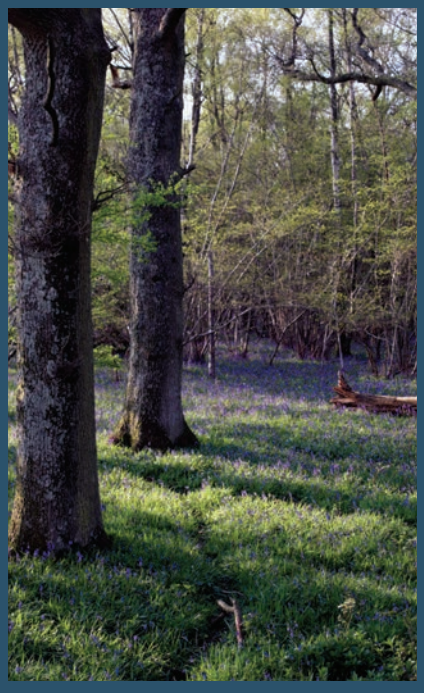
Review of 2004



A full report of the activities of
The Game Conservancy Trust
and Game Conservancy Limited

www.gct.org.uk

THE GAME CONSERVANCY TRUST

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Review of 2004

Issue 36

A full report of the activities of The Game Conservancy Trust (Registered Charity No. 279968) and of Game Conservancy Limited during the year

www.gct.org.uk

The Game Conservancy Trust's Objects

The Trust is registered with the Charity Commission (Registered Charity No. 279968):

- 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 in the conservation of game (especially, but not exclusively, in the conservation of game as a sustainable resource).

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Corporate sponsorship

The Game Conservancy Trust acknowledges the exceptional support of its Corporate Sponsors in 2004, Hiscox, RP Hodson incorporating John Wimble Insurance Brokers and International Motors Limited, in assisting vital research and educational work to conserve game, wildlife and their habitats in Britain.

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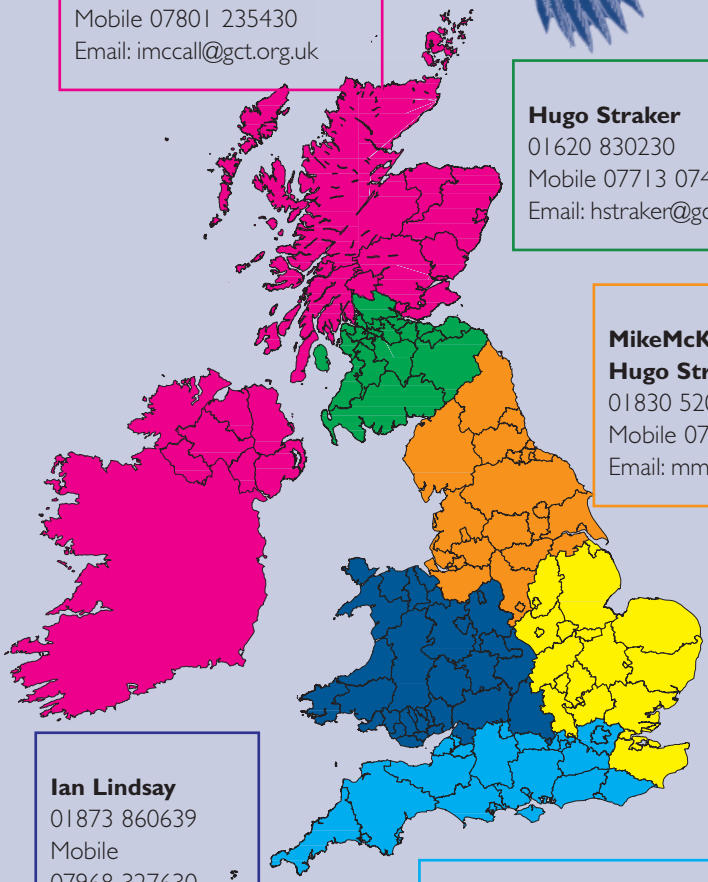

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GAME CONSERVANCY LIMITED

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as at 1 January 2005

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Chairman's report

It is often thought, even by our own members it has to be said, that The Game Conservancy Trust eschews politics. Actually nothing could be further from the truth – much of what we do is geared to informing public policy. Whether it is helping Defra with the options under Environmental Stewardship, or lobbying for sensible measures when the government is looking to regulate the rearing of pheasants or the use of snares, we deploy our science and expert advice to help Defra to do what it wants sensibly. Although we certainly don't get involved in demonstrations or publicity campaigns, we do have a significant influence, especially because, in the main, governments like to move forward on the basis of objective evidence. It is true that it doesn't always work and, in passing the Hunting Act (2004) we were hugely disappointed by the way the House of Commons chose to ignore most of the submissions and findings of Lord Burns' inquiry as well as the later hearings conducted by Alun Michael in Portcullis House. Perhaps where we have the most influence, however, is with government agencies. English Nature, Scottish Natural Heritage and others employ scientists to do research and to develop policy. To engage with these professionals, game management needs its own cadre of scientists who can advocate policy and challenge unsound science. No other game interest group can provide this expertise.

2004 was a very successful year and I am most grateful for the support we have had from our network of members who not only pay their subscriptions, but come to money-raising functions like balls and dinners, generously giving and bidding for all sorts of auction prizes, and buying tickets for the inevitable raffles. Our County Chairmen are key to this success and, on behalf of the Trustees, I thank them for their hard work, enthusiasm and bright ideas. Thanks too to our Council of Trustees, Advisory Members and Vice-Presidents who give us their time by coming to meetings to discuss the running of the Trust, but who are also prepared to read and debate our research and policy papers. As ever, I am also grateful to the continuing and generous support of our main sponsors, International Motors, Hiscox and R P Hodson, as well as many others who chip in to sponsor events, courses and our research projects.

Finally, I should like to thank Teresa Dent and her staff for their cheerful hard work, which I hope you will agree, has contributed to a most productive year.

(The Game Conservancy Trust)

Andrew Christie-Miller addressing the members at the Trust's 2004 AGM at Belvoir Castle. (Louise Shervington)

Chief Executive's report

(Photograph by Sophia Miles)

We are delighted to bring you The Game Conservancy Trust's *Review of 2004*.

The Game Conservancy Trust is a charity working to provide a scientific basis for game and wildlife management. We pride ourselves in developing a practical approach to conservation in the countryside. Because our research is 'applied' we also make it our task to promote our work to practitioners, policy makers and the public (see pages 8 and 10).

2004 was a year of real progress for our research programme. It saw the completion of the first phase of the Lowland Game Release Density Project (see pages 36 and 38). This work is assessing the environmental impact (both positive and negative) of reared and released gamebirds on wildlife habitats in the lowlands. The results will help gamekeepers and shoot managers improve their approach to maximise the conservation value of what they do. It will underpin with science the guidelines in *The Code of Good Shooting Practice*. This project was generously funded by our members through the Research Funding Appeal, and we are very grateful to all those who so kindly contributed.

Gamebird health and welfare (see page 52) is an increasingly political issue and Chris Davis, our veterinarian, has been working closely with Defra vets in their development of the Animal Welfare Bill. This was published as a draft last summer and then considered by a House of Commons Select Committee which produced a rather mixed report. (In March 2005, Defra published a constructive and sensible response and we expect a revised Bill to be published late in 2005.)

Stocking trout in rivers in many ways mirrors releasing pheasants into woodland. The issues are broadly similar. Our study of brown trout stocking nears completion and its results (see page 50) are highly relevant to the Environment Agency's *Trout and Grayling Strategy*.

Farmland ecology has always been a strong element in our work to support game in the countryside. Once regarded by some as a bit of an extravagance, the investment is now paying off in guiding agri-environment policy. Much of the work done

Our research is of a very practical nature, a feature that is well illustrated in our work to restore the River Monnow as a viable trout habitat. (Ian Lindsay)

Grey partridges on our rearing field at Fordingbridge being reared for release in our new partridge reintroduction project. (Sophia Miles)

at our demonstration farm at Loddington, home of The Allerton Project (see page 12), has gone into the new Entry Level Stewardship scheme which was approved by Brussels in December 2004. We have also been advising Defra on how to implement the EU soil management requirements at farm level.

The largest farmland insect study undertaken in Europe was completed by our Entomology Department this year (see page 46). Only a few farmland birds, like the linnet, don't rely on insects to feed their chicks, most of the others need high-protein insect diets to help their chicks grow and fledge. This simple fact is what makes the work of our Entomology Department so central to conservation.

Predation too has been a consistent theme in much of our work, and whereas some, like our improvement of mink control, contribute directly to helping game and river keepers (see page 56), others like our Upland Predation Experiment at Otterburn, are designed primarily to inform policy. This project has now reached its halfway milestone. So far the results suggest that gamekeeping does have a positive effect on the breeding success and population size in some of the ground-nesting waders (see page 64). The next four years will see this project reach completion.

Sadly many of our game animals have fared badly in the face of intensive land-use and many are the subjects of species recovery programmes under the Government's Biodiversity Action Plan. We play a key role in guiding this work for several species and habitats. We are delighted to have hit the interim Biodiversity Action Plan target for black grouse, and we expect to hit the equivalent target for the grey partridge in 2005. A new research project in 2004 was the grey partridge re-introduction project designed to identify the best method of re-introducing greys into areas of very low population or local extinction (see page 32). One could describe this project as the one we were all hoping to avoid, but the 86% decline between 1970 and 2001 has made it essential.

Finally, I am happy to report that the Trust had a good financial year in 2004 and our accounts can be found at the end of this *Review* (see pages 86-89).

Communication

Key achievements

- New look *Review of 2003* was well received by members and was shortlisted for Charity Publishing Awards.
- A range of topical newsletters informed about specific subjects.
- New website launched with fresh and practical feel.
- Best practice guide on strongylosis enabled red grouse managers to avoid the disease in their flocks.
- Press coverage in terms of equivalent advertising costs of editorial column inches hit £2.7m, up from £800,000 three years ago.

Sophia Miles

Below right: Our mink raft training day attracted many despite the weather. (Sophia Miles).

Black grouse are occasionally shot on red grouse days. This guide enables shooters to avoid mistakes.

Publications

This is the second of our new-style annual reviews. The reports are now shorter, punchier and, we hope, clearer. The new format has been popular and last year we entered it for the Charity Publishing Awards and were delighted that it reached the final short list for 'Charity Annual Report of the Year'. We are grateful to Hiscox for sponsoring this.

Our magazine, *Gamewise*, which is produced three times a year, aims to provide more chatty and informative pieces about all our activities as well as keeping our members up to date on wildlife management issues and events.

Over the year we also published a series of newsletters on topics including the National Gamebag Census, black grouse, Northern Ireland news, grey partridges, pheasant densities, Scottish news and two issues on our Allerton farm.

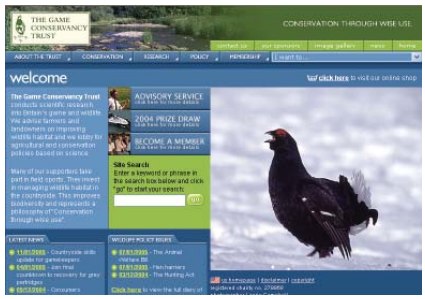
We added to our fact sheet series, with guides to spring feeding, strongylosis control in red grouse, and black grouse identification.

Website

We launched a new website, re-designed for us by Headscape, in the spring. In the following months we built up the content so that it now provides a complete reference to our research work including a database of our scientific papers. Our Advisory Services and courses are highlighted as well as all our county membership events. Combined with stunning photographs kindly donated by Laurie Campbell, the result is now a fresh, informative and practical hub for those wanting to know about the Trust.

Face-to-face

The summer show season gives us the chance to promote our work to a wide audience. The CLA Game Fair and the Scottish Fair at Scone are key events, but we also had busy stands at the Royal Show and at Cereals. In addition we were pleased to



Our new, re-designed website went live in the spring 2004 and attracted an increasing number of 'hits' during the year.

Left: Jonathan Reynolds (middle back row), Mike Short, Rhian Leigh and Tom Porteus collecting their UFAW animal welfare award for the GCT Mink Raft from MP Ben Bradshaw (back left) and UFAW's James Kirkwood (back right). The award achieved a plenty of press coverage. (The Game Conservancy Trust)

be at the Countryside Foundation's Countryside Live event, which brings city school children into contact with the countryside, its wildlife and rural activities.

Our usual one-day game management days and residential courses run by our Advisory Services were well-attended, and increasingly popular.

Policy and politics.

Although we don't run high-profile political campaigns we do try to influence government policy on matters relating to wildlife management. We responded to a series of Defra consultations in 2004 on issues including woodland grants, badgers, wild deer and cross-compliance. We were also successful in getting many of our farmland conservation ideas into the new Entry Level Stewardship scheme. The statutory conservation agencies are also important to us and, in particular, we devoted a lot of effort in helping English Nature and Scottish Natural Heritage resolve the difficult issue of raptors on grouse moors - we emphasised the importance of grouse management in maintaining the upland wader populations that are the basis for England's largest Special Protection Areas (see page 82).

Press coverage

Our media coverage continues to rise across all sectors - especially the sporting press, but also farming, consumer titles, and regular stories in the nationals. One aim in 2004 was to increase coverage in the regional press and we achieved with some excellent stories.

Highlights were our mink raft, which was covered in *The Independent* and *The Daily Telegraph*, and the grey partridge recovery project based at Royston which was a TV story on BBC News 24.

Other coverage included a five-minute interview on black grouse on BBC Radio 4's *Today*; The Game Conservancy Ball in *The Times*, *The Daily Telegraph*, *The Daily Mail* and *Hello*; the woodcock survey in regional press. Our views on the lessons of the Joint Raptor Study at Langholm was discussed extensively by Magnus Linklater in the week-end *Telegraph* and our insect research funded by RELU was featured in *The Saturday Times*.

Boys will be boys when it comes to bugs! Countryside Live enabled us to show lots of children what we do for the countryside. (The Game Conservancy Trust)

Our microscope at Countryside Live attracted a queue of children wanting to see close up. (The Game Conservancy Trust)

BAP species recovery advice

Key achievements

- Tailored on-site advice on 'our' BAP species to over 40 properties.
- Over 200 land managers attended BAP evenings at demonstration sites.
- We had around 400 new recruits to the Partridge Count Scheme.
- Increased awareness of the value of the new Environmental Stewardship Schemes to game and wildlife.

Mike Swan

2004 was a vintage year for Game Conservancy Limited's delivery of practical management advice, especially on Biodiversity Action Plan (BAP) species. The Trust is lead partner for the grey partridge BAP, and joint lead partner for brown hare and black grouse with the Mammal Society and the RSPB respectively. We were therefore delighted to be awarded a £20,000 grant by the Ernest Cook Trust to allow our regional advisory team to offer discounted advisory visits for these three species, and to run a UK-wide series of demonstration events for farmers, keepers and other land managers keen to help them.

This has been particularly timely in the period leading up to the Single Farm Payment and the associated new environmental and stewardship schemes, particularly the Entry Level Stewardship scheme in England. At last we are entering an era when all farmers can join a conservation scheme with potential to improve habitat for our BAP species. The Game Conservancy Trust has researched and developed many of the relevant prescriptions over the last few years.

The Ernest Cook Trust grant enabled our regional advisors to visit over 40 properties across the country. Not surprisingly, the grey partridge was the main interest on 75% of these, but black grouse was the key species on a substantial minority, while the brown hare was the main focus on a few. On several, more than one of these species were present, and so were likely to benefit from the advised prescriptions. With an average of 4.6 people present on these visits, over 200 people with real influence should have benefited.

Of the six demonstration events, one in each advisory region, the one in the north of England was aimed exclusively at black grouse with the remaining five targeted at grey partridges and brown hares. Joining working farmers, gamekeepers and other conservationists, we were especially delighted that senior officials from Defra in England and SEERAD in Scotland attended, and demonstrated their enthusiasm for these examples of best practice.

In many ways, this package of subsidised advice was only the tip of the iceberg. Helping 'our' BAP species has been a key theme of advisory work, training courses,

A generous grant from the Ernest Cook Trust enables us to provide discounted advice for BAP species like the grey partridge. (Alexis de la Serre)

We are making great progress with conserving black grouse, particularly in the North Pennines. (Laurie Campbell)

evening talks, shoot walks and many other events. The practical 'delivery' of our research goes beyond the Advisory Service team, with Peter Thompson (Biodiversity Officer), Stephen Browne (Grey Partridge Ecologist), and Phil Warren (North Pennines Black Grouse Recovery Project Officer), in particular, also offering help and guidance to many people.

As 2004 came to its close, we provided an increasing amount of advice on how the new environmental stewardship schemes could offer both an enhanced environment for these BAP species, and improved conditions for the 'bread and butter' gamebirds, like pheasant, redlegs and red grouse. This is a particularly important link, for, apart from very exceptional circumstances, it is only where a keeper is doing his best for the latter that the former are likely to flourish.

Brown hares are no longer declining in number in the UK, but careful management is necessary to ensure numbers remain stable. (Sophia Miles/Natterjack Publications Ltd)

Loddington in 2004

Key achievements

- We are improving our understanding of the complexity of keepering and its benefits to game and non-game species.
- New projects on aquatic ecology have started.
- Our demonstration role becomes increasingly important as agri-environment policies develop.

Alastair Leake
Chris Stoate

2004 was the third year with no predator control on the farm. We are often asked by visitors how long we intend this to last. The answer is, as long as is necessary for us to be confident about interpreting the effect on wildlife. Kate Draycott continues to count game in autumn and spring, and Chris Stoate continues to monitor songbird numbers. Although it is clear that autumn numbers of game (see page 16) have dropped dramatically and continue to do so, the results so far for spring numbers of game and songbirds are mixed (see page 17).

Our study of feed hoppers and the species that use them has been enlightening. Where feed is abundant, pests like rats and squirrels seem to benefit as much as the songbirds and gamebirds (see page 18).

In 2004, we started a number of inter-linked research projects on soil and water-related issues. These will help us to mitigate problems for brown trout and other aquatic wildlife, while also creating new wetland features on the farmland.

The changes to the Common Agricultural Policy drew a lot of visitors to Loddington in 2004. In future, payments to farmers will be 'de-coupled' from production and will depend on compliance with environmental legislation. We have been showing farmers and their advisors on our training and open days how to cope with this change and maximise the conservation gain.

Visitors in 2004 included two groups from EU-funded water quality programmes, Water4All and the Soil and Water Protection Project (SOWAP) for which Loddington is the principal UK site. We held a training day for The British Institute of Agricultural Consultants (BIAC) and hosted a visit of 30 people from the Danish Wildlife Management College.

Allerton Research & Educational Trust research in 2004

Project title	Description	Staff	Funding source	Date
Effect of predation control (see page 16)	*Effect of ceasing predation control on nesting success and numbers of game and songbirds*	*Alastair Leake, Chris Stoate, John Szczur, Simon Davies, Kate Draycott*	*ARET*	*2001 - on-going*
Monitoring (see page 16)	*Annual monitoring of game species, songbirds, invertebrates and habitat*	*Alastair Leake, Steve Moreby Sue Southway, Chris Stoate, Kate Draycott, Barbara Smith*	*ARET*	*1992 - on-going*
Songbird ecology	*Ecology of songbirds at Loddington, including, species specific studies on tree sparrow and spotted flycatcher, and influence of habitat on nesting success*	*Chris Stoate, John Szczur, Kate Draycott, Frances Lancaster*	*ARET, English Nature, RSPB*	*1992 - on-going*
Grey partridge recovery project (see page 28)	*Restoration of grey partridge numbers: a demonstration project*	*Alastair Leake, Malcolm Brockless, Nicholas Aebischer, Steve Moreby, Sue Southway, Stephen Browne, Julie Ewald*	*Game Conservancy USA, Research Funding Appeal, GCT core funds*	*2001-2006*
SOWAP project	*Demonstrating the use of conservation tillage to protect and enhance soil resources, water quality and biodiversity*	*Alastair Leake, Chris Stoate, Kate Draycott*	*EU Life*	*2003-2006*
Phosphorus from agriculture: riverine impact study	*Impacts of agriculturally-derived silt and phosphorus on aquatic ecosystems in the Eye Brook upper catchment*	*Chris Stoate*	*Defra*	*2004-2008*
Nutrients in water	*Assessing field drain and stream water quality at Loddington*	*Chris Stoate, Kate Draycott*	*Anglian Water*	*2002 - on-going*
Wetting up farmland for wildlife	*Assessment of bird conservation potential of small wet features on farmland*	*Chris Stoate, John Szczur*	*Defra*	*2004-2008*
Pathfinders	*Research element of Vocational Training Scheme, investigating farmers' participation in agri-environment schemes*	*Chris Stoate*	*Defra*	*2003-2005*
Muntjac and ground flora	*Assessment and mitigation of damage to woodland ground flora by muntjac deer in Leighfield Forest*	*Chris Stoate*	*English Nature*	*2004-2007*
PhD: Breeding songbird habitat use	*Foraging behaviour, chick diet and nesting success in relation to invertebrate availability for skylark, yellowhammer and song thrush*	*Kathryn Murray (Supervisors: Chris Stoate, ARET, A Wilcox, Harper Adams College)*	*HEFC, ARET*	*2000-2004*
PhD: Birds and bees	*Role of pollinating insects on autumn berry abundance as food for birds*	*Jenny Walker (Supervisors: Chris Stoate, ARET; J Osborne, Rothamsted Research)*	*BBSRC CASE*	*2004-2007*

Key to abbreviations: BBSRC = Biotechnology and Biological Sciences Research Council; RSPB = Royal Society for the Protection of Birds

The farming year at Loddington in 2004

In contrast to the dry conditions of 2003, 2004 saw plenty of rain (175 mm in August compared with just 9 mm in August 2003). Our automatic weather station recorded rainfall on 61 of 92 days between August and October. With the rain came a difficult, wet harvest and challenging conditions for autumn drilling. Our new in-store drying floor was put to the test and performed well.

Out in the fields we managed to get on top of the black-grass, but the wet weather caused low hagbergs and *Fusarium* in the wheat. We harvested the oats just before the weather broke, and it proved to be a good crop. Yields for oilseed rape and beans were above average, with beans bucking the trend of falling prices. Struggling wheat prices at £65 per tonne represented a sharp fall from £94 per tonne

Key results

- Above average year for oats, oilseed rape and beans.
- Low prices and high drying costs made 2004 an expensive year for wheat.
- Lamb prices, though down on 2003, remained respectable.
- Wet weather made the year difficult with water-logged fields and slug infestation.

Alastair Leake
Phil Jarvis

The farm at Loddington contains many features which can now be found within the Entry Level Stewardship Scheme. (Phil Jarvis)

Table 1

Arable crop yields (tonnes/hectare) at Loddington 1994-2004

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	Est 2004
Winter wheat	7.66	8.61	10.19	7.00	9.34	9.62	8.89	7.25	8.20	8.35	8.20
Winter barley	5.62	7.38	7.38	7.11	5.60	6.20	4.96	3.89	4.52	-	-
Winter oilseed rape	2.13	3.47	3.62	2.61	2.23	3.59	2.93	1.61	3.67	3.03	3.30
Spring oilseed rape	1.26	-	-	2.01	-	-	-	-	-	-	-
Winter beans	1.56	3.19	3.52	4.44	3.64	2.99	3.95	2.29	2.99	4.35§	3.84§
Winter oats	-	-	-	-	-	-	-	-	6.37	7.10	7.10
Linseed	0.82	0.93	-	1.16	-	1.36	-	-	-	-	-

* revised figures; § spring beans

Table 2

Arable gross margins (£/hectare) at Loddington 1994-2004

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003*	Est 2004
Winter wheat	773	1,007	981	551	668	723	572	603	518	836	536
Winter barley	596	877	802	625	478	534	403	315	328	-	-
Winter oilseed rape	520	808	868	593	469	468	523	329	611	614	477
Spring oilseed rape	433	-	-	-	-	-	-	-	-	-	-
Winter beans	450	626	574	616	507	553	573	331	452	491§	415§
Winter oats	-	-	-	-	-	-	-	-	462	759	545
Linseed	473	535	-	497	-	477	-	-	-	-	-
Set-aside	301	331	335	326	296	317	205	204	251	247	217

* revised figures § spring beans

Table 3

Farm conservation costs at Loddington 2004 (£)

Set-aside *(wild bird cover)*[1]	
(i) Farm operations	633
(ii) Seed	1,100
(iii) Sprays and fertiliser	274
Total set-aside costs	**2,007**
Conservation headlands[2]	
(i) Extra cost of sprays	0
(ii) Farm operations	88
(iii) Estimated yield loss	117
Total conservation headland costs	**205**
Grain for pheasants	1,434
Grass strips	114
Stewardship	1,703
Other conservation work	2,159
Total conservation costs	**7,622**
Project-funded seed	(1,100)
Stewardship income	(1,410)
Total profit foregone	
- conservation	**5,112**
- research and education	**1,890**
	7,002

[1] Area of wild bird cover = 7.39 ha

[2] Area of conservation headlands = 4.35 ha

Further information on how these costs are calculated is available from the Allerton Research & Educational Trust

in 2003, and once the costs of drying are added 2004 will prove to have been an expensive year.

In 2004, we sold about 40% of our lambs as stores, but still achieved a respectable price of £42 per lamb. Lambs finished heavier owing to rotational grazing with our neighbour's cattle. We were delighted to have Richard Wright's prize-winning herd of South Devon cattle gracing Loddington's pastures. Our joint-venture farming operation with the team from Oxey Farm had a difficult year, but we came out of it stronger and wiser. Water-logged fields and a hungry army of field slugs were some of the difficulties we encountered.

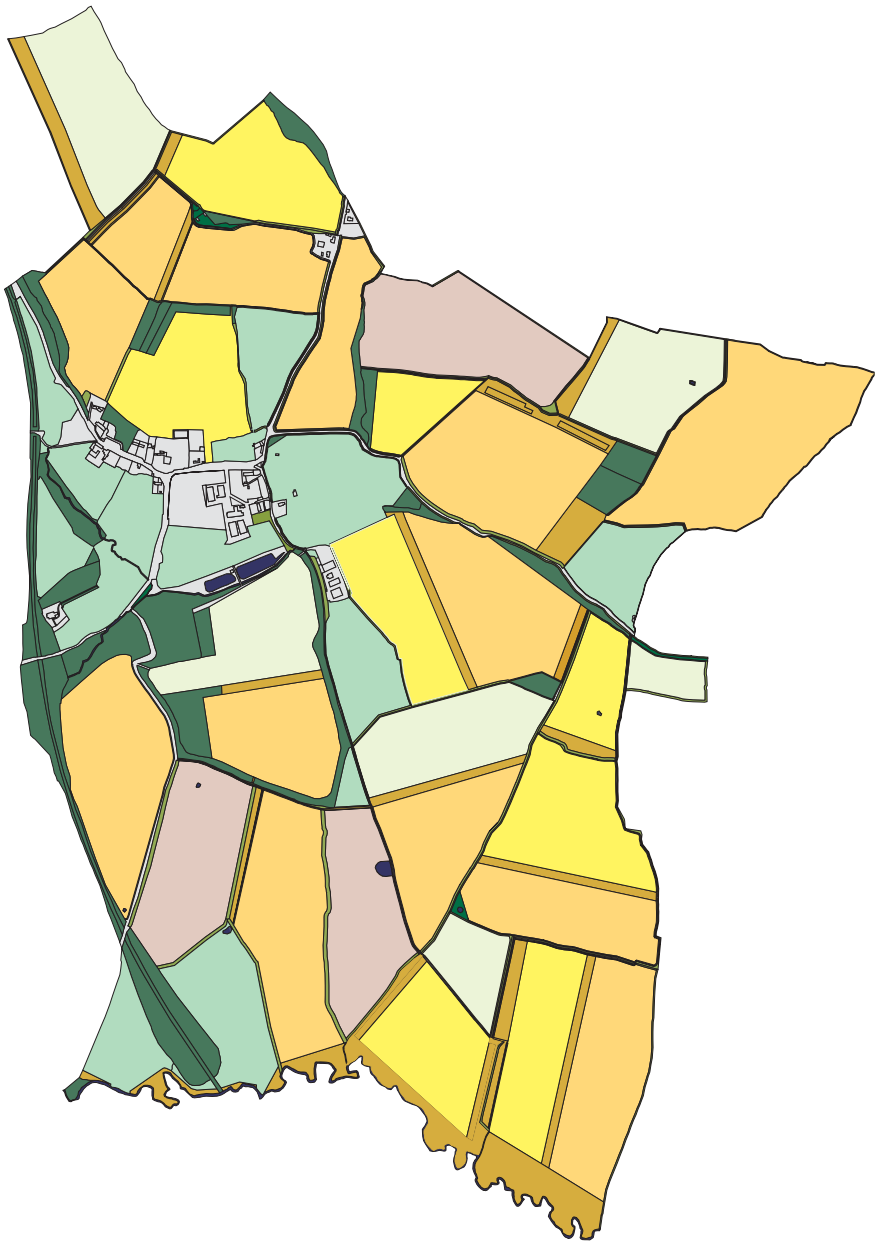


Figure 1

Loddington Estate cropping 2003/04

- Woodland
- Permanent pasture
- Winter wheat
- Winter beans
- Winter oilseed rape
- Winter oats
- Set-aside
- Hedgerow/verge

With our increasing commitment to Countryside Stewardship and woodland management, the farm workforce has been involved in numerous fencing, coppicing and field margin projects. A number of these schemes have been unveiled in the new Entry Level Stewardship.

Far left: wild bird cover on set-aside at Loddington. (Phil Jarvis)

Table 4

Loddington profit and loss 1994-2004 (£)

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Total gross margin	146,170	217,193	219,540	159,705	137,323	143,173	141,896	111,952	144,318	194,144	146,365
Total direct costs	(41,534)	(70,835)	(62,946)	(84,622)	(64,484)	(63,216)	(82,820)	(62,463)	(75,558)	(78,840)	69,966
Gross profit	104,636	146,358	156,593	75,083	72,839	79,957	59,076	49,489	68,760	115,304	76,399
Total overhead costs	(41,421)	(23,615)	(30,544)	(23,059)	(15,329)	(17,287)	(12,302)	(14,246)	(15,482)	(16,339)	22,539
Profit before depreciation	63,215	122,743	126,049	52,024	57,510	62,670	46,774	35,243	53,278	98,965	53,860
Total profit foregone	4,563	6,588	3,453	4,637	3,643	3,533	2,605	3,642	4,907	6,567	7,002
Farm profit (loss)	35,746	114,927	96,925	21,594	25,422	35,550	26,046	3,895	15,064	55,220	32,206

Loddington game and songbirds

Key findings

- Autumn game numbers continue to drop.
- Carrion crow numbers are back to 1992 levels.
- Magpie numbers are not back up to 1992 levels.
- Local people have increased magpie control since 1992.
- Spring pheasant numbers increased as winter feeding improved.
- So did songbird numbers.

Chris Stoate

It has been three years since Malcolm Brockless (our gamekeeper) left Loddington and began work at Royston. Without his predator control, remaining staff have continued other keepering activities such as winter feeding and habitat management as far as possible, but we took on additional help for winter feeding during the 2003/4 winter.

Game numbers

The 2004 autumn pheasant count produced only 137 birds. The greatest decline was in hens and young birds, suggesting that nest predation is the main cause of loss (see Figure 1). Autumn numbers of red-legged partridges also dropped for the third consecutive year. Autumn hare numbers declined in the past two years.

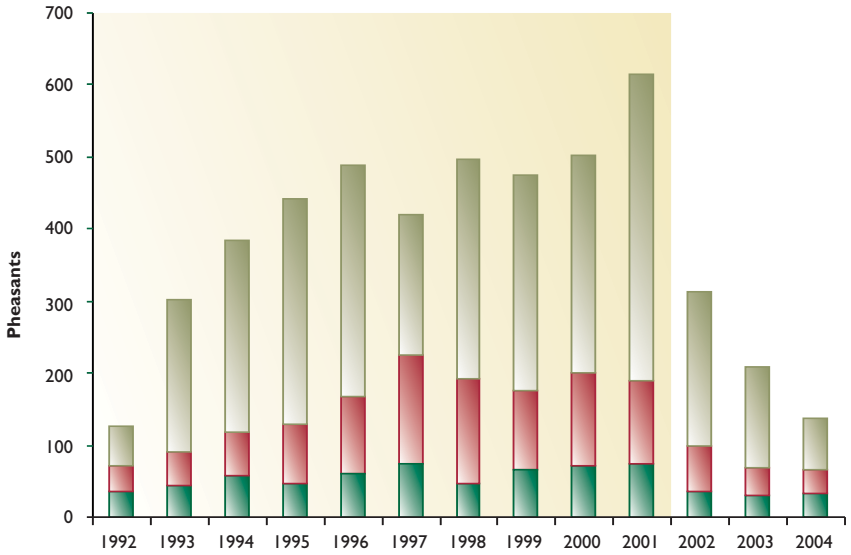
Spring pheasant numbers dropped in the first two years after predator control stopped, but increased in 2004 (see Figure 2). So pheasant numbers survived better through the 2003/4 winter than through the previous two, or moved onto the farm from surrounding releasing estates, probably as a response to our additional winter food. This ties in with earlier research which showed that spring numbers of pheasants are influenced both by availability of food in winter and breeding success the previous summer.

Songbird numbers

Carrion crow numbers have returned to the eight pairs that there were before predator control began in late 1992. However, numbers of magpies, the main nest

Figure 1

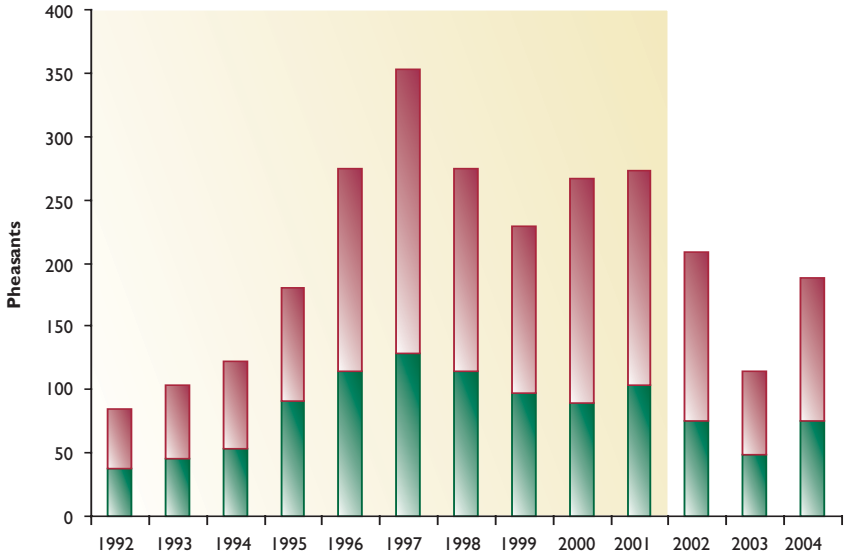
Pheasant numbers in autumn at Loddington



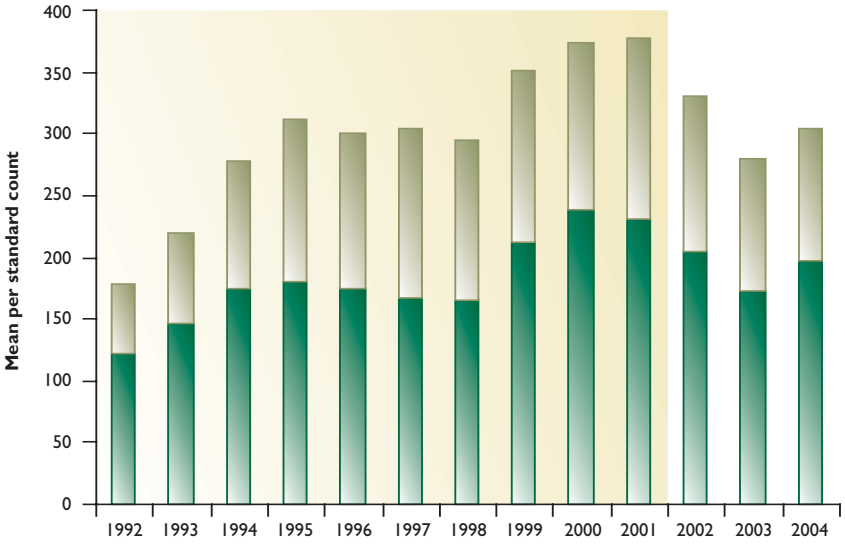
Autumn pheasant numbers continue to drop

Figure 2

Pheasant numbers in spring



Spring pheasant numbers were up on 2003, but had not regained the position they held when we controlled predators



predator of many songbirds, are only back to five, compared with 10 in 1992. A survey of local farmers revealed that half of them have increased magpie control over this period having heard about our work at Loddington, and this may explain the failure of magpies to rebuild their numbers.

Spring songbird numbers declined in 2002, the first year without predator control, and again in 2003, but showed a slight increase in 2004 (see Figure 3). Winter songbird numbers have been monitored since 2000/1 (see Figure 4). Numbers dropped in each of the two years following Malcolm's departure, probably because there was less seed from hoppers, hand feeding and game crops, but increased in 2003/4 with additional effort for winter feeding and better establishment of game crops.

The slight increase in spring songbird numbers, like the pheasants, probably results from improved winter feeding. Winter food may attract birds to Loddington in the late winter/spring and improve their survival and chances of staying on the farm to breed. However, for one species that is migratory and therefore not influenced by winter feeding, there is evidence that predator control affects abundance. Spotted flycatcher nesting success was higher in the early years of the project when Malcolm was present and breeding numbers increased from eight to 14 pairs, but they have dropped back to eight pairs in the last two years since Malcolm left.

Influences on game and songbird abundance

Because the project is not a true experiment with replication and controls, it is difficult to isolate the effect of predator control from other gamekeeping activities such as winter feeding. Both, along with habitat management, appear to be important activities that influence both game and songbird numbers.

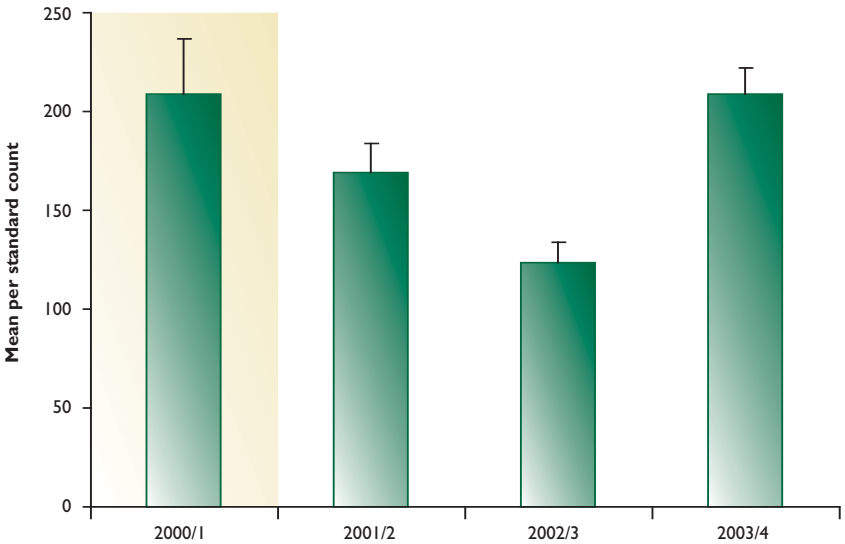


Figure 3

Songbird breeding numbers, spring 1992-2004

Nationally declining species

Other songbird species

Predator control in place

Teasing out the importance of the keeper at Loddington for game and particularly songbirds, is a complex task. (Chris Stoate)

Figure 4

Songbird winter numbers (without greenfinch) at Loddington

Predator control in place

Note: greenfinch is excluded from Figure 4 as a large area of sunflowers established in 2003/4 resulted in exceptionally large numbers of this bird.

The use of feed hoppers

Key findings

- Feed hoppers provide a valuable food source for songbirds in winter
- Unwanted pest species also use the hoppers
- Hoppers emptied faster than project staff could refill them

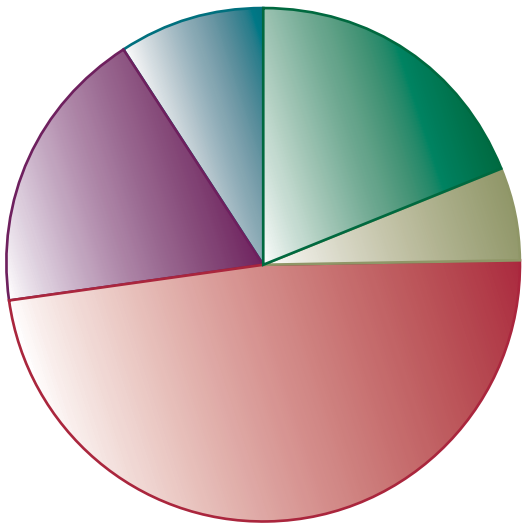
Kate Draycott

Our feed hoppers were popular with small birds such as yellowhammers. (Chris Stoate)

In 2001, Loddington lost its keeper and predator control when Malcolm Brockless left to take up his position on our Grey Partridge Recovery Project at Royston. Other game management continued at Loddington, including the provision of winter food, both through crops grown on set-aside, and by providing food in hoppers.

Figure 1

Time spent by wildlife feeding from hoppers



By the middle of the winter of 2001/2002, it was clear that feeding wildlife using hoppers was more onerous than we had expected. Hoppers were emptying faster than project staff could refill them.

By the end of the year, the amount of grain used during this period was double that when Malcolm was at Loddington. Even more surprising was that gamebird counts indicated that their numbers had halved during this period.

So, where was all this additional grain going? It seemed inconceivable that if gamebird numbers had halved, they were responsible for the additional consumption. We therefore set up a pilot project to get an idea of what was happening, with the possibility of enticing further funding for a bigger project in the future.

In our pilot study we observed several hoppers on the farm that we thought were particularly likely to deplete for a period of a few weeks. Using CCTV cameras 24 hours at a time, we recorded each species visiting the hopper. It is clear from our results that these feed hoppers provide a food source for small birds (see Figure 1). Small birds are capable of feeding both directly from the hopper nozzle, and from the ground beneath where spilt grain is lying. The height of the hopper and the protective guard are useful in ensuring that gamebirds receive a significant proportion of the feed from the nozzle and less from the ground.

We found that mammals generally frequented the hoppers during the night whereas gamebirds, corvids and other small birds were more likely to visit during the day.

Providing wheat through hoppers designed for gamebirds also benefits a range of other species, some of which are desirable from a conservation viewpoint. Small birds and mammals, for example, which are particularly prone to winter starvation, clearly find it a valuable food source.

We found that a number of pest species also used the hoppers, including rats, squirrels and corvids. Thus, in the absence of a gamekeeper who controls the undesirable species, it seems that providing food in an open countryside environment attracts and benefits many species, some which we would prefer not to encourage.

Feeders provide a valuable food source, particularly in the winter when naturally-occurring food is scarce. (Kate Draycott)

Skylarks and yellowhammers at Loddington

Key findings

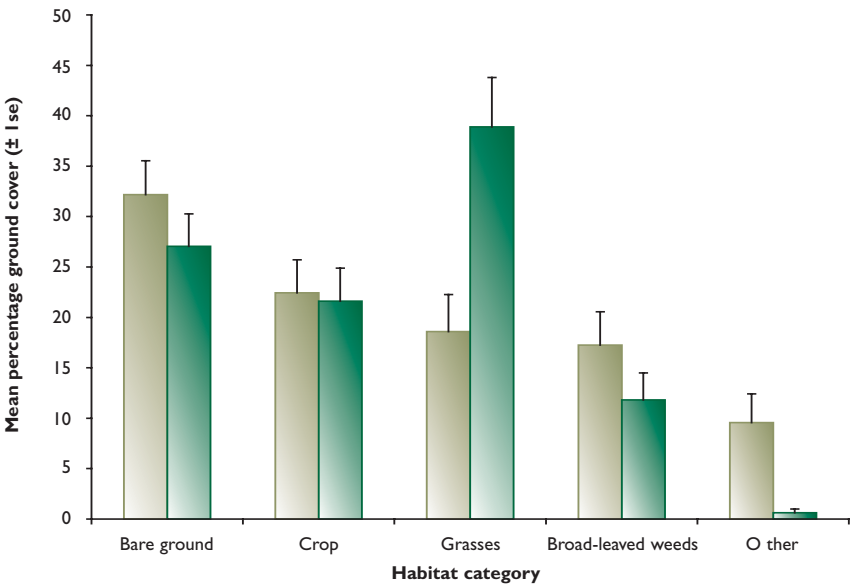
- Managed set-aside strips were important nesting and foraging habitats for skylarks.
- In winter cereals, skylarks preferred to forage in open bare patches than in dense crops.
- Cereal-based set-aside mixes and cereals were preferred foraging habitats of yellowhammers.
- Skylark nest survival was positively related to the area of set-aside around the nest.
- Skylarks and yellowhammers selectively fed caterpillars and spiders to their nestlings. Both species also fed nestlings unripe grain.

Kathryn Murray

Managed hedge, ditch and verge habitats used by breeding yellowhammers at Loddington to nest and forage. (Kathryn Murray)

Figure 1

A comparison of the plant group composition (as a percentage) at skylark nest sites and random sites within the same habitat type



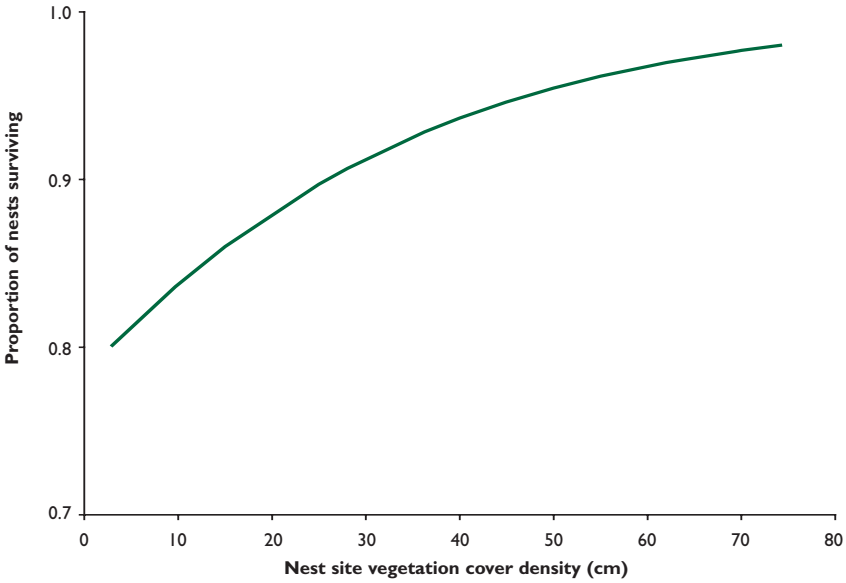


Figure 2

Empirical relationship between skylark nest survival during the nestling stage and density of vegetation cover at the nest site

Skylark and yellowhammer are two familiar farmland birds, with the skylark's distinctive song flight and the yellowhammer's distinguishing colour and characteristic call 'a little bit of bread and no cheese'. Both species have declined nationally owing to agricultural intensification. The skylark is a ground-nester, preferring open spaces and avoiding field boundaries. The yellowhammer occupies hedgerows, ditches and field margins where it nests. Skylarks breed between April and August and yellowhammers between May and September, both making up to three breeding attempts a season and laying a clutch of three to five eggs. The adults are seed-eaters, but nestlings require a predominantly invertebrate diet.

At Loddington, we found skylark nest densities to be highest in set-aside (particularly on beetle banks and in cereal set-aside mixes) and lowest in crops. We found nests in sites with more grass cover (particularly perennial) and less cover of broad-leaved plants (see Figure 1) and nest survival improved with increasing vegetation density at the nest site (see Figure 2).

Yellowhammer nest densities were highest in field margins and herbaceous vegetation. Grass margins can therefore provide suitable nest sites and can be created through Entry Level or Higher Level Stewardship or their national equivalents.

We found that, while feeding young, skylarks foraged most in kale, cereal-based set-aside, beetle banks and grass set-aside, whereas yellowhammers preferred to forage in cereals and cereal-based set-aside. Skylarks also liked winter cereals with exposed bare ground and less crop. Spring cereals or double-row-width cereals improved foraging habitat for skylarks. We found no evidence that either species selected areas with higher invertebrate abundance.

We examined chick diet of the two species using neck collars which allowed us to remove carefully and identify each food item delivered to the chick. Although adults of both species fed their chicks a wide range of invertebrates, both preferred caterpillars and spiders. Both species also fed unripe grain to nestlings and, although this is commonly recorded for yellowhammers, it has not been for skylarks.

We weighed chicks regularly and found that skylark growth rates were better in areas with more set-aside, leading to significantly better chances of fledging. Growth rates were lower around permanent pasture, woodland, hedgerows and buildings.

Skylarks at Loddington clearly benefited from managed set-aside both for nesting and foraging. However, most farms do not have set-aside in strips, but rather in blocks, so our results may not be typical everywhere. Our work illustrates the importance of distributing habitats across farmland in appropriate proportions to benefit farmland birds such as skylarks and yellowhammers.

Many thanks to Harper Adams University College for enabling us to do this work.

Kathryn Murray sampling invertebrates in a cereal field using a D-vac. (The Game Conservancy Trust)

Three-day old skylark chicks begging in the nest. (Kathryn Murray)

Song thrushes and woodland

Key findings

- Nest survival during incubation was positively related to the amount of permanent pasture around the nest.
- Nestlings in woods and hedges survived better than those in gardens.
- Woodland was the most used habitat, and had the best supply of food.
- Song thrushes did not use set-aside when searching for food.

Kathryn Murray

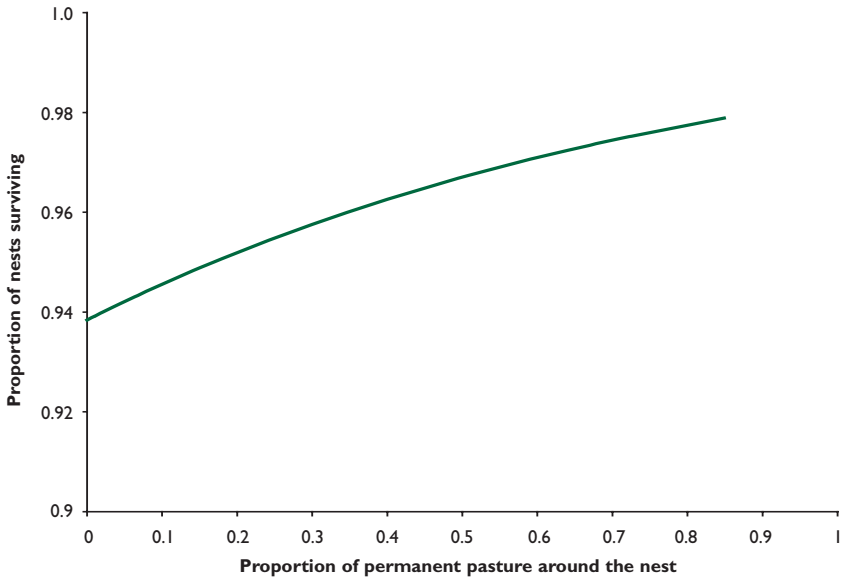
An adult song thrush, tagged for identification. (Kathryn Murray)

The song thrush is a secretive species, foraging in hedgerows, ditches and undergrowth, so we had to use telemetry to study them during the breeding season. Song thrushes nest between March and August and lay a clutch of between two and five eggs, which hatch after 13 days. We found nests by searching suitable areas and then checked them daily. Once the young were at least two days old, we caught the males using mist nets at the nest. We chose males because they do most of the foraging, while the female spends most time brooding the young, thus males give a better indication of habitat use.

We used 'back-pack' radio-tags, which weighed less than 5% of the bird's weight and were fitted with thermistors (tiny thermometers), which told us that birds were

Figure 1

Empirical relationship between song thrush nest survival and proportion of permanent pasture around the nest



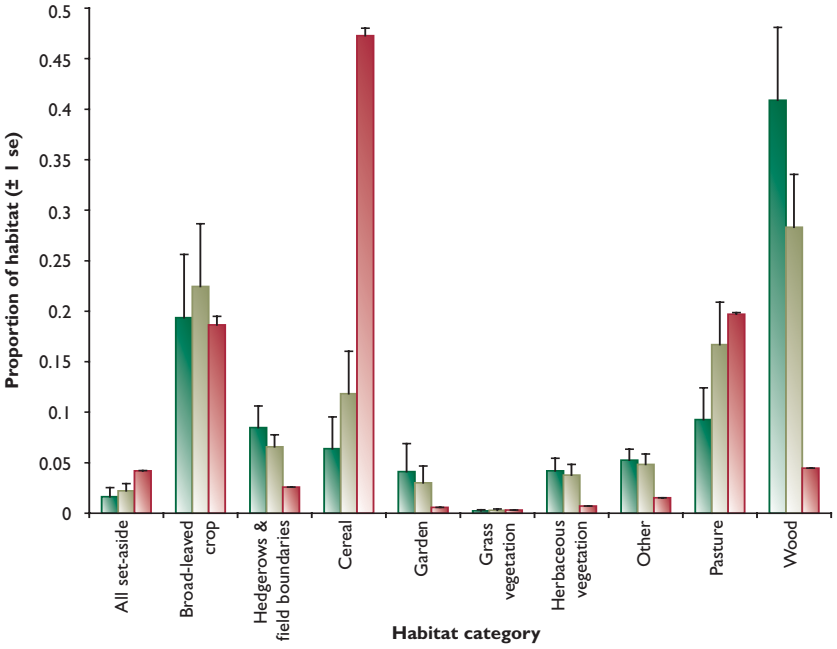


Figure 2

Habitat availability compared with habitat use by provisioning song thrushes across Loddington during 2000-2002

Song thrush foraging use

Song thrush range

Song thrush study area

Foraging song thrushes used woodland significantly more than all set-aside and cereal, and used 'other' and boundary habitats significantly more than grass vegetation. Permanent pasture, cereals and broad-leaved crops were used less than expected when song thrushes were feeding nestlings.

alive and well. We took a series of 'fixes' over at least three days for each bird and plotted them on a map to determine foraging habitat.

Most song thrushes nested in woodlands and hedgerows and some females settled less than 15 metres apart. Nestling survival was better in these habitats than in gardens, where the largest cause of nest failure was predation during incubation. Nest survival was positively related to predator control. Nest survival during incubation increased with the amount of permanent pasture around the nest (see Figure 1). Pastures are rich in earthworms, and this may have allowed females to spend more time on their eggs and less time foraging for food. In woodland, nest survival was low at the beginning and end of a season, perhaps reflecting changes in habitat structure and concealment from predators.

Relative to availability, woodland, hedgerows and field boundaries were the habitats used most by song thrushes when feeding their young (see Figure 2), and these held most earthworms and other invertebrates. Song thrushes did not use wildlife crops or set-aside when feeding their young.

Many thanks to Harper Adams University College for enabling us to do this work.

A song thrush nest with eggs, in a wood. (Kathryn Murray)

Woodland and lowland game ecology in 2004

Key achievements

- Away from release pens, the effects of released pheasants on the habitat are subtle and difficult to detect.
- Game management benefits woodland habitat.
- Low densities of deer can significantly alter structure in small farm woodlands.

Rufus Sage

Our research programme of impacts of released game on lowland habitats was again a major component of the research effort in the Lowland Game Research department in 2004. We present results from our extensive wood-edge and hedgerow survey (see page 26). We find that as pheasants disperse from release points, impacts are subtle and difficult to detect in the context of other land-uses.

In the first stage of a study of the effect of game in lowland woodlands we compared interior structure and wildlife in 80 game and 80 non-game woods (see page 38). Initial indications are that game management does improve these habitats for wildlife. In 2005 we hope to look at woodland edge habitats in the same sample of woods.

After the first of two field seasons, we have found no effects of the release of red-legged partridges on chalk grassland plants and insects. The second year of study will focus on butterflies and soils and will be reported in the *Review of 2005*.

On page 40 we report a study which documents the effects of deer in small farmland woods and the consequences for wildlife and game interests.

We present the ninth consecutive year of spring and autumn counts of wild-breeding pheasant in East Anglia (see page 26), which were lower than 2003 in terms of breeding density and productivity.

In our extensive survey of woodcock we identify environmental factors influencing the use of certain woods by these birds and provide a baseline for future surveys (see page 34). We completed the penultimate year of fieldwork for our six-year DTI-funded study of the impact of SRC cropping on farmland wildlife.

A pheasant in woodland. (Alexis de la Serre)

Lowland game research in 2004

Project title	Description	Staff	Funding source	Date
Pheasant population studies (see page 26)	*Long-term monitoring of breeding pheasant populations on releasing and wild bird estates*	*Rufus Sage, Maureen Woodburn, Roger Draycott*	*Core funds*	*1996 - on-going*
Wildlife in short-rotation coppice	*Monitoring wildlife use of short-rotation coppice commercial plantations*	*Rufus Sage, Mark Cunningham*	*DTI*	*2000-2005*
Austrian pheasant ecology	*Habitat use and mortality of radio-tracked pheasants on the Seefeld Estate in Austria during the breeding season*	*Roger Draycott*	*M Hardegg*	*1999-2004*
Pheasant releasing density studies (see page 36)	*Investigating relationships between different densities and biodiversity*	*Rufus Sage, Maureen Woodburn, Roger Draycott*	*Research Funding Appeal*	*2001-2006*
Ecology of reared grey partridges	*Population monitoring of reared and wild grey partridges to determine feasibility of releasing as a re-stocking measure*	*David Parish*	*Scottish Fair, Various charitable trusts*	*1997 - on-going*
Game crops and farmland birds	*Use of game crops by songbirds in grassland regions throughout the year*	*David Parish*	*SNH, Tesco, John Ellerman Foundation, various charitable trusts*	*2003 - on-going*
Monitoring East Lothian Local BAP	*Monitoring effects of LBAP measures on bird populations in East Lothian*	*David Parish, Hugo Straker*	*Various charitable trusts*	*2001 - on-going*
Control of willow beetle in short-rotation coppice	*Testing means of controlling willow beetle within crop to improve crop viability*	*David Parish, Steve Hubbard (Dundee Uni)*	*Carnegie Trust for Scottish Universities*	*2003-2005*
Releasing and woodlands survey (see page 38)	*Comparing woodlands with and without game management*	*Rufus Sage, Andrew Hoodless Roger Draycott*	*Research Funding Appeal*	*2004-2006*
Woodcock breeding survey (see page 34)	*Evaluation of a survey method and calculation of national population estimate*	*Andrew Hoodless*	*Shooting Times Woodcock Club, an anonymous English charitable trust*	*2002-2004*
Unharvested crops and songbird populations	*Large-scale field experiment investigating the impact of winter feeding on songbird populations*	*David Parish*	*SEERAD*	*2004-2008*
Monitoring agri-environment schemes in Scotland	*Investigating whether RSS, CPS and OAS achieve ecological, archaelogical, sociological and landscape aims*	*David Parish Various non-GCT collaborators*	*SEERAD*	*2004-2008*
Lees Court Estate Project	*To quantify the biodiversity and economics of a quality, released bird shoot following management for game, including comparison sites*	*Rufus Sage, Prof N Leader-Williams, DICE at Kent University, Tracy Greenall*	*Sir John Swire Charitable Trust, Lees Court Estate, Holland & Holland*	*2000-2005*
Partridge Count Scheme (see pages 27 and 42)	*Nationwide monitoring of grey and red-legged partridge abundance and breeding success*	*Nicholas Aebischer, Stephen Browne, Julie Ewald, Nina Graham, Dave Parish*	*Core funds*	*1933 - on-going*
National Gamebag Census (see pages 42 and 78)	*Monitoring game numbers with annual bag records*	*Nicholas Aebischer, Julie Ewald, Claude Gillie, Gillian Gooderham*	*Core funds*	*1961 - on-going*
Sussex study (see page 30)	*Long-term monitoring of partridges, weeds, invertebrates, pesticides and land use on 62 square kilometres of the South Downs*	*Nicholas Aebischer, Julie Ewald, Steve Moreby, Dick Potts (consultant)*	*Core funds*	*1968 - on-going*
GIS project	*Investigation of the extent and consequences of game and fish management for wildlife in Britain*	*Julie Ewald, Neville Kingdon, Stephen Tapper, Nicholas Aebischer, Nina Graham*	*Countryside Alliance*	*1999-2004*
Partridge releasing experiment (see page 32)	*Determining best release methods as a tool for restoring grey partridges in the UK*	*Nicholas Aebischer, Francis Buner, Stephen Browne, Des Purdy*	*Westminster Overseas Fellowship, GC-USA*	*2004-2006*
PhD: Dispersal of released pheasants	*Radio-tracking released pheasants to determine mortality and dispersal in relation to density and habitat quality*	*Claire Turner Supervisor: Rufus Sage*	*Research Funding Appeal*	*2001-2005*
PhD: Released partridges on NNR chalk grassland	*Comparing flora and fauna on high density partridge release sites on chalk downland NNR with similar chalk downs*	*Sarah Callegari Supervisor: Rufus Sage*	*English Nature Research Funding Appeal*	*2002-2006*
PhD: Grey partridges and raptors	*Investigation of grey partridge behaviour, habitat use and survival in relation to raptor abundance*	*Mark Watson Supervisor: Nicholas Aebischer*	*GC-USA*	*2000-2004*

Key to abbreviations:
DTI = Department of Trade and Industry; SNH = Scottish Natural Heritage; SEERAD = Scottish Executive Environment and Rural Affairs Department

Lowland game counts

Key findings

- Breeding densities of wild pheasants remained stable during 2004.
- Fewer sites were counted owing to late harvest and poor counting conditions.
- There was lower productivity than in recent years.
- Stocks of wild pheasants remain high.

Roger Draycott

Wild pheasant counts in East Anglia

With help from gamekeepers and estate owners we count pheasants on a sample of wild pheasant shoots in East Anglia each year. These counts have three aims:

1. To estimate annual productivity.
2. To determine long-term trends in abundance.
3. To assess the influence of land use and habitat quality on pheasant abundance and productivity.

We count in spring to determine breeding densities and in late summer to assess productivity (breeding success). Typically we count around 11 sites each year (range six to 24) but in 2004, wet weather caused a late harvest and poor counting conditions, so we achieved reliable counts on only five sites. Mean breeding density in 2004 was 33 territorial cocks per 100 hectares and 66 hens per 100 hectares (very similar to 2003 - see Figure 1). Breeding success in 2004 was lower than in 2003 owing to unfavourable weather late in the breeding season (see Figure 2). However, owing to good breeding numbers, overall densities of wild pheasants in the autumn remained high.

Figure 1

Breeding densities of wild pheasants in spring (five sites in 2004)

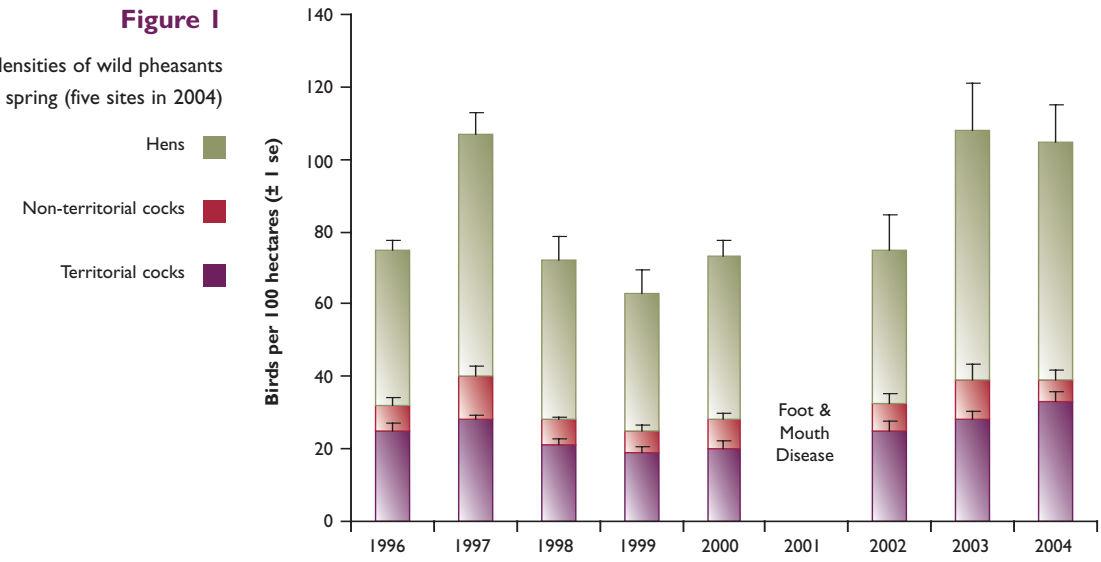


Figure 2

Wild pheasant productivity (five sites in 2004)

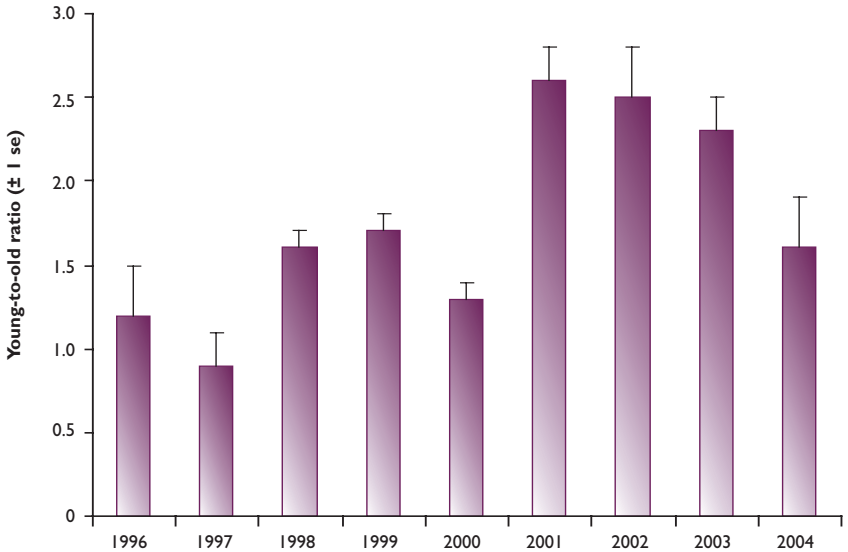


Table 1

Grey partridge counts

a. Grey partridges in spring 2004

	Number of sites		*Spring pairs*	
Region	*2003*	**2004**	*2003*	**2004**
South	*86*	113	*294*	410
Eastern	*155*	208	*2,643*	3,734
Midlands	*99*	132	*511*	719
Wales	*1*	4	0	44
Northern	*67*	132	*654*	1,163
Scotland	*95*	130	*589*	1,036
Overall	*503*	719	*4,691*	7,106

b. Grey partridges in autumn 2004

	Number of sites		*Young-to-old ratio*		*Autumn density (birds per km² (100ha))*	
Region	*2003*	**2004**	*2003*	**2004**	*2003*	**2004**
South	*81*	75	*2.4*	2.7	*7.0*	5.1
Eastern	*155*	136	*2.6*	2.3	*22.4*	21.8
Midlands	*90*	85	*2.9*	2.8	*10.3*	7.7
Wales	-	1	-	-	-	-
Northern	*91*	89	*3.4*	2.7	*17.0*	12.9
Scotland	*103*	81	*3.0*	2.5	*6.2*	6.3
Overall	*520*	**467**	*2.8*	**2.5**	*13.2*	**12.3**

Grey partridge counts

The grey partridge counts for the spring and autumn of 2004 are summarised in Table 1. The number of contributors to the spring counts increased in 2004 in all regions. The highest number of partridges recorded on one return is 253 pairs on a property in Norfolk, although several other properties in Norfolk submitted returns in excess of 200 pairs. When the Partridge Count Scheme began in 1999, returns were almost entirely from Norfolk. Now there are clusters of properties from across the country that have more than 200 pairs of grey partridges. The highest spring density recorded in 2004 was 43 pairs per 100 hectares on a property in Northumberland, with 87 pairs on 200 hectares. Overall the number of grey partridge pairs recorded in 2004 was 20% higher than in 2003, with 203 properties exceeding the Biodiversity Action Plan target levels for 2010.

Considering the poor weather, autumn counts were surprisingly good. In 2003 we had 520 returns (39%) and 467 in 2004. The area of land in the scheme increased from 274,000 hectares in 2003 to 347,000 hectares in 2004. The 2004 breeding season was a stark contrast to 2003, with June being significantly cooler and wetter. It is surprising that the young-to-old ratio and the autumn densities were not worse than they were. However, there were large differences between properties. The total number of birds counted in autumn 2003 was 28,181 and 24,452 in 2004 with densities falling slightly. So far the highest number of partridges on one site is 1,181, at a density of 129 birds per 100 hectares. There is an increasing number of properties with autumn densities over 100 birds per 100 hectares - the highest reached 213 birds per 100 hectares.

The first target for the grey partridge Biodiversity Action Plan is to halt the decline by 2005. Our data continue to suggest that this may be achieved. Over winter, sites may need supplementary feeding to maintain stock if natural food supplies are scarce. We hope that options within the Entry Level and Higher Level Stewardship schemes in England and their equivalents in Scotland, Wales and Northern Irelandwill transform national prospects for this species.

Key findings

- Number of returns up 43% on 2003.
- Spring pairs recorded up 51% on 2003.
- Autumn breeding success (young-to-old ratios and densities) marginally lower than in 2003.

Edward Darling

Grey partridge recovery project

Key findings

- Spring pairs of partridges on the demonstration area in 2004 were 2.5 times higher than at the start.
- On the demonstration area, autumn numbers in 2004 were seven times higher than at the start.

Nicholas Aebischer
Malcolm Brockless
Julie Ewald

Our project site near Royston. (Malcolm Brockless)

The Grey Partridge Recovery Project is based near Royston on 10 square kilometres (1,000 hectares) of chalk arable farmland on the Hertfordshire/Cambridgeshire border, flanked by a reference area of similar size. We aim to achieve a spring density of 18.6 pairs of grey partridges per 100 hectares.

We count partridges in March (spring pair counts) and in early September, after harvest (autumn counts). We determine the sex of all grey partridge adults and, in the autumn counts, record the number of young birds in each covey. We started from a low base, with only 2.9 pairs per 100 hectares on the demonstration area in 2002 and 1.3 on the reference area (see Table 1). By spring 2004, the density on the demonstration ground had increased to 8.0 pairs per 100 hectares compared with 1.4 on the reference area.

Figure 1

Distribution of grey partridge coveys at Royston in autumn 2004, showing barren pairs, single males and brood sizes

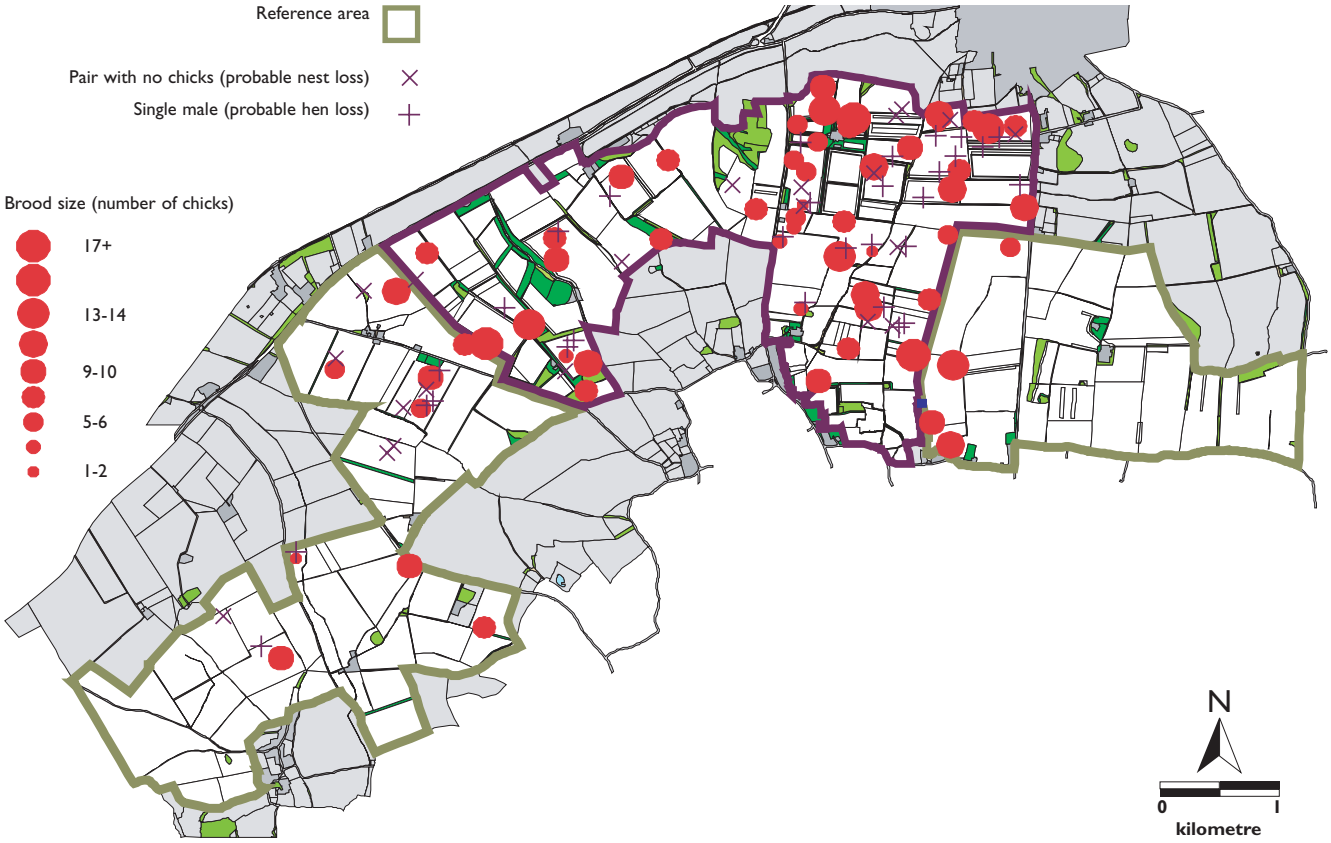


Table 1

Counts of grey partridges at Royston since the start of the project
(counts carried out when partridge management was under way are in bold).
Target densities based on *A Question of Balance*.

a. Spring pairs per 100 hectares

Area	2002	2003	2004
Demonstration	2.9	**5.1**	**8.0**
Reference	1.3	2.1	1.4

b. Autumn birds per 100 hectares

Area	2001	2002	2003	2004
Demonstration	7.6	**28.8**	**39.2**	**53.4**
Reference	7.9	6.3	17.9	11.8

Come and visit!

A demonstration is no use without people seeing it! To be inspired on how you might help grey partridges on your land, come and see the precise management techniques being used at Royston, and learn how we make the most of available grants. We arrange open days for visitors during the summer. Alternatively, you may like to arrange a group visit at a time to suit you. For more information please call Martin Tickler on 01379 586551 or 07730 065935. We have produced a leaflet summarising the results at Royston, which is available from Fordingbridge.

In 2004, there was twice as much rain in July as in 2003, and 10 times as much in August (181 mm in total). Harvest was late, leading to delays in the game counts. Despite the weather, productivity in 2004 was surprisingly good (see Figure 1). The young-to-old ratio of 2.8 on the reference area was marginally lower than in 2003 (2.9), and slightly higher than on the reference area (2.6). Countryside Stewardship options put in on many farms are starting to mature, and have improved the habitat and partridge density (see Table 1). The demonstration area now holds seven times as many birds as before we started (53.4 birds per 100 hectares compared with 7.6), and there has been only a marginal increase on the reference area (11.8 compared with 7.9).

We would like to thank all the farmers who help host this work.

A successful covey. (Malcolm Brockless)

Grey partridges on the Sussex Downs

Key findings

- At low densities grey partridges disperse further.
- Partridges that move furthest have highest mortality.
- Adult mortality above 70% per year is usually followed by local extinction.

Dick Potts

This was our 37th year of studying grey partridges on the Sussex Downs and it is fair to ask why the work continues. It does so for two reasons. First we are carrying out what is the longest, continuous study of the effect of modern farming on wildlife and, secondly, we are still gaining new and important information. For example, just when it looked as though grey partridges were going to disappear, chick survival in 2004 was close to a record high.

This was a much-needed boost. Since 1957, when the first systematic counts were made, the number of nesting pairs has dropped by 96%. This was in spite of the fact that we knew how numbers could be restored. However, the necessary management measures were considered too costly in relation to farm economics. Hopefully this has changed with the Single Farm Payment and Entry Level Stewardship Scheme.

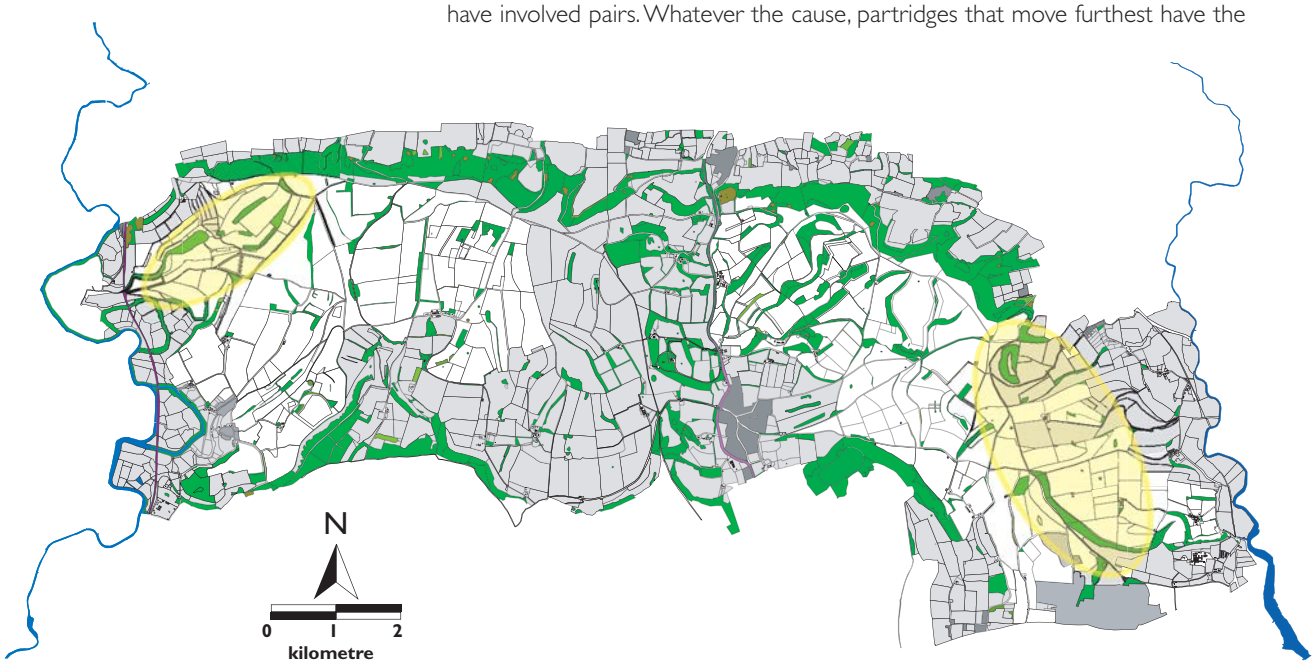
In parallel with the numerical decline, the area occupied has shrunk to two patches totalling less than 15% of the study area. Inevitably we have to ask if partridge populations in such patches are viable in the long term. Is it possible that the birds could be tempted into surrounding areas where they would be doomed by higher mortality? The only partridge population that Dick Potts studied to complete local extinction, one in Cornwall, persisted for years at low density and then suddenly vanished. Could that happen in Sussex?

There have now been over 70 population studies of grey partridges. Of these, 12 provide information on dispersal distances, including six that were carried out at very low densities. On the Sussex Downs, the two areas that still have partridges are 13 kilometres apart with virtually no partridges in between (see Figure 1). Grey partridges could theoretically cover such distances, but it is likely that the Sussex partridges now form two isolated groups. This is important because there is evidence in four out of the six low-density studies that partridges in such situations disperse far more than normal (see Figure 2). So why is this? We know that the dispersing birds are not searching for nesting cover because there is plenty to spare. In any case, if nesting cover was the cause, one would expect birds to disperse long distances when they are numerous, not the other way round. One clue is that males move further than females. Finding a partner is difficult because females are in short supply owing to fox predation, and because pairings do not occur within a covey (brothers and sisters never pair with one another).

The difficulty of finding a mate seems to be one reason for long dispersal distances at low densities and part of the explanation for the relationship plotted in Figure 2. However, this is not the only reason, because many of the long-distance movements have involved pairs. Whatever the cause, partridges that move furthest have the

Figure 1

The two remnant populations of grey partridges (yellow shading) within our Sussex study area in 2004. The area where counts take place is shown white



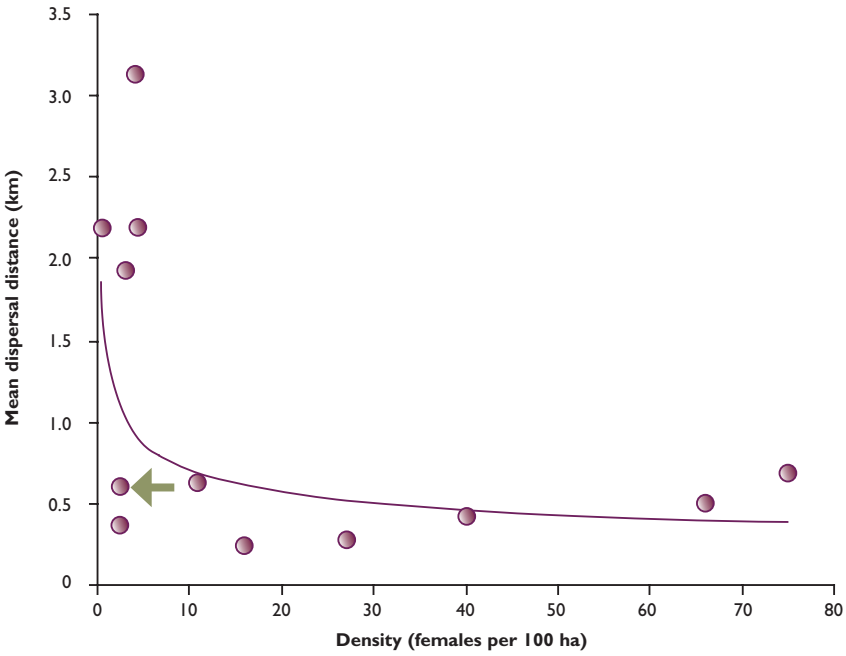


Figure 2

Dispersal distances in relation to density of grey partridges in 12 studies

← Mark Watson's study

highest mortality, and we found that adult mortality above 70% per year is a feature of local grey partridge populations that later become extinct.

Mark Watson's recent radio-tracking of grey partridges on the Sussex Downs showed that dispersal distances of males are not currently long (averaging 600 metres), which suggests that the situation is not yet critical. But a further decline could trigger the low density restless searching for mates or better habitats, and the consequent high mortality that cause stocks to vanish.

Fortunately the grey partridge management on the Sussex Downs has improved and local extinction has probably been averted. We still have enough partridges and enough enthusiasm to sustain a recovery.

Because siblings do not form pairs, most of these birds must find partners from other coveys. (Francis Buner)

Countering local grey partridge extinctions

Key findings

- Releasing flocks of game-farm partridge poults does not result in successful reintroduction because of high over-winter losses.
- Fostering bantam-reared or artificially-reared poults to wild barren pairs is more likely to succeed.
- Where no barren pairs exist, a nucleus of free-living adults must be established.

Stephen Browne
Francis Buner

As lead partner for the UK Grey Partridge Biodiversity Action Plan (BAP), we have a responsibility to do all we can to achieve the BAP targets, which are to stabilise grey partridge numbers by 2005 and to ensure that the breeding population is above 150,000 pairs by 2010. Given the extent of the partridge decline, this is not an easy task because the species has disappeared from large parts of its former range, and is at a very low density in others. Many landowners and keepers are keen to get partridges back onto their land, but are failing despite appropriate management because too few wild partridges remain in their area. Re-establishment through releasing is the obvious solution, especially as grey partridges are relatively easy to rear in captivity. However, experience has shown many times over that releasing flocks of game-farm poults in late summer does not work because of high over-winter losses. We have therefore launched a new research project which aims to identify optimal release methods, then produce scientifically sound recommendations for re-establishment using releasing.

The project started with a review of existing and historical rearing and releasing techniques by searching through old gamekeeping and game management books and magazines, and by speaking to a wide range of gamekeepers and other interested parties. The review identified that the ideal system for producing birds for reintroduction would be to obtain eggs laid in the wild, hatch them under captive grey partridges, allow the captive pair to rear the chicks to eight weeks, then either release the chicks with the adults or foster the young to a barren pair of wild grey partridges. However, the review also established that it was most unlikely that wild eggs would be widely available for this purpose. There was also conflicting evidence about the suitability of captive grey partridges as parents, and about their ability to hatch and raise sufficient numbers of chicks for a releasing programme. Therefore, we needed a compromise that would result in a system that was easy, practical, cost-effective and would produce young grey partridges of sufficient quality for reintroduction.

The most suitable compromise, already used successfully by several keepers, is to obtain eggs from a reliable source (eg. a reputable game farm), hatch the eggs

Fostering is dependent on barren pairs in the wild. Here, a male grey partridge is eager to foster these juveniles. (Stephen Browne)

A broody hen is ideal for rearing the chicks to the fostering stage. (Arthur Scott)

Juvenile grey partridges fostered to barren pairs learn the necessary skills needed to survive. (Francis Buner)

under bantams and allow them to rear the chicks to eight weeks. The young are then fostered to wild barren pairs of grey partridges. An alternative is to hatch and raise chicks under artificial heat sources and foster these to barren pairs. Fostering to barren pairs allows the young partridges to learn behaviour traits such as where to find food and avoid predation and it also holds them to the release site by establishing a parental-bond. These two systems of chick rearing and fostering are dependent on the presence of barren pairs in the wild. If no grey partridges are present in an area suitable for a reintroduction attempt, it is necessary first to establish a nucleus of free-living adults. The review identified two possible methods for doing this: releasing a captive-reared family covey of full-grown birds in late autumn, and releasing captive-reared pairs in spring.

We are field-testing these chick and adult releasing techniques over the next two years in East Anglia and in Wiltshire/Hampshire. In each of the two study regions, we have chosen one site for an intensive study involving all four release methods. We shall follow the fate of the released birds through the use of radio-telemetry. In each region, we have selected a further 12 extensive sites where only one release method will be used per site. At each extensive site, we shall mark all released young with coloured leg-rings, and monitor the outcome through standardised spring and autumn counts.

The rearing field at Fordingbridge has successfully adopted the techniques required to rear partridges under bantams and has already reared a total of over 4,000 grey partridges. The birds produced on the rearing field include around 40 broods of bantam-reared partridges and 40 broods of partridges reared in a standard game-farm fashion. We also produced 40 family coveys of grey partridges by fostering 15 four-week-old chicks to pairs of ex-laying game-farm birds, for release in late autumn.

We released the first broods after harvest 2004. The released broods appeared to adapt quickly to their surroundings in the wild and behaved much as one would expect a wild covey to behave. Survival, which was 85% in both regions after the first few months after release, was high and dispersal away from the release site was low. The young appeared to behave much the same as wild broods; they have not moved very far, have not packed together and although these are very early results they are very encouraging.

The next stage of the project involved establishing free-living adult grey partridges at sites where partridge numbers are very low or where the species is absent. We began by releasing family coveys in October 2004 and shall release pairs in early spring 2005. We will assess the survival of the birds by counting pairs in March/April 2005.

Francis Buner (our Westminster Overseas Research Fellow) and Sara Olmedo constructing fostering pens for grey partridges on the rearing field at Fordingbridge. (Nicholas Aebischer)

How many woodcock breed in Britain?

Key findings

- More than 900 woods were surveyed across Britain for the Breeding Woodcock Survey.
- Woodcock were present at 44% of sites and densities in occupied woods averaged 4.17 males per square kilometre (100 hectares).
- There was regional variation in the occupancy of woods and abundance of woodcock, the general pattern being of higher numbers in southern Scotland, northern and eastern England and relatively low numbers in Wales and south-west England.

Andrew Hoodless

During May and June 2003, with the British Trust for Ornithology (BTO), we ran the first national survey of breeding woodcock in Britain. Owing to its secretive behaviour and activity at dawn and dusk, there has long been uncertainty about the woodcock's status as a breeding bird, although information from general bird surveys organised by the BTO pointed to a decline. For our survey, we devised a method based on counts of roding males at dusk (see *Review of 2003*). 'Roding' is the term given to the distinctive display flight of males during the breeding season. Three counts were made by volunteer observers at points within the wood that gave good visibility. Observers made counts in randomly-selected one-kilometre squares that were stratified by region and woodland area, although a small number of non-random sites were

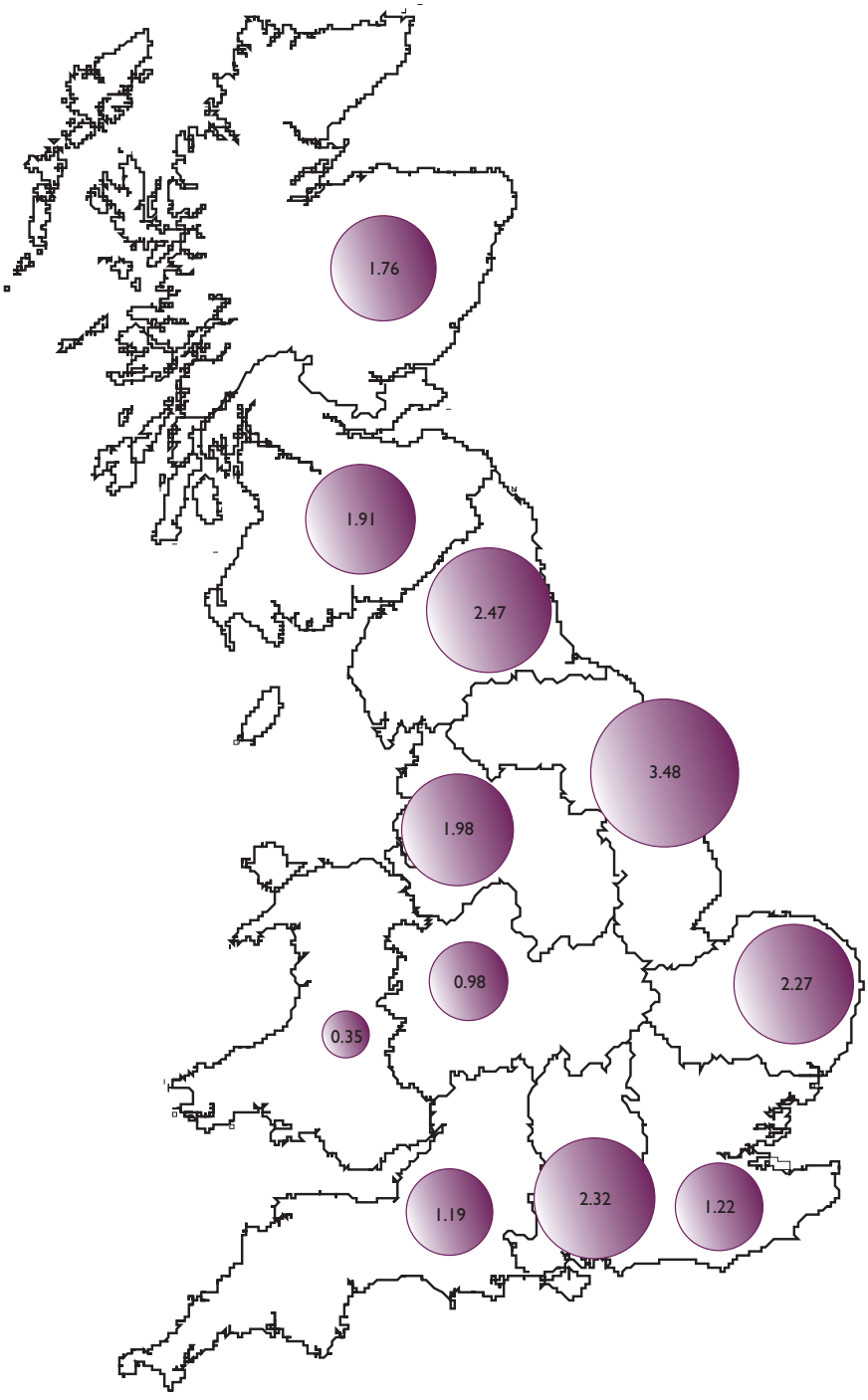


Figure 1

Boundaries of regions used for the woodcock survey and mean densities for all sites surveyed including zero counts (males per 100 hectare square containing at least 10 hectares of woodland). Regions were selected on the basis that each contained similar amounts of woodland within four size classes.

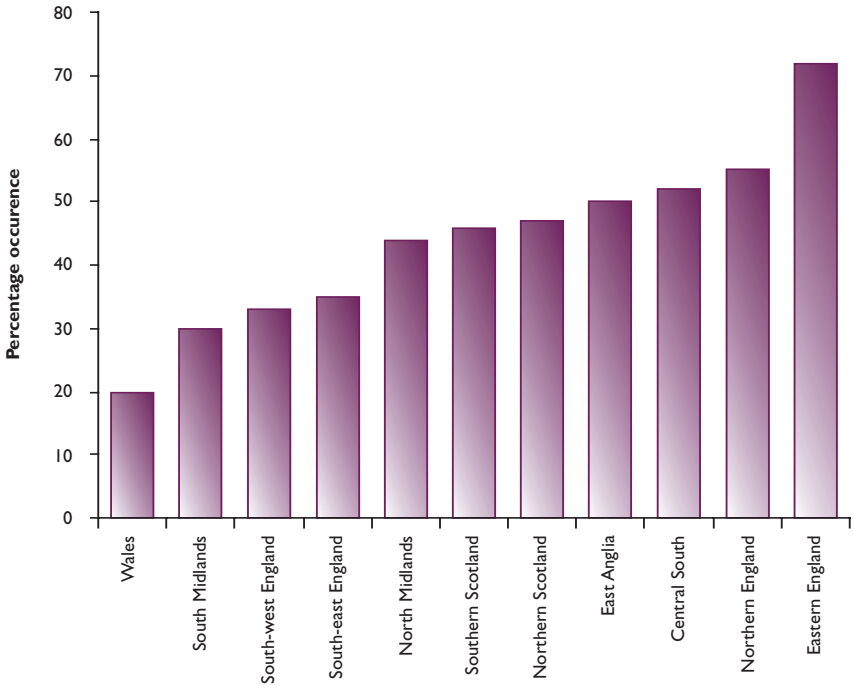


Figure 2

Regional rates of woodcock occurrence (percentage of surveyed woods where woodcock were recorded)

included. The basic unit of abundance was the number of passes of roding woodcock during one hour at dusk. This was converted to an estimate of the number of individual males based on earlier calibration work (see *Review of 2003*).

The survey was a great success, with counts from 937 sites. We now have a basis for monitoring future population change, with a good sample in each region of Britain. Overall, the frequency at which woodcock occurred in woods was encouraging, with roding birds recorded in 416 (44%) of the woods visited. However, at most sites woodcock were present only at low densities (average 4.17 roding males per 100 hectares) and only 5% of occupied sites had more than 10 roding males per 100 hectares. There was appreciable variation between regions in the occupancy of woods and abundance of birds. This was one of the most striking findings of the survey, showing that woodcock are far from evenly distributed (see Figure 1).

The occupancy of woods was highest in eastern England where woodcock were reported in 72% of woods and was lowest in Wales with birds recorded in just 20% of woods (see Figure 2). Regions with low rates of occupancy also had low densities of woodcock within occupied woods, with Wales as the lowest (average 1.73 roding males per 100 hectares). The highest densities within occupied woods (more than four males per 100 hectares) were found across southern Scotland, northern England and the north Midlands down through eastern England into East Anglia. Central southern English counties also contained high densities.

The regional pattern of woodcock abundance in our survey largely mirrors that depicted in the BTO atlas, but there are two notable differences. South-east England and Dumfries and Galloway no longer appear to be hotspots for the species and there may have been declines in these regions in the last 15 years.

So what size is the British woodcock population? Using our estimates of male woodcock density in one-kilometre squares for 11 regions we can extrapolate to regional estimates of numbers from the total number of one-kilometre squares within each region containing different proportions of woodland. This gives population estimates of 21,000 males for England, 18,000 males for Scotland and 1,000 for Wales. If it is assumed that there are similar numbers of females, the total number of breeding woodcock for Britain is approximately double that estimated in the BTO's *New Atlas of Breeding Birds 1988-91*.

We thank all the volunteers who participated in the survey and the BTO Regional Representatives who organised the coverage. We are grateful to the Shooting Times Woodcock Club and an anonymous English charitable trust for funding the survey.

A typical woodcock wood in the south of England. (Andrew Hoodless)

Effect of pheasant releasing on edge habitats

Key findings

- Songbird numbers and diversity were highest along woodland edges nearest the release pen.
- Butterfly and bumblebee diversity and abundance did not vary with distance from the release pen.
- Woodland edges close to release pen had lower plant diversity than other woodland edges.

Maureen Woodburn
Rufus Sage

In 2002 we launched a three-year research project looking at the impacts of released pheasants on habitats and wildlife in the wider countryside, ie. away from the release sites themselves (see *Review of 2003*). The main aim of this research was to look at relationships between the density of released pheasants and common wildlife indicators, such as plants, songbirds and butterflies. The fieldwork was carried out in 2002 and 2003 at over 100 different shooting estates in England, and in 2004 we pulled together the data collected.

The study encompassed sites releasing from a few hundred to over 50,000 pheasants, and we grouped these into four distinct regions or Natural Areas: the Wessex Downs, North Devon and Somerset, the East Anglian Plain and Bedfordshire area. At each site we defined eight sampling stations along a one-kilometre transect, starting at the edge of a wood containing a release pen and following field and wood edges away from the release site into the adjacent farmland to where few pheasants venture. At each station we measured hedgerow or wood-edge structure and plant diversity and songbird, butterfly and bumblebee diversity and abundance. We compared these measures with distance along the transect, and between sites (with numbers released).

In hedgerows there was no variation in either songbird abundance (individuals) or diversity (species) along transects, and the density of pheasant releasing between sites had no effect either. Hedgerows in the Wessex Downs region had more songbirds than in the other three areas. For woodland edges we found there were more songbird individuals and species along those closest to the pen (see Figure 1). This may reflect the fact that the pen is often sited in the largest piece of woodland in an area. However, we know that pheasant release woods are managed in a way that makes them more attractive to other birds of woodland edge as well (see page 38).

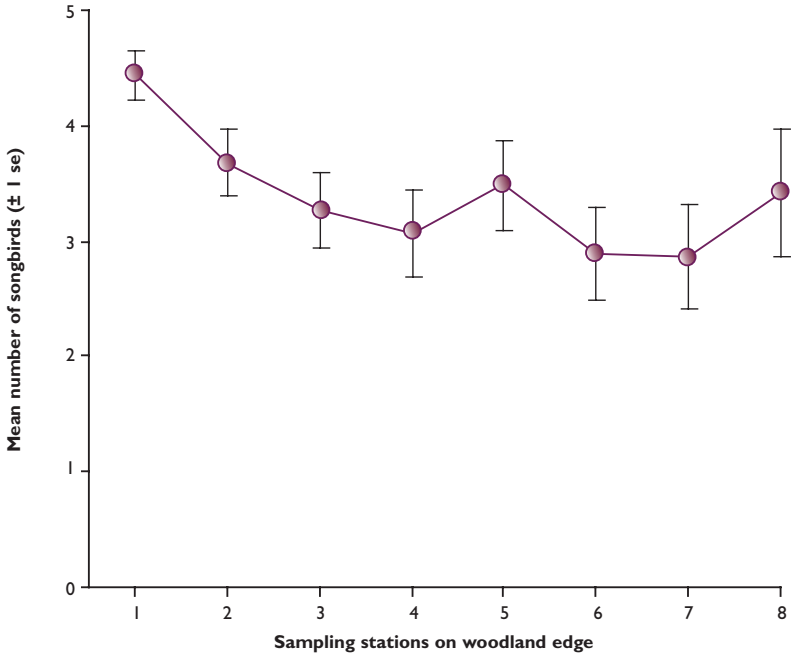
Butterfly and bumblebee diversity and abundance did not vary along the length of the transects in either hedgerows or woodland edges. There was also no effect of releasing density. This suggests that these insects are not affected by released pheasants in woodland edge and hedgerow habitats. It was apparent that at most study sites butterflies and bumble bees were not abundant.

Woodland edges closest to the release pen had lower plant diversity than other woodland edges, but again we could detect no relationship with the quantity of birds released. There was no overall variation in plant diversity in either the base of the hedgerow or in the verge either side. However, there were differences between the natural areas. In particular, the arable areas had greatest diversity in the hedge verge,

Figure 1

Mean number of songbirds recorded at woodland edge sampling stations. Station 1 is nearest to the wood with the release pen and station 8 is furthest away.

We found more songbirds at woodland edge stations nearest the release pen wood compared with other woodland edges along the transect.



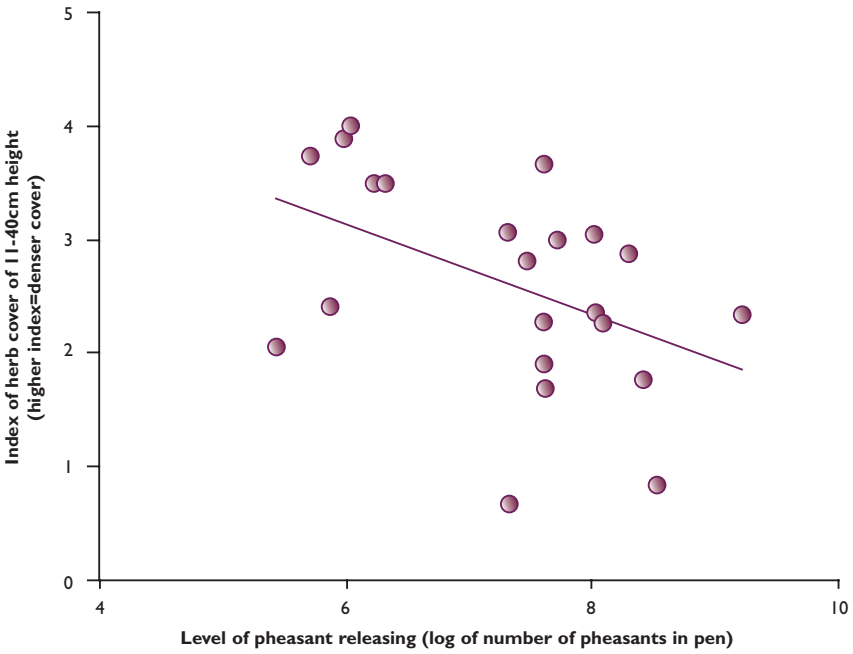


Figure 2

Relationship between the degree of herb cover in hedgerows at 11-40 cm height and the level of pheasant releasing (recorded as the log of the number of pheasants in the release pen). These data are for the North Devon and Somerset area only.

In the grassland areas there was reduced herb cover in the base of the hedge with increasing density of pheasants in the release pen

whereas the grassland sites had greatest diversity in the hedge base. Livestock grazing in the grassland areas resulted in sparser hedges, which prevent the hedge bottoms from shading out the flora.

The structure of the herb layer did not vary in hedgerows along the length of the transect or between sites. Looking at the grassland hedges only, we found that plant structure was reduced in hedges nearer the release pen and with increasing levels of releasing (see Figure 2). We also found that the amount of bare ground in the base of the hedge was greatest nearer the release pen, but this, again, was not related to the level of releasing.

We need to interpret the results of this study in the context of the heavily-managed environments within which we are working. Modern farming frequently leaves little space for wildlife. This means we have been trying to discern potentially subtle effects in often heavily-degraded habitats (eg. sprayed or over-grazed hedgerow verges). Within this context, we think we have undertaken a robust and comprehensive study, which strongly suggests that releasing pheasants has, in general, a relatively benign impact on field-edge and wood-edge habitats and their wildlife.

We think, however, that there are specific conflicts between releasing gamebirds and wildlife, which the study reported here was not designed to address. These issues have been referred to in the *Reviews of 2002* and *2003* and we are currently looking at these in more detail.

Bumble bees were not affected by pheasant release densities. (Laurie Campbell)

On balance we believe that pheasant releasing has a relatively benign impact on field edge and woodland edge habitat for other wildlife. (Roger Draycott)

Effect of pheasant management on wildlife in woods

Key findings

- Lowland woods managed for pheasants had a more open structure than non-game woods and greater cover of herbs and brambles.
- More songbirds, especially warblers, were recorded in game woods.
- Total deer numbers were greater in game woods, but the relative abundance of deer species and the incidence of browsing were more influenced by region than game management.
- There were no differences in squirrel numbers or activity between game and non-game woods.

Roger Draycott
Andrew Hoodless

Since 2002 we have adopted a range of approaches to assess environmental effects of pheasant releasing. This has included looking at changes in ground flora caused by pheasant poults in woodland release pens (see *Review of 2003*) and the influence of release density on wildlife biodiversity in the wider countryside (see page 36). We know from previous research that pheasant shooting provides a major incentive for planting and managing woodlands. However, we have not documented previously how game management influences plants and animals within these woods. For example, in game woods, supplementary feeding, releasing pheasants, shrub planting, skylighting, creation of flushing points and ride and edge management are all common practice. These techniques, perhaps with the exception of ride management, are unlikely to occur in farm woodlands where there is no game interest.

To determine the effect of pheasant releasing and its associated management on woodland biodiversity, in summer 2004 we surveyed 159 woods in two regions: East Anglia and the Hampshire and South Wessex Downs. Half of these woods were managed for game (ie. they each contained at least one pheasant release pen and supplementary feeding took place in winter), whereas there had been no game management in the remaining woods for at least 25 years. We randomly selected about 40% of woods within each treatment group and region from all the deciduous and mixed woodland within each region and the remainder from our existing contact databases. Frequencies of woodland types were comparable between game and non-game woods with about 90% of woods in each group dominated by oak or ash.

Between mid-May and mid-July we measured vegetation cover, dominant species and habitat structure using a point-quadrat method at 40 points over an area of four hectares within in each study wood. We recorded signs of mammal activity (browsing, feeding, droppings) at the same 40 points and counted individuals of each bird species within the four-hectare block. We avoided the woodland edge as this is a distinct habitat and may be the focus of a separate study in the future.

We found that herbs and grasses occurred more frequently in ground quadrats in game woods than non-game woods (see Figure 1), but there were significant regional differences as well (more herbs in Hampshire, more grasses in East Anglia). Analysis of vegetation structure in six height bands revealed a more open canopy in game woods and higher vegetation density up to one metre. There was a higher density of brambles in game woods than non-game woods up to a height of 30 centimetres, but there were no differences between the woods in the abundance of woody shrub species above 30 centimetres.

Overall, we observed more birds in game woods and, regionally, we saw more in Hampshire than in East Anglia. Warblers were more abundant in game woods, a differ-

Warblers such as blackcaps were more abundant in woods managed for game than in non-game woods. (Andrew Hoodless)

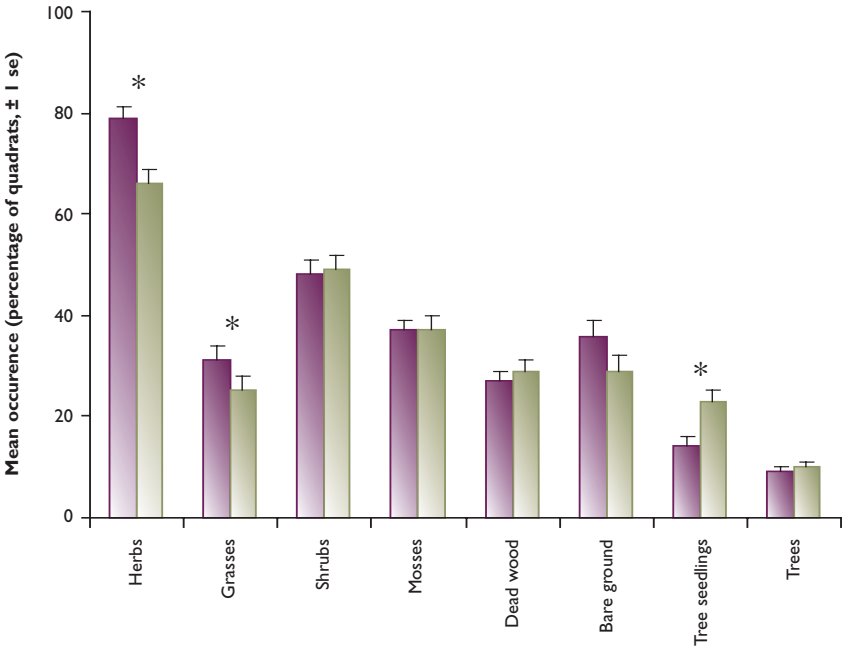


Figure 1

Frequency of occurrence (% quadrats) of different plant types in woods managed for game and in non-game woods

Woods managed for game

Non-game woods

* Significant difference

ence which we attributed to numbers of blackcaps and willow warblers. None of the bird groups were more abundant in non-game woods (see Figure 2).

We observed more deer in game woods with more roe deer in Hampshire and greater numbers of muntjac in East Anglia. Signs of deer browsing were more frequent in non-game woods in East Anglia, but more frequent in game woods in Hampshire, possibly reflecting regional differences in the abundance of different deer species and management policies. We need to do further analyses of deer numbers, vegetation structure and bird numbers within each region to understand better the complex interaction between the effects of deer and game management on woodland vegetation and birds. We found no evidence of management or regional differences in grey squirrel numbers or levels of damage.

These results suggest that the interiors of lowland woods managed for pheasants have a more open structure, creating favourable conditions for the growth of herbs and brambles and supporting higher densities of songbird species requiring dense low cover for nesting. Our findings indicate that outside the release pen, impacts of released pheasants on woodland flora and fauna tend to be benign or positive. We need to do further work, however, to assess what may be subtle changes in floral communities and to understand fully the mechanisms by which management for pheasants affects other woodland species.

During the study we surveyed 159 woods in two regions, East Anglia and Hampshire/South Wessex Downs. (Rufus Sage)

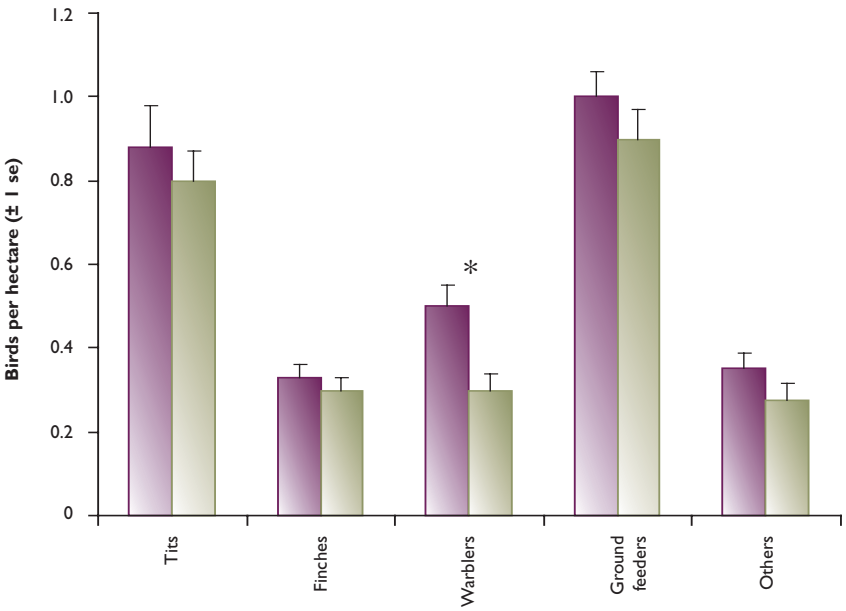


Figure 2

Average songbirds per hectare in 80 game managed woods and 79 non-game woods

Woods managed for game

Non-game woods

* Significant difference

Note: Numbers have been corrected for the effects of region, survey date and time of day.

The effect of deer in small farm woodlands

Key findings

- Vegetative cover was greater where deer were excluded.
- Some plant species increased when grazing was removed and some decreased.
- Woods with greater vegetative cover are better for pheasants and other wildlife.

Rufus Sage
Mike Swan

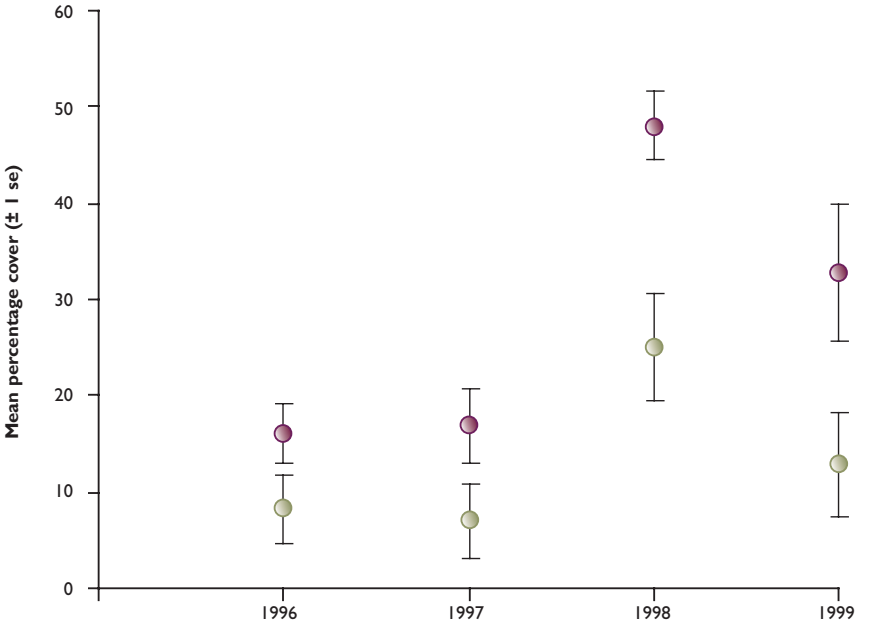
With one or more species of deer found in almost every parish, most keepers must cope with deer. A herd of fallow in a cover crop can be devastating, and unprotected coppice will grow little if there are a lot of roe browsing there. An electric fence protects the former, and piling brash on cut stools usually mitigates the latter. What people fail to see are the more subtle effects. Even with systematic culling, deer may be having more effect on habitat than is realised.

We assessed the impact of a density of around nine roe deer per 100 hectares on ground and shrub vegetation in six small woodlands on a largely arable estate in Dorset. The woods were about 10% of the total area. In January 1996, we erected 30 deer exclosures, each two metres square and 1.5 metres high, five in each of the six small woods. Each exclosure was paired with a nearby control plot for comparison. We measured vegetation at six heights using a cover board in late winter and mid-summer in each of the following four years.

Vegetative cover was increased by excluding deer and the effect increased significantly during the four-year study period (see Figure 1). Also, plant species composition changed in the exclosure plots compared with the controls by the end of the study

Figure 1

Average vegetative cover (%) up to one metre from the ground in deer exclosure and grazed plots in six study woodlands in winter



The effect of the deer, represented by the difference between the two points in each year, was much greater in years 3 and 4 than in years 1 and 2, indicating that the effect of grazing each season accumulated over time. We observed similar differences and trends between years in the summer.

Where deer are excluded, the undergrowth is dense and provides cover for game and wildlife. (Roger Draycott)

period (see Figure 2 summer, and Figure 3 winter) with, for example, more bramble and less bare ground and grass where grazing was removed.

People have suggested that where deer occur in large woodland blocks at densities of less than 10 per 100 hectares, there may be little or no effect on woodland vegetation. Our work on farmland with small woods, suggest that small numbers of deer do affect vegetation because they are concentrated.

Although browsing is a natural ecological process and can maintain or enhance the conservation interest of some habitats, unbrowsed shrubby cover provides habitat for many species. Woods with plenty of cover hold more pheasants during the shooting season and in the spring and summer. Many woodland birds, particularly warblers, small mammals, butterflies and moths like woods with shrubs and a ground flora. Our study shows that browsing in small farm woods, even by a few roe deer, can reduce the conservation value of these areas.

We wish to thank Tim Palmer on whose land we conducted the work, and Hugh Oliver-Bellasis and The British Ecological Society for helping to fund the study.

Roe deer are keen woodland browsers. (Alexis de la Serre)

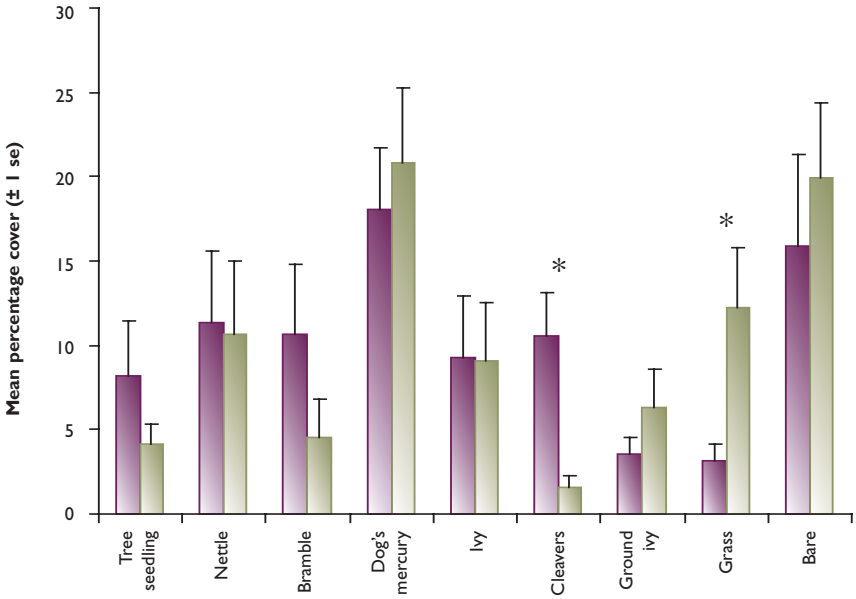


Figure 2

Percentage cover of dominant vegetation species in deer exclosures (fenced) and grazed areas in summer 1999

Deer exclosures (fenced)

Grazed areas

* Significant

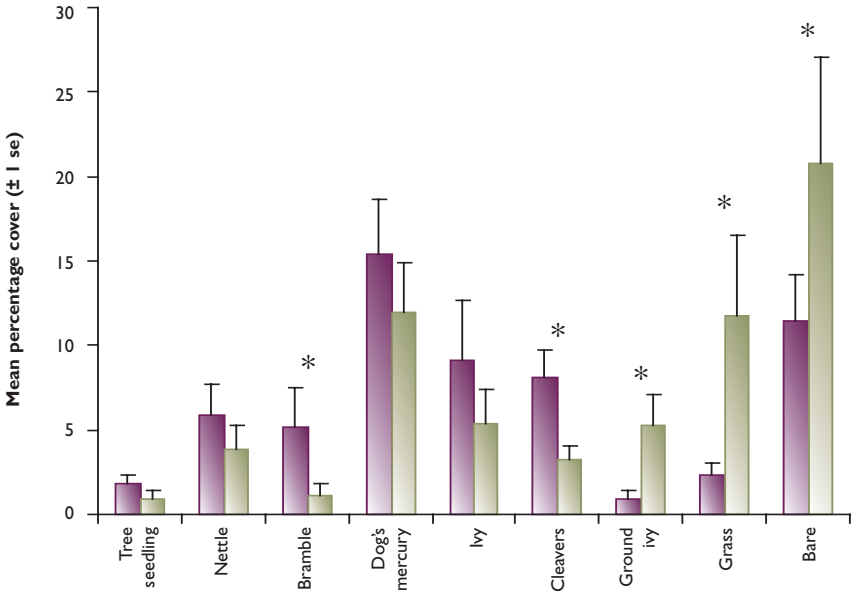


Figure 3

Percentage cover of dominant vegetation species in deer exclosures (fenced) and grazed areas in winter 1999

Deer exclosures (fenced)

Grazed areas

* Significant

Changes in grey partridge abundance

Key findings

- UK grey partridge bags are lower now than at any time during the last 200 years.
- Partridge Count Scheme sites are on course to hit the first BAP target.

Nicholas Aebischer

The decline in numbers of grey partridges in the UK, and indeed across Europe, is well recognised. The UK government officially monitors national bird abundance through the British Trust for Ornithology (BTO)'s Breeding Bird Survey, which replaced the earlier Common Birds Survey in 2000. Together, they have documented a partridge decline of 86% from 1967 to 2000. The magnitude of the decline has led to the grey partridge being declared a Biodiversity Action Plan (BAP) species, and we were nominated as lead partner to take forward its three targets: halt the decline by 2005; ensure that the population is above 150,000 pairs by 2010; and maintain and where possible enhance the current range.

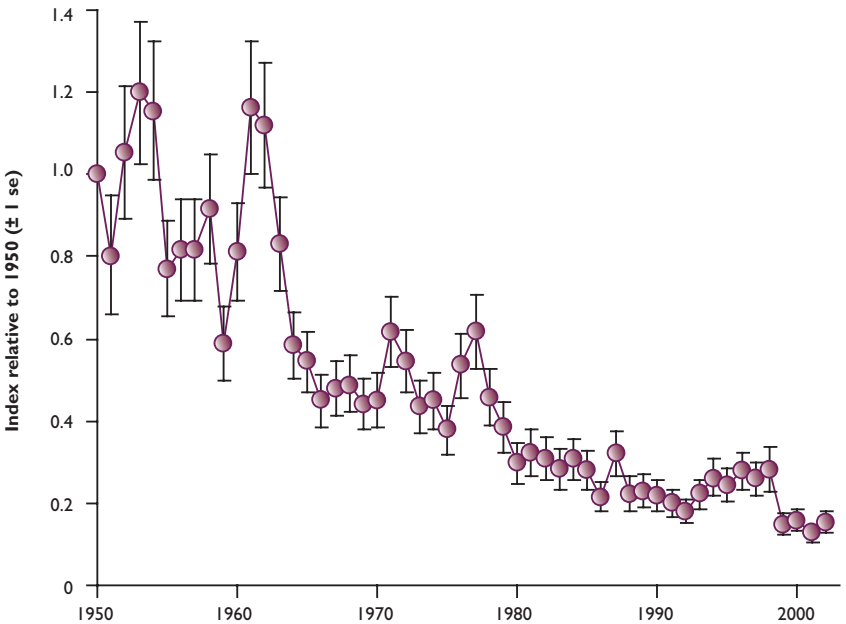
Thanks to our members, we have information on how numbers of grey partridges have changed from two sources. One is the Partridge Count Scheme, which is based on counts of live birds on the ground. Since 1950, a total of 257 long-term participants have contributed data on grey partridge spring pair density (see Figure 1). We have taken changing estate participation into account in our statistical analysis of long-term trends, and present average annual spring densities as an index relative to 1950 (index value of 1). The pattern of decline is similar to that from the BTO surveys, with densities over the last four years averaging only 15% of the densities recorded up to 1963, ie. showing a decline of 85%.

The other source is the National Gamebag Census, which contains information on numbers of partridges shot per unit area. Based on information extracted from game books, several bag series extend back over 200 years, so that the census provides a unique insight into historical trends (noting that bags reflect shooting effort as well as partridge abundance). Between 1804 and 2002, a total of 1,186 estates contributed data on grey partridge bags. Analysis showed that the decline since the 1950s was only part of the picture (see Figure 2). The broader time-frame revealed that in fact there had been large-scale *increases* in the bag during the course of the 19th century, peaking around 1900. During this period, the agricultural revolution led to an increase in the arable habitats favoured by partridges, land enclosure provided hedgerows and hence nesting habitat, predator control reduced mortality, numbers of partridges soared and partridge management for shooting became widespread. Comparing the early 1800s with the late 1900s, it is apparent that the situation now, under intensive agriculture, is considerably worse (on average, about 80% lower) than that 200 years earlier, before the increase.

Partridge bags over the years have reflected spring pair density. (Laurie Campbell)

Figure 1

Grey partridge index of spring pair density 1950-2002 from the Partridge Count Scheme, relative to 1950



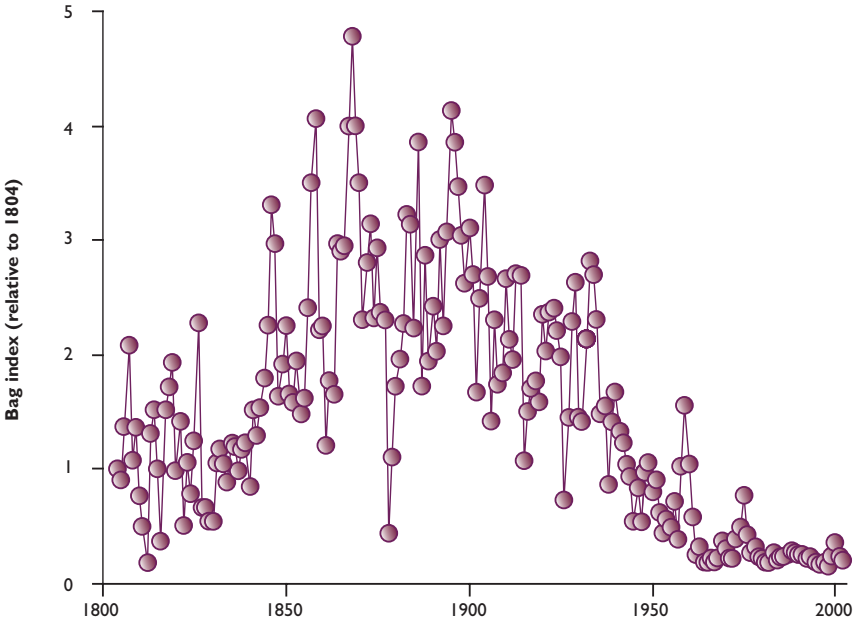


Figure 2

Grey partridge index of bag density 1804-2002 from the National Gamebag Census, relative to 1804

Our National Gamebag Census contains data on grey partridge bags from 1804 to the present day. (The Game Conservancy Trust)

So what is the current situation, particularly with respect to the BAP targets? Since 1999, the Partridge Count Scheme has been expanded as part of our commitment to the UK Grey Partridge Biodiversity Action Plan (see page 27). The annual pattern of change in spring pair density is similar for new recruits and long-term contributors (see Figure 3). Both groups show encouraging spring densities from 2000 to 2003, averaging +13%. This differs from the BTO's Breeding Bird Survey figure of -21%. Our data suggest that farms in the Partridge Count Scheme have halted the decline, and hence will meet the first BAP target – a most encouraging result. Sadly, the picture in the wider countryside is still uncertain. There must therefore be no relaxation in the on-going information campaign to farmers, land owners and shoot managers, who are the people best placed to help restore the fortunes of the grey partridge. The launch of the Entry Level Stewardship scheme in 2005 should provide a much-needed boost to assist the recovery of this bird across the country.

We thank the keepers, farmers and landowners who have provided returns over the years to the National Gamebag Census and the Partridge Count Scheme. We are most grateful to them all and congratulate them on their partridge successes so far.

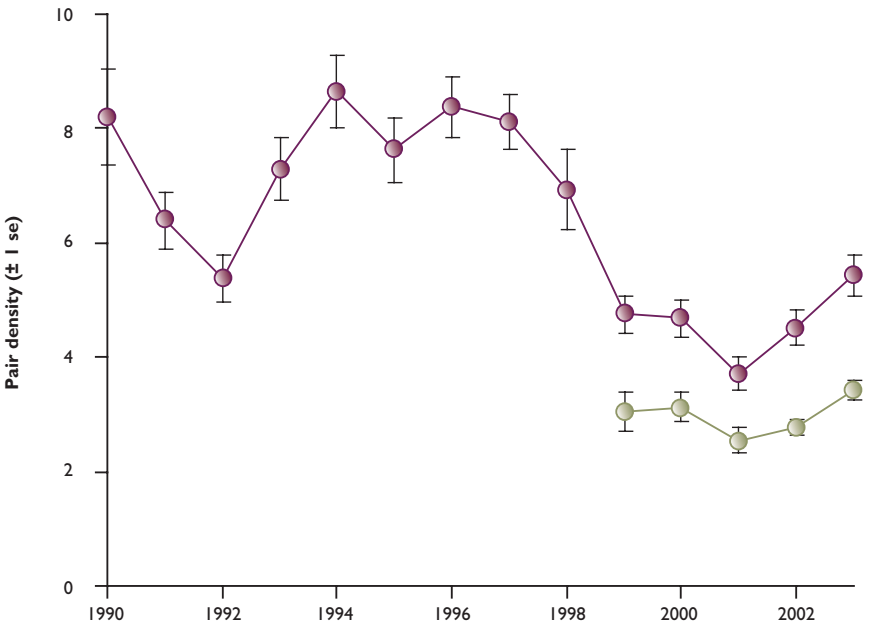


Figure 3

Grey partridge spring pair densities 1990-2003 from the Partridge Count Scheme. Data from long-term contributors and new recruits since the scheme was relaunched in 1999 are presented separately.

Long-term contributors

New recruits to Partridge Count Scheme

Farmland ecology summary for 2004

Key achievements

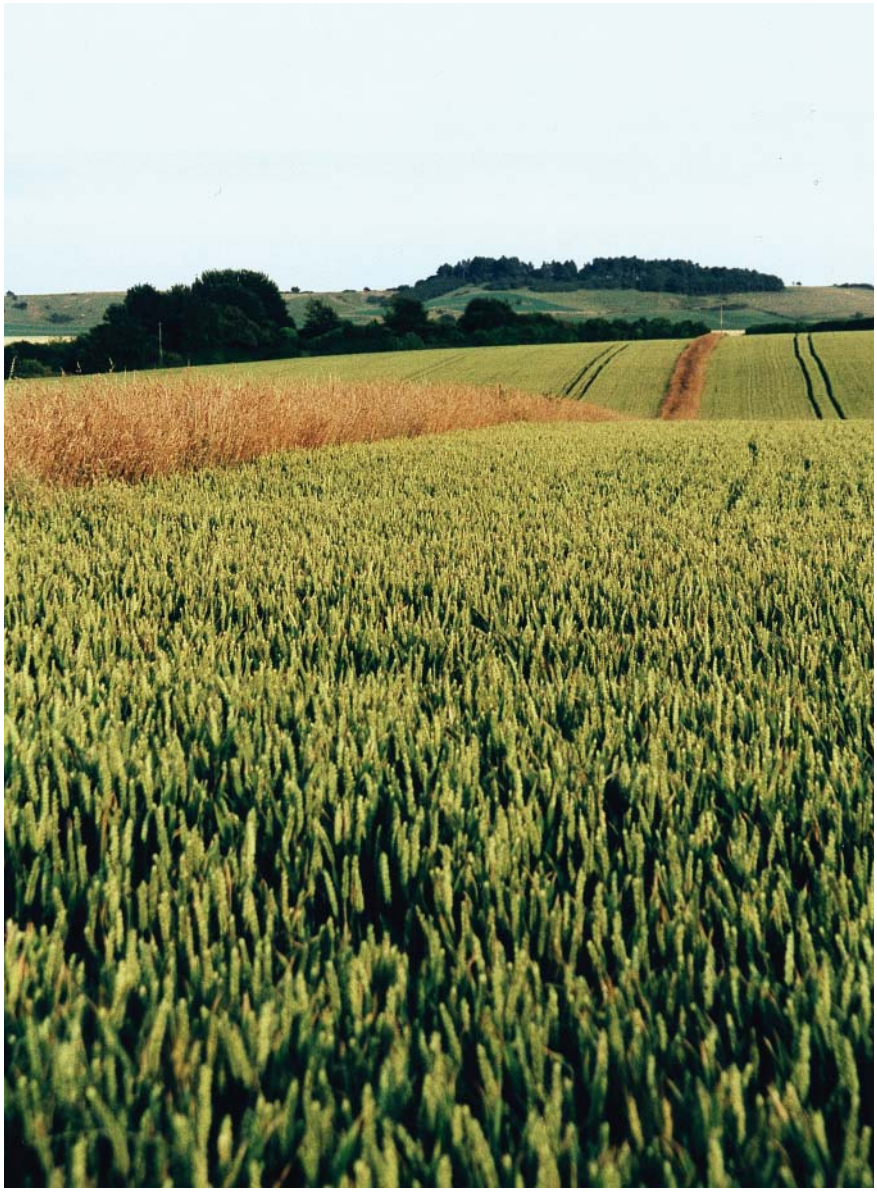
- Completion of three major projects.
- Indirect effects of pesticides project showed yellowhammer chicks to be at risk.

John Holland

We completed three major projects in 2004: the '3D-farming' project (see page 46); the indirect effects of pesticides project; and a desk study examining the risks of pesticide use to farmland biodiversity. Our previous grey partridge research has been especially useful for the latter project and illustrates the value of long-term studies. In common with the grey partridge, we found in the indirect effects of pesticides study that the survival of yellowhammer chicks was linked to insecticide use, indicating that a much wider group of birds is at risk. We hope that these effects will be mitigated through well-managed set-aside and environmental stewardship schemes.

In the Sustainable Arable Farming for an Improved Environment (SAFFIE) project, we found that undrilled patches and wide-spaced rows did not improve access for foraging skylarks in winter cereals, even though other studies did find that undrilled patches supported more skylarks and for longer into the summer. At this stage the data are still being analysed, so we will report on this fully in the *Review of 2005*.

As a continuation of our work on integrated pest control, we successfully applied along with Imperial College, London and Rothamsted Research for just over £1 million from the Rural Economy and Land-Use (RELU) initiative. We will be looking at how the proportion of land devoted to habitat features (beetle banks, wild flower strips, and grass strips) influences the level of invertebrate pest control.



Beetle bank. (Sophia Miles)

A set-aside strip on one of our study sites at Cranborne. (John Holland)

Farmland research in 2004

Project title	Description	Staff	Funding source	Date
3D farming	*Using field margin management techniques to increase beneficial insect numbers and diversity on farmland*	*John Holland, Tom Birkett, Barbara Smith, Sue Southway, Heather Oaten, Sue Thomas*	*Defra, SEERAD, Dow AgroSciences, HGCA, HDC, PGRO, Tesco, Unilever, GCT donations, CWS Farmcare, The Chadacre Agricultural Trust, The Dulverton Trust, The Manydown Company, The Worshipful Company of Farmers, The Yorkshire Agricultural Society*	*1999-2004*
Indirect effects of pesticides	*Determining whether availability of chick-food in summer or seed in winter is controlling survival and breeding success of farmland birds*	*John Holland, Barbara Smith, Sue Southway, Tom Birkett*	*Defra*	*1999-2004*
Larval food plant provenance	*Comparing the effect of plant provenance on the development of butterflies*	*Barbara Smith*	*Core funds*	*2003-2004*
Risks of pesticides to wider biodiversity	*Developing a scheme to assess risks to wider biodiversity arising from pesticide use*	*John Holland*	*Defra, PSD*	*2003-2004*
Sustainable arable farming for an improved environment (SAFFIE)	*Enhancing farmland biodiversity by integrating novel habitat management in crop and non-crop margins*	*John Holland, Sue Southway, Barbara Smith, Tom Birkett, Heather Oaten*	*This project was sponsored by Defra, SEERAD and English Nature through the Sustainable Arable LINK programme. The industrial funders are BPC, CPA, HGCA, RSPB, Safeway Stores plc, Sainsbury's Supermarkets Ltd, Syngenta and the National Trust*	*2002-2007*
Passerine and gamebird chick diet	*Identifying selection and relative use of invertebrates in chick diet*	*Steve Moreby*	*Various projects Core funds*	*2000 - on-going*
Individual-based predator-prey spatio-temporal dynamics	*Using laser-marked beetles to investigate spatial-temporal dynamics of a predatory beetle in relation to its aphid prey*	*John Holland Dr L Winder (Plymouth Uni) Prof J Perry (IACR Rothamsted)*	*BBSRC*	*2000-2005*
PhD: Beetles and their diet	*Examining the nutritional quality of invertebrates consumed by beetles*	*Sarah Oakes (Supervisors: John Holland, GCT and Dr L Winder, Plymouth University)*	*Plymouth University, Core funds*	*2000-2004*

Key to abbreviations: BBSRC = Biotechnology and Biological Sciences Research Council; BPC = British Potato Council; CPA = Crops Protection Association; HGCA = Home Grown Cereals Authority; HDC = Horticultural Development Council; LEAF = Linking Environment and Farming; PGRO = Processors and Growers Research Organisation; PSD = Pesticides Safety Directorate; RSPB = Royal Society for the Protection of Birds; SEERAD = Scottish Executive Environment and Rural Affairs Department; EN = English Nature; Defra = Department of the Environment, Farming and Rural Affairs

Making biodiversity work for the farmer

Key findings

- Largest ever study of insect distributions on arable farmland.
- Up to 1.57 million beetles per hectare found over-wintering in the soil.
- Predatory insects are encouraged by weeds, but 10-14% weed cover is optimal.
- Set-aside strips sown with game cover can encourage predatory invertebrates within the crop, but sown mixtures need to be developed for this purpose.
- Ground-active predatory insects can contribute to pea aphid control.

John Holland

Acknowledgements

The 3D Farming project was supported under the Sustainable Arable LINK programme with financial contributions from the Department of the Environment, Food and Rural Affairs, Scottish Executive Environment Rural Affairs Department, Dow AgroSciences, Home-Grown Cereals Authority, Horticultural Development Council, Processors and Growers Research Organisation, Tesco and Unilever with further support from The Game Conservancy Trust with donations from The Chadacre Agricultural Trust, The Dulverton Trust, The Manydown Company, The Worshipful Company of Farmers and The Yorkshire Agricultural Society.

The overall aim of our '3D' project was to develop management strategies for enhancing natural control of aphid pests in field crops, allowing farmers to fulfil their environmental commitments without jeopardising profitable crop production. This was achieved by looking at the '3Ds': invertebrate *D*ensity, *D*iversity and *D*istribution. Our research partners, Rothamsted Research, Central Science Laboratory and Scottish Agricultural Colleges, examined whether aphid control could be increased by parasitic wasps manipulated using aphid pheromones, and by hoverflies, encouraged using flower-rich margins. Our Entomology Department studied the distribution of ground-active insects, weeds and soil moisture across six fields on the Cranborne Estate, Dorset using a grid of 973 sampling locations. After the first year, we established 20-metre wide set-aside strips sown with wild bird cover in four fields. For most species (insects and weeds), distribution differed within fields, between fields and between years as did the levels of natural pest control. Insects that over-winter in the field margins and invade the field in spring were generally most abundant within 100 metres of the field boundary peaking in number during May (see Figure 1a) whereas those over-wintering in the soil were spread across fields and were most abundant in July (see Figure 1b).

Insect distribution patterns may change through time either as a consequence of movement or survival. Studies of marked beetles revealed that movement was unlikely to be responsible as few beetles crossed the field boundaries. On the other hand, survival did vary between fields. In one field the average (mean) number of beetles emerging from the soil was 1.57 million per hectare. Arable soils are therefore an important source of invertebrates for pest population suppression and as food for farmland birds and small mammals. The survival of larvae was strongly linked to soil moisture levels in winter. Weed cover affected the distribution of adults, but there was an optimum level of weed cover (10-15%) beyond which numbers declined. Further experiments in which we manipulated weed cover using herbicides confirmed that adults were more abundant in weedy crops.

Numbers of grain aphids were lower at 10 and 30 metres from the set-aside strips compared with the field margin in one of the two years in which this was examined, suggesting that set-aside strips were encouraging natural control. In the other year half the strips had been re-sown and overall flower abundance was lower.

Tom Birkett marking beetles for the 3D study. (John Holland)

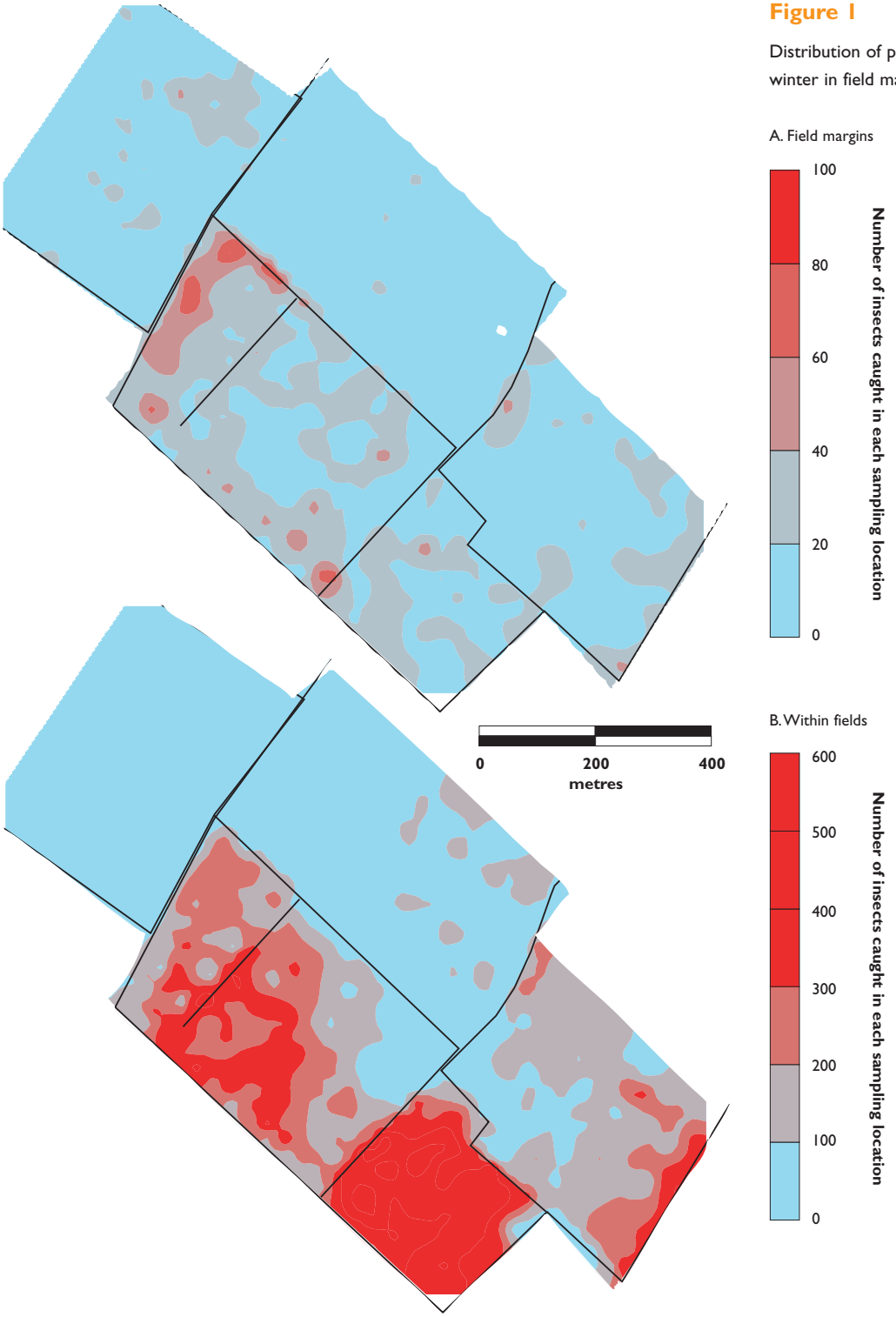


Figure 1

Distribution of predatory insects that over-winter in field margins and within fields

The set-aside strips had no impact on the abundance of pea aphids although studies of their distribution confirmed that predatory insects exerted some control. We believe there is potential to improve levels of natural pest control using set-aside strips, but the composition of plants needs to be carefully chosen if the habitat is not to act as a sink drawing predatory insects out of the crop.

The uneven distribution patterns found indicate that levels of biocontrol are highly variable, but could be reduced by providing over-wintering habitat (eg. beetle banks) and reducing cultivations (eg. ploughing) that destroy larvae in the soil. Boundaries provide a source of insects in spring and a refuge from adverse field operations (eg. insecticide applications and ploughing), but may also inhibit the movement of some species. Allowing some weeds to survive within the crop and having flower-rich borders surrounding crops will encourage predatory insects.

River ecology summary for 2004

Key achievements

- We completed the largest survey of brown trout carried out by the Trust – over 200 sites on 11 rivers providing information on population dynamics, stocking effects and results of habitat improvement schemes.
- We continued delivery of the largest, scientifically-monitored programme of trout habitat restoration in the UK on the Monnow Project.
- We developed novel techniques for fish marking and population assessment.

Ian Lindsay

Above right: The fisheries team. From left: .Dylan Roberts, Dominic Stubbing, Ravi Chatterji and Ian Lindsay. (Ravi Chatterji)

We have continued our demonstration of large-scale habitat restoration for wild brown trout stocks through our lead partnership of the River Monnow Project in Herefordshire. We have now completed over 40 kilometres of bank improvement, and are close to our final target. Following the development of habitat improvement techniques on the River Piddle in Dorset in the mid-1980s, the River Monnow Project provides a valuable opportunity to implement and monitor their effects on range of

We use gravel jetting on our restoration projects to clean silt from the river bed to encourage areas for fish to spawn. (Ian Lindsay)

The River Monnow Project is a partnership, funded by the Defra Rural Enterprise Scheme, between The Wild Trout Trust, The Salmon and Trout Association The Salmon and Trout Trust, The Grayling Society, Environment Agency Wales, The Monnow Fisheries Association, and is led by The Game Conservancy Trust.

A recently improved stretch of upland river - it doesn't get much better than this! (Ian Lindsay)

species at catchment level and to demonstrate the financial benefits from restored wild trout populations.

The Environment Agency's *Trout and Grayling Strategy* has been a major focus of attention among the trout angling community, particularly as it could place restrictions on stocking in many rivers. The main issue has been concern over the possible impact of stocked fish on wild trout populations. To date, little science has been available to guide this debate and the proposed regulations have been based largely on a precautionary approach. Perhaps the most significant contribution to this issue has been our investigation of stocking by Ravi Chatterji, which is jointly funded by the Wild Trout Trust. The interim results of this work are reported on page 50.

Fisheries research in 2004

Project title	Description	Staff	Funding source	Date
Fisheries research	*Developing wild trout fishery management methods, including reports of historical fisheries research*	*Ian Lindsay, Dylan Roberts, Dominic Stubbing*	*Core funds, GC London Fish Group, Reseach Funding Appeal*	*1997 - on-going*
Assessment of habitat improvement on brown trout and salmon	*Monitoring brown trout and juvenile salmon abundance after fencing and coppicing on the river Clywedog 1997-2000*	*Ian Lindsay, Dylan Roberts*	*Environment Agency Wales*	*1998 - on-going*
Monnow Improvement Project	*Large-scale conservation and scientific monitoring of 30km of river habitat on the River Monnow in Herefordshire*	*Ian Lindsay Dylan Roberts*	*Defra, Rural Enterprise Scheme, Monnow Improvement Partnership*	*2003-2006*
PhD: Trout stocking	*Investigating the impact of stocking on wild trout stocks to identify optimal stocking strategies*	*Ravi Chatterji (Supervisors: Prof Peter Williams and Dr Tony Bark, Kings College, London) and Ian Lindsay, Dylan Roberts, Dominic Stubbing*	*Wild Trout Trust, British Trout Farmers Restocking Assoc, GC London, regional fisheries clubs, regional fundraising events*	*2002-2005*

Brown trout stocking in rivers

Key findings

- Growth of introduced trout appears negligible and their residence is short for both upland rain-fed rivers and lowland chalk streams.
- This may explain why previous research reported no impact of stocking on wild populations.
- It is still too early in the study to form firm conclusions.

Ravi Chatterji

We are near to completing the third and final year of our investigation into the success of stocked brown trout and their effects on wild brown trout in both upland spate rivers and lowland chalk streams.

The work started in 2002 in response to concerns over the impacts of brown trout stocking on wild trout populations. The science available at the time was insufficient to quell these concerns, not least because little field research had been done. This is particularly true for chalk streams, most of which occur in Britain.

There are many possible stocking effects, but our project was designed to detect changes in the abundance and growth rates of wild fish in response to stocking. Such changes could occur through competition between fish.

We introduced fertile, farmed brown trout adults (of approximately a pound in weight) into 36 sites, located on seven rivers across England and Wales. We used a further 12 sites as controls. which received no fish. The timing (spring) and the three different levels of stocking we used are typical of many fisheries. The highest stocking level used doubled the number of adult trout present in the river. We stocked fish from two different fish farms so that we could evaluate the performance of different hatchery strains.

We have surveyed the fish populations each summer (2002 to 2004) using the standard electro-fishing technique. We are using the information collected during this monitoring to compare the growth and recapture rate of stocked and wild fish and, by comparing control and treatment sites, ascertain whether the introductions are having any negative effects on the growth and abundance of wild brown trout. We are also comparing effects between the two categories of river.

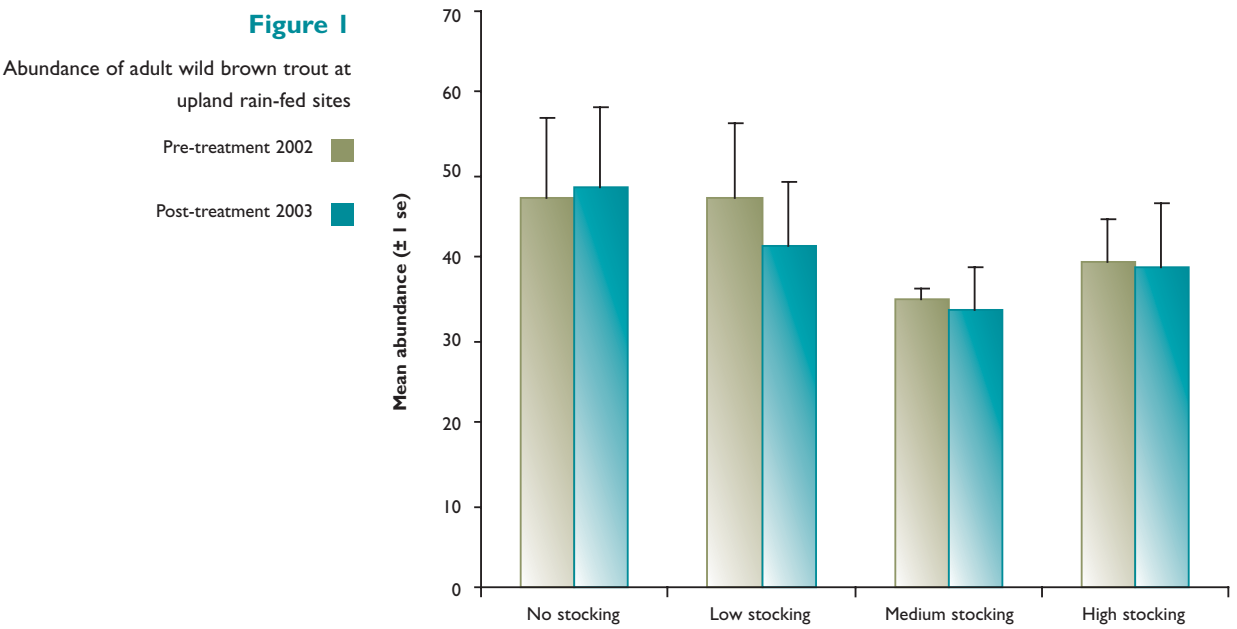
Preliminary results suggest that the growth of introduced trout may be negligible and their residence short for both upland rain-fed rivers and lowland chalk streams. This could explain why some previous investigations (done in North America and continental Europe) have reported no impact of stocking on wild populations. Our initial results appear to concur with these findings (see Figures 1 and 2). However, it is still too early in this study to make firm conclusions. More information will be released when we complete analysis of the 2004 data.

Early results regarding the relative performance of the two hatchery strains suggest that the success of stocking exercises, in terms of the number of stocked fish recaptured in the site of introduction, can be dependent on the strain used and the nature of the receiving water.

Future work is likely to include investigations into the effects of infertile (triploid) brown trout stocking. This type of stocking has been proposed to prevent inter-

Figure 1

Abundance of adult wild brown trout at upland rain-fed sites



Steffan Jones and Ravi Chatterji holding wild brown trout from the River Bourne, one of the lowland chalk streams being studied in the stocking project. (Ravi Chatterji)

breeding between fish of wild and farmed origin and avoid subsequent contamination of the wild gene pool. However, considerably less is known of the effects of triploids on the abundance and growth of wild brown trout compared with their fertile (diploid) counterparts.

The project is supported by The Game Conservancy Trust, The Wild Trout Trust, The British Trout Farmers Restocking Association and members of a variety of angling associations. The work could not be undertaken without the kind permission of the many riparian owners.

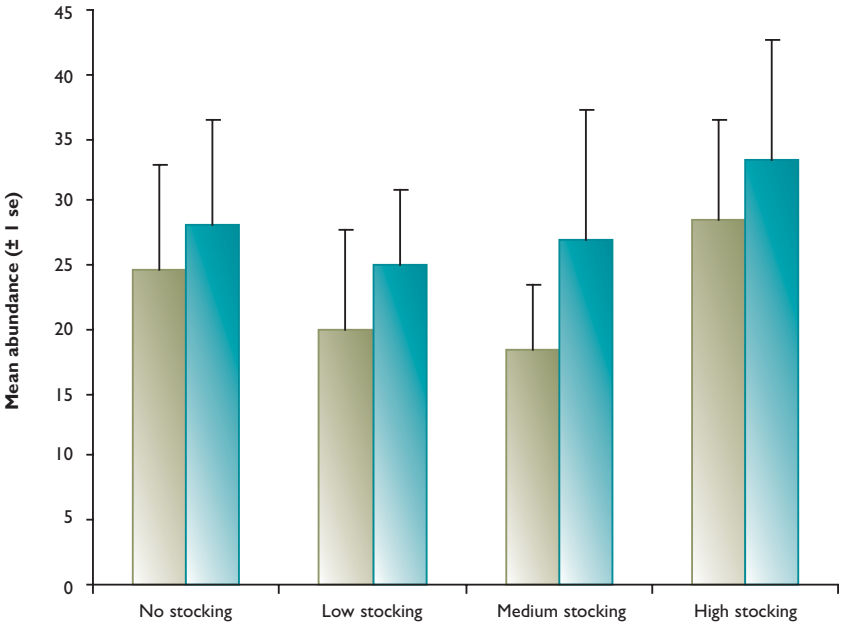


Figure 2

Abundance of adult wild brown trout at lowland chalk stream sites

Pre-treatment 2002

Post-treatment 2003

Wildlife health summary for 2004

Key achievements

- We demonstrated that bits have no obvious effect on gamebird welfare.
- The rearing field was used successfully to produce grey partridges for releasing project.
- Work on *Mycoplasma* showed *Mg* to be a primary pathogen in gamebirds.

Chris Davis

2004 was warm and humid causing various game management problems, but disease levels were low and the call on veterinary practices appeared to be minimal. There were reports of increased mortality among chicks and some hatchery problems, and parasites such as gapeworms and coccidia seemed to enjoy the muggy weather. There were rumours of imported drugs being used although we saw no evidence of this. Such products should never be used as doing so will place the game meat markets in some jeopardy.

On our rearing field at Fordingbridge we completed our study using grey partridges as models for *T. tenuis* in red grouse, the results of this are summarised on page 80.

We continued with another study on the effects of bits on pheasant poults (see page 54). This year we had no feather pecking in either group and the data suggest little difference between bitted and unbitted birds. This shows that the bits have no demonstrable negative effect on birds, even in the absence of feather pecking in unbitted birds. We hope to expand and repeat this work in 2005.

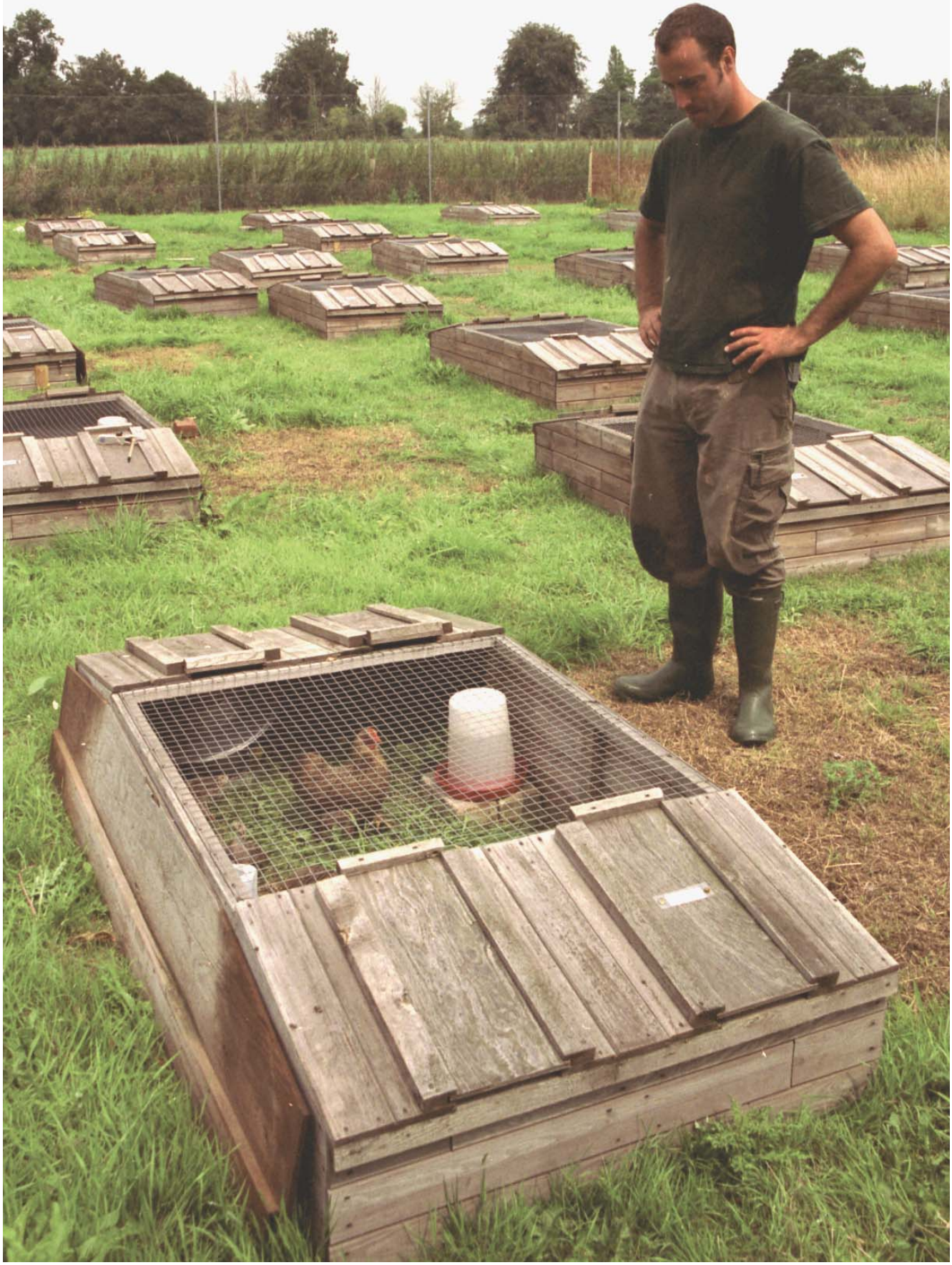
The main thrust of the rearing field's activities in 2004 was in producing grey partridge chicks and poults as part of the partridge release project (see page 32). For this we needed to rear some birds under bantam hens, breaking our own rules on biosecurity, which caused some interesting disease and parasite problems. The end result was worth it, however, and we produced a fine bunch of poults and adults for release.

Our *Mycoplasma* (*Mg*) project with Janet Bradbury and Anne Forrester at Liverpool University went well in 2004. The studies have clearly shown that the recent *Mg* isolates from UK pheasants are capable of causing clinical disease in day-old and 20-week-old birds. Thus *Mg* is a primary pathogen in gamebirds although in adult birds the mycoplasmosis may be exacerbated by avian pneumovirus. There was no evidence that avian pneumovirus on its own caused disease in adult pheasants. The *Mg* 6/85 vaccine proved safe in one-day-old and adult pheasants, but gave little protection. The reasons for this are not clear. However, the use of a commercial pneumovirus vaccine may give some protection in the face of a dual challenge with *Mg* and the pneumovirus. We hope to test the pneumovirus vaccine to see if it is more successful than the *Mg* vaccine in the field.

Dr Sheelagh Lloyd's work at Cambridge University on *Hexamita* continued with the development of an infection model and transmission studies for both pheasants and partridges. Sheelagh is still collating the data. However, it appears that contaminated pens may remain infective for up to two days after the diseased birds have been removed.

Gamebird welfare research in 2004

Project title	Description	Staff	Funding source	Date
Gamebird health	*Disease prevention and control in game and wildlife*	*Chris Davis, Des Purdy*	*Core funds*	*1998 - on-going*
Hexamita	*Investigating the pathology and epidemiology of* Hexamita *in reared gamebirds*	*Chris Davis, Sheelagh Lloyd (Camb Univ) Des Purdy*	*Lord Iliffe Charitable Trust, Roxton Bailey Robinson*	*2000-2004*
Mycoplasmosis	*Investigating* Mycoplasma *as a respiratory disease agent in reared gamebirds*	*Chris Davis, Janet Bradbury (Liverpool Vet School), Des Purdy*	*Research Funding Appeal National Gamekeepers' Organisation*	*2002-2004*
Rotavirus	*To investigate disease prevention and cause in reared gamebirds Auchincruive)*	*Chris Davis (SAC Veterinary Science Division,*	*Core funds*	*1999-2004*
Strongylosis control	*Development of strongylosis control techniques*	*Dave Newborn David Baines*	*Core funds*	*1980-2005*



Our rearing field was used for producing grey partridges for our new releasing project. Here Mike Sharp attends to the bantams and their adopted chicks. (Sophia Miles)

To bit or not to bit?

Key findings

- Mortality is higher in flocks of unbitted pheasants because of increased feather pecking.
- Feather pecking constitutes a welfare problem in gamebird flocks.
- Food consumption among bitted birds is similar to that in non-bitted birds.

Chris Davis

Gamebirds reared in captivity, in common with most poultry, are prone to the vices of feather pecking and cannibalism. The poultry industry attempts to control this by a variety of means varying from long-term breeding policies to short-term remedies such as beak cautery. Environmental enrichment techniques have been tried in both gamebird and poultry rearing with limited success. Even in extensive (free range) poultry systems, feather pecking and cannibalism are major causes of mortality and are important welfare issues.

In gamebird rearing, fitting small plastic bits into the beaks of the pheasants for a period of three to four weeks during the early rearing period usually prevents feather pecking and cannibalism. Bits are removed before the birds' release at six to seven weeks old.

A bird from a bitted group at five and a half weeks old with feather score 5 (good overall feathering). Note the plastic bit fitted into the nares. (Des Purdy)

Although pen enrichment techniques are to be encouraged, they don't always prevent feather pecking and cannibalism. Beak trimming, apart from any welfare concerns, is no longer considered acceptable in gamebirds as they need to be released into the wild with their beaks intact. Long-term breeding policies similar to those used in poultry are likely to lead to a loss of 'wildness', which would be counter-productive for a gamebird.

Most game rearers would prefer not to bit birds routinely as the operation is time-consuming. But to leave the birds unbitted and bit as required would expose them to outbreaks of feather pecking, which would be difficult to stop. However, there has been little research to support this view.

To rectify this, we conducted a study with the Game Farmers' Association across a range of facilities. Each farm had bitted and unbitted birds. Birds were bitted at the

Unbitted bird at five and a half weeks. Note the bare back and bleeding from tail blood quills. (Des Purdy)

normal or at a nominal three weeks old and, apart from the bit, other management was the same for both groups. If feather pecking became a welfare problem in any unbitted group, there was the facility to bit the affected birds to minimise this.

We found that all the bitted birds maintained good feather condition throughout the study, whereas the condition of the unbitted birds deteriorated in all cases where feather pecking was evident. In five out of seven cases the condition of the 'unbitted' birds deteriorated so much that they had to be bitted on welfare grounds. At all sites, feather pecking adversely affected the welfare of the birds. Six of the seven farms (one did not comment) considered the non-bitted birds unfit for release, as they would have been liable to chilling in bad weather. Five farms provided data on mortality, four of which showed an increase in mortality in the non-bitted birds. The exception showed an increase in mortality in the bitted birds, but this was associated with an outbreak of hexamitiasis. Two of the three farms where body weight was measured demonstrated a weight advantage in favour of the bitted birds. This was reversed in the third farm possibly owing to hexamitiasis. Of the sites where it was measured, there was little difference in food consumption.

In further studies we have shown that where feather pecking does not occur, bitted birds perform as well as unbitted ones.

Pheasant with bit in situ and due for removal. (Des Purdy)

Unbitted bird at five and a half weeks. Note the bare back, absence of a tail and lesions on hock and tarsal areas. (Des Purdy)

Predation research summary for 2004

Key achievements

- The GCT Mink Raft was used to steer incisive mink control on two rivers in southern England.
- Water vole numbers built up substantially during the absence of mink.
- Water voles recolonised stretches from which they had been absent while mink were present.
- GCT Mink Raft wins award from animal welfare organisation.

Jonathan Reynolds

The invention of the GCT Mink Raft in 2002 initiated two years of intensive research on how best to manage the introduced mink for the benefit of native wildlife such as water voles.

Improving mink control

The mink control projects on the River Itchen in Hampshire and the River Wylye in Wiltshire, already reported in the Trust's *Review of 2003*, continued in 2004. On the Wylye, Trust research staff, Mike Short and Tom Porteus, have maintained both monitoring and trapping roles. On the Itchen we reduced our involvement to a monitoring role only, in line with available funding, relying on the river keepers to provide the low level of trapping required. In both cases, mink presence was held at near-zero levels from the start of the project to the end of July 2004, allowing water vole numbers to build rapidly from initial levels (see Figure 1). Indeed, water voles have been so numerous on the Wylye that they actually hindered the discovery and trapping of mink that appeared there in late summer. The latter appeared to be a female with young which either moved in from adjacent rivers, or perhaps were missed somewhere along the river corridor. Overall, though, we were very satisfied that the GCT Mink Raft had proved itself in practical mink control, and that we had developed a near-optimal strategy for using it in these conditions.

There are several aspects of mink control that we would like to improve further, but shortage of external funding prevents us undertaking the research. Our involvement on the Wylye has now ended due to lack of funding, though the Itchen project is still being funded at a modest level by the Environment Agency, which also funds mink removal projects elsewhere in the UK. In general, there is a clear shortage of money in the UK for water vole conservation, and it is understandable that - having

A water vole - the reason behind our work on mink eradication using the GCT Mink Raft. (Jonathan Reynolds)

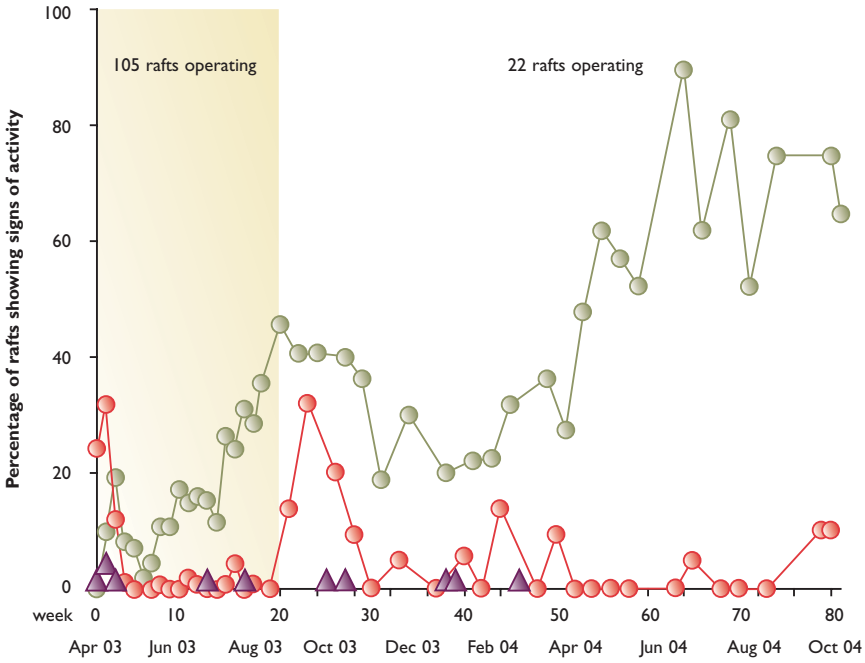


Figure 1

Mink and water vole activity on the River Itchen, April 2003 to October 2004

Mink captures

Mink activity

Water vole activity

been given a viable technique for mink control in the form of the GCT Mink Raft - conservation agencies and Wildlife Trusts now place the emphasis on action rather than further research. At a national level, policy for water vole conservation is led by the Environment Agency, whereas Defra has the lead role in devising policy for introduced and invasive species such as the mink.

Unusually, mink control is a case where predator control is wanted outside the game management sector. It has allowed us to discuss predator control issues with audiences for whom predator control is normally a distasteful and taboo subject, and to demonstrate that a rational and sensitive approach is possible. The GCT Mink Raft continued to attract considerable attention in 2004, and has been adopted by conservation bodies all over the country. In September, further press coverage was prompted by our receipt of the 2004 Wild Animal Welfare Award (the first ever offered) from the Universities Federation for Animal Welfare (UFAW). This award recognised that, by ensuring focused, effective trapping, mink rafts also deliver benefits in welfare, for both target and non-target animals. UFAW is very much a science-driven organisation, hence we were delighted to receive this acknowledgement from them of the improvements we had made to mink control practice. The award was presented by Minister Ben Bradshaw, which in itself ensured awareness of the issues at the highest levels.

A water vole being released unharmed from a live-catch trap mounted on a GCT Mink Raft. (Jonathan Reynolds)

Predation research in 2004

Project title	Description	Staff	Funding source	Date
Mink control strategies	*Experimental eradication of mink on parts of Itchen and Avon catchments*	*Jonathan Reynolds, Mike Short, Tom Porteus*	*Environment Agency, Core funds*	*2003-2006*
Fox control methods	*Experimental field comparison of fox capture devices*	*Jonathan Reynolds, Mike Short, Austin Weldon*	*Core funds*	*2002-2006*
Mammal population trends	*Extracting cull data on mammalian game species and predators from the National Gamebag Census*	*Jonathan Reynolds, Nicholas Aebischer*	*Joint Nature Conservation Committee*	*2003 - on-going*
Analysis of hare numbers	*Analysis of regional trends in winter hare numbers based on sighting records from beaglers and harriers*	*Stephen Tapper*	*Association of Masters of Beaglers and Harriers*	*2002-2004*

Upland ecology summary for 2004

Key achievements

- The Upland Predation Experiment reached its half-way point.
- A strongylosis best practice management leaflet was produced.
- New raptor research is being developed.

David Baines

Our research programme is developing along three broad, but inter-related themes: biodiversity, diseases and habitat management.

Our biodiversity theme has three main components: evaluating the conservation benefits of driven grouse shooting through good moorland management; assessing how the impact of raptors on grouse can be reduced; and species recovery. Our flagship project is the Upland Predation Experiment at Otterburn, run by Kathy Fletcher and Craig Jones, which reached its half-way point in 2004. To-date, we have established links between predator control, grouse moor re-establishment and improvement in the fortunes of several species of ground-nesting birds (see page 64), but much remains to be done during the second phase.

Our raptor research has been low-key since the end of the Joint Raptor Study, but we expected to start a new experiment in 2005 to determine whether diversionary feeding of hen harriers can improve grouse chick survival. Meanwhile, our work on predator-prey relationships at Langholm is suggesting new interpretations of previously accepted facts (see page 70).

The black grouse recovery project in northern England managed by Phil Warren has produced further increases in numbers of lekking males (see page 62) and we hope for significant funding from the Heritage Lottery Fund for work in Northumberland.

Despite the success of several disease trials by Dave Newborn and Adam Smith, we still find a reluctance from managers to follow our best practice guidelines on the use of medicated grit and countering the ever-increasing threat of sheep ticks and tick-borne diseases such as louping ill. Our newly formed Disease Working Group is helping to shape a programme with new projects in 2005. In addition to improving our best practice guidelines, we will also explore the possible transmission of diseases from released gamebirds on the moor edge to grouse.

Habitat management has had least attention to-date. Moorland habitats are threatened, not only from over-grazing, but from nitrogen deposition, acidification and climate change. These may be manifested in several ways, including attacks by heather beetles and the spread of competitive species like purple moor grass (*Molinia*) and soft rush *(Juncus)* on moor margins. We hope to begin work on this in 2005.

Above: Rebecca Beaston holding a curlew chick. Left: measuring the wing length on a golden plover chick. Scenes such as these are typical within many of our upland research projects. (David Baines)

Upland research in 2004

Project title	Description	Staff	Funding source	Date
North of England grouse reasearch	Ecology and management of red grouse in England	Dave Newborn, David Baines	Core funds, Gunnerside Estate	1980 - on-going
Black grouse research	Ecology and management of black grouse	David Baines, Mike Richardson	English Nature, Private donors	1989 - on-going
North Pennines black grouse recovery	Black grouse restoration	Phil Warren, Mike McKendry	MoD, English Nature, RSPB, Northumbrian Water	1996-2006
Grouse moors - other species	Effects of grouse moor management on other bird species	David Baines Kathy Fletcher, Rob Foster, Craig Jones, Danny Lawson	Uplands Appeal, Core funds	1998-2008
Louping ill - waders	Impact of louping ill on breeding waders	David Baines, Dave Newborn, Rebecca Beeston	North York Moors National Park	2003-2004
Human access and wildlife	Effects of increased access on breeding waders and black grouse	David Baines, Kathy Fletcher, Mike Richardson	English Nature	2003-2004
Louping ill - red grouse	Disease management in North York Moors	Dave Newborn David Baines	North York Moors NP, local moor owners	1996-2004
PhD: Red grouse populations	Grouse dispersal and mortality in relation to parasite management	Philip Warren (Supervisors: David Baines, GCT; Dr C Thomas, Durham Univ)	EU Objective 5b	2000-2005
PhD: Red grouse and strongylosis	Field and lab-based experiments on impact of anthelmintics	Ruth Cox (Supervisors: David Baines, GCT; Dr C Thomas, Durham Univ)	Anonymous donors	2000-2004
Scottish grouse research	Long-term monitoring of red grouse and worm burdens	Adam Smith, David Howarth	Scottish Trustees, Core funds	1985 - on-going
Grouse productivity	Effect of grouse chick and maternal diet on grouse productivity	Adam Smith, David Howarth, Alan Kirby	Scottish Trustees	1999-2004
Diversionary feeding	Developing a hen harrier diversionary feeding trial	David Baines	SNH	2004 - on-going
Mountain hare ecology	Effects of parasites on mountain hares	Adam Smith, Scott Newey	Scottish Trustees	2000-2004
Tick control	Tick control in a multi-host system	Adam Smith, Alison Taylor	Scottish Trustees	2000-2007
Woodland grouse - Scotland	Ecology and management of woodland grouse	David Baines, Isla Graham	The Dulverton Trust, LIFE, SNH	1991-2006
Langholm research	Montoring raptors, grouse, voles, pipits, waders and foxes	David Baines Ann-Marie MacMaster	SNH	1992 - on-going
PhD: Muirburn	Examining fire behaviour characteristics	Matt Davies (Supervisors: Adam Smith, GCT; Colin Legg, Edinburgh Univ)	NERC, Core funds, Scottish Trustees, SNH	2002-2004
PhD: Tick ecology	Spatial ecology of sheep ticks	Ellie Watts (Supervisors: Adam Smith, GCT; Justin Irvine, CEH; Alan Bowman, Aberdeen Univ)	NERC	2003-2006

Key to abbreviations: LIFE = European Union Financial Instrument for the Environment; SNH = Scottish Natural Heritage; NERC = Natural Environmental Research Council; MoD = Ministry of Defence; RSPB = Royal Society for the Protection of Birds.

Red grouse monitoring

Key findings

- Poor breeding performance of red grouse in Scotland.
- Average number of red grouse in England increases for third year in a row.
- Bad year for strongyle worm burdens in grouse.

David Baines

We survey 39 sites twice a year for red grouse in Scotland and northern England as part of our long-term monitoring scheme. Spring counts give the breeding densities, whereas the July counts provide information on breeding success and autumn stocks for shooting. We gather shot birds at 13 of these sites to check for strongyle worm burdens. In 2004, densities and breeding success showed a clear geographical difference between Scotland and northern England and hence data from the two countries are treated separately.

Scotland

The core red grouse monitoring on 21 Scottish moors in 2004 suggested poor breeding performance of red grouse on many of them. Spring pair counts appeared not to reflect the moderately productive year of 2003 with mean numbers of spring pairs (8.6 per 100 hectares) in 2004 lower than in 2003 (13 per 100 hectares). Production counts in July and August were poor, with the density on 17 of 21 moors down on 2003 (see Figure 1). We counted 57% fewer young grouse in 2004 compared with 2003 and this showed in the decline of the average young-to-old ratio from 1.6 to 0.8 year on year.

Northern England

Our long-term monitoring on 18 English sites has again shown an increase in the

Figure 1

Average density of young and adult grouse in July/August using counts from 21 sites in Scotland 1990-2004

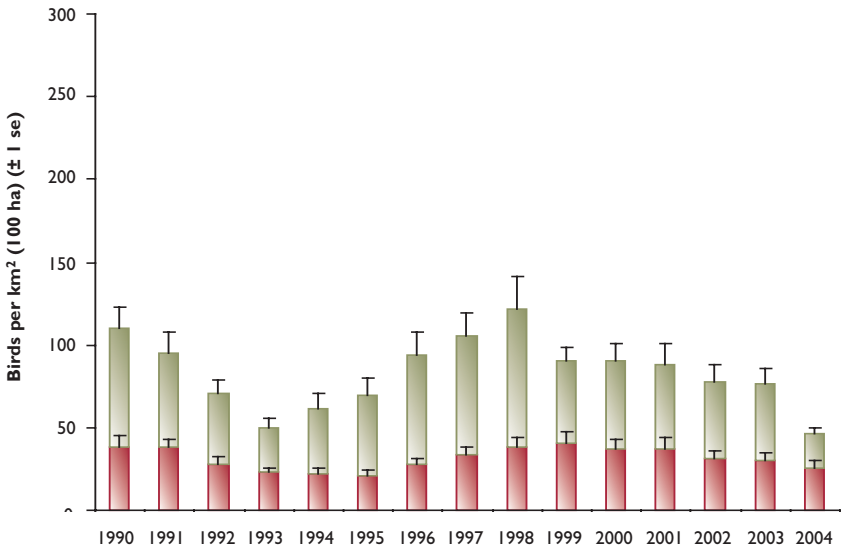
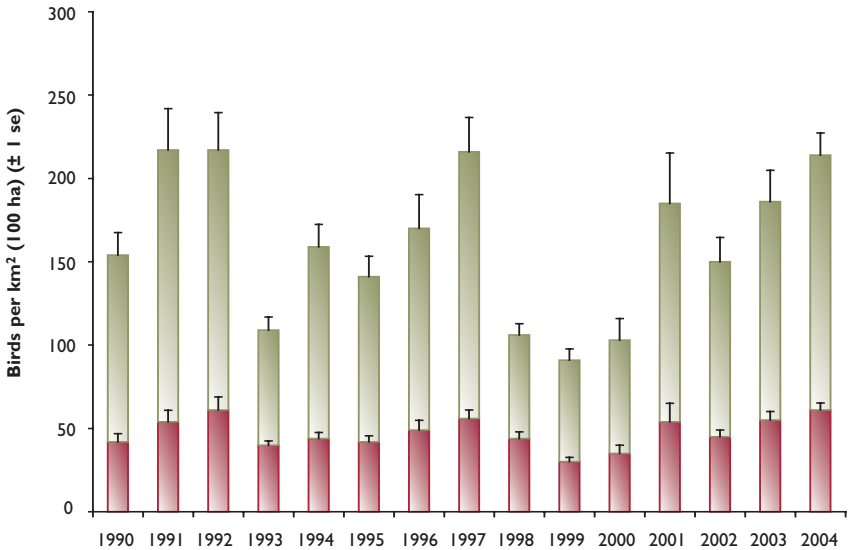


Figure 2

Average density of young and adult grouse in July using counts from 18 sites in northern England 1990-2004



We count red grouse pairs in spring to determine the breeding population and then again in the summer to find out how well they bred. (Laurie Campbell)

average number of red grouse for the third year in succession. This increase was a combination of higher spring densities of adults and more importantly an increase in their breeding success (see Figure 2). High July densities have led to several estates, particularly in the northern Dales, having an excellent shooting season with some breaking their record bags. This increase has not been universal, however, with some moors, particularly in the southern Dales, having similar July densities to 2003 and hence limited shooting. This poor performance may have been linked both to wet weather and the associated rise in strongyle worm parasites (see Figure 3).

Strongyle worm counts

We monitor five moors in Scotland and eight in northern England each year to assess strongyle worm burdens in a random sample of shot young red grouse and a further sample of shot adults.

In both Scotland and England, warm wet weather from mid-June to September was ideal for the free-living strongyle larva survival and subsequent consumption by grouse. The effects of the increased larval pick-up are evident in the high parasite burdens found in August shot grouse in Scotland (see Figure 3) and England, particularly the young birds, which had almost a five-fold increase on the 2003 levels. With continued warm wet weather into the autumn, the long-term prognosis does not appear encouraging for the 2005 season. Effective parasite control will have been essential on the majority of estates through the winter of 2004/05.

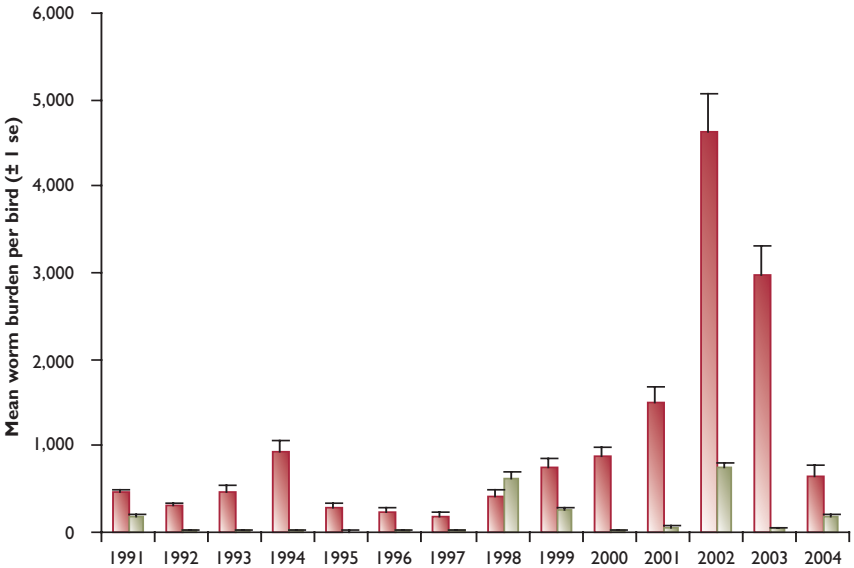


Figure 3

The geometric mean strongyle worm burdens from shot grouse (young and adults) sampled at five moors in Scotland 1991-2004

Adult

Young

Black grouse and capercaillie

Key findings

- English black grouse population nears 1,000 males.
- Black grouse breeding success low in 2004.
- Breeding success for capercaillie at lowest level since 1998 and at second lowest since 1991.

Phil Warren
David Baines

Black grouse lek counts

We monitor the numbers of black grouse males attending leks at study sites in northern England annually as part of our black grouse recovery project. Results from these lek surveys represent an increase of 4% per year since 1998 and suggest that numbers have recovered to 1990 levels (see Figure 1). Full surveys of the English population were undertaken in 1998 and 2002, when 773 and 895 males were counted respectively. Extrapolating from the 2004 monitoring, we estimate that the population may now be closer to 1,000 males.

These early signs of black grouse recovery show that we are on course to meet the Biodiversity Action Plan target for black grouse in England of restoring the 1996 levels (800 males) by 2006.

Black grouse breeding success

Since the project's start in 1996, we have monitored black grouse breeding success annually in northern England using pointing dogs in August. In northern England black grouse breeding success is often lower than in other parts of the UK (see Figure 2) and in 2004 breeding success in northern England was moderate at 1.3 chicks per hen

Figure 1

Number of black cocks attending 28 leks in northern England 1989-2004

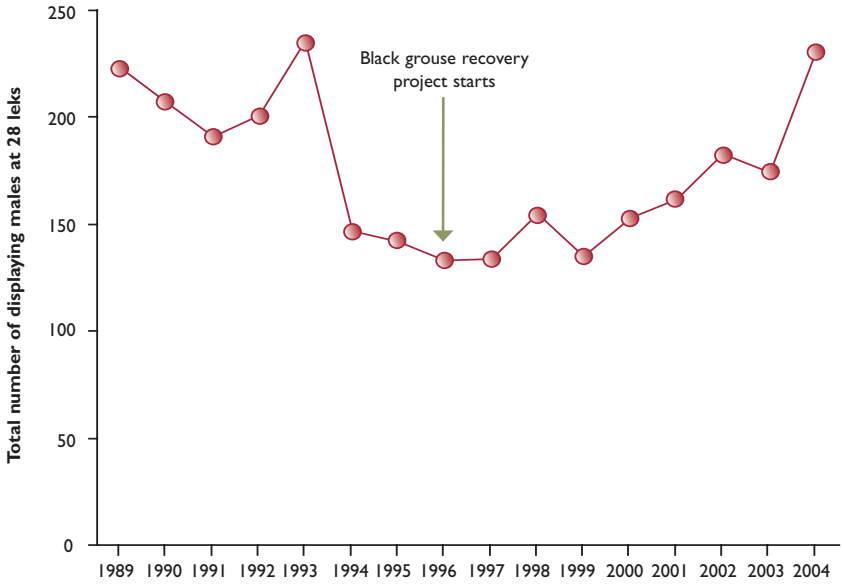
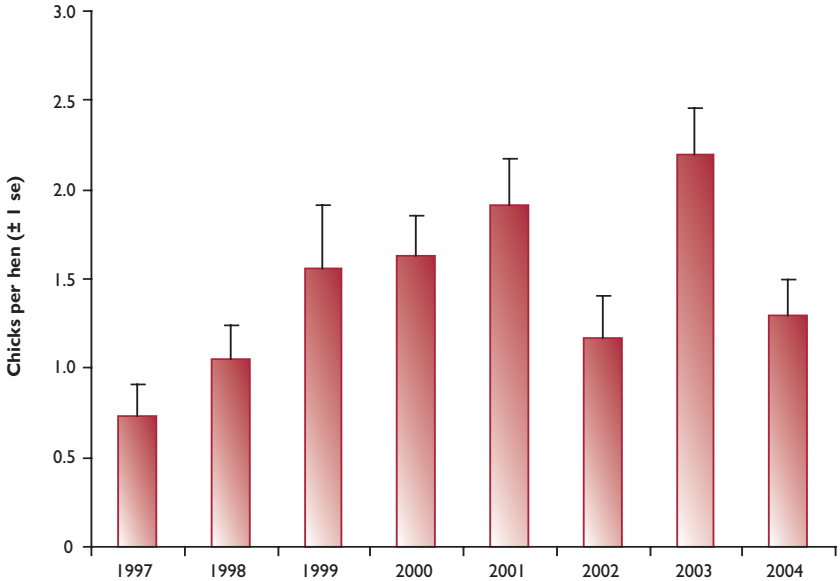


Figure 2

Annual black grouse breeding success (chicks per hen) in northern England 1997-2004



Capercaillie breeding success in 2004 was at its lowest level since 1998. (Laurie Campbell)

compared with two chicks per hen in 2003. This low breeding success reflects poor weather in June when the chicks hatched.

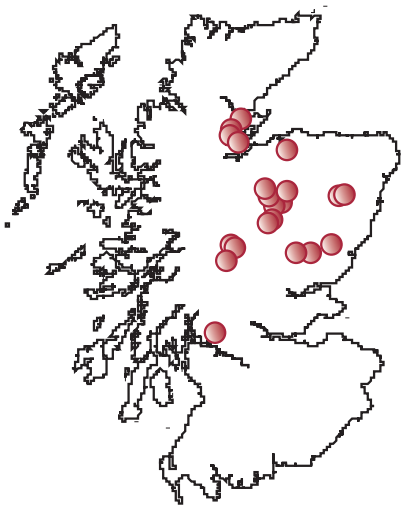
Capercaillie monitoring

Capercaillie breeding success in 2004 was at its lowest level since 1998 and was the second lowest since 1991 (see Figure 3). Our annual survey of capercaillie in 21 forests (see Figure 4) revealed only 0.3 chicks per hen. It is likely that this is because of the cold, wet weather in the summer, particularly during the early chick-rearing period.

We have calculated that 1.1 chicks per hen are required to maintain a stable population. But, in the absence of mortality due to fence collisions, only 0.6 chicks per hen may be enough to maintain a stable population. Unfortunately, capercaillie breeding success in 2004 failed to exceed even this lower level of productivity. The Scottish capercaillie population is not out of the woods yet!

Figure 3

The distribution of 21 forests surveyed to assess breeding success in 2004



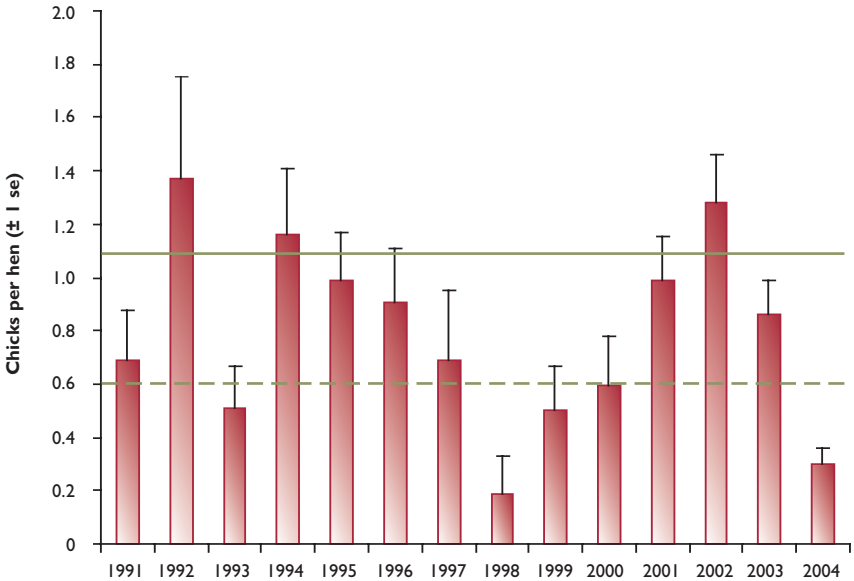


Figure 4

Capercaillie breeding success (chicks per hen) 1991-2004

— Chicks per hen required to maintain population

– – Chicks per hen required to maintain population without fence collisions

Note: apart from 2003-2004, capercaillie breeding success was derived from a different subset of forest areas each year.

Does predator control help ground-nesting birds?

Key findings

- Gamekeepers continue to reduce numbers of the main predators on the keepered sites.
- None of the pairs of waders successfully fledged young on the unkeepered sites in 2004, whereas the percentage of successful pairs was between 50% and 100% for the same species on keepered sites.
- The trends in abundance of the wader and small passerine species are unclear in relation to keepering but, for red grouse, both abundance and breeding success were higher on the keepered sites than on the unkeepered sites in all years since keepering began.
- In autumn 2004, the keepering switched from the Otterburn to the Bellshiel site, marking the half-way point in the project.
- These results are preliminary - no firm conclusions should be drawn until the end of the experiment.

Kathy Fletcher

The Upland Predation Experiment based at Otterburn in Northumberland aims to quantify the effect of predator control on ground-nesting birds on moorland and surrounding farmland. The project is now in its fourth full year. The project has four plots, each about 12 square kilometres (1,200 hectares), on which bird abundance and reproduction have been monitored since 2000. In the autumn of 2000, predator control started on the Otterburn and Ray Demesne plots. The nearby Bellshiel and Emblehope plots remained unkeepered as experimental controls.

Gamekeeping on Otterburn and Ray Demesne has reduced foxes by more than 50%, and crows by more than 90%. Stoat and weasel abundance appears not to have changed markedly on either the keepered or unkeepered plots. The number of weasels appears to fluctuate in line with the vole cycle, as do sightings of short-eared owls, which returned to low levels on all plots following the vole peak of

Project scientist, Kathy Fletcher, with her dogs on the Ray Demesne plot. (David Douglas)

Table 1

Spring pair counts in the Upland Predation Experiment, 2000-2004

a. Otterburn plot (keepered autumn 2000-2004)

	Curlew	Golden plover	Lapwing	Red grouse
2000	17	5	3	26
2001	No data collected owing to Foot and Mouth Disease			
2002	14	11	6	40
2003	9	11	8	81
2004	11	10	6	143

b. Ray Demesne plot (keepered autumn 2000-2004)

	Curlew	Golden plover	Lapwing	Red grouse
2000	21	6	12	50
2001	No data collected owing to Foot and Mouth Disease			
2002	18	9	14	55
2003	22	8	18	92
2004	18	7	19	159

c. Bellshiel plot (unkeepered 2000-2004)

	Curlew	Golden plover	Lapwing	Red grouse
2000	14	4	7	13
2001	No data collected owing to Foot and Mouth Disease			
2002	10	2	4	18
2003	7	0	1	14
2004	4	1	2	9

d. Emblehope plot (unkeepered 2000-2004)

	Curlew	Golden plover	Lapwing	Red grouse
2000	4	7	2	26
2001	No data collected owing to Foot and Mouth Disease			
2002	4	7	1	22
2003	3	4	1	16
2004	3	3	1	19

So far, curlew have responded well in our Upland Predation Experiment on the plots where we have a gamekeeper. (Laurie Campbell)

2003. There were more sightings of peregrines and goshawks on the keepered plots in 2004, but it is unlikely that any change in the breeding success of prey species observed between keepered and unkeepered areas have been caused by natural variation in raptor abundance.

Spring densities of red grouse continue to increase on the keepered plots, with 2004 showing a four-fold increase on the baseline densities (see Table 1). In 2004, although the proportion of hens with broods remained high (see Figures 1 and 2), there were fewer young per h en than in 2003 (mean 2003 = 5.7 young per hen; mean 2004 = 2.9 young per hen). However, the keepered plots (see Figures 1 and 2) still produced three times more young per hen than the unkeepered plots (see Figures 3 and 4). The numbers of grouse were high enough for driven shooting and worm burden data were collected on both keepered plots. The worm burdens, on average, were not high and probably did not limit breeding success in 2004.

Figure 1

Otterburn plot: percentage of pairs that fledged young for curlew, golden plover, lapwing, meadow pipit and red grouse, 2000-2004 (no data for 2001 owing to Foot & Mouth Disease)

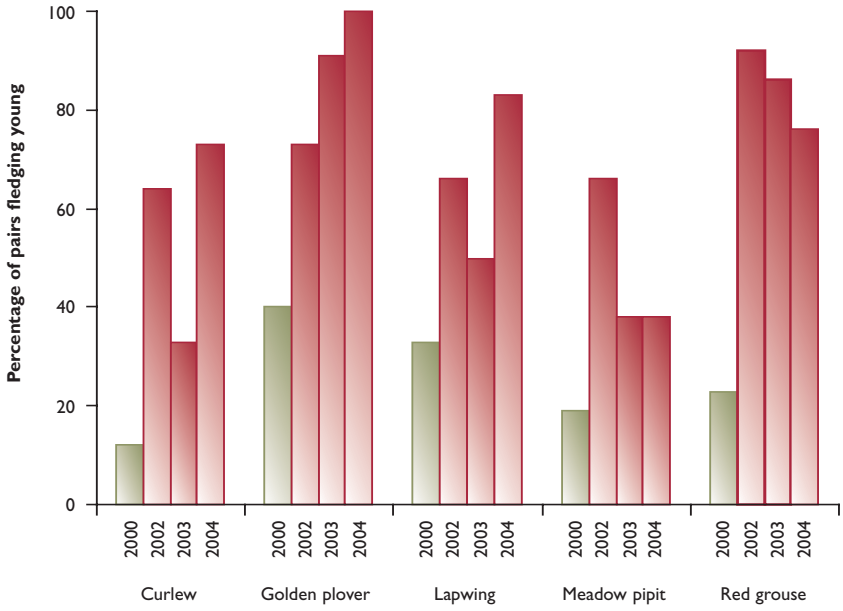
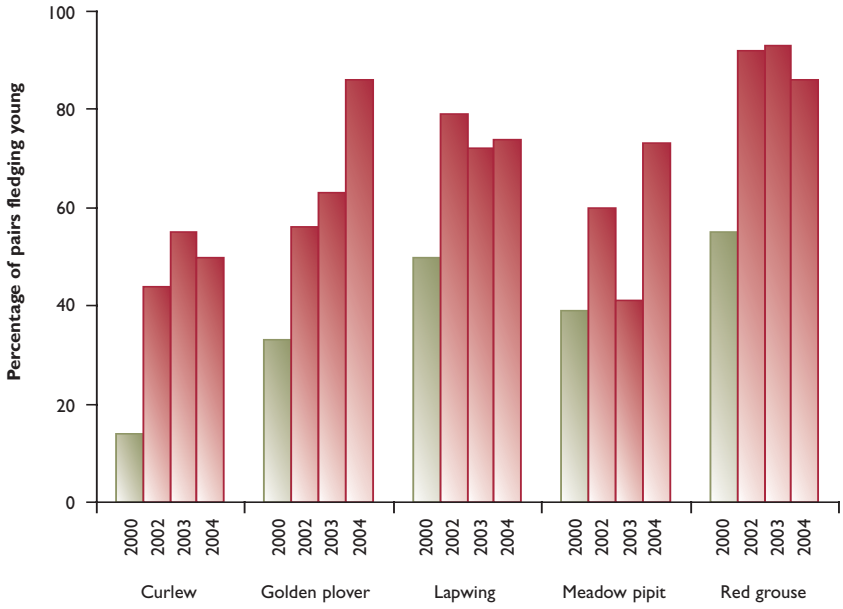


Figure 2

Ray Demesne plot: percentage of pairs that fledged young for curlew, golden plover, lapwing, meadow pipit and red grouse, 2000-2004 (no data for 2001 owing to Foot & Mouth Disease)



Breeding success for curlew, golden plover and lapwing on the keepered plots was between two and four times greater in 2004 than before predator removal started on the keepered plots (see Figures 1 and 2). In contrast, no wader chicks fledged on the unkeepered plots (see Figures 3 and 4).

The numbers of breeding pairs of golden plover and lapwing increased on the keepered plots and decreased on the unkeepered ones (see Table 1). The numbers of pairs of curlew have fallen on both keepered and unkeepered plots (see Table 1). More meadow pipit nests fledged chicks on the keepered plot (see Figures 1 and 2), but no discernible trend occurred in the spring abundance of meadow pipits or skylarks in relation to predator removal.

At this point in the project, the trends in abundance of the wader and passerine species are not yet clear, although the abundance of red grouse has increased in response to predator removal. The trends in breeding success suggest that predator removal may benefit various ground-nesting birds. However, the numbers of pairs in most species are small and the influence of other factors cannot be ruled out at this stage. We cannot, therefore, draw any firm conclusions until the experiment has gone to full term. Analysis of the differences between the keepered and unkeepered plot data collected so far have led the Scientific Advisory Committee to recommend the switch of keepering from Otterburn to Bellshiel in autumn 2004. We should therefore complete the project in 2008.

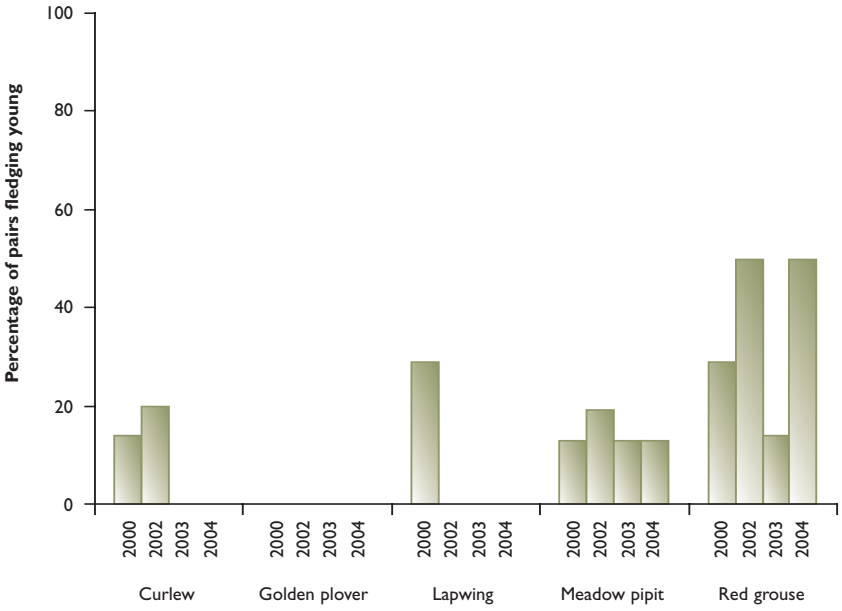


Figure 3

Belshiel plot: percentage of pairs that fledged young for curlew, golden plover, lapwing, meadow pipit and red grouse, 2000-2004 (no data for 2001 owing to Foot & Mouth Disease)

Keepered

Unkeepered

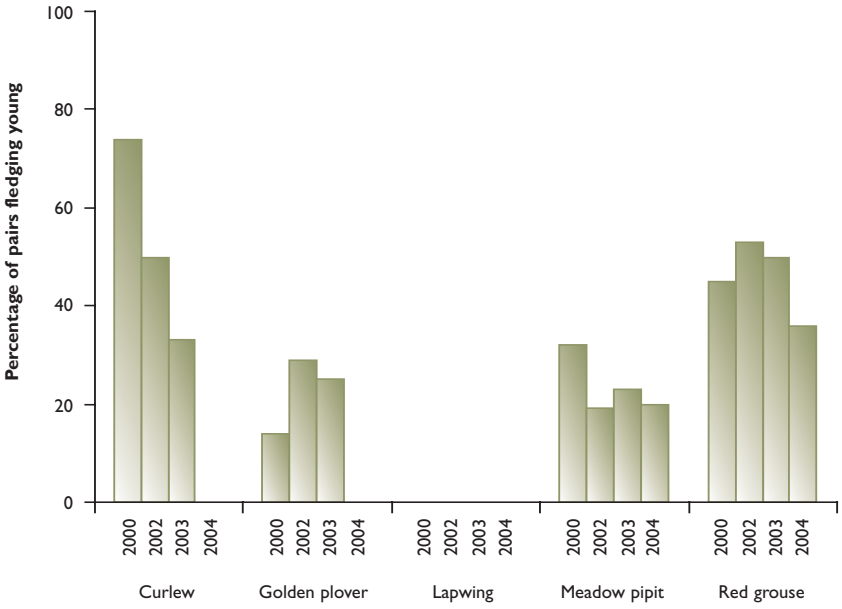


Figure 4

Emblehope plot: percentage of pairs that fledged young for curlew, golden plover, lapwing, meadow pipit and red grouse, 2000-2004 (no data for 2001 owing to Foot & Mouth Disease)

Keepered

Unkeepered

This clutch of curlew eggs was predated by crows. (David Baines)

Effects of open access on black grouse in England

Key findings

- Birds disturbed regularly flushed to greater distances than birds disturbed less, and this was particularly noticeable in spring and winter.
- Disturbance had no effect on dispersal distances of yearling males and females.
- Disturbed hens laid eggs five days earlier than non-disturbed hens.

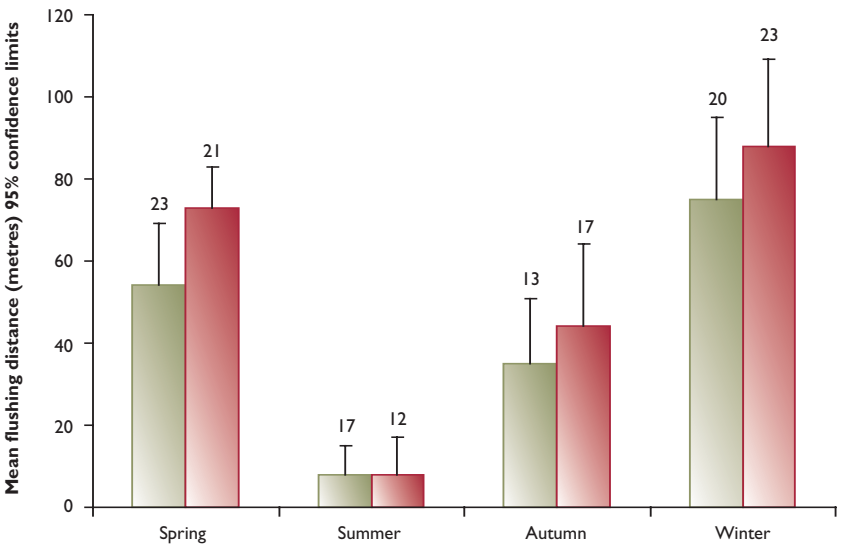
David Baines

Opening up moorland areas for public access has raised concern for the conservation of species like the black grouse. (Laurie Campbell)

Black grouse declined both in range and abundance during the whole of the 20th century. Now they are found only on moorland margins in northern England, where almost 90% are confined to the North Pennines Area of Outstanding Natural Beauty. There are areas that have been opened up for increased public access, so the black grouse may be at risk from increased human disturbance.

Figure 1

The effects of season and disturbance treatment on flushing distances of black grouse in the North Pennines (sample sizes are given at the top of each column)



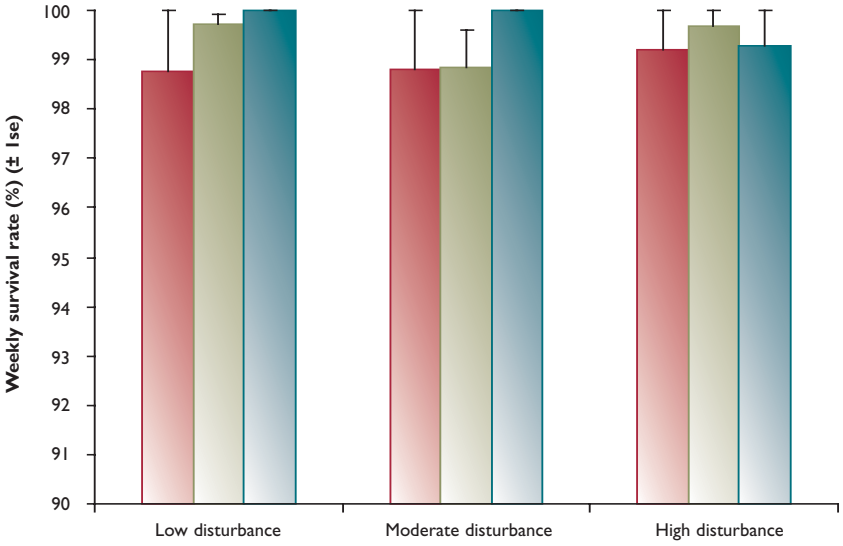


Figure 2

Weekly survival rates (± 1 se) of black grouse in relation to age, season and disturbance treatment. Juvenile and winter rates are for the period September to April (by which time juveniles have become adult), summer rates are for the period May to August.

Juveniles

Adults winter

Adults summer

We undertook a two-year study funded by English Nature to quantify the risk of increased human disturbance on black grouse in northern England. To do this, Mike Richardson and others caught and radio-tagged 77 black grouse between 2002 and 2004 and randomly assigned one of three 'disturbance categories' to each. We disturbed the birds by approaching them until they flushed. We varied the frequency of disturbance from no disturbance (low), weekly disturbance (moderate) to twice weekly disturbance (high). We compared the behaviour (flushing distances, home range size, timing of dispersal, dispersal distances, and the on-set of breeding) and demographic changes (clutch size, breeding success and survival rates) for birds within each disturbance category.

When birds were disturbed regularly, they flushed at greater distances from the observer. This was most noticeable in spring and winter when they flushed at an average of 62 metres and 82 metres (see Figure 1). In this period, birds exposed to a lot of disturbance flushed at 32% greater distances than those subjected to moderate disturbance. For 26 yearling birds, we measured dispersal distances from hatch sites to where they eventually settled and bred. Females dispersed further (6.0 km) than males (0.6 km). Two phases of dispersal occurred in yearling females, the first in late autumn (median date 13 November) and the second in spring (median date 10 April). This was not affected by disturbance. Disturbance influenced the start of breeding, with disturbed females laying on average five days earlier, irrespective of female age or year.

Despite the behavioural differences associated with disturbance, there were no detectable demographic responses, ie. no significant differences in clutch size, hatching success, breeding success or survival between different disturbance treatments. Adult females laid larger clutches (mean 9.3 eggs) than first breeding females (7.4 eggs) and bred more successfully with 51% rearing broods compared with only 13% of juvenile females. Over winter, the weekly survival rates (see Figure 2) were equivalent to 68% of juveniles surviving from September to April, and to 81% of adults. Over summer, they corresponded to a 97% survival of black grouse from May to August. The primary cause of death was predation, chiefly by mammals (65%), with stoats and foxes the main predators, but also raptors (18%).

Although the disturbance regimes in this study did not affect black grouse demography, we cannot be certain that the disturbance levels in our study will be typical of 'open access'. Consequently, the behavioural changes that we observed may have repercussions that we don't know about, so we suggest the following:

- Identifying key wintering sites where birds may be most prone to disturbance and consider restricting access to them.
- Widening the restrictions on dogs to include August and key breeding sites on allotment ground.
- Providing viewing facilities at leks for bird-watchers.
- Monitoring black grouse numbers and habitat use in relation to visitor pressure after access has been opened.

How much of a problem for black grouse is disturbance by walkers? (Adam Smith)

An update on monitoring at Langholm in 2004

Key findings

- Only two hen harrier pairs attempted to breed in 2004, only one breeding successfully.
- Pipit abundance continues to be stable.
- Red grouse numbers have not recovered.

David Baines

Langholm Moor. (The Game Conservancy Trust)

Numbers of harriers have continued to fall since the peak in 1997. In 2004, only two pairs attempted to breed (see Figure 1), well below the 13 pairs for which the Langholm Special Protection Area (SPA) was designated. One of the pairs failed during incubation when the clutch of five eggs disappeared. The second pair successfully reared three chicks from a clutch of six eggs. With increasingly long data sets now available to us, some of the relationships described between hen harrier numbers, breeding success and their chief prey appear to have changed. Few harriers turned up to breed in 2004 in spite of high vole numbers (see Figure 2). For the last four years, vole abundance has been a poor predictor of both the number of harriers and their

Figure 1

The number of breeding male and female harriers at Langholm, 1992-2004

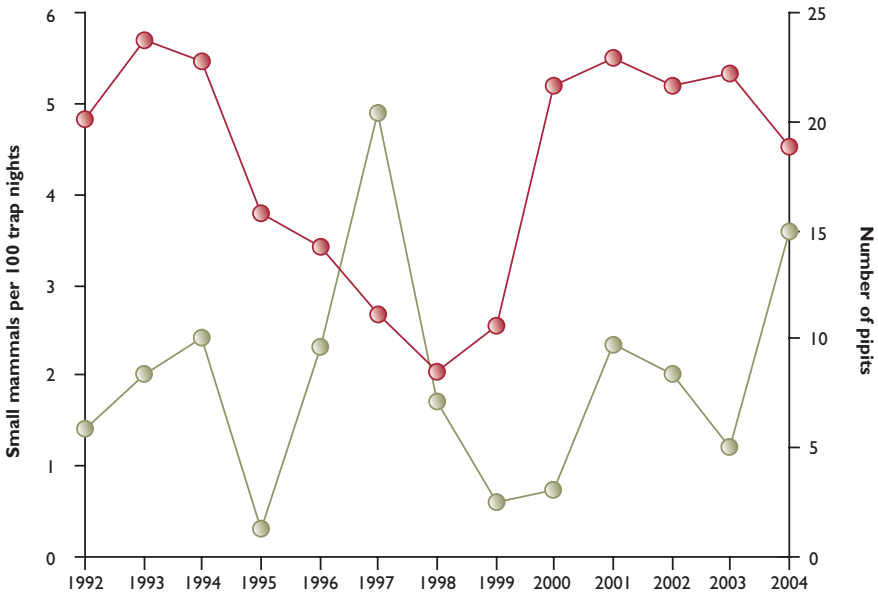


Figure 2

Numbers of small mammals and pipits at Langholm in spring

Pipits (right axis)

Small mammals (left axis)

Small mammal data are presented per 100 trap nights. In 2001, data were collected six weeks later than usual owing to Foot & Mouth Disease

subsequent breeding success. The two breeding females in 2004 were the same as those that bred in 2003, suggesting that either there were few potential recruits or Langholm was no longer attractive.

Meadow pipit abundance has been stable over the last five years and now appears to be at levels similar to those observed at the start of the study. Over the 13 years, pipit abundance has been negatively correlated with the numbers of breeding female harriers, suggesting that harriers themselves may be regulating pipit abundance.

Despite fewer harriers, red grouse abundance has not recovered. Counts on 10 areas, each of 50 hectares, produced an estimate of only 4.4 and 4.8 grouse per 50 hectares during spring and summer respectively (see Figure 3). It is likely - but not proved - that in the absence of gamekeeping, grouse numbers may be limited by predation from foxes and crows. Numbers of predators have increased since grouse keepering on the moor stopped in 1998. Our data on carrion crows show a steady annual increase over the last five years. Unfortunately, we have no measures of fox abundance, except numbers killed, for the period of the Joint Raptor Study. In 2002 we started counts of fox scats along 29 kilometres of transects walked monthly. These show an increase over the last three years. It is likely that higher numbers of predators following cessation of keepering will be impacting upon ground-nesting birds, including both red grouse and hen harriers.

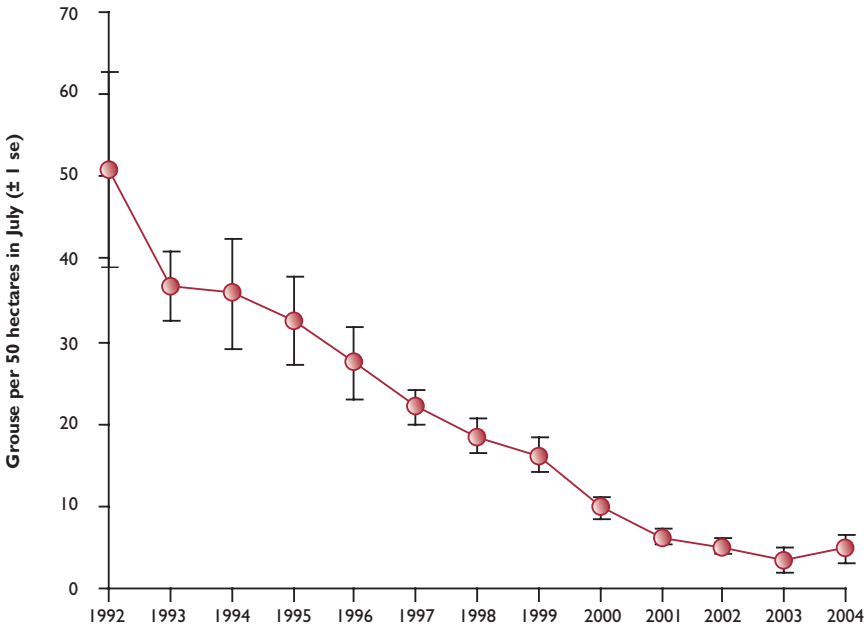


Figure 3

Average number of red grouse (young and adults) counted at Langholm on 10 50-hectare areas in July from 1992 to 2004

Factors limiting range expansion for black grouse

Key finding

- Due to the limited disperal capacity of male black grouse, to meet the BAP targets of expanding the range and linking isolated populations, it may be necessary to translocate males from core to peripheral areas.

Phil Warren

The black grouse population in the UK has declined and contracted owing in part to the direct loss, fragmentation and degradation of habitat. This has disrupted the black grouse population structure in northern England, resulting in at least two distinct sub-populations in the region, Northumberland (north of the Tyne Gap) and the North Pennines (see Figure 1).

Since 1996, the North Pennines Black Grouse Recovery Project has addressed this decline. In 1999, black grouse became a Biodiversity Action Plan 'Priority Species', for which we and the RSPB are lead partners. The Recovery Project has been responsible for implementing the Species Action Plan for black grouse in England, the main objectives of which are to:

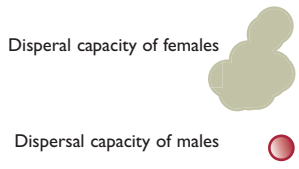
- Restore the population to its 1996 level of 800 males by 2005
- In the long term (20 years), increase the range
- Prevent further fragmentation of populations
- Promote re-colonisation of formerly occupied areas by 2005

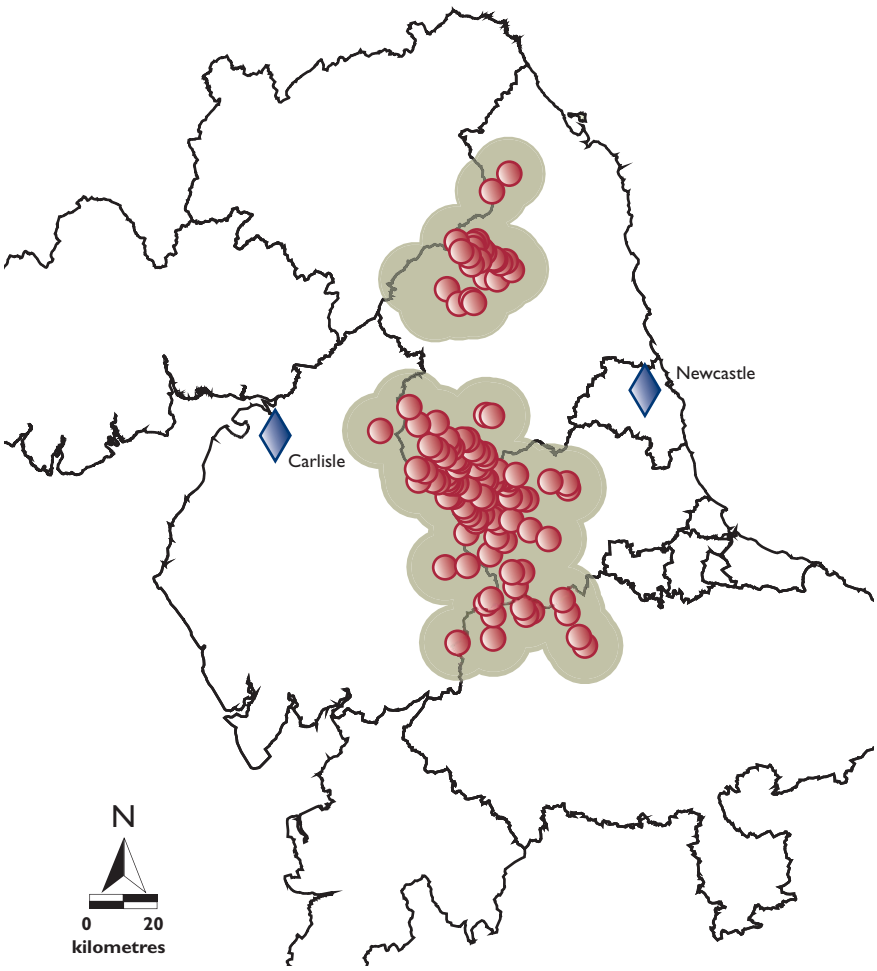
The project is achieving its short-term objectives in relation to abundance, with the population in 2002 numbering 895 males compared with 773 males in 1998. The range, however, is at best only being maintained, and localised contractions continue. Expanding this range may be difficult because of the limited dispersal powers of black grouse.

Recent radio-tracking studies have measured the dispersal distances of 48 juvenile black grouse (28 males and 20 females). The average dispersal distance of yearling males was 0.8 kilometres, whereas the equivalent distance for females was 8.0 kilometres. Similar differences between male and female dispersal have been observed during earlier studies in the North Pennines and elsewhere in Europe.

Figure 1

Dispersal capacity of male and female black grouse and evidence of fragmentation of the black grouse population in northern England





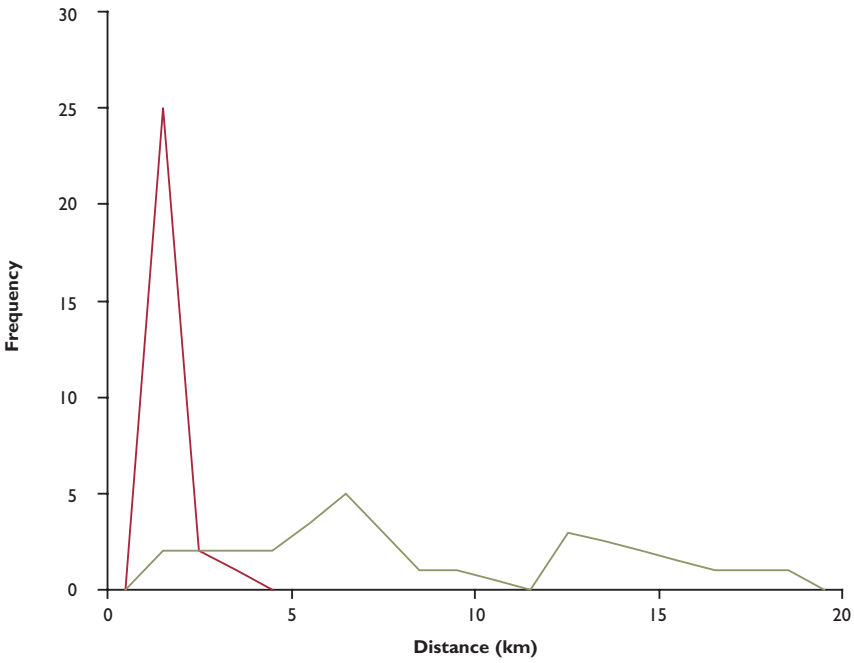


Figure 2

Dispersal distances of 28 male and 20 female black grouse in the North Pennines, 1998-2004

Males

Females

In continuous black grouse habitat, leks are spaced at approximately two-kilometre intervals, which is typical along the valley sides of the North Pennines. Fragmentation of habitat on a small local scale is unlikely to affect the overall population much, as females can disperse easily between fragments. However, should fragmentation occur at a landscape scale with patches separated by distances of more than 20 kilometres, then sub-populations become disconnected and genetic isolation is a possibility.

Given limited male dispersal, range expansion may prove difficult to achieve in the short and longer-term. Several sightings of females outside the current described range (based on lek locations) suggest that male absence may be limiting breeding range expansion. This hypothesis is based, however, on data gathered largely within the core of the North Pennines range and assumes that dispersal distances are similar at the margins of the range where densities of birds are lower. This assumption is reasonable given that both dispersal frequencies and distances of both black grouse and red grouse appear to be density-independent.

We therefore propose to try and extend the range by moving males from core areas of the North Pennines where there are plenty, to areas on the north and southern boundaries where there are no leks, but within range of dispersing females.

Moving males from core areas to the edge of their current area may be the only way to extend the species' range. (Laurie Campbell)

Grouse chick diet

Key findings

- Grouse populations on more nutritious heather moorland are the most productive.
- Bigger eggs result in better chick survival.
- Early hatching chicks survive better than late ones.
- Chick diet affects growth rates and this is linked to survival.

Alan Kirby
Adam Smith

Chick survival is influenced even before nesting hens hatch their clutches through hen nutrition and subsequent egg quality. (Alan Kirby)

Diet affects grouse production in two ways: first during the spring when hens are coming into breeding condition; then during the period when chicks grow prior to fledging. We have been investigating whether improving diet is a potential management tool for increasing grouse breeding success.

We reviewed 20 years of autumn grouse density data from across Scotland. We found that long-term changes in abundance were related to food quality. Moors with high levels of nitrogen in heather are the ones on which grouse numbers have been increasing, whereas the opposite is true for nutrient-poor moors (see Figure 1).

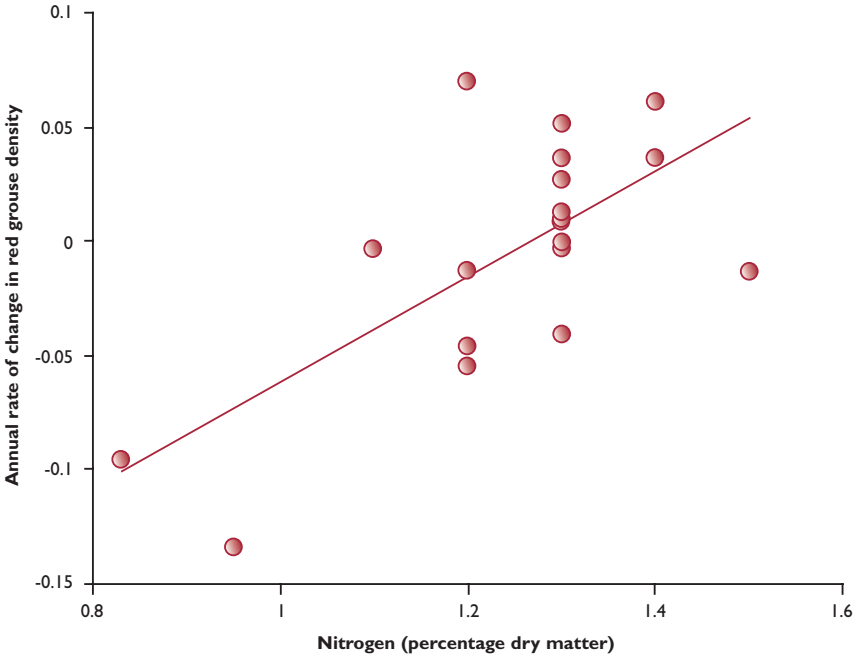
Understanding the way this works could lead to better management. Early work in the 1960s and '70s showed that the condition of the hen before breeding affects clutch size, with more eggs produced on moors where the heather has most available phosphorus. We wanted to know whether maternal and chick diet also affected chick survival. To examine this, we conducted field experiments and analysed breeding data from other studies.

Between 1999 and 2004 we monitored grouse hens and chicks on two estates in Strathspey recording hatching date and success from 219 nests and the egg size and fate and weight of chicks from 1,773 eggs. As on many moors, the clutches we

Figure 1

Autumn grouse densities compared with nitrogen levels in heather

Autumn grouse densities are increasing (the average annual rate of change over 20 years is greater than 0) in areas where nitrogen levels are highest



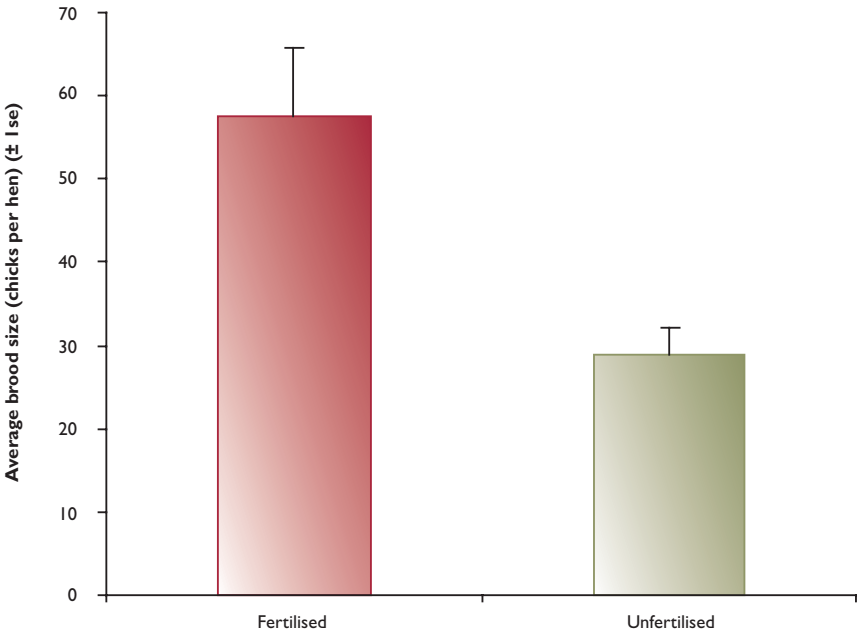


Figure 2

Average brood size (chicks per hen) at 50 days old on sites where heather has been fertilised and on unfertilised sites

Fertilised

Unfertilised

Note: Fertilisation is an experimental technique and we do not suggest this as a management option as there is no persistent improvement in grouse breeding success.

monitored hatched over a large range of dates (13 May to 26 June: first clutches only) suggesting that individual hens come into breeding condition at different times. The broods that hatched 10 days earlier than the average for that site survived 10% better than broods that hatched at the normal time. We also found that chick survival increased with egg size. However, any benefits to grouse production may be off-set as larger eggs are also associated with smaller clutches.

Although maternal condition does affect chick survival, it is likely that factors affecting chicks after hatching will be most important in determining survival to fledging. Although predation and disease are important, diet determines the growth rate and survival. For the first month after hatching, chick diet contains 5% invertebrates on average. Where there are more invertebrates chicks grow quicker. This is important because fast-growing chicks survive better than slow-growing ones: models based on the 97 chicks we caught from 23 broods suggest that five-day-old chicks of around 18g had an 18% chance of surviving to 50 days old, whereas ones of 30g had a 45% chance of surviving to this age. As well as invertebrates, nutritious heather is also essential. Grouse chicks choose shoot tips high in nitrogen and phosphorus and their survival is better when heather quality is improved with fertiliser (see Figure 2). A fertile moor also supports more invertebrates.

Although many of these effects of diet are small and must be seen in the context of major influences like predation and disease, this work highlights the importance of maximising habitat quality. Future work will focus on best practice for restoring and managing nutritious heather stands and creating invertebrate-rich hotspots.

At a given age, the bigger the chick the better it survives. (Alan Kirby)

Heather burning

Key findings

- There is a clear relationship between the amount of fuel and fire intensity.
- It is very difficult to achieve a 'clean' burn even with the most intense management fires.

Matt Davies

Plumes of smoke are a common site on our moorlands during the burning season which runs from October to April. (Matt Davies)

Over the last three years, in collaboration with the University of Edinburgh and Scottish Natural Heritage (SNH), we have been investigating the nature of fires that occur during muirburn.

We are developing models to predict fuel moisture, the impact of moisture content on flammability and heather regeneration, and we are testing existing fire risk models to see whether they can be developed as tools for land managers.

We conducted a series of experiments involving 18 fires over two years on Ralia and Crubenmore moors. These experiments have examined interactions between fireline intensity (a measure of fire/heat output and controllability) and fire impact, and how these are affected by fuel loading (the amount of heather present) and variations in weather conditions. Analysis of the data is at an early stage, but we have found a number of relationships.

There is a clear effect of fuel loading on components of fireline intensity such as flame height and rate of spread: fires are more intense and spread faster where there is more fuel (see Figures 1 and 2). More detailed analysis will allow us to provide predictions of fire behaviour based on specific fuel loads and weather conditions.

There is a significant relationship between flame height and rate of spread: faster moving fires generally have taller flames. Fast moving fires with tall flames are not just caused by higher wind speeds - fuel available and slope angle in relation to the fire direction also affect the rate of spread and observed fire height. With more data, this relationship could be turned into a simple field guide to how fire spreads. It will then be possible to identify rapidly the fires that are likely to move too quickly to control and extinguish them.

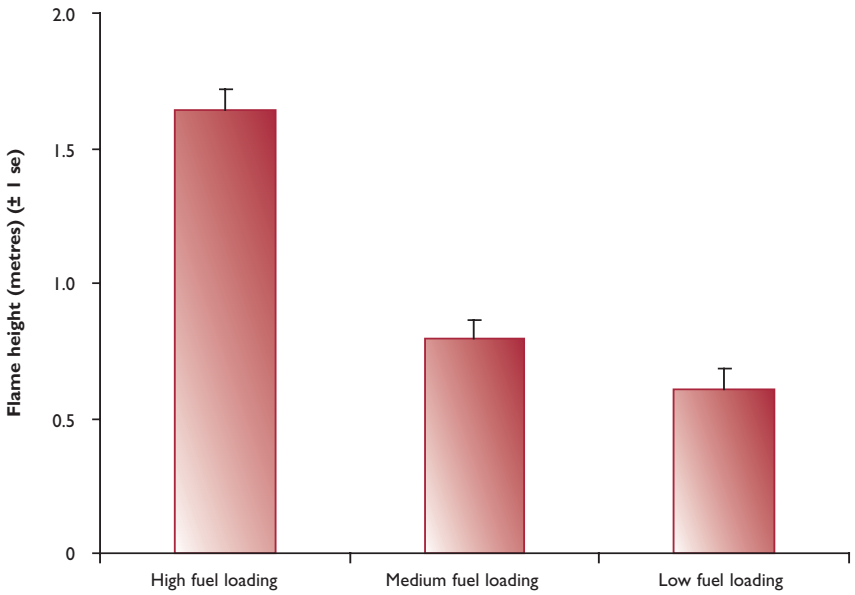
Findings such as these demonstrate the rather obvious conclusion that where there is more fuel, fires are hotter! However, one of the most important aspects of this research has been to understand the rather complicated variability in behaviour that lies both within and between different fires (this is well demonstrated by the wide error bars on Figures 1 and 2). We have used in-depth monitoring before, during and after the fires to produce data that enable us to understand this and, crucially, to develop links between the intensity of a fire and its impacts on the ground.

For example, we have used a variety of techniques to measure rates of temperature change at different levels in the vegetation (canopy, ground level and two centimetres below-ground). We found that extensive heating just a couple of centimetres below ground level is rare (see Table 1). This is important as temperatures above 50°C are likely to be lethal to heather plants.

The data show that although the deep moss layers found beneath many older heather stands may be killed by fires, they are not burnt away (the average moss

Figure 1

Average flame height of fires in three fuel classes.



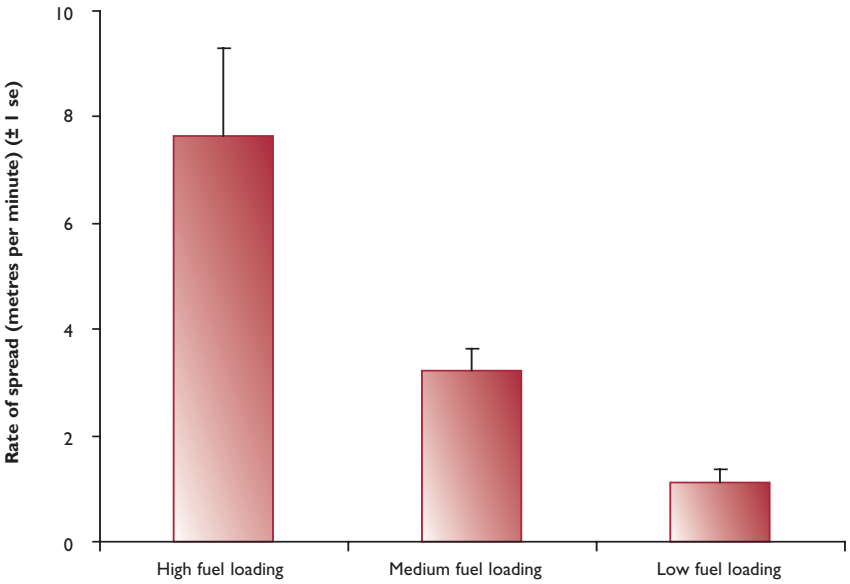


Figure 2

Average rate of spread of fires in three fuel classes.

depth removed from all fires was just 2.1±0.7mm). It is difficult to achieve a 'clean' burn even with relatively intense fires. Good regeneration from seed is important in older stands, but moss mats (dead or alive) provide poor seedbeds.

Combining these analyses suggests that there may be significant problems with burning large areas of rank heather. Big fires in such stands will be difficult to control and regeneration of younger heather poor. A solution could be combination cutting (for firebreaks and regeneration) or double-burning the heather at small scales. Essentially much old heather could be left unburnt with only small areas of old stand being burnt or cut on rotation in such a way to ensure good heather regeneration. Public agencies are increasingly turning their attention to the practice of muirburn and there is no room for complacency, but there are many possibilities for developing good practice.

An experimental fire in a high fuel loading plot. Posts are used as reference points for measuring rates of spread and flame heights. (Scott Newey)

Table 1

Average (± 1se) temperature (°C) reached in heather fires at canopy height, ground level and two centimetres below ground in high, medium and low fuel loadings

Fuel load	Canopy	Ground	Buried
High	653 (34)	322 (50)	8 (4)
Medium	688 (24)	375 (56)	6 (2)
Low	516 (77)	253 (84)	38 (27)

Long-term bag trends of three gamebirds

Key findings

- The National Gamebag Census provides a historical dimension that is missing in other UK bird monitoring schemes.
- It provides trends for species poorly covered by other schemes.
- It corroborates the population declines of red grouse and snipe
- It suggests that the conservation status of woodcock may be misjudged.

Nicholas Aebischer

The population status of UK birds is summarised by placing each species on one of three lists - red, amber or green - according to international conservation criteria. We review below the trends in bags of three game species that have been amber-listed: red grouse, woodcock and snipe. The bags have been collected through our National Gamebag Census (NGC), thanks to many volunteers. The NGC began formally in 1961, but many shoots have contributed earlier historical records; others have joined more recently. For each species, shoots that provided one year of data only were omitted, as were years when no bags were given. We have taken shoot turnover into account in our analysis of long-term trends, and we present changes in the average annual number of birds shot per 100 hectares as an index relative to the situation in 1900 (index value of 1). These results span a length of time considerably longer than that of other bird monitoring schemes, and these species in particular are poorly covered by such schemes.

Red grouse

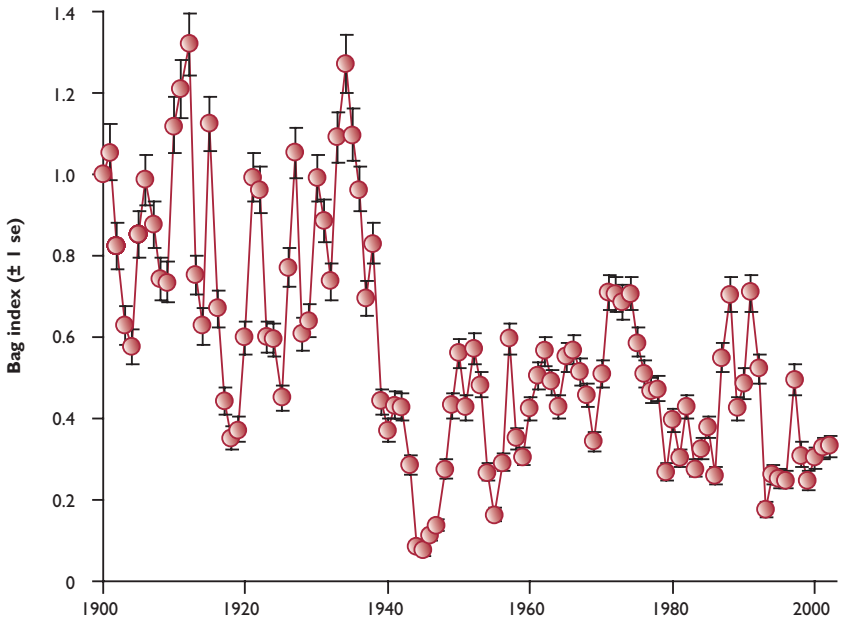
Between 1900 and 2002, a total of 495 upland moors provided data on red grouse bags. The bags show strong annual fluctuations, but nevertheless it is clear that there were high bags up to the Second World War, a collapse in numbers shot during the War itself, followed by a partial recovery until the early 1970s, then a further decline over 30 years of the order of -40% (see Figure 1). This pattern reflects the intense management for grouse carried out by the Victorians and Edwardians, which included predator eradication and rotational heather burning to produce a patchwork of different-aged stands. Grouse management was largely abandoned during the Second World War, but recovered until the mid-1970s, when grazing, afforestation and predators increased, reducing grouse abundance and bags.

Snipe

Between 1900 and 2002, a total of 1,029 shoots provided data on snipe. Bags come primarily from wintering birds, which migrate from northern and eastern Europe. The trend is an increase up to the Second World War (with a dip during the First World War) followed by a collapse and on-going decline throughout the second half of the 20th century (see Figure 2). This pattern reflects changes in land drainage and cultivation. The loss of wetlands and damp meadows probably accounts for this drop in wintering snipe bags.

Figure 1

Red grouse index of bag density (National Gamebag Census data), relative to 1900



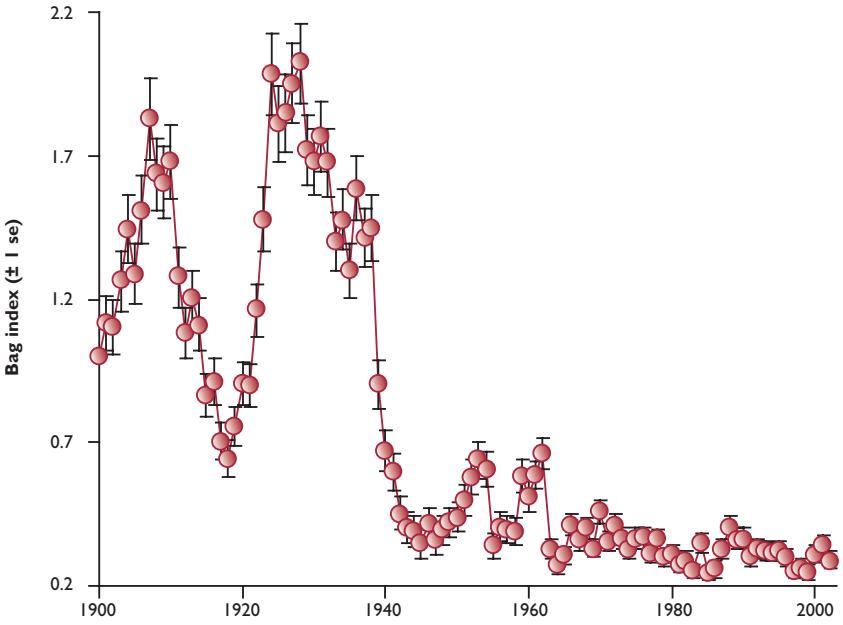


Figure 2

Snipe index of bag density (National Gamebag Census data), relative to 1900

The loss of wetlands and damp meadows probably accounts for the drop in snipe bags. (Laurie Campbell)

Woodcock

Between 1900 and 2002, a total of 1,290 shoots provided data on woodcock. Like snipe, woodcock that are shot are mostly wintering birds. Ringing returns suggest that approximately one in seven is local, the others arriving from Scandinavia, the Baltic States and Russia. The trend in the woodcock bag is very different from the other species. The average bag during the last 30 years of the 20th century is similar to, or even higher than during the first 30 years (see Figure 3). This may indicate that the status of woodcock in Europe has changed little over the last century, and that the conservation status of this secretive bird has been misjudged.

We thank the keepers, farmers and landowners who have kept records over the last 100 years and who have so kindly made them available to us.

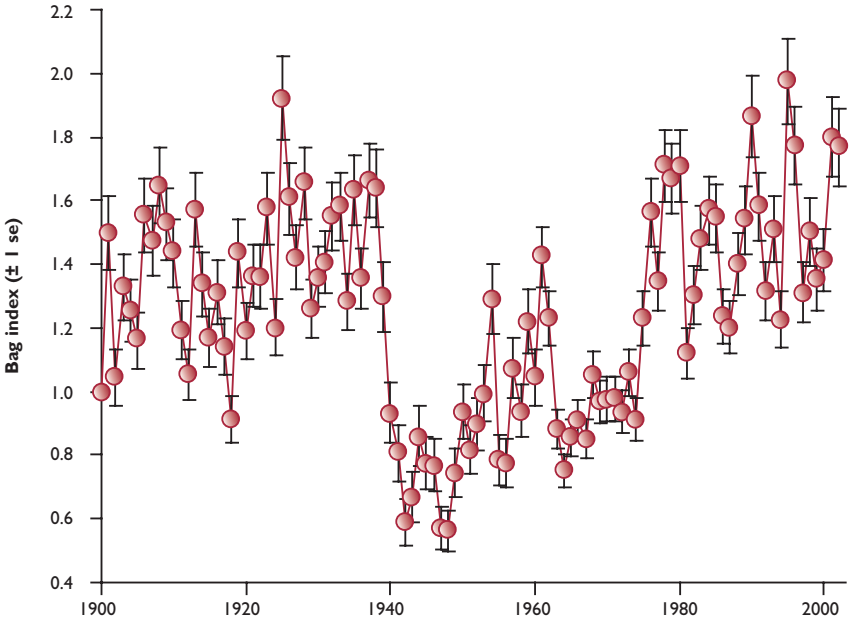


Figure 3

Woodcock index of bag density (National Gamebag Census data), relative to 1900

Join the census

The Trust is continually seeking new participants to expand the coverage and accuracy of the National Gamebag Census. We encourage all readers who do not already contribute to contact the NGC co-ordinator in Fordingbridge. Please call 01425 652381 for more information.

Treatment of trichostrongyle infections

Key findings

- Worm burden is inversely related to the size of dose of anthelmintic drug.
- The frequency of dose influences clearance of *T. tenuis* parasites, with multiple doses providing better clearance.

Des Purdy

The caecal nematode, *Trichostrongylus tenuis,* causes poor breeding success and periodic population crashes in red grouse. Our research has focused on the control of parasite burdens through medicated grit. However, the efficiency of this approach is influenced by the frequency with which grouse visit medicated grit piles and the amount of grit they consume. Thus the dose rate varies from bird to bird and from moor to moor, depending on the availability and use of alternative sources of grit. This will affect treatment success.

On our rearing field we assessed the efficacy of different flubendazole (Flubenvet) treatments on the clearance of *T. tenuis,* using grey partridges as a model for grouse. This drug belongs to a large family of anthelmintic benzimidazole compounds and is closely related to fenbendazole (Panacur), the active ingredient in medicated grit.

We infected flock-housed worm-free adult grey partridges with 4,000 *T. tenuis* larvae each. Two weeks later, following the establishment of *T. tenuis* infection, we treated orally groups of 10 birds at total dose concentrations of four, eight and 20 mg/kg body weight of flubendazole over a nine-day period. Additionally, each of these three doses were split, such that birds were treated either on a daily basis, three times, or only once during the nine-day treatment. This potentially mimicked how wild red grouse use medicated grit. Over the course of the experiment we moved the birds onto fresh ground to prevent them from recycling the *T. tenuis* infection.

Chris Davis (left) being helped by Craig Morris to administer the worming drug. (Des Purdy)

Dosing a grey partridge with an anti-strongyle worm drug. (Des Purdy)

In all the birds' caeca we counted the worms 14 days after treatment. Figure 1 shows the reductions in worm burdens achieved by the different dosing regimes, and demonstrates that 20 mg/kg administered daily gives the best clearance of *T. tenuis*. This resulted in a reduced worm burden of just 3.5 per bird compared with 139.6 in the untreated control group - a reduction of 97.5%. All treatments gave appreciable reductions in worm burdens in the grey partridges, but at each of the three concentrations, a single dose was the least effective in reducing trichostrongle numbers.

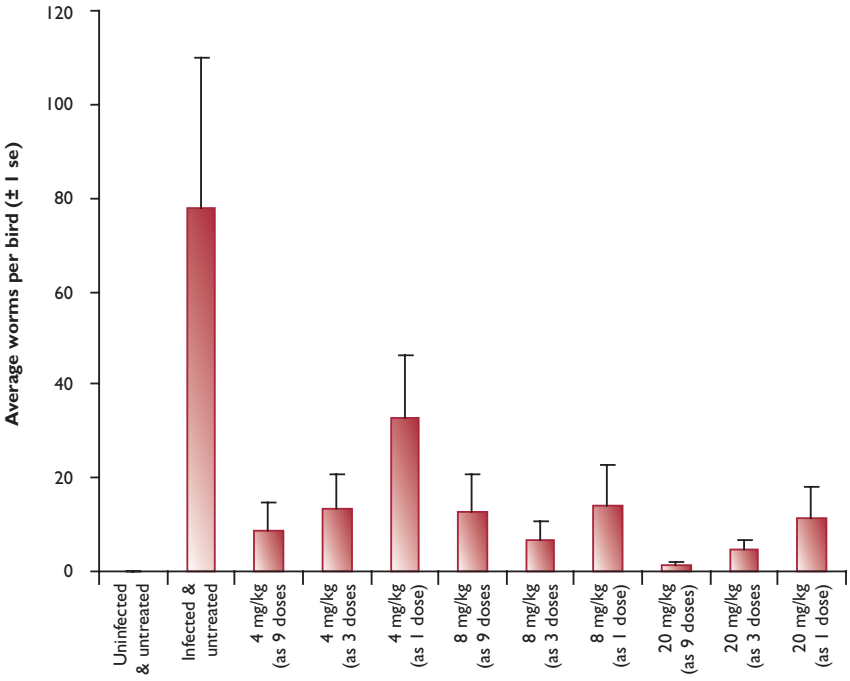


Figure 1

Average number of *Trichostrongylus tenuis* per grey partridge (geometric mean ± 1se) 37 days after infection in relation to dose size and frequency

Waders on English grouse moors

Key findings

- In England JNCC has designated four large areas of upland as Special Protection Areas (SPAs) for birds – particularly waders.
- These SPAs are primarily managed for grouse.
- Thus the wader populations on the SPAs seem to depend on gamekeeping for grouse shooting.
- On other areas away from grouse moors upland waders appear to be dying out.

Stephen Tapper
Julie Ewald

A casual observer might be forgiven for suspecting that grouse moor management, rather than being part of nature conservation, is largely at odds with it. The plight of the hen harrier, especially in England, and the apparent unsatisfactory condition of upland Sites of Special Scientific Interest certainly suggest it. Talk to a few grouse moor keepers, however, and they will maintain that they are not just producing grouse, but are looking after the crown jewels of upland bird life. Is this true?

In England there are 7,958 square kilometres of upland moor - defined by Defra's Moorland Line. This includes many cherished landscapes like Dartmoor and the Lake District. Such areas may look scenic, but just how rich are they in birdlife? This has largely been answered by the UK's statutory conservation agency, the Joint Nature Conservation Committee (JNCC). When the UK signed the European Birds Directive (79/409/EEC) in 1979 it was required to designate the country's most important bird sites as Special Protection Areas (SPAs) as part of the Europe-wide Natura 2000 network. Using a systematic and objective procedure, it nominated 85 sites in England, including four large areas of upland moor: the North York Moors; the South Pennines; the Bowland Fells; and the North Pennines. At 1,472 square kilometres, the latter is by far the largest of England's SPAs. On all four of these SPAs, grouse moor management is the dominant form of land use (74% of land area).

The SPA designation of these four areas is due primarily to the high densities of breeding waders that they sustain: curlew, golden plover and dunlin are key species, but snipe, lapwing and redshank are common too. The geographical coincidence

Figure 1

Map of the North Pennines SPA and list showing the species and numbers for which the designation was made. SPA data from JNCC. Grouse moor information from our GIS project 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

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

Species	N England (74% grouse moor)	Wales	SW England
Red grouse	-13	-36	-66
Dunlin	-7	-25	-75
Golden plover	-8	-32	-50

between the management for grouse and high wader abundance, taken with other evidence, suggests that grouse management is sustaining the wader populations that have in turn led to the SPA designations (see Figure 1).

Some believe that bird abundance is less important than bird diversity, arguing that the total 'bird assemblage' is the best indicator of conservation success. We checked this assemblage for upland waders by comparing the species distribution in the British Trust for Ornithology's two atlases of breeding birds in the 1970s and in 1990s. We counted the 10x10 kilometre squares where a given species was present in the 1970s, then tallied the gains and losses in the 1990 survey. We compared the losses and gains of the two uniquely-upland waders (dunlin and golden plover) in England and Wales, and found that they were closely linked to the fortunes of red grouse (see Table 1). In south-west England, where grouse management no longer takes place, the grouse and waders have disappeared from over half the squares. In Wales too, where grouse shooting has dwindled, the range of these birds has contracted by about a third. Only in the North of England, where grouse shooting has been retained, are all three species largely holding their own.

Curlew, snipe and lapwing, which also breed in lowland districts, show range contractions on moorland during the last 40 years. Some of these losses are dramatic and worrying. On Dartmoor the curlew is threatened with extinction, as is the golden plover; lapwing numbers there have dropped by 70%. The Berwyn Mountains of North Wales - itself an SPA for three species of raptor - appears to have lost all its golden plover and practically all its curlew.

This evidence suggests that the moorland gamekeepers are right. They *have* got the upland crown jewels. Furthermore, without the gamekeeping, it looks as though some species of wader might, over time, die out completely in some areas.

Grouse moors are also important areas for uncommon raptors such as the merlin. (Laurie Campbell)

SPA designation in the North Pennines is primarily due to the waders sustained in the area, particularly key species like curlew. (Laurie Campbell)

Scientific publications in 2004

by staff of The Game Conservancy Trust

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Note: the publications listed as 2003 did not appear in print before the Review of 2003 *went to press. For a complete record of the scientific publications by staff of The Game Conservancy Trust, we therefore include them here.*

Financial report for 2004

Summary and key points

- There was a surplus of £75,965 on the general fund.
- Income increased by 2% overall, with unrestricted income rising by 5%.
- Total costs increased by less than 1%, with particular reductions in fundraising and administration costs.

The summarised accounts for the year ended 31 December 2004, set out on pages 88 and 89, are not the statutory accounts but are a summary of information relating to the consolidated Statement of Financial Activities and Balance Sheet of The Game Conservancy Trust and its wholly-owned subsidiary Game Conservancy Limited. The full annual accounts, which were approved by the Trustees on 20 April 2005, and from which the summarised accounts have been derived, have been independently audited; and the auditors' report was unqualified. The full accounts, the auditors' report and the Trustees' annual report, all of which have been submitted to the Charity Commission, may be obtained from the Trust's Headquarters.

Review of financial transactions and position

2004 was a reasonable financial year. The Trust hit its financial targets and achieved a surplus on the general fund (the budget was break even). There was a planned decrease in restricted funds from £869,932 to £578,855 as income received in previous years was spent on research projects.

As planned, the Trust again spent a record amount on its charitable objects (£3,480,213) and this increased to 64% of total expenditure. Direct research expenditure again exceeded £2 million, and the spend on conservation projects rose to over £500,000, as the habitat restoration project on the River Monnow, funded mainly by Defra, entered its second year.

Total income increased by 2% in the year, and unrestricted income increased by 5%. Increasing unrestricted income was one of the Trust's fundraising aims.

Total costs increased by less than 1% with particular reductions in fundraising and administration costs (reduced by 3% and 10% respectively).

The decrease in restricted funds is reflected in the balance sheet (see page 89) where the net current assets have reduced slightly from £549,096 to £520,196. As anticipated, the Trust drew down on its investments during 2004. The Trust's investment managers more than met their objective of achieving double the return on cash with a return in the year of 12%.

The General Fund Reserve increased in the year, and unrestricted funds (General and Designated) now represent the amount used to finance fixed assets plus 3½ months' General Fund expenditure. The Trustees have agreed that the total amount held in unrestricted funds should ideally be six months' General Fund expenditure plus the amount used to finance fixed assets. The Trustees are satisfied that the Trust's financial position remains secure, but it is still a priority to build the Trust's reserves to the target level over the next few years.

A W M Christie-Miller
Chairman of the Trustees

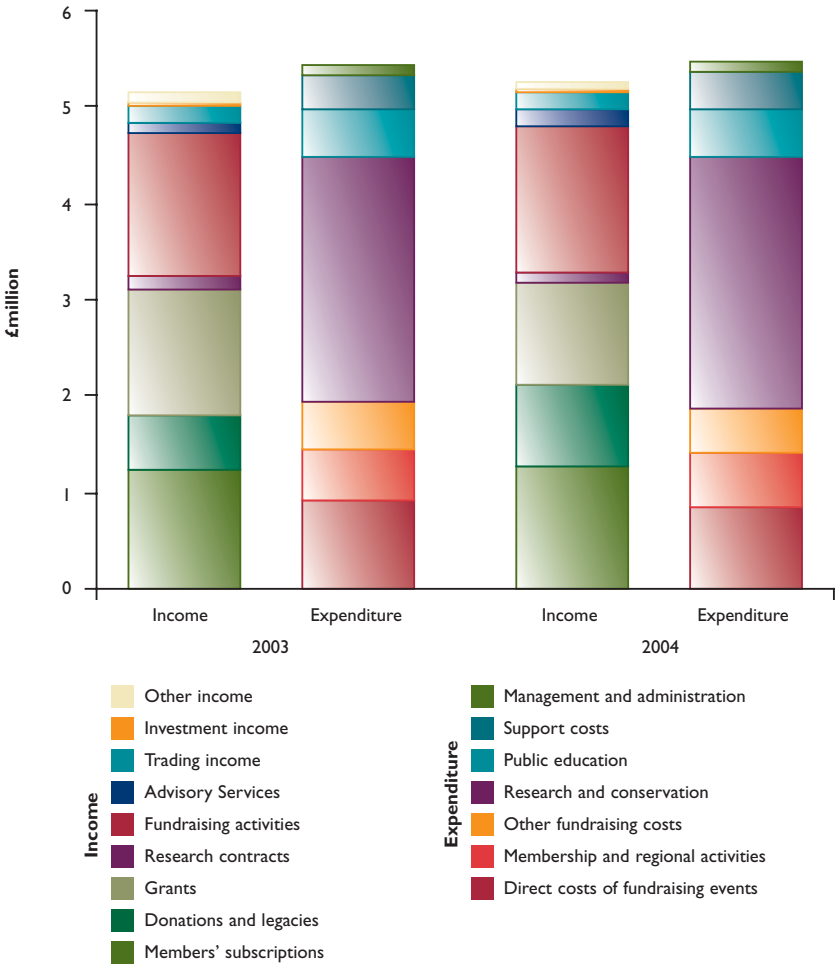

Figure 1

Incoming and outgoing resources in 2004 (and 2003) showing the relative income and costs for different activities

Independent auditors' statement

to the Trustees and Members of The Game Conservancy Trust

We have examined the summarised accounts set out on pages 88 and 89.

Respective responsibilities of Trustees and Auditors
The Trustees are responsible for preparing the summarised accounts. Our responsibility is to report to you our opinion on the consistency of the summarised accounts within the Annual Review with the full annual Consolidated Accounts and Trustees' Report. We also read the other financial information contained within the Annual Review and consider the implications for our report if we become aware of any apparent misstatements or material inconsistencies with the summarised accounts.

Basis of opinion
We conducted our work with reference to Bulletin 1999/6 'The auditors' statement on the summary financial statement' issued by the Auditing Practices Board for use in the United Kingdom.

Opinion
In our opinion the summarised accounts are consistent with the full annual Consolidated Accounts and Trustees' Report of The Game Conservancy Trust for the year ended 31 December 2004.

FLETCHER & PARTNERS
Chartered Accountants and Registered Auditors
Salisbury, 28 April 2005

consolidated

Statement of financial activities

for the year ended 31 December 2004

	General Fund £	Designated Funds £	Restricted Funds £	**Total 2004 £**	Total 2003 £
INCOME AND EXPENDITURE					
INCOMING RESOURCES					
Voluntary income					
Members' subscriptions	1,281,310	-	-	**1,281,310**	1,220,385
Donations and legacies	219,249	11,946	590,927	**822,122**	596,364
Grants	93,459	-	972,509	**1,065,968**	1,294,947
	1,594,018	11,946	1,563,436	**3,169,400**	3,111,696
Furtherance of charitable objects					
Research contracts	102,545	-	-	**102,545**	132,271
Activities for generating funds					
Fundraising events	1,539,533	-	-	**1,539,533**	1,487,032
Advisory Service	160,120	-	-	**160,120**	121,827
Trading income	169,624	-	-	**169,624**	165,290
Investment income	43,410	-	-	**43,410**	39,479
Other income	47,678	-	24,403	**72,081**	94,402
TOTAL INCOMING RESOURCES	3,656,928	11,946	1,587,839	**5,256,713**	5,151,997
RESOURCES EXPENDED					
Costs of generating funds					
Direct costs of fundraising events	840,457	-	-	**840,457**	907,819
Membership and regional activities	575,470	1,882	-	**577,352**	556,613
Other fundraising costs	402,181	1,505	57,888	**461,574**	477,160
	1,818,108	3,387	57,888	**1,879,383**	1,941,592
Activities in furtherance of the charity's objects					
Lowlands research	689,016	4,630	726,486	**1,420,132**	1,470,874
Uplands research	308,282	2,178	357,604	**668,064**	688,738
	997,298	6,808	1,084,090	**2,088,196**	2,159,612
Conservation	107,535	1,690	409,217	**518,442**	394,051
Public education	414,070	1,566	64,617	**480,253**	473,075
Support costs	128,936	1,282	263,104	**393,322**	345,217
	1,647,839	11,346	1,821,028	**3,480,213**	3,371,955
Management and administration	115,016	2,259	-	**117,275**	128,829
TOTAL RESOURCES EXPENDED	3,580,963	16,992	1,878,916	**5,476,871**	5,442,376
NET INCOMING/(OUTGOING) RESOURCES	75,965	(5,046)	(291,077)	**(220,158)**	(290,379)
OTHER RECOGNISED GAINS AND LOSSES					
Realised gains/(losses) on investments	9,994	-	-	**9,994**	(37,005)
Unrealised gains on investments	101,470	-	-	**101,470**	57,744
NET MOVEMENT IN FUNDS	187,429	(5,046)	(291,077)	**(108,694)**	(269,640)
BALANCES AT 1 JANUARY 2004	1,283,626	248,431	869,932	**2,401,989**	2,671,629
BALANCES AT 31 DECEMBER 2004	£1,471,055	£243,385	£578,855	**£2,293,295**	£2,401,989

consolidated

Balance sheet

at 31 December 2004

	2004		2003	
	£	£	£	£
FIXED ASSETS				
Tangible assets		670,425		670,683
Investments		1,265,412		1,384,253
		1,935,837		2,054,936
CURRENT ASSETS				
Stock	27,509		23,627	
Debtors	640,961		666,526	
Cash at bank and in hand	532,337		586,048	
	1,200,807		1,276,201	
CREDITORS:				
Amounts falling due within one year	680,611		727,105	
NET CURRENT ASSETS		520,196		549,096
TOTAL ASSETS LESS CURRENT LIABILITIES		2,456,033		2,604,032
CREDITORS:				
Amounts falling due after more than one year				
Life membership subscriptions	152,101		158,719	
Finance lease obligations	10,637		43,324	
		162,738		202,043
NET ASSETS		£2,293,295		£2,401,989
Representing:				
INCOME FUNDS				
Restricted funds		578,855		869,932
Unrestricted funds:				
Property refurbishment fund	82,088		91,761	
Other designated funds	161,297		156,670	
Total designated funds	243,385		248,431	
General fund	1,490,992		1,307,047	
Non-charitable trading fund	(19,937)		(23,421)	
		1,714,440		1,532,057
TOTAL FUNDS		£2,293,295		£2,401,989

Approved by the Trustees on 20 April 2005 and signed on their behalf

ANDREW CHRISTIE-MILLER
Chairman of the Trustees

Staff of The Game Conservancy Trust

in 2004

CHIEF EXECUTIVE	Teresa Dent BSc, ARAgS
Personal Assistant	Wendy Smith
Head of Finance	Alan Johnson ACMA
Finance Assistant - Trust	Stephanie Slapper
Finance Assistant - Limited	Lin Dance
Accounts Clerk (p/t)	Sue Connelly
Head of Administration & Personnel	Kate Oliver
Receptionist/Secretary	Joanne Hilton
Head Groundsman	Craig Morris
Headquarters Cleaner (p/t)	Rosemary Davis
Headquarters Janitor	Chris Johnston
Head of Information Technology	James Long BSc
DIRECTOR OF POLICY AND PUBLIC AFFAIRS	Stephen Tapper BSc, PhD
Head of Education	Mike Swan BSc, PhD
Head of Publications	Sophia Miles *(until December)*
Press Officer	Morag Walker
Press & Publications Assistant (p/t)	Louise Shervington
Field Officer – Farmland Ecology	Peter Thompson DipCM, MRPPA (Agric)
Research Assistant - Hare Ecology	Jennie Stafford
DIRECTOR OF RESEARCH	Nick Sotherton BSc, PhD
Secretary (p/t)	Lynn Field
Head of Fisheries Conservation	Ian Lindsay BSc
Fisheries Research Scientist	Dylan Roberts BSc
Fisheries Biologist (p/t PhD student)	Dominic Stubbing HND, MIFM
PhD student *(King's College)* - Fish Ecology	Ravi Chatterji BSc, MSc
Field Assistants - Monnow Project	Jodie Bee BSc, Richard Parr *(July-August)*
Fishery Assistant	Edward Noyes *(July-August)*
Research Assistant	Robert Walker *(July-September)*
Monnow Project Co-ordinator	Gill Watkins
Monnow Team Leader	Ben Rodgers
Monnow Senior Tree Worker	Oliver Watkins
Monnow Habitat Workers	Philip Howells, Robert Powell
Head of Lowland Gamebird Research	Rufus Sage BSc, MSc, PhD
Ecologist - Pheasants, Wildlife (p/t)	Maureen Woodburn BSc, MSc, PhD
Ecologist - Partridges, Pheasants	Roger Draycott HND, MSc, PhD
Ecologist - Pheasants, Woodcock	Andrew Hoodless BSc, PhD
Project Ecologist - Energy Crop Studies	Mark Cunningham BSc, MSc
PhD student *(Imperial College)* - Pheasant Releasing Studies	Clare Turner BSc
PhD student *(Reading)* - Gamebird Releasing Studies	Sarah Callegari BSc, MSc
PhD student *(University of Kent)* - Game and Wildlife	Tracy Greenall BSc, MSc
PhD student *(John Moore's, Liverpool)* - Quail Chick Ecology	Dave Butler BSc
MSc student *(Newcastle)* - Woodcock	Libby Holmes BSc *(April-August)*
MSc student *(Reading)* - Woodcock	Inigo Urrutia BSc *(April-September)*
MSc student *(Reading)* - Gamebird Releasing Studies	Liz Shearer BSc
Sandwich student	James Grecian *(until June)*
Seasonal Research Assistants	Diane Ling BSc, Louise Stratton BSc *(until July)*
Ecologist - Scottish Lowland Research	David Parish BSc, PhD
Research Assistant	Iain Soutar *(September-October)*
Head of Wildlife Disease & Epidemiology	Chris Davis BVM&S, MRCVS
Game Technician/Stockman	Des Purdy BSc, PhD
Rearing Field Assistant	Mike Sharp BSc *(May-October)*
Head of Predation Control Studies	Jonathan Reynolds BSc, PhD
Research Assistant	Mike Short HND
Research Assistant	Thomas Porteus BSc, MSc
Research Assistant	Austin Weldon BSc *(from July)*
Head of Entomology	John Holland BSc, MSc, PhD
Senior Entomologist	Steve Moreby BSc, MPhil
Entomologist	Sue Southway BA
Post Doctoral Entomologist	Barbara Smith BSc, PhD
Assistant Entomologist	Tom Birkett BSc, PgC
Assistant Entomologist	Heather Oaten BSc, MSc
Research Assistants	Steve Bedford *(from January)*; William Brown BSc *(Jan-Jul)*; Rachel Lucas BSc *(Feb-Aug)*; Peter Davey BSc *(Jan-May)*
Placement student *(Bath)*	Euan Douglas *(from June)*
Director of Upland Research	David Baines BSc, PhD
Office Manager	Julia Hopkins
Black Grouse Recovery Officer	Phil Warren BSc
Research Assistant - Black Grouse	Michael Richardson BSc
Otterburn Senior Scientist - Upland Predation Experiment	Kathy Fletcher BSc, PhD
Research Assistant - Upland Predation Experiment	Robin Foster HN
Research Assistants - Upland Predation Experiment	Helen Foster *(May-Aug)*; Megan Griffiths BSc *(Mar-May)*; Nigel Fairney BSc *(Mar-June)*; Claire Henderson MSc, BSc *(March-July)*; David Fletcher *(June-July)*
Head Gamekeeper - Upland Predation Experiment	Craig Jones
Gamekeeper - Upland Predation Experiment	Danny Lawson *(until October)*

Trainee Gamekeeper - Upland Predation Experiment	Joe Pattison	
Senior Scientist - North of England Grouse Research	David Newborn HND	
PhD Student *(Imperial College)* - Red grouse population dynamics	Nils Bunnefeld	
Research Assistants	Anna Johnson BSc *(July only)*; Pam Staley *(March-August)*	
Research Assistant - Langholm	Anne-Marie MacMaster *(March-July)*	
Placement Student	Deborah Coldwell *(from October)*	
Senior Scientist - Scottish Upland Research	Adam Smith BSc, MSc, DPhil	
Senior Scientist - Woodland Grouse	Isla Graham BSc, MSc, PhD *(until December)*	
Ecologist - Mountain Hares	Scott Newey BSc, MSc	
Ecologist - Red Grouse Productivity	Alan Kirby BSc, MSc, PhD *(until December)*	
Research Assistant - Scottish Upland Research	David Howarth	
Research Assistant - Ticks	Alison Taylor BSc, PhD	
PhD student *(Edinburgh)* - Muirburn	Matt Davies BSc, MSc *(until December)*	
PhD student *(Aberdeen)* - Tick Ecology	Ellie Watts BSc	
Masters student (*Glamorgan)* - Black Grouse	Charles Horsford BSc *(April-August)*	
Masters student (*Glamorgan)* - Ticks	Frances Hall BSc *(April-August)*	
Masters student (*Imperial College)* - Grouse Diet	Claire Wyllys *(June-July)*	
BSc student (*Edinburgh)* - Muirburn	Nicola Evans *(March)*	
Placement student	Ella Steel *(from July)*	
Seasonal Research Assistants	Ross Hunt, Fredrik Dahl	
DEPUTY DIRECTOR OF RESEARCH	Nicholas Aebischer Lic ès Sc Math, PhD	
Secretary & Librarian	Claude Gillie CertEd *(until June)*; Gillian Gooderham *(from June)*	
Assistant Biometrician	Peter Davey BSc *(from May)*	
Grey Partridge Ecologist	Stephen Browne BSc, MSc, PhD	
Westminster Fellow - Grey Partridges	Francis Buner Dipl Biol, Cand Dr Phil II *(from July)*	
Postgraduate *(Leon, Spain)* - Grey Partridges	Sara Olmedo de la Cruz BVM, MSc *(July-August)*	
Volunteer - Grey Partridges	Arthur Scott *(August)*	
Raptor Ecologist	Mark Watson BA, MSc *(until February)*	
Head of Geographical Information Systems	Julie Ewald BS, MS, PhD	
Research Assistant - GIS	Neville Kingdon BSc	
Research Assistant - GIS	Nina Graham BSc	
MSc Student *(Reading)* - GIS	Inigo Urrutia *(April-September)*	
Placement Student *(Bath)* - GIS	Courtney Kennedy *(from September)*	
Placement Student *(Harper Adams)* - GIS	James Daplyn *(from September)*	

as at 1 May 2005

DIRECTOR OF FUNDRAISING	Edward Hay	020 7290 0117, ehay@gct.org.uk, 07717 856951
Assistant to Director of Fundraising	Caroline Gilkes	020 7290 0116, cgilkes@gct.org.uk
London Event Manager	Sally Thomas	020 8743 5079, sthomas@gct.org.uk, 07734 537586
Corporate Sponsorship Manager	Liz Scott	01425 651037, lscott@gct.org.uk, 07803 180958
Sales Centre Manager	Mike Davis	01425 651003, mdavis@gct.org.uk
Head of Membership	Tim Bowie	01844 281899, tbowie@gct.org.uk, 07740 873772
Regional Fundraiser - North of England	Henrietta Appleton	01833 622028, happleton@gct.org.uk, 07889 891956
Regional Fundraiser - South of England	Max Kendry	01789 840348, mkendry@gct.org.uk, 07803 180957
Head of Membership Records/Funding Manager/Legacies	Corinne Duggins Lic ès Lettres	01425 651012, cduggins@gct.org.uk
Membership Records Administrator	Vacant	01425 651024, records@gct.org.uk
Membership Records Assistant: Gift Aids/MRs/New Members	Bridget McKeown	01425 651010, bmckeown@gct.org.uk
Membership Records Assistant: Renewals	Jenny Bowen-Jones	01425 651011, jbowen-jones@gct.org.uk
Membership Records Assistant: Donations	Mary Barnes BA	01425 651016, mbarnes@gct.org.uk

DIRECTOR ADVISORY SERVICES & SCOTLAND	Ian McCall BSc[1]	
Secretary - Scottish HQ	Irene Johnston	
Administrator - Scottish Auction	Sarah Lukas *(January-June)*	
PR & Education - Scotland	Katrina Candy HND	
Co-ordinator Advisory Services	Liz Scott[2] *(until September)*; Lynda Ferguson *(from September)*	
Advisory Services Assistant (p/t)	Lynda Ferguson *(until September)*	
Regional Advisor - Central & Southern Scotland & Northern England	Hugo Straker NDA[3]	
Regional Advisor - Wales, Midlands	Ian Lindsay BSc[4]	
Secretary to Ian Lindsay (p/t)	Mandie Pritchard	
Regional Advisor - South of England	Mike Swan BSc, PhD[5]	
Regional Advisor - Eastern & Northern England (p/t)	Martin Tickler MRAC[6]	
North of England Regional Advisor & Biodiversity Officer	Mike McKendry ARICS	
Secretary to Mike McKendry	Gillian Robson *(from January)*	

[1] Ian McCall is also Regional Advisor for Tayside, Fife, Northern Scotland & Ireland; [2] Liz Scott is also Corporate Sponsorship Manager; [3] Hugo Straker is also Development Officer for Central and Southern Scotland; [4] Ian Lindsay is also Head of Fisheries Research; [5] Mike Swan is also Head of Education; [6] Martin Tickler is also Eastern Regional Organiser

Staff of the Allerton Research and Educational Trust

The Game Conservancy Trust manages the Allerton Project for the Allerton Research and Educational Trust

Head of the Allerton Project	Alastair Leake BSc, MBPR (Agric), PhD
Secretary (p/t)	Rosemary Barker *(until March)*, Jenny Kipling *(from March)*
Head of Research	Chris Stoate BA, PhD
Research Ecologist	Kate Draycott BSc
Ecologist	John Szczur BSc *(from Nov, previously Field Assistant)*
Field Assistant	Simon Davies BSc, MSc *(April-July)*
Research Assistant	Frances Lancaster BSc *(April-August)*
Placement student	Matthew Davies HND *(until July)*; Caroline Sherrott *(from September)*
Game Keeper - Royston	Malcolm Brockless
Farm Manager	Philip Jarvis HND
Farm Assistant	Michael Berg
Catering Assistant (p/t)	Jeanette Parr

Index of research projects

covered in this Review

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Harrogate	Alison Robinson	01423 568012
High Wycombe	Karen Bartlett	01494 464666
Inverness	Susie Swift	01463 246300
London	Martin Webster	020 7841 4000
Manchester	Mike Harrison	0161 926 4900
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