grain regularly or on demand. For protection, pheasants are released into a large enclosure within the wood – called a release pen – from which they can fly into and out of as they become more mature. Clearly a large number of birds on a relatively small patch of ground could affect the local ground flora, both by eating and trampling plants and by increasing the soil nutrients with faeces. The Nature Conservancy Council (forerunner of English Nature) commissioned The Game Conservancy Trust to look at this, principally because it was busy designating many ancient semi-natural woods as SSSIs and it needed to know if pheasant releasing did any harm to these sites.

Clare Ludolf[60] and her colleagues surveyed 48 release pens in regular use, and a further eight pens that had remained disused for at least three years. These were matched with a series of control sites where no pheasants were released. They found some plants (like wood avens and seedling hawthorn) were absent from active pens, whereas others such nettle and chickweed did better in them. Overall some annuals did better in the release pens whereas it was often the shade tolerant perennials that fared worse. Figure 11 (page 25) shows how the major groups were affected, and, importantly, indicates that once pens fall into disuse these plant groups recover.

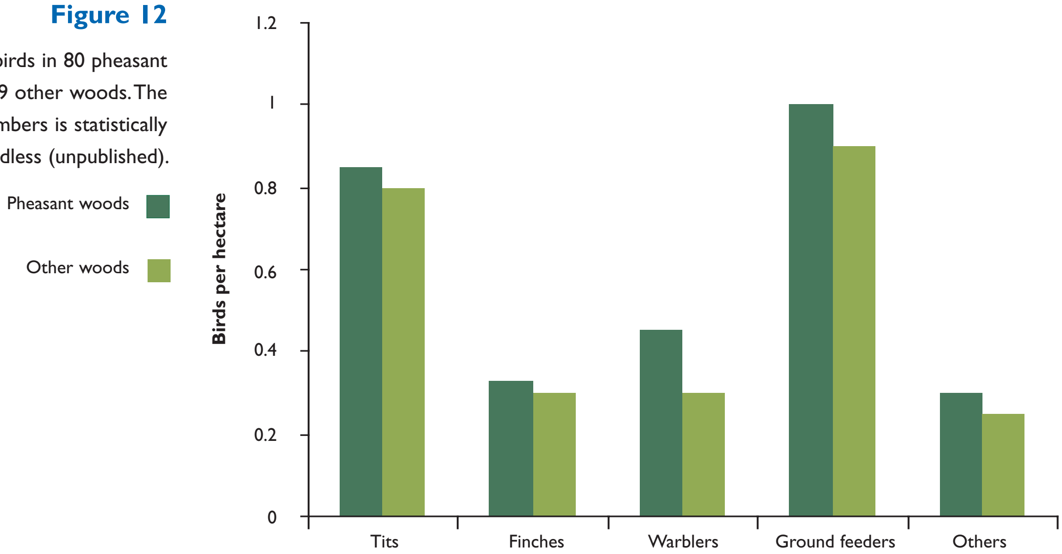
Although there have been suggestions that other groups, like butterflies, are negatively affected, these associations have turned out to be without foundation[61]. However, there are steps that game managers should adhere to if their pheasant woods are in ancient semi-natural woodlands. These include making sure no more than one third of the wood is used as part of the pen, that pheasant numbers do not exceed a specific density, and that things like straw should not be spread on feed-rides. English Nature, the Forestry Commission and The Game Conservancy Trust have produced an advisory guide for these circumstances[62].

Apart from the flora, management for pheasants could affect biodiversity in other ways. To assess the effect on songbirds, Roger Draycott and Andrew Hoodless surveyed 80 woodlands that were being managed for game and another 79 that were not. In all categories they found slightly more birds in game woods and a large and significantly greater number of warblers – especially blackcaps and willow warblers (see Figure 12). This effect is most likely due to the larger number of skylights, rides and shrubs in game woods.

The management of woods for pheasant shooting results in higher numbers of songbirds and woodland butterflies. Even large numbers of pheasants in release pens seem to have only a short-lived effect on the local ground flora.

Figure 12

Relative number of songbirds in 80 pheasant woods compared with 79 other woods. The difference in warbler numbers is statistically significant. Draycott & Hoodless (unpublished).



WOODLAND MANAGEMENT AND FLOWERS AND BUTTERFLIES

Peter Robertson and colleagues[63,64] assessed different types of woodland management at Wimborne St Giles in East Dorset. Here a block of original ancient woodland was in six states of management. Historically most of the wood had been hazel coppice with oak or ash standards, but some had not been coppiced for 17 to 30 years (unmanaged coppice), some had been cut between one and three years previously (managed coppice), and in some the coppice had been mostly removed and replanted with hardwood timber trees a hundred years ago (high forest). Blocks were separated by wide 25-50 metre rides cut 10 to 15 years previously and mown annually. There were also young conifer and mature conifer plantations of spruce, fir, larch and pine.

In these habitats they assessed the ground flora and butterfly fauna as indicators of biodiversity.

In this study the habitats that were managed by coppicing and ride cutting tended to have a richer ground flora and butterfly fauna than those that were neglected or managed solely for timber. Such management is typical of woodland kept for pheasant shooting.

A pearl-bordered fritillary – a species typical of woodland glades and rides. (The Game Conservancy Trust)

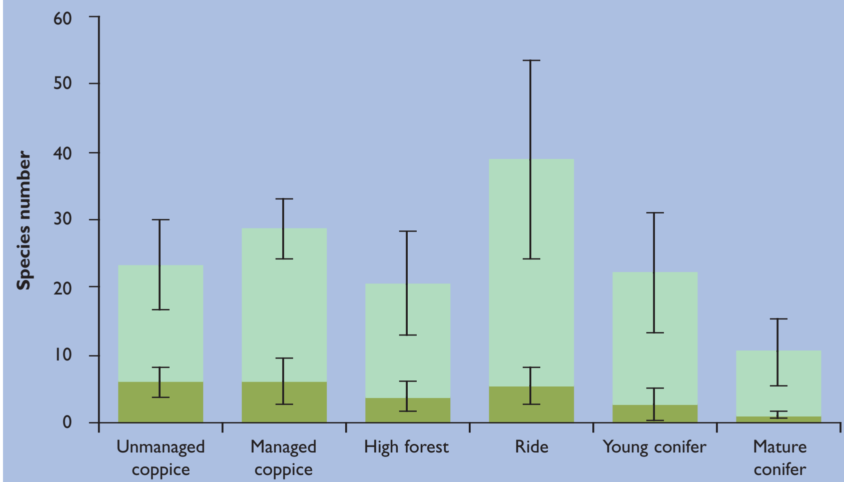


Figure 13

Average numbers of ground flora plant species found in each habitat and those species which are characteristic of ancient semi-natural woodland. After Ludolf *et al*[64]

Ground flora plant species

Species of semi-natural woodland

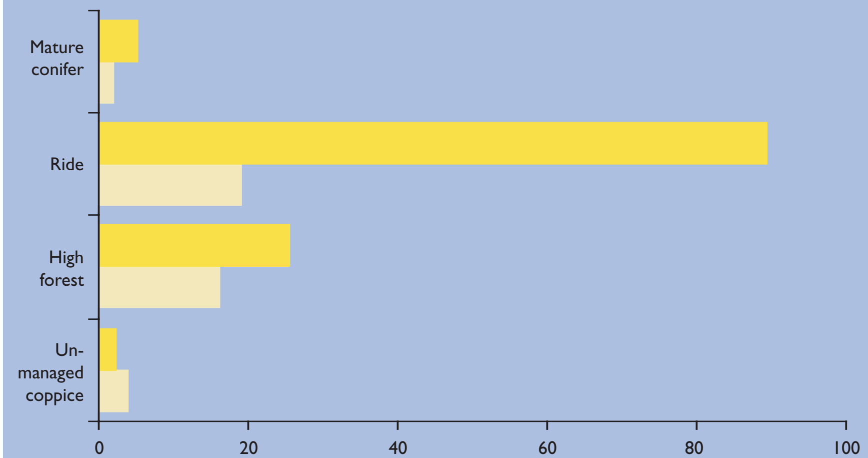


Figure 14

Number of butterfly species and individuals seen along transects of woodland habitat. After Ludolf *et al*[64]

Individual butterflies

Species

Farmland – the forgotten Neolithic ecosystem

In his seminal work on Britain's flora, Sir Arthur Tansley[15] dismissed farm crops as 'artificial communities' with only a few associated native weeds. Although he admitted that farm crops had been little studied, except by agronomists who were interested in crop yield, he was conspicuously ignoring 48% of the Britain's land surface[26]. This was a profound mistake. So eminent was Tansley in his day that a whole generation of post-war conservationists followed his line of thought. Save for some biologists, who were alarmed at the environmental impact of the organo-chlorine pesticides on birds of prey, no-one took the ecology of croplands seriously. No one, that is, except for some wildlife biologists interested in gamebirds.

These biologists, while reviving the management of grey partridge on post-war estates, were able to monitor year on year the collapse in breeding success of this bird during the mid 1950s. Eventually they discovered that, although the new agricultural herbicides appeared to cause no direct harm to the birds, they removed their food supply so that the young game chicks were starving to death[65,66,67]. This provoked much wider research into the ecology of cereal crops. Dick Potts' land mark paper on the subject, published in 1974, was entitled *Studies on the cereal ecosystem*[68]. This was a somewhat provocative title as the term 'ecosystem' had been largely reserved for giant regional ecological systems like oceans, tropical forests or the arctic tundra. It got people thinking. The essence of Potts' case was that cropland has a longer history than most people appreciate and, as a consequence, has its own unique flora and fauna, making it as worthy of conservation as an oak wood or a peat bog.

Farming evolved independently in the Near East, China, Central America, Andes-Amazonia, and eastern United States – built around various staple crops. The first farming in Europe appeared in the Near East or the Levant (today's southern Turkey, Syria, Iraq and Jordan) around 9,000 years ago when Britain was cloaked in forest and populated by Mesolithic hunters. Jared Diamond[8] gives a good account of how wild heavy-seeded cereal grasses were probably plucked by hand from hillsides in a region where people may have had a rather settled lifestyle. Although gathering such a wild, harvest was very productive (getting 50 times the energy from the seed than was

Farmland at Laxton, Nottinghamshire. Here the old medieval open field system remains largely unaltered by land enclosure. (Stephen Tapper)

Brown hares are typical of the many species that have spread to Britain because of our agricultural landscape. (Alexis de la Serre)

needed to gather it) they would have quickly discovered that by cultivation and deliberate sowing their harvests could be substantially improved. These Neolithic peoples, with polished stone tools and quern stones spread west across Europe during the subsequent 4,500 years, reaching Britain by about 5,500 years ago.

Over the millennia many plants adapted to agriculture. Most are transitory pioneer annuals that flourish on disturbed ground and would otherwise die out in the face of other dominant perennials if it were not for the regular cultivations. The seeds of many of these species were gathered up in the harvest and spread with next season's sowing along with the wheat and barley. Farming changed Britain from predominantly forest with clearings, to open country with patches of woodland. This allowed animals adapted to grassland or steppe to find a home in our countryside. Birds like larks, finches, buntings and plovers, as well as gamebirds like grey partridges and quail are such species. Mammals such as brown hares, field voles and harvest mice are examples too. Less obvious are the many invertebrates.

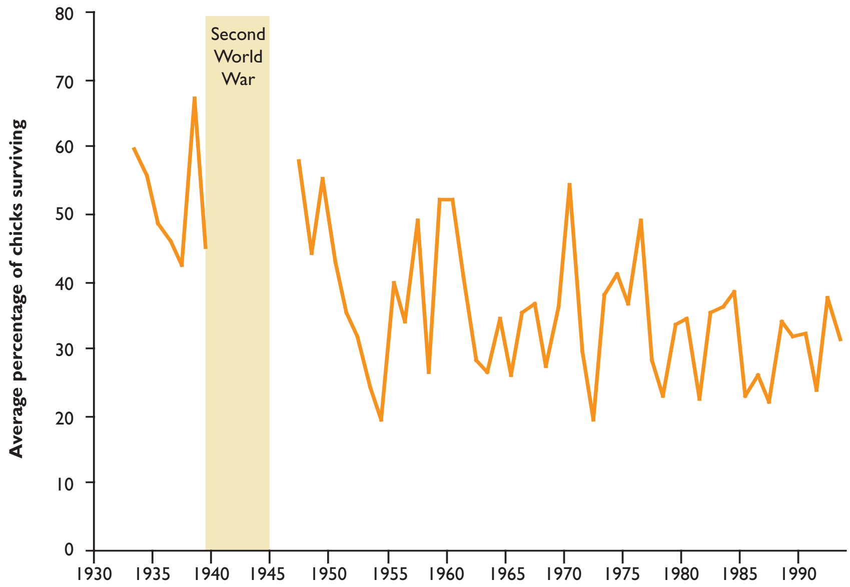
The first farmers in Britain cultivated the light chalkland of southern England where traces of their 'Celtic' fields can still be seen. These Neolithic stone-age farmers used wooden or bone ploughs and kept livestock as well as growing cereals. Eventually bronze and iron implements allowed the heavy land in the vales to be cleared and cultivated too. By the time the Romans arrived, Britons had been farming for over 2,000 years and the landscape may have had much the same character of woods and open fields as it has today. By Saxon times settlements had moved to lower ground, often adjacent to water courses or springs, leaving the higher ground to livestock grazing.

The later medieval farming village was at the centre of three enormous communal fields which went through a simple rotation of wheat, followed by beans followed by fallow. Each field was divided into blocks or furlongs, and each of these into strips or selions. Although some authors have praised such a landscape as a communal one where the countryside was open to all, in fact as Rackham[49] points out, it was very much a planned countryside and replaced a more ancient one of private enclosed fields.

However, the landscape would change again following the agricultural revolution. Advances in crop rotation and livestock breeding encouraged a less communal approach to farming. The revolution was driven by big estates that reorganised the tenant farmers and encouraged them to implement the new methods. Norfolk was a centre of change and Holkham Hall the pioneer estate. Increased yields and increased

Figure 15

Country-wide autumn brood counts of grey partridges allow summer chick survival to be calculated each year. This series shows how pre- and immediately post-war, on average, 50% of all partridges hatching were surviving until autumn. In the 1950s survival dropped substantially and since then it has averaged only around 30%. This, combined with a loss of habitat and increased predation, because of less predator control by gamekeepers, caused grey partridge numbers to decline[69].



profit meant estates could demand higher rent. The key to improving soil fertility was a rotation based on turnips and manure. By the middle of the 19th century farming was in a golden age; but, by the latter half, imports of cheap corn and meat from the New World had started a deepening recession. Except during periods of war, the first half of the 20th century was a period of depressed 'dog and stick' farming.

In the aftermath of the Second World War, European governments determined to boost and protect home production by modernisation and by subsidy. Government-funded labs developed new crop varieties, novel pesticides and highly mechanised systems. Two developments made a big difference; these were herbicide and bag nitrogen. These two innovations alone transformed the look of the countryside. People noticed. They wrote letters to newspapers and the BBC lamenting the loss of poppies in the fields and the dark blue-green of the winter wheat.

Terence Blank and Charles Coles counting partridges at Damerham in East Dorset around 1950. (The Game Conservancy Trust)

A kale and quinoa game crop planted to help partridges on the Chilterns, near Royston. (Stephen Tapper)

At this time, in the early 1950s, game biologists Terence Blank and Charles Coles noticed the sudden and unexpected decline in grey partridge production. Investigations led by Sir Richard Southwood at Imperial College suggested that the root cause was poor chick survival. Pretty soon a similar pattern was being picked up across Britain (see Figure 15).

The response of the game biologists was to look for alternative ways of producing a game harvest. In this they were greatly helped by an expanding poultry industry so they were able to adapt the technology and diets developed for chickens and turkeys to pheasant and partridge rearing. Consequently, today, lowland shooting depends primarily on birds that have been reared in game farms for release in the summer for the autumn shooting.

Meanwhile the plight of the grey partridge instigated a research programme into the decline funded by private subscription. This Partridge Survival Project began in 1968 along the Sussex Downs and, with additional support from research councils, soon developed into a much wider study into the ecology of arable farming. This work continues and illustrates how changing farming practice is affecting our countryside wildlife. It is not all about pesticides. For example, a key change has been a shift away from mixed farms with a ley rotation to all arable farms with rotations that include break crops (see *The disappearance of undersowing*, page 32). This breaks the life cycle of species like the sawfly, cutting their abundance, which in turn affects the survival of partridge chicks and other birds.

Game biologists were pioneers of wildlife research on arable land and were the first to recognise the repercussions of the indirect effects of herbicides on the invertebrate and bird fauna.

Since then the development of game management on farmland has really consisted of two themes:

1 Improving and adapting the hand rearing and release systems for pheasants and redleg partridges so that shooting can be sustained under modern farming conditions.
2 Trying to develop ways of restoring components of the cereal ecosystem so that grey partridges and other species can be better conserved.

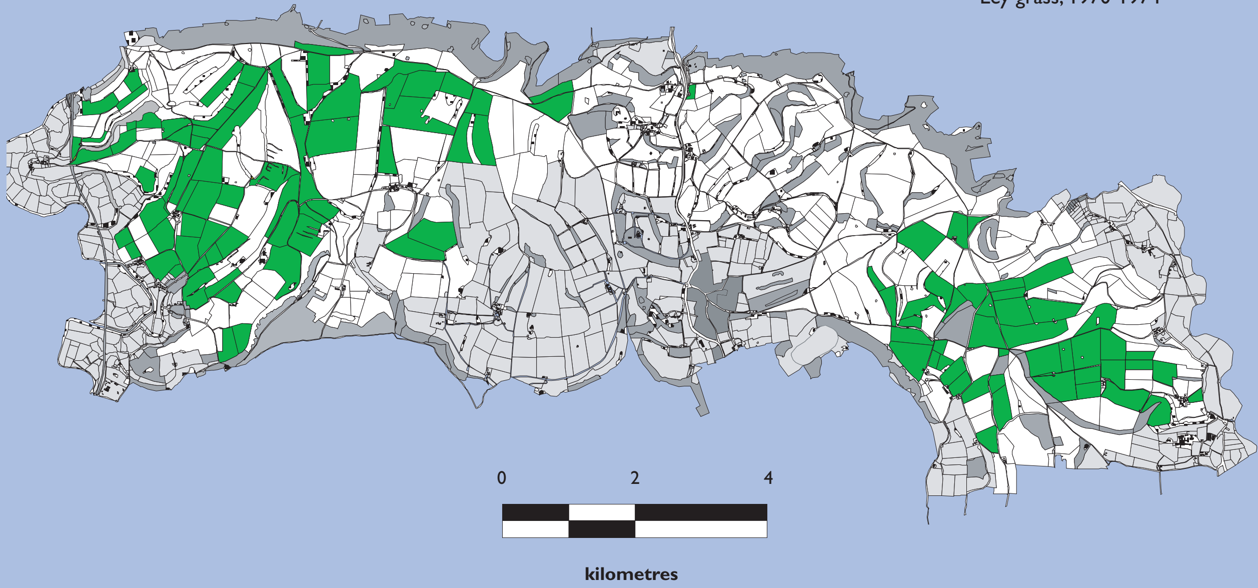
Rearing and releasing gamebirds

Although special crops for gamebirds have probably always been used on occasion, it is noteworthy that Payne Gallwey in 1895 makes only a passing reference to "scratching a little buckwheat" into rough ground, whereas he goes into considerable detail about woodlands for pheasants and farm crops that hold partridges[54]. Similarly game crops do not feature in the pre-war advisory guides from the ICI Research Station in Hertfordshire. It is clear, however, that a patchwork of mixed crops was an important feature of good partridge ground and the growing tendency for bigger fields was

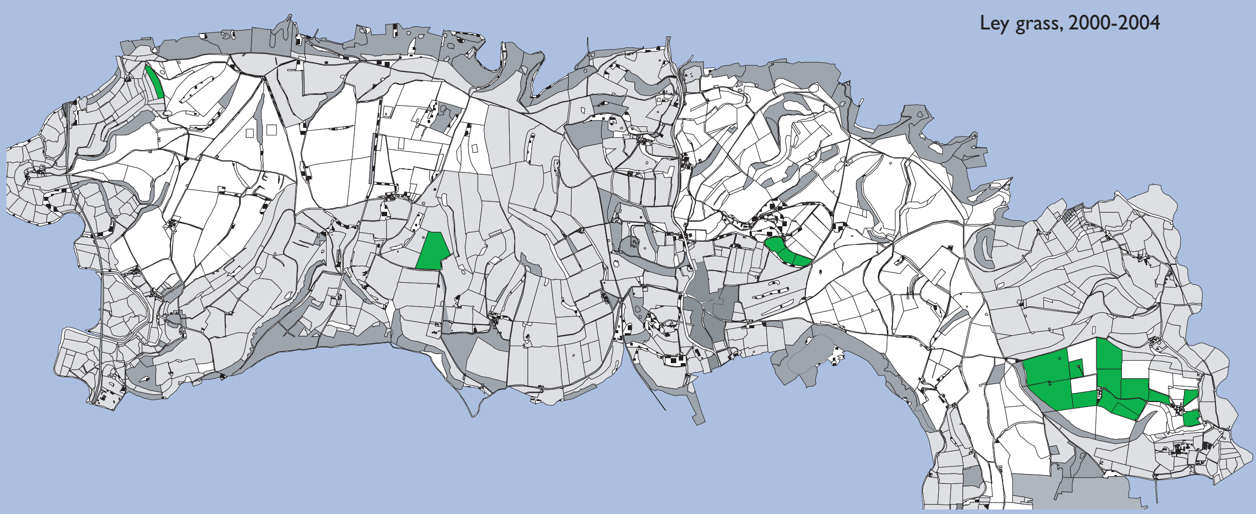
THE DISAPPEARANCE OF UNDERSOWING

In the early 1970s most farms along this stretch of the South Downs north of Worthing, between the rivers Arun and Adur, had a ley farming rotation where each field for two or three years was sown with a cereal crop, the final one of which was undersown with grass. This grass ley was therefore established over winter without the need for cultivation. This 'green bridge' from cereals to grass without ploughing helps to maintain cereal insects like sawflies that over-winter in the soil as pupae. Sawfly caterpillars are common in wheat and barley fields in mid-June on farms with undersowing. They provide ideal food for insectivorous birds – especially partridge chicks. The two maps show, in green, fields which were undersown in the 1970s compared with today. Only one farm today has maintained this traditional rotation.

Ley grass, 1970-1974



Ley grass, 2000-2004



becoming detrimental to game, but even by 1968 game crops like buckwheat were only given brief consideration.

By 1980, however, certainly as a consequence of big fields and simple arable rotations, game advisors where putting much more emphasis on special game crops and supplementary food for holding birds. They were considering not only a range of crops, but also experimenting with new ones and new varieties. They were selling seed mixes in one-acre packs and seed companies, too, were beginning to sell special mixtures for game. Some of these game sowings, like mustard, are transient; others like artichoke are more or less permanent.

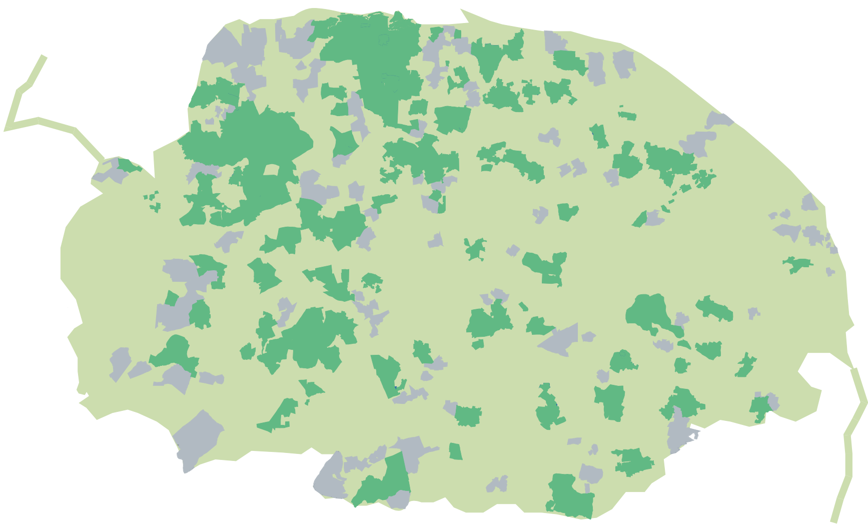


Figure 16

Game shooting properties in Norfolk. In green are those estates that are known to plant game crops. Grey are those where there is no information but where the planting of such crops is likely. From Julie Ewald's survey of gamekeepers from the National Gamekeepers' Organisation.

In Julie Ewald's survey she has recorded that out of 1,305 shooting properties, 70% now put about 3% of their arable area into one kind of game crop or another. She lists some 16 different types of game crop including annuals, biennials and perennials.

Although put in for pheasants and partridges, these over-winter crops also attract songbirds. Table 3 shows some popular game crops and which birds frequent them. In most cases the birds are feeding on the seed heads, but sometimes the crop provides a damp, protected environment under which birds like blackbird and song thrush can forage. Clearly some game crops like kale and quinoa are chosen by a lot of species whereas others are very specific. Gold finches, for example, are particularly fond of teasels.

Not only are these birds found in game crops, they appear to be supporting them in substantial numbers. A series of over-winter bird counts done in game crops in Scotland showed that there were often up to 100 times as many birds in the game crops as there were in nearby arable crops, set-aside or stubble[71].

Further, more often than not, gamekeepers put out hoppers of wheat and other grain for pheasants in these cover crops as well as in woodland. Songbirds come to these countryside bird tables throughout the winter months. A survey of wintering songbirds in Sussex found that these feeders were being used regularly by corn buntings, reed buntings, yellowhammers and linnets[72]. In Julie Ewald's survey, over 32,000 tonnes of grain are put out each winter for pheasants.

The adoption of 'bird seed mixtures' into agri-environment schemes, such as Entry Level Environmental Stewardship, is a testament to the value of similar game cover for wild birds across England.

Thousands of hectares of game crop and thousands of tonnes of grain, put out for pheasants and partridges, help many species of songbirds over winter.

Table 3

Birds that are associated with different game cover plants. Taken from *Where the birds sing* by Alastair Leake and Chris Stoate[60]

	Kale	Teasel	Sunflower	Borage	Triticale/wheat	Millet	Quinoa	Linseed
Pheasant	✓							
Blackbird	✓							
Song thrush	✓							
Dunnock	✓						✓	
Greenfinch	✓		✓	✓				
Goldfinch		✓						✓
Redpoll							✓	
Chaffinch	✓				✓		✓	
Tree sparrow					✓		✓	
Yellowhammer					✓	✓		
Reed bunting	✓					✓		
Corn bunting					✓		✓	

Dozens of yellowhammers come to the pheasant feeders at the Allerton Project farm, Loddington. (Chris Stoate)

Table 4

Rare arable weeds discovered during a survey of 17 farms which adopted conservation headlands in some of their fields. From a study by Phil Wilson[76]

Species	Number of farms
Dense silky bent	1
Corn chamomile	1
Dwarf spurge	7
Broadleaved spurge	1
Dense-flowered fumitory	3
Red hemp-nettle	2
Sharp-leaved fluellen	7
Round-leaved fluellen	9
Venus's looking-glass	7
Field gromwell	2
Prickly poppy	2
Rough poppy	2
Corn parsley	1
Shepherd's needle	1
Night-flowering catchfly	3
Field woundwort	3
Narrow-fruited cornsalad	2

The very rare rough poppy was discovered on farms that had adopted conservation headlands. (Phil Wilson)

Restoring the cereal ecosystem

Trying to find ways to conserve biodiversity in cereals is challenging if, at the same time, one is also trying to retain many of the benefits that modern agriculture provides. Switching to organic has appeal, but yields drop and long periods of grass are needed in the rotation to re-build fertility[73]. Extra subsidies and higher commodity prices are needed to make it economically worthwhile.

Another strategy is to sacrifice a small percentage of the crop to conservation. This idea was given a considerable boost by the discovery that partridge broods, after hatching, do not wander for miles in acres of cereal but, if they are getting enough to eat, spend most time along the field edge[74]. Hence, if one restricted the use of pesticides around field edges (headlands), conservation areas could be created that would support the flowers and insects that the game chicks needed to survive. Most field headlands have a relatively low yield in any case so the sacrifice need not be that great. The idea was that in an otherwise normal cereal crop, herbicide and insecticide would be kept off the outer six metres. Six metres was chosen, not for any biological reason, but because it was a typical length of spray boom that could be switched off on farm machinery of the time.

In the early 1980s, The Game Conservancy Trust began a series of trials of these 'conservation headlands' on a north Hampshire farm (Manydown). Dividing the farm

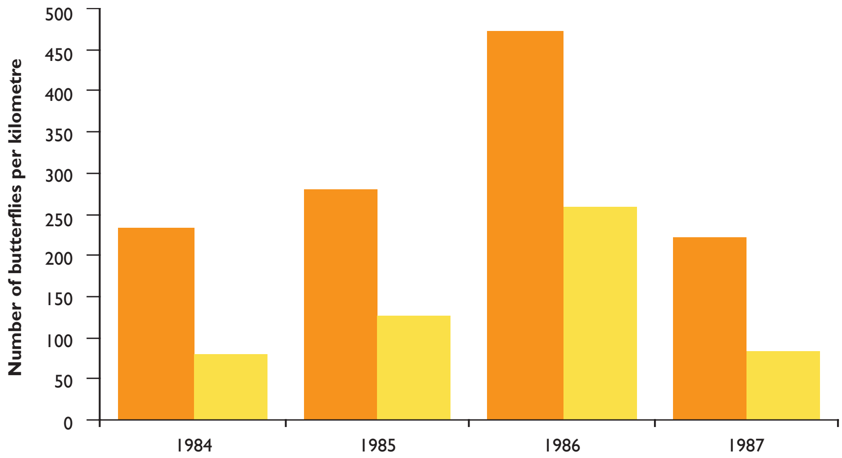


Figure 17

Butterfly numbers on experimental conservation headlands at Manydown in Hampshire. 29 different species were recorded along these field edges. From Dover, Sotherton & Gobbett[77]

Conservation headlands

Standard headlands

A comma butterfly – a typical hedgerow species that benefits from conservation headlands. (Laurie Campbell)

into blocks of fields, some of which were conventionally farmed, and others which had conservation headlands, a programme of ecological studies was set up to monitor the effect on wildlife. The trial, and subsequent roll-out to a series of other farms, showed that not only was partridge chick survival improved back to pre-war levels[75], but the technique also helped to conserve the cereal fauna and flora – most notably the rare arable weeds.

A botanical survey organised in 1986 by the then Nature Conservancy Council identified that some 25 species of arable weed had continued to decline since the 1950s. Two of them, lambs succory and thorow-wax, had apparently become extinct. A survey of 17 farms that adopted conservation headlands, however, showed that many of these flowers could be revived in these headlands (see Table 4). It seems that in many places the soil seed bank still contains these plants and simply not applying the regular herbicide allows them to germinate and re-appear.

Conservation headlands are field edges that are mostly unsprayed and therefore contain many flowering annuals. (Stephen Tapper)

Conservations headlands, invented to improve the survival of gamebirds, now offer the last hope for saving, on a wide scale, the ancient flora of cereal fields that has remained with us since the Neolithic. Thankfully conservation headlands are now supported by Environmental Stewardship.

Some common birds like the robin doubled in numbers at Loddington. (Laurie Campbell)

The Game Conservancy Trust's Allerton project at Loddington illustrates how the abundance of nationally-declining farmland bird species can be doubled in less than five years. Farms that adopt this game management strategy will be able to deliver Defra's Public Service Agreement on a local scale.

Another group to benefit from conservation were the butterflies. Figure 17 shows numbers of butterflies seen flying over conservation headlands compared with regular margins. Because conservation headlands are only in place for a short summer season there is not time for butterflies to breed in them, so what happens is that they rest and feed on the wild flowers and simply skip over the rest of the sprayed crop. No doubt this improves their survival. However, the absence of spraying also protects the hedgerow and many perennial flowers like knapweed and scabious, from spray drift. Hedge banks provide a year-round habitat for many insects especially butterflies like the comma and tortoiseshell, which need perennials as food for their caterpillars.

As yet, conservation headlands have not been adopted on a wide scale and even among the 1,000+ game estates surveyed by Julie Ewald, only 15% are using them. This is partly because, from a farmer's point of view, they are not always easy to manage – especially on heavy land or where adjacent field boundaries contain invasive weeds like sterile broom or cleavers, but also because more or less simultaneously with their deployment, the EU adopted set-aside as a key production limiting mechanism, in spite of the complete absence of field studies examining the environmental consequences of set-aside. This was a clear case of policy not being underpinned by science.

Nevertheless, it has been possible to adapt the rules so that set-aside land can be turned into useful wildlife habitat. This has been best shown at The Game Conservancy Trust demonstration farm in Leicestershire (see *Allerton Farm, Loddington: farming, game and wildlife*, page 37) where the set-aside has been distributed around the farm in 20-metre wide strips sown with either cereal-based plant mixtures (for birds in summer) or kale-based mixtures for cover in winter[78,79]. Although designed for birds, these set-aside strips have also proved to be the best habitat on the farm for butterflies[79].

The farm at Loddington comprehensively illustrates the big increase in bird life that can be achieved if several aspects of game management operate simultaneously. Here a gamekeeper undertook predator control in summer, game feeding in winter, and, with the farm, woodland improvements and set-aside management. Game and songbird numbers substantially increased.

One of Defra's objectives and performance targets under its Public Service Agreement is to "…preserve biological diversity by: reversing the long-term decline in the number of farmland birds by 2020, as measured annually against underlying trends."

Chris Stoate[80] has compared the abundance and breeding success of birds at Loddington with other nearby farms. Looking mainly at those species that have undergone national declines, he showed that a combined abundance index for these species doubled over a five year period at Loddington, but continued to decline at the other sites (Figure 18).

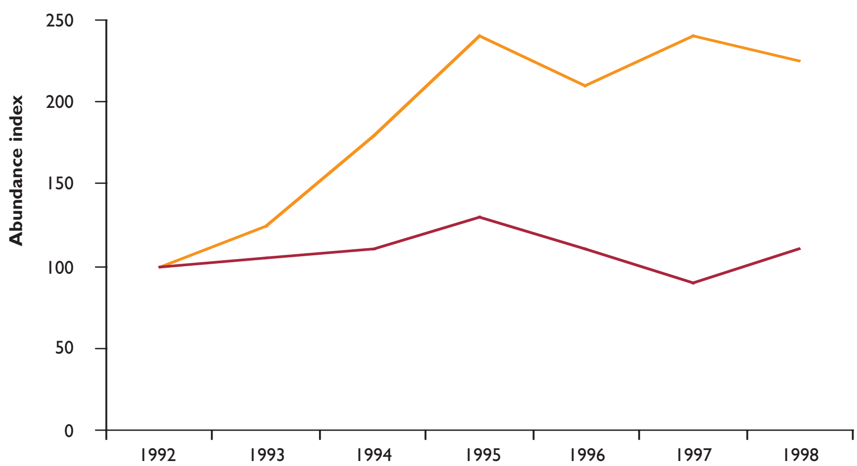
He monitored the nesting success of birds at Loddington and showed that in the absence of carrion crows and magpies, most species bred more successfully. This shows that the corvid control by the gamekeeper was probably critical to the songbird success[80].

Figure 18

Changes in abundance of nationally-declining birds at Loddington compared with two similar nearby farmland sites. Gamekeeping and habitat improvements began at Loddington in 1992. From Stoate & Szczur (2001)[80].

Loddington

Other nearby farmland sites



ALLERTON FARM, LODDINGTON: FARMING, GAME AND WILDLIFE

This 823 acre Leicestershire farm has been run by The Game Conservancy Trust under the auspices of the Allerton Research and Educational Trust – set up in 1992 after the death of Lord and Lady Allerton. Founder Chairman of the Trust and executor of the Allerton Estate, the late Philip Grimes intended that it should be a demonstration platform to show how game management and farming could be integrated to the benefit of wildlife using the methods developed by The Game Conservancy Trust.

In the 10 years after 1992 the policy was to modernise the farming, adopt novel conservation measures, and to employ a full-time gamekeeper to encourage wild game using predator control, winter feeding and habitat management.

Harvest mice are now common along the beetle banks and wide field margins. (Laurie Campbell)

In 10 years:

- Autumn numbers of pheasant increased from less than 150 to over 600.
- Numbers of brown hares increased more than 10-fold.
- Overall songbird numbers more than doubled, while the trend in numbers on nearby farms continued to decline. As examples, between 1992 and 2001 the following increases in numbers of breeding pairs were recorded: wren 47 to 141; dunnock 46 to 144; robin 54 to 110; blackbird 66 to 143; song thrush 14 to 64; whitethroat 25 to 45; blackcap 19 to 38; chiffchaff two to 10; willow warbler 28 to 45; spotted flycatcher eight to 14; chaffinch 135 to 229.
- Harvest mice have thrived in the field margins and especially in the beetle banks planted with the long-stemmed grass, cock's-foot.

Since 2002, fox, crow, magpie and other predator control has ceased while keeping the other measures going. This will help unravel the relative effects of each part of the programme.

> *The achievements of the "The Allerton Project" should encourage all those concerned with conservation. It represents an exciting and feasible way forward for many British farmers.*

Jonathon Porritt (2002) in *Where the birds sing. The Allerton Project: 10 years of conservation on farmland*[70]

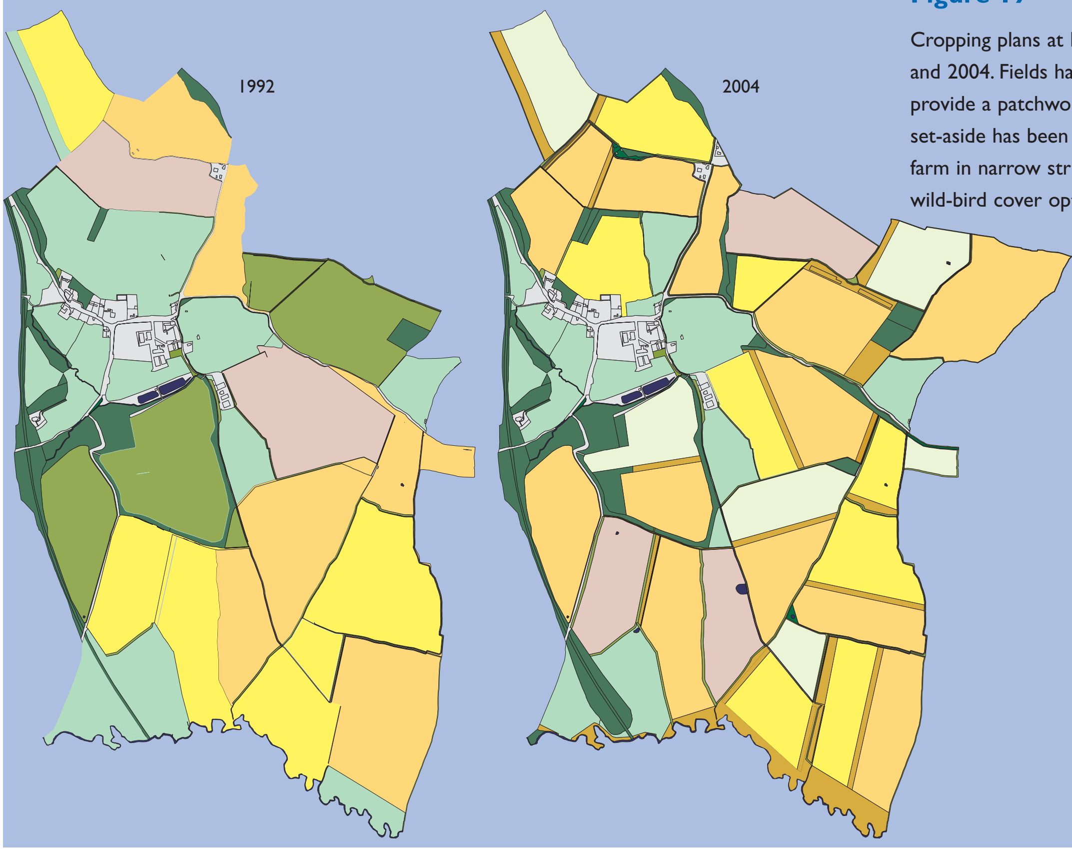


Figure 19

Cropping plans at Loddington for 1992 and 2004. Fields have been split up to provide a patchwork of crops and the set-aside has been distributed around the farm in narrow strips that are planted with wild-bird cover options[70]

A final thought – the role of the gamekeeper

Throughout this report where we have considered game management and its relationship to nature conservation, we have actually been referring to the work carried out by gamekeepers. Heather burning, ride cutting, and pheasant feeding are undertaken by keepers across Britain. Also, as gamekeepers are on the ground day and night, they are usually the first to notice wildlife events, and are in the front line in dealing with those members of the public who stray from footpaths or ignore simple countryside conventions.

A key aspect of gamekeeping, however, is predator control. Even though pheasant rearing and releasing make predator control less important on farmland shoots than it was in Edwardian England, it is still part of every gamekeeper's work. Predator control has, of course, changed a lot since Victorian times; high powered rifles and spot lamps have replaced gin traps for fox control, and Larsen traps have replaced the poisoned egg for controlling crows and magpies. With many species protected by law, gamekeepers have had to become more selective and have to accommodate predation losses which their grand parents would not have tolerated. This is as it should be. The ethic of *conservation through wise use* embraces the idea that conservation (biodiversity) should benefit from the use (game shooting). Just as farming is expected to make concessions for wildlife, game production has to as well. In spite of this, predator control is widely misunderstood and often disapproved of.

The science of predation is better understood than it was 30 years ago. Then the principal paradigm was that prey populations compensated for predation losses by reduced mortality through other means or improved productivity. *Prey numbers affect the numbers of predators; not the other way round* was the prevailing view. Hence, in the 1970s, predator control was seen by many as a damaging waste of time. Now we can see that this was simplistic. If we are willing to accept that prey populations can be over hunted, over fished and over shot by humans, it obvious that some predators can affect prey abundance too – especially when most are generalists and able to sustain themselves on common species while eliminating some vulnerable ones.

We have proved experimentally that gamebird stocks are substantially increased by predator control[81], and we have seen here that this is likely to be true for a range of ground-nesting waders as well. Predator control has been used to conserve vulnerable species[82] and it is probably now needed to save water voles, stone curlews, and capercaillie. Nevertheless, for nature conservation, predator control is really viewed as a fire brigade measure not as regular conservation practice. If predator control is to gain wider acceptance as a conservation measure, it needs a firmer rationale.

Habitat like hedgerow is important for game and wildlife, but gamekeeping will enormously increase its value to both. (Stephen Tapper)

Fred Allen, headkeeper at North Farm, Sussex, in 1974. Here the hard work of predator control was largely undermined by intensive farming, which left the partridges, saved from crows and foxes, short of food and starving. Game management depends on habitat, food supply and protection from predators. Dick Potts likened it to a three-legged stool – which only works if all three are in place. (Stephen Tapper)

This rationale is likely to involve two ideas; the first being the phenomenon of intra-guild predation[47]. This suggests that foxes, for example, are particularly abundant in Britain because we no longer have native wolves or lynx that would otherwise limit their numbers. This idea suggests that in a sense the gamekeeper takes the place of these top carnivores, and so relieves the predation pressure on medium-size prey species. The second idea is the relationship between habitat and predator control.

Dick Potts showed this in his early studies of grey partridges[83]. He suggested that for this bird, habitat improvements alone would not improve numbers but, when combined with some predator control, they would have a positive effect (see Figure 20). Essentially predator control unlocks the potential of habitat improvement. The reason, he suggested, was that generalist predators often respond more readily to the habitat changes than the species they are designed to benefit.

A common counter to the use of predator control for conservation is that such a high level of intervention could not be justified in terms of cost. As a general rule, possibly not. However, in the instances highlighted in this report, the work is not paid out of the public purse, but from private funds. All one has to do is to recognise this contribution.

Whatever view we take about predator control, it behoves all involved to be honest about what is going on. Too often we see the public being given the impression that abundant wildlife comes about because it is protected from man and not the result of his hard work. As Budiansky points out – good poetry; poor science[5]. Time and again in magazines, on radio, but especially on television, we encounter journalists who are eager to visit country estates to make enchanting natural history films about wildlife and then carefully air-brush out the gamekeeper and the fact that it was his work that made the film possible in the first place.

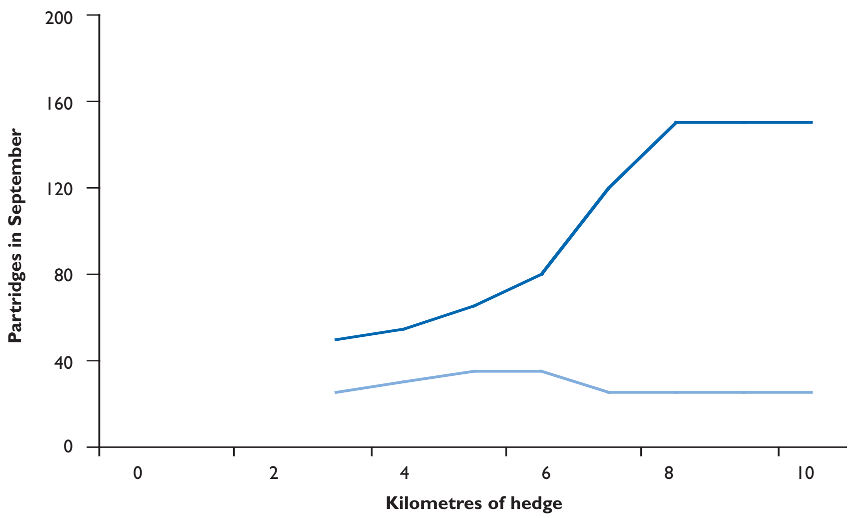


Figure 20

Using a simulation model of a partridge population developed from field studies, this graph shows how the number of partridges is affected by improving the amount of hedgerow on a farm. Without predator control, autumn abundance improves only slightly, but with it numbers increase nearly three-fold for a doubling of nesting cover. From a study by Potts (1980)[83].

Predator control

No predator control

References

1 **Anon** (1980) *World Conservation Strategy: Living Resource Conservation for Sustainable Development*. International Union for Conservation of Nature and Natural Resources, Gland, Switzerland

2 **Prescott-Allen, R & Prescott-Allen, C** (1996) Assessing the impacts of uses of mammals: the good, the bad and the neutral. In: *The Exploitation of Mammal Populations*. (Eds: VJ Taylor & N Dunstone). Chapman & Hall, London. 45-64.

3 **Anon** (2000) *Our countryside: the future. A fair deal for rural England.* The Ministry of Agriculture, Fisheries and Food and the Department of Environment, Transport and Regions, The Stationery Office, London. 176 pages.

4 **Anon** (2002) *Johannesburg Summit 2002; United Kingdom Country Profile.* United Nations, Johannesburg. 80 pages.

5 **Budiansky, S** (1995) *Nature's keepers. The new science of nature management.* Weidenfeld & Nicholson, London. 310 pages.

6 **Ambrose**, SE (2005) *Undaunted Courage: The pioneering first mission to explore America's wild frontier.* Simon & Schuster UK Ltd, London. 574 pages.

7 **Darwin, C** (1859) *On the Origin of Species by Natural Selection.* J Murray, London.

8 **Diamond, JM** (1997) *Guns, germs and steel: A short history of everybody for the last 13,000 years.* Jonathan Cape, London. 480 pages.

9 **Plowright, W** (1982) The effects of Rinderpest and Rinderpest control on wildlife in Africa. *Symposia of the Zoological Society of London*, 50, 1-28.

10 **Grzimek, B** (1960) *Serengeti Shall Not Die.* Hamish Hamilton Ltd, London. 344 pages.

11 **Ruddiman, WF** (2005) How did humans first alter global climate? *Scientific American*, 292, 34-41.

12 **Leopold, A** (1933) *Game Management*. Scribner's, New York. 481 pages.

13 **Tucker, G** (2004) The burning of uplands and its effect on wildlife. *British Wildlife*, April, 251-257.

14 **Jones, M** (1986) *England before Domesday.* Batsford, London. 174 pages.

15 **Tansley, AG** (1968) *Britain's Green Mantle: Past, Present and Future.* George Allen and Unwin, London. 327 pages.

16 **Gimingham, CH** (1995) Heaths and moorland: An overview of ecological change. In: *Heaths and moorlands: Cultural landscapes.* (Eds: DBA Thompson, AJ Hester & MB Usher). HMSO, Edinburgh. 9-19.

17 **Gimingham, CH** (1981) Conservation: European heathlands. In: *Heathland and related shrublands of the world. B. Analytical studies.* (Eds: RL Specht). Elsevier Scientific Publishing, Amsterdam. 249-259.

18 **Jackson, JD** (1974) *Grouse and forestry*. The Game Conservancy, Fordingbridge. 28-34.

19 **Tudor, GJ & Mackay, EC** (1995) Upland land cover change in post-war Scotland. In: *Heaths and moorlands: Cultural landscapes.* (Eds: DBA Thompson, AJ Hester & MB Usher). HMSO, Edinburgh. 28-42.

20 **Robertson, PA, Park, KJ & Barton, AF** (2001) Loss of heather *Calluna vulgaris* moorland in the Scottish uplands: the role of red grouse *Lagopus lagopus scoticus* management. *Wildlife Biology*, 7, 11-16.

21 **Magnusson, M** (1995) Foreword. In: *Heaths and moorlands: Cultural landscapes.* (Eds: DBA Thompson, AJ Hester & MB Usher). HMSO, Edinburgh. xii-xvi.

22 **Rodwell, J** (1991) *British Plant Communities: Volume 2 Mires and heaths.* Cambridge University Press, Cambridge. 628 pages.

23 **Redpath, SM & Thirgood, SJ** (1997) *Birds of prey and red grouse.* Stationery Office, London. 148 pages.

24 **Hudson, P & Newborn, D** (1995) *Red Grouse and Moorland Management.* The Game Conservancy, Fordingbridge, Hampshire. 169 pages.

25 **Anon** (2003) *England's best wildlife and geological sites: The condition of Sites of Special Scientific Interest in England in 2003.* English Nature, Peterborough. 116 pages.

26 (1999) The Countryside Information System. Version 6. Department of Environment, Transport and Regions, London.

27 **Hudson, P** (1992) *Grouse in Space and Time: The population biology of a managed gamebird.* Game Conservancy Ltd, Fordingbridge, Hampshire. 224 pages.

28 **Ewald, JA, Kingdon, NJ, Aebischer, NJ, Tapper, S & Graham, NA** (unpublished) *Quantification of management for shooting on upland estates, and implications for breeding wader distributions*.

29 **Brown, AF & Bainbridge, IP** (1995) Grouse moors and upland breeding birds. In: *Heaths and moorlands: Cultural landscapes.* (Eds: DBA Thompson, AJ Hester & MB Usher). HMSO, Edinburgh. 51-66.

30 **Tharme, AP, Green, RE, Baines, D, Bainbridge, IP & O'Brien, M** (2001) The effect of management for red grouse shooting on the population density of breeding birds on heather-dominated moorland. *Journal of Applied Ecology*, 38, 439-457.

31 **Etheridge, B, Summers, RW & Green, RE** (1997) The effects of illegal killing and destruction of nests by humans on the population dynamics of the hen harrier *Circus cyaneus* in Scotland. *Journal of Applied Ecology*, 34, 1081-1105.

32 **Heydon, MJ & Reynolds, JC** (2000) Demography of rural foxes (*Vulpes vulpes*) in relation to cull intensity in three contrasting regions ofl Britain. *Journal of Zoology*, London, 251, 265-276.

33 **Fletcher, K** (2005) Does predator control help ground-nesting birds? In: *Review of 2004*. The Game Conservancy Trust, Fordingbridge, Hampshire. 64-67.

34 **Thorpe, R, Sheehan, J & Walker, M** (2004) The birds of RSPB Lake Vyrnwy reserve. *Welsh Birds*, 4, 20-30.

35 **Baines, D** (2000) *Breeding wading birds in the Dartmoor National Park: An assessment of factors potentially limiting population size.* Report to Dartmoor National Park Authority. 18 pages.

36 **Sharrock, JTR** (1976) *The Atlas of Breeding Birds in Britain and Ireland.* BTO, Tring, Hertfordshire. 476 pages.

37 **Gibbons, DW, Reid, JB & Chapman, RA** (1993) *The New Atlas of Breeding Birds of Britain and Ireland 1988-1991*. T & AD Poyser, Berkhamsted. 520 pages.

38 **Wilson, AM, Vickery, JA & Browne, SJ** (2001) Numbers and distribution of northern lapwings *Vanellus vanellus* breeding in England and Wales in 1998. *Bird Study*, 48, 2-17.

39 **Taylor, IR & Grant, MC** (2004) Long-term trends in the abundance of breeding lapwing *Vanellus vanellus* in relation to land-use change on upland farmland in southern Scotland. *Bird Study*, 51, 133-142.

40 **Baines, D** (1990) The roles of predation, food and agricultural practice in determining the breeding success of the lapwing (*Vanellus vanellus*) on upland grasslands. *Journal of Animal Ecology*, 59, 915-929.

41 **Galbraith, CA & Tucker, C** (2000) *Report of the UK raptor working group.* Department of the Environment, Transport and Regions, and Joint Nature Conservation Committee, Bristol and Peterborough. 123 pages.

42 **Thirgood, S, Redpath, S, Newton, I & Hudson, P** (2000) Raptors and red grouse: Conservation conflicts and management solutions. *Conservation Biology*, 14, 95-104

43 **Thirgood, SJ, Redpath, SM, Rothery, P & Aebischer, NJ** (2000) Raptor predation and population limitation in red grouse. *Journal of Animal Ecology*, 69, 504-516.

44 **Thirgood, SJ, Redpath, SM, Haydon, TJ, Rothery, P, Newton, I & Hudson, PJ** (2000) Habitat loss and raptor predation: disentangling long- and short-term causes of red grouse declines. *Proceedings of the Royal Society of London*, B 267, 651-656.

45 **Smith, AA, Redpath, SM, Campbell, ST & Thirgood, SJ** (2001) Meadow pipits, red grouse and habitat characteristics of managed grouse moors. *Journal of Applied Ecology*, 38, 390-400.

46 **Potts, GR** (1998) Global dispersion of nesting hen harriers (*Circus cyaneus*): Implications for grouse moors in the UK. *Ibis*, 140, 76-88.

47 **Anon** (1999) *A Question of Balance: Game animals and their role in the British Countryside.* The Game Conservancy Trust, Fordingbridge, Hampshire. 288 pages.

48 **Rackham, O** (1976) *Trees and Woodland in the British Landscape.* JM Dent & Sons, London. 204 pages.

49 **Rackham, O** (1994) *The Illustrated History of the Countryside.* BCA, London. 240 pages.

50 **Rodwell, J** (1991) *British Plant Communities: Volume 1 Woodlands and scrub.* Cambridge University Press, Cambridge. 395 pages.

51 **Simpson, J** (1903) *The new forestry, or the continental system adapted to British woodlands and game preservation.* Pawson & Brailsford, Sheffield. 220 pages.

52 **Hiley, WE** (1954) *Woodland management*. Faber and Faber, London. 463 pages.

53 **Tapper, SC** (1992) *Game Heritage: An Ecological Review from Shooting and Gamekeeping Records.* Game Conservancy Ltd, Fordingbridge, Hampshire. 140 pages.

54 **Walsingham, L & Payne Gallwey, R** (1895) *The Badminton Library: Shooting. Field and covert.* Longmans, Green, and Co, London. 357 pages.

55 **Anon** (1954) *Forestry and Pheasants.* ICI Game Services, Fordingbridge, Hampshire. 43 pages.

56 **Mccall, I** (1988) *Woodlands for pheasants.* The Game Conservancy, Fordingbridge, Hampshire. 99 pages.

57 **Anon** (1963) *Annual Report 1962/3.* Eley Game Advisory Service, Fordingbridge, Hampshire. 67 pages.

58 **Anon** (1999) *A New Focus for England's Woodlands: Strategic priorities and programmes*. Forestry Commission, Edinburgh. 36 pages.

59 **Cobham Resource Consultants** (1997) *Countryside Sports: Their economic, social and conservation significance.* Standing Conference on Country Sports, Reading. 118 pages.

60 **Ludolf, C, Payne, S & Robertson, P** (1989) The effect of pheasant release pens and strawed rides on ancient woodland ground flora. In: *The Game Conservancy Review of 1988.* The Game Conservancy, Fordingbridge Hampshire. 42-46

61 **Clarke, SA & Robertson, PA** (1993) The relative effects of woodland management and pheasant *Phasianus colchicus* predation on the survival of the pearl-bordered and small pearl-bordered fritillaries *Boloria euphrosyne* and *B. selene* in the South of England. *Biological Conservation*, 65, 199-203.

62 **Sage, R, Swan, M, Currie, F & Goldberg, E** (2003) *Woodland conservation and pheasants.* The Game Conservancy Trust, Fordingbridge, Hampshire. 8 pages.

63 **Robertson, PA, Woodburn, MIA & Hill, DA** (1988) The effects of woodland management for pheasants on the abundance of butterflies in Dorset, England. *Biological Conservation*, 45, 159-167.

64 **Ludolf, IC, Robertson, PA & Woodburn, MIA** (1989) Changes in the ground flora and butterfly populations of woodlands managed to encourage pheasants. In: *Biological Habitat Reconstruction*. (Eds: GP Buckley). Bellhaven Press, London. 312-327.

65 **Blank, TH, Southwood, TRE & Cross, DJ** (1967) The ecology of the partridge. I. Outline of population processes with particular reference to chick mortality and nest density. *Journal of Animal Ecology*, 36, 549-556.

66 **Southwood, TRE** (1967) The ecology of the partridge. II. The role of pre-hatching influences. *Journal of Animal Ecology*, 36, 557-562.

67 **Southwood, TRE & Cross, DJ** (1969) The ecology of the partridge. III. Breeding success and the abundance of insects in natural habitats. *Journal of Animal Ecology*, 38, 497-509.

68 **Potts, GR & Vickerman, GP** (1974) Studies on the cereal ecosystem. *Advances in Ecological Research*, 8, 107-197.

69 **Potts, GR** (1986) *The Partridge. Pesticides, predation and conservation.* Collins, London. 274 pages.

70 **Stoate, C & Leake, A** (2002) *Where the birds sing: The Allerton project: 10 years of conservation on farmland.* The Game Conservancy Trust, Fordingbridge. 66 pages.

71 **Parish, DMB & Sotherton, NW** (2004) Game crops and threatened farmland songbirds in Scotland: a step towards halting population declines. *Bird Study*, 51, 107-112.

72 **Brickle, NW** (1997) The use of game cover and game feeders by songbirds in winter. In: *1997 Brighton Crop Protection Conference – Weeds.* BCPC, Farnham, 1185-1190.

73 **Wookey, B** (1987) *Rushall: The story of an organic farm.* Basil Blackwell, Oxford. 210 pages.

74 **Green, RE** (1984) The feeding ecology and survival of partridge chicks (*Alectoris rufa* and *Perdix perdix*) on arable farmland in East Anglia. *Journal of Applied Ecology*, 21, 817-830.

75 **Rands, MRW** (1985) Pesticide use on cereals and the survival of grey partridge chicks: A field experiment. *Journal of Applied Ecology*, 22, 49-54.

76 **Wilson, PJ** (1994) Managing field margins for the conservation of the arable flora. In: *Field Margins: Intregrating Agriculture and Conservation.* (Eds: ND Boatman). British Crop Protection Council, Farnham, Surrey. 253-258.

77 **Dover, J, Sotherton, N & Gobbett, K** (1990) Reduced pesticide inputs on cereal field margins: the effects on butterfly abundance. *Ecological Entomology*, 15, 17-24.

78 **Boatman, ND & Stoate, C** (2000) Integrating biodiversity conservation into arable agriculture. *Aspects of Applied Biology*, 62, 21-30.

79 **Boatman, ND & Bence, SL** (2000) Management of set-aside to enhance biodiversity: the wild bird cover option. *Aspects of Applied Biology*, 62, 73-78.

80 **Stoate, C & Szczur, J** (2001) Could game management have role in the conservation of farmland passerines? A case study from a Leicestershire farm. *Bird Study*, 48, 279-292.

81 **Tapper, SC, Potts, GR & Brockless, M** (1996) The effect of an experimental reduction in predation pressure on the breeding success and population density of grey partridges (*Perdix perdix*). *Journal of Applied Ecology*, 33, 965-978.

82 **Reynolds, JC & Tapper, SC** (1996) Control of mammalian predators in game management and conservation. *Mammal Review*, 1, 127-156.

83 **Potts, GR** (1980) The effects of modern agriculture, nest predation and game management on the population ecology of partridges, (*Perdix perdix* and *Alectoris rufa*). *Advances in Ecological Research*, 11, 1-82.