Review of 2011

A full report of the activities of the Game & Wildlife Conservation Trust

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Review of 2011

Issue 43

A full report of the activities of the Game & Wildlife Conservation Trust (Registered Charity No. 1112023) during the year

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GAME & WILDLIFE CONSERVATION TRUST OBJECTS

- To promote for the public benefit the conservation of game and its associated flora and fauna;
- To conduct research into game and wildlife management (including the use of game animals as a natural resource) and the effects of farming and other land management practices on the environment, and to publish the useful results of such research;
- To advance the education of the public and those managing the countryside in the effects of farming and management of land which is sympathetic to game and other wildlife.
- To conserve game and wildlife for the public benefit including: where it is for the protection of the environment, the conservation or promotion of biological diversity through the provision, conservation, restoration or enhancement of a natural habitat; or the maintenance or recovery of a species in its natural habitat on land or in water and in particular where the natural habitat is situated in the vicinity of a landfill site.

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as at 1 January 2012

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Chairman's report

by Ian Coghill

(L-R) Ian Coghill awarding the Ruffer Cotswold grey partridge trophy to Ola Baalack at the CLA Game Fair. © Peter Thompson/GWCT

I have had the opportunity this year to meet numerous members and supporters around the country, and am deeply grateful to the many county committees who put on enjoyable and informative events to raise funds for our work. The commitment of so many people to the work of the GWCT is a huge inspiration to me, the trustees and the staff.

Our organisation finds practical and effective conservation solutions; things that will help wildlife, in our fields, rivers, woods and moorland. Increasingly, we are finding that traditional game conservation techniques have a lot to teach mainstream conservation about how to achieve effective species recovery. The key is improved breeding success and producing a 'surplus'. For example, it is now apparent that without legal predator control many intended reserves merely encourage birds to breed in places where they are almost certain to lose their eggs or chicks before they fledge.

We should be proud that we spend a greater proportion of our funds on practical research than any other comparable organisation. An even greater source of pride is that so many people put this research into practice, on their farms, estates or shoots. Every member and supporter can take pride from the fact that their willingness to fund our high quality research has resulted in some of the best practical solutions to conservation problems ever devised.

No charity can operate without the generous support of many people, businesses, charitable trusts and organisations. One of the reasons I have relished the opportunity to come to so many events this year is to take the chance to say a personal thank you to all the people who so generously make our work possible. We really do appreciate your help.

There is not space to thank everyone individually, so as an example let me choose the Underwood Trust who made us an exceptionally generous endowment in 2011, the first of its kind. The income from it will fund, in perpetuity, an annual Underwood Fellowship to investigate how to improve the sustainability of game management and sporting fisheries, and in particular, to look at how and whether these activities provide benefits for all.

Thank you one and all for helping us generate the science that will help keep the British countryside and its game and wildlife as we wish it to be.

Chief Executive's report

by Teresa Dent

Teresa Dent and Jim Paice (Minister of State for Agriculture and Food). © Peter Thompson/GWCT

2011 was a very busy year. A series of major policy reports, new wildlife legislation and white papers, in both England, Wales and Scotland, highlighted the increasing challenges facing those involved with managing our countryside.

We have worked hard to drive home our key messages. A new Government at Westminster, and a refreshed political mandate in Scotland has created new opportunities to do that. I feel we have grasped them well and that we are making progress with getting game conservation better understood and appreciated for its ability to deliver results on the ground both for game and other species.

Early in the year, the Food and Farming Report drew attention to the demands that the world's burgeoning population will put on food production. In March, Scotland brought in the Wildlife & Natural Environment Act, a major overhaul of wildlife legislation with some far reaching implications for landowners and sportsmen. The Scottish Government also launched Scotland's first Land Use Strategy. In June, Defra's Natural Environment White Paper was launched – a significant event as the last one was 20 years ago. That was followed in December by the launch of the Water White Paper 'Water for Life'.

These policy issues are covered in detail in the policy report on page 7, but they do, in the round, draw attention to both the relevance of our research and the importance of getting involved in policy. The central challenge in the food and farming report and the Land Use Strategy is how do we reconcile the need to produce more food from our countryside with conserving our wildlife? This has been at the heart of our 20 years' work at the Allerton Project, where we have shown how to maintain crop yields while doubling abundance of Biodiversity Action Plan species after just three years.

The long-term research done by our predation department (see page 76) was crucial in preventing an outright ban on snaring in Scotland, including even the responsible use of snares as a means of pest control.

In England many proposals, home-grown from our research, went into the Natural Environment White Paper. But if the UK's Governments are going to achieve the stated European 2020 mission "...to halt overall biodiversity loss, support healthy well-functioning eco-systems and establish coherent ecological networks, with more and

better places for nature for the benefit of wildlife and people", it is going to have to get its conservation skates on. We know from research in the uplands (at Otterburn) and the Allerton Project at Loddington, that game conservation with its multi-faceted approach (habitat management, winter feeding and predator control), can offer much faster recovery for some species than the more conventional, habitat only approach. Our Advisory Service is working hard to share these insights with other organisations through our partnership working programme (see page 12).

Our ability to influence water issues has been enhanced by our new collaboration with the Salmon & Trout Association who relocated to our offices in March. Paul Knight, its chief executive, is an eloquent and knowledgeable advocate and, as our partner, is making full use of the research coming from our fisheries research centre at East Stoke (which we took on in 2009).

The charity world faced a few challenges in 2011 too, with the economic climate and Government spending cuts affecting the sector. Conservation charities were not immune. Our voluntary income did not grow as much as we had budgeted for, and there were fewer research contracts for Government departments available. This has left us with a deficit on general funds in this year's accounts and means that we will have to focus hard on fundraising in 2012. The fact that we are a membership charity, with strong volunteer fundraising in individual counties, is a saving grace as that gives us regular, repeatable income that is of huge value. The situation was much more serious for some other charities and the Farming & Wildlife Advisory Group (FWAG) went into administration late in 2011. This was a sad day for farmland conservation. We believe that FWAG advisors played an important role; it was an organisation that we had worked closely with over the years and had hoped to collaborate with more in the future. We are in touch with many of the advisors and the new English regional FWAG groups that are re-forming. We hope we can both help them and work together in years to come.

We are now collaborating with the Salmon & Trout Association who are making full use of our fish research. © William Beaumont/GWCT

Our policies

2011 was perhaps the year when the differences between the UK's various regional approaches to conservation policy became explicit, justifying the Trust's strategy of increasing capacity for placing research into policy.

by Adam Smith and Alastair Leake

HRH The Duke of Edinburgh enjoyed a tour of our Allerton Project farm to find out about our latest research. © Morag Walker/GWCT

England

South of the border a number of policy review consultations announced by the Coalition Government in their first year of office manifested themselves as new reports. The Nature of England White Paper (NEWP) set out the Government's vision for the natural environment and included a number of the suggestions we put forward in our response. Key among these was the announcement of the creation of 12 Nature Improvement Areas (NIAs). These are the manifestation of our 'Landscape Scale Delivery' vision and involve farmers and landowners working in partnership to restore and connect wildlife on a large scale, something we already know is good for biodiversity.

The White Paper also committed the Government to 'getting the best value' from agricultural land, which included improving the environment as well as food production. This is a theme which we have long researched, although through the past two decades this has been done against a back drop of food surpluses and consequently surplus land. With a growing population, increased food prices and pressure on natural resources, there is a steadily increasing need to produce more from less and with less impact. This will require the high degree of management we advocate in our approach to game management and modern farming.

Underpinning this are other Government commitments we sought on soil management, diffuse pollution and a new biodiversity strategy. Our research has been

The GWCT Scottish Game Fair is growing in popularity and is a key event. © GWCT

key and often unique in being able to inform our response to this and other related new policies.

Last year also saw a number of policy initiatives emerge from Brussels. The Water Framework Directive becomes law in just three years and prompted a companion to the NEWP; the Water White Paper. In the face of increased consumption and erratic rainfall, the management of our water resources will be a major challenge. Our fish stocks and the biological health of our watercourses are undoubtedly affected by over-abstraction. Although farm practice continues to improve, better aquatic environments remain elusive. It is said that 'a solution to pollution is dilution' and indeed this is so, but with low rainfall and over-abstraction we will soon be faced with the opposite effect.

UK level

Linking the work of English and Scottish policy teams has been the emergence of perhaps the most significant environmental policy issue for the UK for 2011 and beyond. We have been developing our reaction to the European Commission's (EC) proposals to reform the Common Agricultural Policy (CAP). This is something we in

Jim Paice and Helen Phillips were some of many VIPs that visited Andrew and William Pitts' farm in Northamptonshire to look at wildlife crop trials. © Peter Thompson/GWCT

Adam Smith, our director Scotland, and Pete Wishart, MP for Perth and North Perthshire, discuss the central exhibit at the Scottish Game Fair 2011. © GWCT

the Trust take a keen interest in because the funding for our precious agri-environment schemes comes from the CAP. Whereas the UK has concentrated CAP funds into agri-environment, many other countries have tended to use the funds for rural development projects. Consequently the Commission is seeking additional environmental action from farmers as a condition of their Single Farm Payment. The proposals fall well short of our existing environmental schemes and could deter UK farmers from re-joining these. This is why we have worked hard this year to improve the schemes, both for the participants and the wildlife. The Government has at last agreed to look seriously at supplementary feeding for farmland birds as a new environmental stewardship option.

Scotland

Though CAP reform is a UK level discussion within the EC, there are significant regional differences in the way any settlement is delivered on the ground in each UK country. The election of the new Scottish Government in 2011, was reflected in ever further divergence in land management policies. Scotland's first Rural Strategy was published this year and our work with MSPs and Scottish Government helped ensure recognition of sporting management in this vision. The strategy is not a fixed document and there are on-going consultations on the key elements: forestry, agriculture and carbon. The management of Scotland's peatlands and the expansion of woodland were two areas where we advised the Scottish Government in 2011.

Some elements of this vision have been translated into law in recent years. 2011 saw the result of our intensive work with MSPs, agencies and other organisations to improve the Wildlife & Natural Environment Bill. As ratified, the Act ensured snaring was saved, the ability to release pheasants was protected and a more flexible approach to muirburn was introduced. Our Scottish headquarter's team has continued to work with the results of this Act as the various codes and licences have been developed and introduced through 2011.

Developing balanced conservation policy approaches to predation has remained a high priority. Much of the work is on-going, such as the critical analysis of the Hen Harrier Conservation Framework, exploration of impacts on capercaillie populations, the Langholm Moor Demonstration Project and technical inputs to the Environment Council processes. But as well as these specific approaches, we have worked at encouraging a general understanding that following game conservation principles is an effective way to conduct nature conservation in our landscape. We were therefore delighted when these aspirations were recognised in the Statement of Intent we signed with Scottish Natural Heritage at the GWCT's Scottish Game Fair.

Teresa Dent and Ian Jardine, SNH chief executive, signed a Statement of Intent at our Scottish Game Fair. © Phil Hannah

Communication and public affairs

by Tom Oliver

(Centre) Tom Oliver taking part in a debate on the Natural Environment White Paper at the CLA Game Fair. © Morag Walker/GWCT

This is the first report of the communication and public affairs team, established in early 2011, at the same time as the creation of a separate policy directorate. Some responsibilities are inherited from the previous public affairs team: GWCT publications, including the annual *Review*, *Gamewise* and our research newsletters; our media output, including press and broadcast media and the management of media stories relevant to our work. We also have two new areas of work. The first is the planning and management of our Parliamentary engagement. This includes running the Game & Wildlife Conservation All Party Parliamentary Group, which had its inaugural meeting in December 2010. We are also embarking on a new programme of long-term dialogue with influential commentators and columnists, with the aim of achieving better informed debate on the issues central to our work and our charitable objects.

During the year, our magazine *Gamewise* covered a considerable range of subjects, from marking the 50th anniversary of our National Gamebag Census, planning insect-rich habitats for farmland chicks and the proposed sale of the Forestry Commission estate, to the reintroduction of eagle owls and white-tailed eagles, the decline

of wading birds in the lowlands and the visit of His Royal Highness the Duke of Edinburgh to the Allerton Project at Loddington. The magazine also highlights our practical work on best practice and training, as well as celebrating county events organised by our volunteers. We conducted research with our readers to discover their views on the magazine which were, happily, consistently favourable.

Last year we generated media coverage with an equivalent value of £6.6m across 1,400 titles, national, regional and specialist. Among the best of our broadcasting was coverage of our woodcock research on the *BBC's Springwatch*, three slots on the evening prime-time *BBC One Show* and a fascinating and very well researched programme, *The Truth About Wildlife*, on the history of our grey partridge research. This included footage from a *Tomorrow's World* programme featuring Dick Potts from 1970, vividly illustrating the value of our long-term research. Our media presence included regular references in most national newspapers and some international ones, including the reporting of the Glorious Twelfth in the *New York Times* and the *Singapore Daily*. There has also been extensive coverage of the Trust in regional and local titles, supporting the work of our recruiters and fundraisers.

Our All Party Parliamentary Group (APPG) has now met three times since it was founded at the end of 2010. We have established a policy of 'partnership on the platform', whereby we offer to share each of our meetings with another leading organisation in the field of the subject chosen for debate. So far, this has included the CLA when discussing wildlife legislation, the RSPB on agri-environment reform and the Salmon & Trout Association on the Water White Paper. Two of our APPG meetings have been addressed by Richard Benyon MP, Minister for Natural Environment and Fisheries, while Mary Creagh MP, Shadow Environment Secretary, Gavin Shuker MP and Fiona O'Donnell MP, both Opposition Defra front benchers, have also attended our meetings. We are very grateful indeed to Rt Hon Nicholas Soames MP and Roger Williams MP for their generosity in supporting the APPG as its chairman and vice-chairman respectively. Meanwhile, we have pursued an intensive programme of meeting MPs and peers, including newly-elected and newly-appointed members.

The work of broadening our connections and explaining our work to commentators, journalists, bloggers and opinion formers is a long-term project. It is nonetheless extremely important in helping to ensure that subjects of importance to us are covered in the media, but are also discussed accurately and, we hope, constructively. The future for the Trust and its work lies, at least in part, in attitudes and understanding which are influenced so strongly by the media, both conventional and new. Getting good debate going can only help, as we did with our first ever debate at the CLA Game Fair on the Natural Environment White Paper.

James Keith (GWCT Trustee) and Mary Creagh MP (Shadow Environment Secretary) at our APPG meeting. © Morag Walker/GWCT

Our APPG group has now met three times. The meeting with the RSPB discussed agri-environment reform. © Morag Walker/GWCT

Broadening the message

by Ian Lindsay

Getting our messages out to land managers, policy makers and their advisors was a priority in 2011.
© Peter Thompson/GWCT

Today, the Trust's advisory team plays a national role in promoting game management options in the recovery of a wide range of wildlife species. But although the role of beetle banks and insect-rich habitats, options developed by the Trust and now embodied within agri-environment schemes, are now in common use, to date they haven't achieved significant responses in some wildlife populations. Partly this appears to be due to the lack of additional management such as predator control, which is part of the game management 'system'. For a number of species, and particularly for ground-nesting birds, habitat improvements alone seem, as yet, not to be delivering measureable recovery. Our main demonstration projects including the Allerton Project at Loddington, the Grey Partridge Recovery Project at Royston and the Upland Predation Experiment at Otterburn, have sought to show the benefits of a comprehensive package comprising habitat management, predator control and supplementary feeding. Despite this, for many species, the additional investment in extra management such as predation control and supplementary feeding is made almost exclusively by the game management community.

'Broadening the message'; delivering the game management prescription beyond its traditional audience has been a priority during 2011. Of a total of 218 presentations and training events delivered by the advisory team, over half were directed at the staff, wardens, managers and members of conservation organisations. Issues as diverse as predator control for upland waders, water voles, grey partridges and brown hares were covered. In addition, our programme of training events, seminars and demonstrations for universities reached over 950 undergraduate and postgraduate students attending land and wildlife management courses at 30 prominent institutions. Particularly among conservation workers directly involved 'on the ground', this has been a highly rewarding strategy. Subjects from upland waders to water voles and lapwing were covered, revealing a widespread enthusiasm to implement a broader range of options at the heart of game management.

In 2011 we also developed partnerships with a number of other organisations, aimed at achieving a joint approach to the wider delivery of our research. With the Woodland Trust, we launched a new leaflet entitled *Woodland creation and management for pheasants* at the CLA Game Fair. We are also working regularly with Butterfly Conservation, the National Gamekeepers' Organisation, the Wildlife Trusts and the Salmon & Trout Association using our joint expertise to provide targeted up-to-date advice.

The impressive Afghan talks helped raise money for the Trust as well as the Colonel's Fund.
© Morag Walker/GWCT

Novel fundraising ideas

by Edward Hay

It has been an interesting and challenging year for our fundraising team. Across our 40 county groups we are seeing some fantastic and novel ideas for events that are kindly organised through our extremely supportive county committees.

Of course we love the annual and biannual dinners, which are enjoyed in many counties, as they provide our charity with fruitful and generous funds to keep the wheels rolling. Just as importantly we are seeing unique and new events such as frog racing, singing waiters, clay days, triathlons and the hugely popular shoot walks. I mention just a small proportion of 150 different events organised to raise money for the Trust by our members in 2011.

These county events, to which members and their like-minded friends come, give us cheer while we are reminded of the gloomy economic climate in the press daily. I particularly wish to thank you for all your support and work in making these events happen, and for spreading our message throughout the country.

Our shoot walks are hugely popular.

The fabulous women who took part in the run in Hyde Park, and helped raise money while having fun.

Our national events this year have been good fun. Our first sporting event, and an all women one, made a slow start, but once it took hold there was no stopping the women who took part. The run in Hyde Park, London, was a great success helping to raise our profile, while encouraging people to learn about us and our work, and raising money enjoyably at the same time.

The impressive Afghan talks have been enjoyed and supported phenomenally well by our members and their friends and colleagues. Both of these events have helped two charities, the GWCT and the Colonel's Fund, each of which the audiences cherish and support. Hearing the first-hand accounts of the Grenadier Guards, which is one of many regiments serving in Afghanistan, proved subject matter that appealed to our members and has also helped to spread the word to new audiences who are interested in the work we do.

We are talking to new audiences and spreading our message far and wide throughout the country.

These events are so important and are a continued lifeline for our future. To all the county chairmen, committee members, donors and volunteers that support us, thank you. I wish you well for the forthcoming year.

Membership and marketing

by Andrew Gilruth

We remain incredibly appreciative of the support our existing members give us. Over this difficult year, our members and supporters continued their commitment to the organisation's vision and scientific research. 21,147 members supported our important research projects and we experienced only a modest 1% decline in numbers. Without this level of support we could not function – thank you.

Our network of membership recruiters (with special thanks to Jamie Daniell, Steve Richardson and David Thurgood) worked hard at a time when charities are finding it increasingly difficult to recruit members. In an age when people no longer need to join an organisation to get access to its information, membership of a charity seems more like marriage. It represents a level of commitment that people need to work towards rather than jump into.

Indeed, many charities have found that some people are more willing to become a 'supporter' of a project (such as the woodcock migration study) than a member. This is a point that Elly Woolston, who became chair of our membership and marketing committee in 2010, has been urging the Trust to develop.

At Elly's suggestion, we also began trials to attract new supporters, both within and outside the game conservation community, with the opportunity to support exciting new science projects. The results were very promising, bringing in 87 completely new people to support the woodcock migration study. Elly's committee, onto which she has brought professionals with a record of successful charity fundraising, is encouraging further trials of recruiting supporters of key projects among the shooting community and among other countryside supporters who appreciate the value of our research.

As well as this recruitment drive, we invited members to attend one or more of our 154 regional events across the country, actively encouraging ex-members to re-join the Trust so that they could come to one these special days. The response was very positive with 58 ex-members re-joining to visit the award-winning estate at Arundel Castle. Recruitment successes like this will be used to formulate future plans.

Many people wanted to support our woodcock migration study. © Peter Thompson/GWCT

Director of Research's report

by Nick Sotherton

(Above and below) Our science is all field-based.
© Merlin Becker and William Beaumont/GWCT

As usual, this year's *Review* is a mixture of reporting on projects nearing completion, those about to start and the on-going long-term messages from our work.

Since we started managing our Allerton Project demonstration farm at Loddington, for gamebirds, we have conducted annual songbird counts to monitor the effect of this management on farmland birds (see page 64). We can now calculate that 20% to 30% of the increases we observed in bird abundance since we started in 1992, can be attributed to the creation and management of habitats. The remaining increase can be attributed to predator control and winter feeding ie. duties carried out by gamekeepers.

After what seems to be a long time, we can finally report on two significant studies on fox snaring (see page 76) that have recently been published. It is invidious to pick out members of the research department for praise, but I will make the exception for Jonathan Reynolds and Mike Short for their work on this controversial topic. Jonathan's report is well worth reading.

Our two articles on woodcock also make good reading as Andrew Hoodless and his research student, Adele Powell, begin to unravel the mysteries of this enigmatic bird (see pages 22 and 26). Some of the migration data we are beginning to generate show details of their breeding grounds, flight paths and daily distances travelled. With sufficient funding, we hope that there will be more of this information to come.

We also report on the success of the new formulation of medicated grit designed by the Trust to control the strongyle parasite worm in red grouse that used to cause populations to crash periodically (see page 50). Such crashes may be a thing of the past as the success of medicated grit becomes apparent; a really good example of our practical, effective conservation in action.

Our *Review* also allows us to report on the latest analyses of our long-term databases. Our long-term sets of data on grouse numbers and grey partridge densities go back 50 years and our gamebag census returns go back to before Darwin was born!

Our scientists are making great progress in the uplands tackling ticks and worms.
© Kathy Fletcher/GWCT

These data are expensive to collect, store and analyse and almost impossible to fund outside core sources of money. Yet they are invaluable in supporting our agreements concerning the value and sustainability of wildlife management. In this *Review* we comment on trends in numbers culled in the six species of deer found in the UK (see page 42). Not surprisingly all show an increase, particularly roe and muntjac. These increases coincide with concerns about the deteriorating quality of some habitats; a conservation conundrum developing before our very eyes?

Finally, our research team published 37 scientific papers this year including the publication and defence of four PhD theses from research students working in collaboration with us at UK universities and supervised by our staff. We also welcomed 15 MSc students to conduct their research projects with us, 14 of them gaining distinctions for their Master's degree. Well done to them all.

Detailed studies help us unravel the natural history of our game species. © Carlos Sánchez/GWCT

Grey squirrels and breeding woodland birds

It appeared that birds in open nests, such as spotted flycatchers, benefited most from squirrel removal. © Nigel Housden/Pinsharp Photography

KEY FINDINGS

- We looked at the effect of squirrel removal on the breeding success of woodland songbirds.
- Post-nesting fledging was sometimes, but not always, higher when we removed squirrels.
- Birds in open nests were most affected by grey squirrel removal.

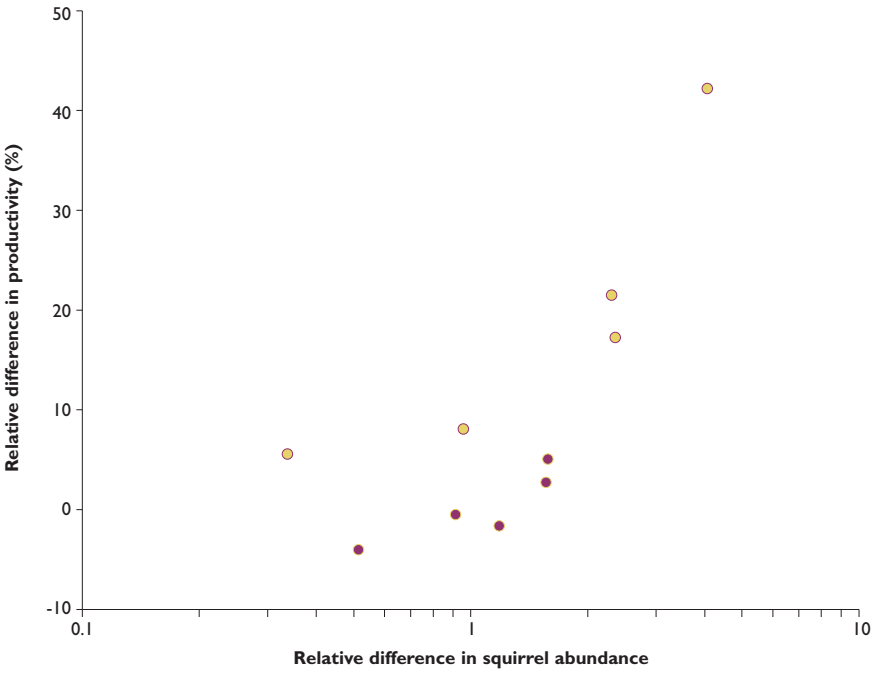
Rufus Sage

This study aimed to determine whether grey squirrel removal could lead to an increase in the productivity of woodland birds. Although there is some recent evidence to suggest that increases in grey squirrels may affect birds, these have only been correlative studies. The work reported here was a randomised removal experiment carried out in 2008 and 2010. We counted adult and young birds in 20 woods in England grouped into 10 pairs. Both woods in each pair contained squirrels prior to the field programme and good habitat for birds. We then controlled squirrels using approved methods in one randomly-selected wood in each pair. We counted territorial breeding birds in all woods and followed this with twice-weekly counts of post-nesting fledged broods. We calculated productivity of songbirds based on the ratio of the number of broods to the number of adult territories. We then compared these ratios with the treatments with and without squirrel removal and with counts of squirrels also collected during the bird surveys. We did this for the songbird community as a whole and for hole-nesters and open-nesting species separately.

In year one, squirrel removal increased productivity (brood-to-territory ratio) in the all-songbirds group in the five pairs of woods whereas in year two, results were mixed. When the difference in the index of squirrels within pairs of woods was large

Figure 1

1a) All songbirds



Each point represents a measure in the removal wood relative to the non-removal wood in one pair of woods. The vertical axis is the relative difference in the brood-to-territory ratio. The horizontal axis is the ratio of squirrel numbers in the squirrel counts (logarithmic scale)

(ie. squirrel removal was apparently effective), the measure of productivity increased in the removal wood relative to the non-removal one (see Figure 1a).

Our analysis of open-nesters and hole-nesters indicated that the relationship between relative productivity and relative squirrel abundance in the all-bird group was probably caused largely by an effect on the open-nesting species (see Figure 1c). Data for hole-nesting species showed no clear relationship between squirrel removal and bird productivity (see Figure 1b), whereas relative productivity of (potentially more vulnerable) open-nesting species went up when squirrels were effectively removed at three sites. Note that in Figure 1c, two points have been removed because the estimates of productivity for open-nesting species only at those two sites were unreliable owing to low sample sizes. This includes the data for the outlying high point in Figure 1a.

Our results suggest that we detected an effect of squirrel control on productivity in woodland birds, but they are not conclusive. They were not caused by a large effect of squirrel removal on one or two especially vulnerable bird species, but seemed to hold for mainly open-nesters as a group. This suggests that the productivity of open-nesting species, and possibly some others, could be improved by effective grey squirrel control in some circumstances. However, further work would be useful to see whether this relationship can be confirmed.

ACKNOWLEDGEMENTS

This work was funded by the European Squirrel Initiative and The Barnby Trust.

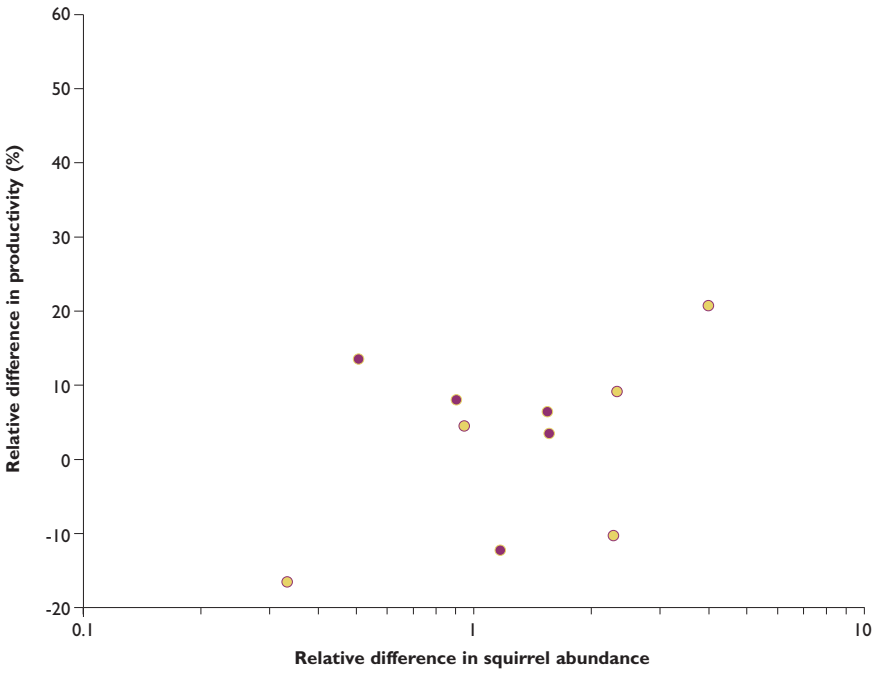


Figure 1

b) Hole-nesting songbirds

2008

2010

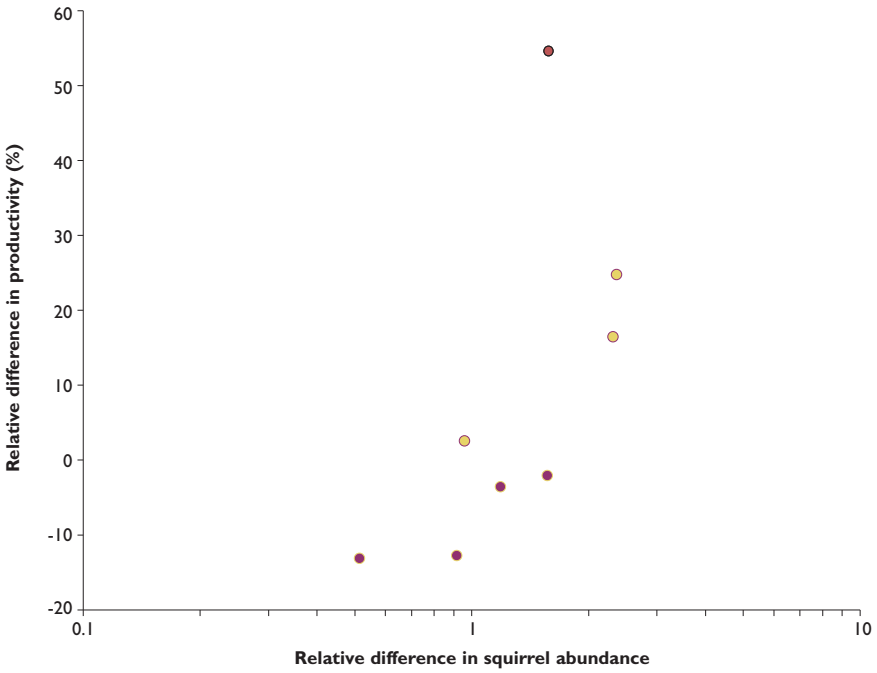


Figure 1

c) Open-nesting songbirds

2008

2010

Disease and mortality in wild pheasants

Wild hen pheasant with necklace radio-transmitter attached. © Kayleigh Hogg/GWCT

KEY FINDINGS

- Wild pheasants on an estate in Norfolk suffered high rates of mortality in the breeding season.
- Predation rates were low.
- Hen pheasants lost body condition during May and June resulting in poor survival and productivity.

Roger Draycott
Rebecca Blamey

ACKNOWLEDGEMENTS

We thank the Earl of Romney and the other landowners who supported this project and Crowshall Veterinary Services for undertaking post-mortem examinations.

The population status of wild pheasants is difficult to determine because of the large numbers of birds that are released each summer. Historically, wild pheasants have fared best in the eastern counties where there is relatively low rainfall, a high proportion of the land is cultivated and there is a long history of traditional gamekeeping. Indeed, today, most of the shoots that focus on wild pheasant management are in the eastern counties. In recent years there has been concern among some landowners and gamekeepers in Norfolk and elsewhere, that there have been localised incidences of high mortality during the breeding season, leading to poor autumn counts and, ultimately, lower bags in the shooting season. For example, one estate in Norfolk suffered significant losses of wild breeding birds in spring 2005 and again in 2010. Few corpses were found and among the ones that were, there was no consistent cause of death. Interestingly, the problems affecting the wild pheasant stock on this particular estate did not appear to affect grey partridges, which are increasing in numbers. This suggests that factors other than predation, habitat quality and weather were involved.

We radio-tagged 50 wild hen pheasants in March to determine their survival and breeding success and to identify the main causes of mortality. Hens were located at least three times a week between April and July and we collected detailed information on the nests of the tagged birds. The radio-tags had an in-built mortality switch, which enabled us to detect when a bird had died and retrieve the body soon after death. If we found the carcass intact, we sent it to a specialist gamebird diagnostic veterinary practice for post-mortem examination.

When tagged, all birds were in excellent body condition and exhibited no signs of disease or other problems. Of the 50 hens radio-tagged, 33 died between 1 March and 31 August. Survival from the beginning of March to mid-April was 100%. Subsequently, there were major losses (60%) through May and June. A few more birds died in July and August, but the rate of loss was much lower (10%). The causes of death of these 33 birds are shown in Figure 1. Despite all hens being in good condition when tagged in March, the majority (63%) of birds subsequently found dead were in an extremely poor or emaciated condition (see picture opposite). We often found dead birds at the base of tall vegetation, typically in cereal fields. We would not have found these birds had they not been radio-tagged.

We identified higher than expected levels of mortality for a managed wild pheasant population, but levels of predation on both birds and nests were relatively low. The high mortality was due to a dramatic loss of condition in hens. This was

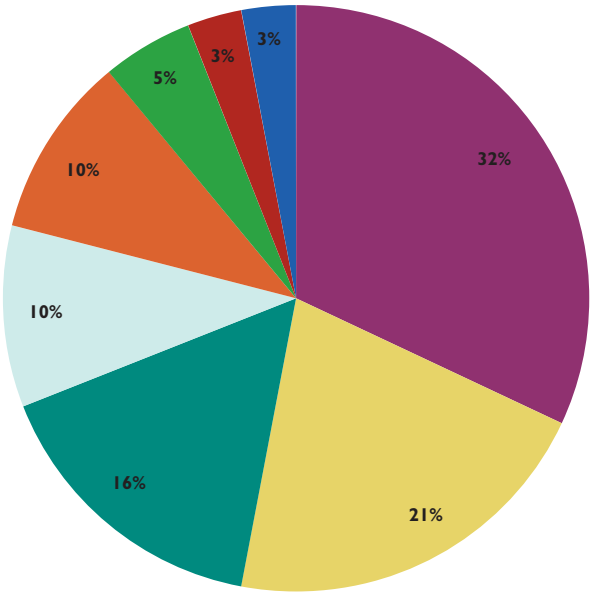


Figure 1

Causes of death of 33 wild hen pheasants in Norfolk, April-August 2011

- Kidney damage
- Fox
- Parasites
- Egg peritonitis
- Unconfirmed
- Liver damage
- Stoat
- Vehicle collision

associated with a high incidence of parasites and kidney damage, which was probably caused by corona virus. What is not clear is whether the loss of condition is a result of disease, or whether hens in poor condition were more vulnerable to disease. Productivity of the pheasants was also low, owing to a high rate of nest abandonment.

We are repeating the work in 2012 and will collect more information on the causes of mortality on this estate. We will also undertake post-mortem examination of pheasants from other shoots to determine how widespread these problems are. Very little is known about the prevalence and importance of diseases in wild pheasants and these results provide our first insight into what could be an important and, thus far, under-researched area.

Hen pheasant found in emaciated state.
© Kayleigh Hogg/GWCT

The origins of our wintering woodcock

Looking at the chemical composition of a woodcock's feather has enabled us to work out its hatching or moulting location. © David Mason

KEY FINDINGS

- Stable-hydrogen isotope analysis of woodcock feathers has provided clear indications of the origins of woodcock wintering in different parts of Britain and Ireland.
- There is a high degree of mixing of woodcock from different breeding populations across wintering sites, but Scotland and Ireland appear to support a higher proportion of woodcock from central and northern Scandinavia, whereas in southern England more birds seem to originate from western Russia and the Baltic States.

Andrew Hoodless
Adele Powell

The mass influx of migratory songbirds, waders and waterfowl to the British Isles from colder regions to the north and east in winter has fascinated naturalists for generations and the origins of woodcock, in particular, has long intrigued hunters. Given that Britain and Ireland host a large proportion of the European population of the Eurasian woodcock in winter, a better understanding of the origins of migrants is important to enable assessments of the effects of changes in habitat, climate or hunting pressure. As well as understanding the size and status of breeding woodcock populations, information on the composition of wintering populations in different areas is essential if we are to ensure sustainable population management at a European scale.

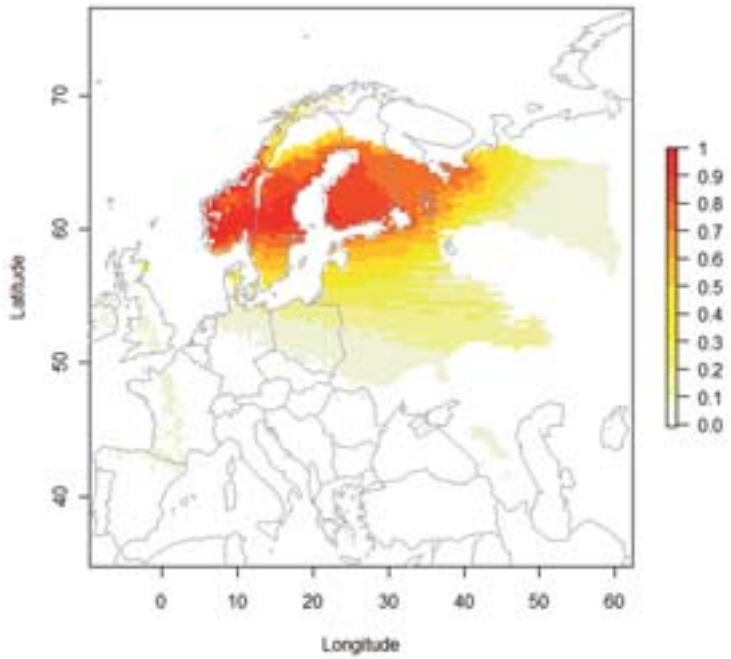
Until recently, recoveries of ringed birds provided the only information on the breeding sites of migrant woodcock wintering in Britain and Ireland. However, new techniques are now enabling us to obtain this information far more quickly. Stable-isotope analysis enables the hatching or moulting location of a bird to be estimated from the chemical composition of its feathers. The technique relies upon the fact that every chemical element occurs in two or more forms, known as isotopes, which have tiny but detectable differences in mass and weight. The isotopes in a bird's food are locked into the keratin in the feathers as they grow and retained until the next moult, typically a year later for flight feathers. By measuring the ratio of the isotopes of certain chemical elements in feathers, the place of feather growth can be estimated by reference to known maps showing global gradients of isotope ratios. The technique enables large numbers of samples to be processed, as only a single capture (or a dead bird) is required, producing a contemporary snapshot of breeding origins. Pioneering studies in North America during the late 1990s and early 2000s using stable-hydrogen and stable-carbon analyses highlighted the value of the technique by revealing exciting new insights into songbird migration, such as the existence of 'leap-frog migration' in Wilson's warblers, whereby birds from more northerly breeding areas wintered further south than southerly breeding populations.

Using 136 feathers collected from 26 breeding locations across Europe, including Norway, Sweden, Finland, Belarus, Russia and some central European countries, we found that hydrogen isotope ratios, δ^2H, showed good correspondence with known geographical patterns of δ^2H in rainwater from different areas of Europe. This was expected since a high proportion (typically about 70%) of the woodcock diet consists of earthworms and water constitutes about 90% of an earthworm. We produced

robust calibration equations for estimating rainwater δ^2H values, and hence breeding area, from adult and juvenile woodcock feather δ^2H values. We found accurate ageing of woodcock to be important for the correct interpretation of hydrogen isotope values and hence country of origin. There was a statistical difference in the distributions of δ^2H in feathers from adults and juveniles, which was probably related to a seasonal difference in the timing of feather growth.

A total of 1,129 first primary feather samples from woodcock shot in six wintering areas across Britain and Ireland, during December and January in four winters, were then analysed. Samples were collected in Scotland (Borders, Fife), Wales (Ceredigion, Pembrokeshire), Ireland (Galway, Mayo) and England (Norfolk, Hampshire and Cornwall). The hydrogen isotope data yielded good latitudinal information on woodcock origins, but relatively poor longitudinal information. Hence, we refined the analysis, using ring recoveries to create migration models to improve estimates of longitude. This gave us a clear indication of the main breeding origins of birds from a given wintering area (see Figure 1).

(a) South-east Scotland



(b) Norfolk

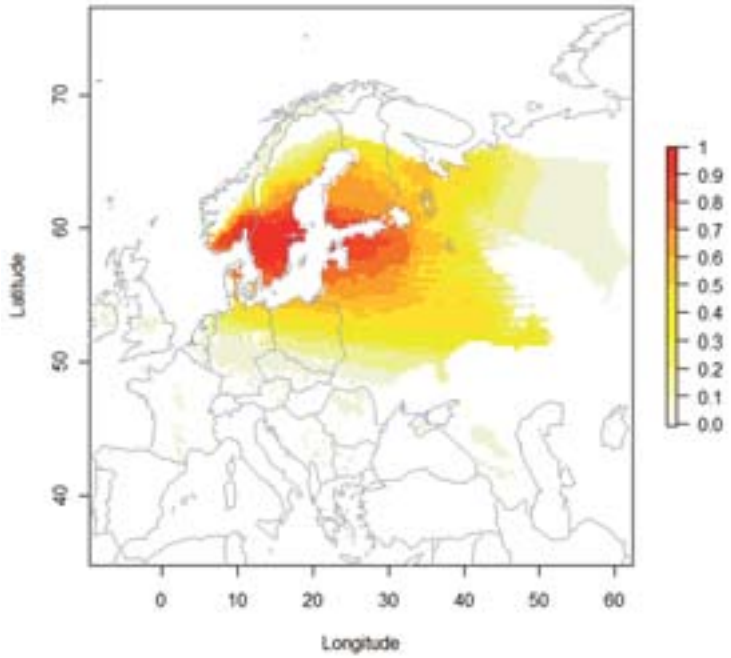


Figure 1

Examples of breeding origin maps determined from stable-hydrogen isotope analysis of woodcock primary feathers, showing the breeding areas of adult woodcock wintering in (a) south-east Scotland and in (b) Norfolk

The scale is a percentage probability, with darker red areas being those of highest likelihood of origin

The bulk of our wintering woodcock breed in Russia, the Baltic States, Scandinavia and Finland.
© Andrew Hoodless/GWCT

The results suggest a high degree of mixing among woodcock originating from Scandinavia, Finland, Russia and the Baltic States across all six wintering areas. Nevertheless, there was an indication of broadly parallel links between the core breeding regions associated with each wintering area. Hence, a high proportion of the woodcock wintering in Scotland and Ireland come from central and northern Scandinavia, whereas in southern England a higher proportion of birds originate from southern Sweden and the Baltic States. This fitted findings from ring recoveries in France which strongly suggested that the bulk of woodcock wintering there originated from western Russia.

Overall, we estimated that approximately 51% of the woodcock wintering in Britain and Ireland come from north-western Russia and the Baltic States, 39% from Scandinavia and Finland, with only 10% from central Europe, Britain and Ireland (see Figure 2 for regional differences). Woodcock attributed to central European breeding grounds constituted only 2% of the wintering birds in Scotland ranging to 19% in Hampshire. As long suspected, some Scottish breeders appeared to move to Ireland in winter. Our analysis indicated that some also flew to Cornwall, although in both cases Scottish birds constituted less than 5% of the wintering individuals.

This study provides far greater detail on the origins of migrant woodcock wintering in particular areas of Britain and Ireland than was previously available. It could easily be repeated at some point in the future to investigate changes in numbers of woodcock migrating to us as a result of habitat degradation on particular breeding grounds or climate change. We will now focus on determining the main migratory routes taken by woodcock across Europe and the extent of wintering site fidelity.

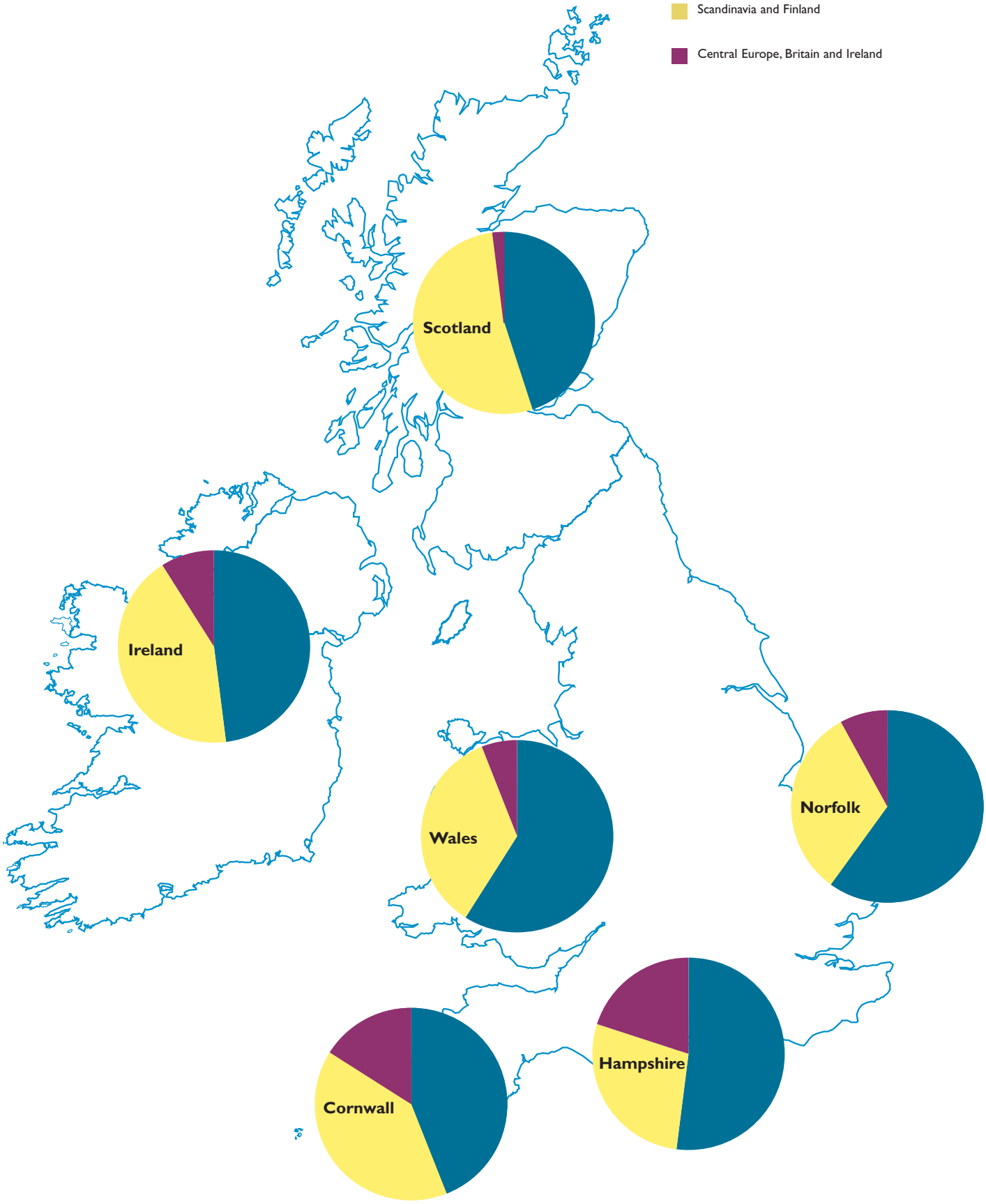
ACKNOWLEDGEMENTS

We are grateful to the Countryside Alliance Foundation, Natural Environment Research Council, James-Maunder Taylor and contributors to the Woodcock Migration Appeal for providing funding and to everyone who contributed woodcock feathers. The assistance with this work of Steve Van Wilgenburg and Keith Hobson (University of Saskatchewan), Jason Newton (NERC Life Sciences Mass Spectrometry Facility), Steve Brooks (Iso-Analytical Ltd), Jacquie Clark (British Trust for Ornithology) and Andrew Gosler (University of Oxford) is appreciated.

Woodcock are often seen in groups of up to six or seven birds on fields at night at migration times.
© Andrew Hoodless/GWCT

Figure 2

Variation in the relative proportions of woodcock from different breeding grounds across six wintering areas in Britain and Ireland



Tracking migratory routes of woodcock

We fitted woodcock in Cornwall with geolocators to find out more about the routes they take to their breeding grounds. © Andrew Hoodless/GWCT

KEY FINDINGS

- A trial of miniature data-loggers has proved promising for determining the spring and autumn migration routes of woodcock wintering in Britain.
- Of four woodcock tagged at the same winter site in Cornwall, two flew to Russia to breed, one to Belarus and one to Sweden.
- The birds flew up to 3,500 kilometres (km) in a year, with distances of up to 1,200km covered between stops, at a speed of up to 40km/hour.

Andrew Hoodless

Our analysis of hydrogen isotopes in feathers has provided information on the origins of migrant woodcock wintering in the UK, but we still know very little about the routes taken by individual birds back to the main breeding grounds in Scandinavia, Finland, Russia and the Baltic States, stop-over locations in Europe or journey times. Detailed knowledge of migratory routes and timing is important in evaluating the importance of stop-over sites and the potential effects of habitat change and hunting seasons in different countries.

During February and March 2010, we fitted 23 woodcock with geolocators on the Lizard Peninsula, Cornwall, and in February 2011 we tagged a further 28 birds at the same site. Geolocators work by logging the time of day and daylight levels, from which we can determine the time of sunset and sunrise and hence deduce longitude and latitude at midday and midnight. In good conditions, the accuracy of positional fixes can be to within 150 kilometres of the true location, although latitudinal information is very inaccurate or unusable for three to four weeks around the equinoxes. The tags are small and lightweight (1.5 grams) and have been used successfully to track the migrations of several bird species over long distances, such as Arctic terns from Greenland to Antarctica and great snipe from Sweden to central Africa. However, geolocators have the disadvantage that they need to be retrieved to download the data. Hence, we selected tagging locations where we knew from previous ringing that woodcock exhibited high wintering site fidelity and where there was also relatively high shooting pressure, in the expectation of retrieving about 15-20% of the tags.

During the winter of 2010/11, we recovered four of the geolocators fitted to woodcock in February/March 2010 on the Lizard Peninsula. The downloaded data revealed that all four birds had left Cornwall during the third week of March, with two flying to Russia to breed, one to Belarus and one to Sweden. Position fixes were not obtained every day because shading by vegetation caused noise on the light curve at dawn or dusk, but this was mainly an issue during June-August. During the migration periods the light data were relatively clean. The data were sufficient to identify stop-over locations, breeding areas and overall journey times.

The journeys confirmed that, as shown by stable isotopes, there can be a high degree of mixing of woodcock from different breeding grounds on the same wintering site. They also highlighted differences in the timing of arrival at and departure from

Ringing woodcock. © Jess Chadwick/GWCT

ACKNOWLEDGEMENTS

We are grateful to the *Shooting Times* Woodcock Club and contributors to the Woodcock Migration Appeal for funding. Thanks are due to landowners on The Lizard, Cornwall, for their long-term support of our woodcock research and to members of the Woodcock Network for their dedication to ringing woodcock each winter. This work forms part of a collaboration with Dr Yves Ferrand at the Office National de la Chasse et de la Faune Sauvage in France.

the same breeding region. For instance, of the two birds that went to Russia, one arrived near Nizhniy Novgorod after one month, the other near Tver after two and a half months. Both followed a more northerly route back to Britain in autumn than when migrating east in spring, and both took about one month to complete their journeys. But one departed a full month later than the other, not leaving Russia until 1 November (see Figure 1). It is apparent that woodcock are able to fly 1,000-1,200 kilometres non-stop in 24 hours, which equates to a speed of about 40 kilometres per hour, but break their journeys with stops of 11-17 days en route.

We anticipate retrieving more tags in Cornwall during January and February 2012 and, with the assistance of ringers in the Woodcock Network, we plan to deploy geolocators in west Wales, Norfolk and north-east Scotland in late winter 2012 to build a more complete picture of woodcock migrations with better geographical spread.

Figure 1

Migration of two woodcock fitted with geolocators caught on the Lizard Peninsula, Cornwall, between February and March 2010

Both departed on their spring migration during the third week of March and spent the breeding season in Russia. Note that the lines do not reflect the true route of travel but indicate the sequence of known stopping points. It is possible that one bird (blue line) was disturbed from its breeding ground by the forest fires near Moscow in summer 2010

Declining lowland waders: the Avon Valley

Between 1990 and 2010 redshank numbers in the Avon Valley have declined from 117 to 22 pairs. © David Mason

There has been a severe decline in numbers of breeding lapwing, redshank and snipe in lowland England and Wales since the early 1980s. For the UK as a whole, the lapwing is 'red-listed' as a bird of conservation concern owing to population declines and the redshank and snipe are 'amber-listed'. Historically, wet grassland sites have been important strongholds for breeding waders in the lowlands, including river valleys, such as the Arun, Avon and Test valleys, as well as grazing marshes such as the North Kent Marshes and Somerset Levels. However, at many of these sites, particularly those not managed as nature reserves, changes in landscape character and agricultural management have resulted in declining wader populations.

The Avon Valley between Salisbury and Christchurch provides an example of the changes and pressures facing breeding waders in lowland England. Parts of the valley have Sites of Special Scientific Interest and Special Protection Area designations reflecting their value for a wide range of species, including breeding waders, wintering wildfowl, otters and certain insects, molluscs and plants of national importance. Since 1993, an Environmentally Sensitive Area (ESA) scheme has operated in the valley to encourage wildlife-sensitive farming, now superseded by an Environmental Stewardship scheme. We have conducted periodic surveys of waders in the Avon Valley since the early 1990s and since 2007 we have conducted more intensive studies to assess lapwing breeding success and the effectiveness of agri-environment measures at reversing lapwing population declines.

Surveys on about half the available wet grassland within the valley suggest that between 1990 and 2010 lapwing numbers declined from 208 to 71 pairs, redshank from 117 to 22 pairs and snipe from 29 displaying males in 1990 to none currently (see Figure 1). Reasons for these declines are complex and there may be subtle differences between the species which our relatively crude habitat measures do not fully explain. However, substantial changes in landscape character and livestock numbers since the early 1980s have undoubtedly been important. Currently, strongly fluctuating water levels, resulting in a rapidly drying soil surface in spring or leading to summer floods, and an increasing polarisation of sward conditions towards intensively grazed

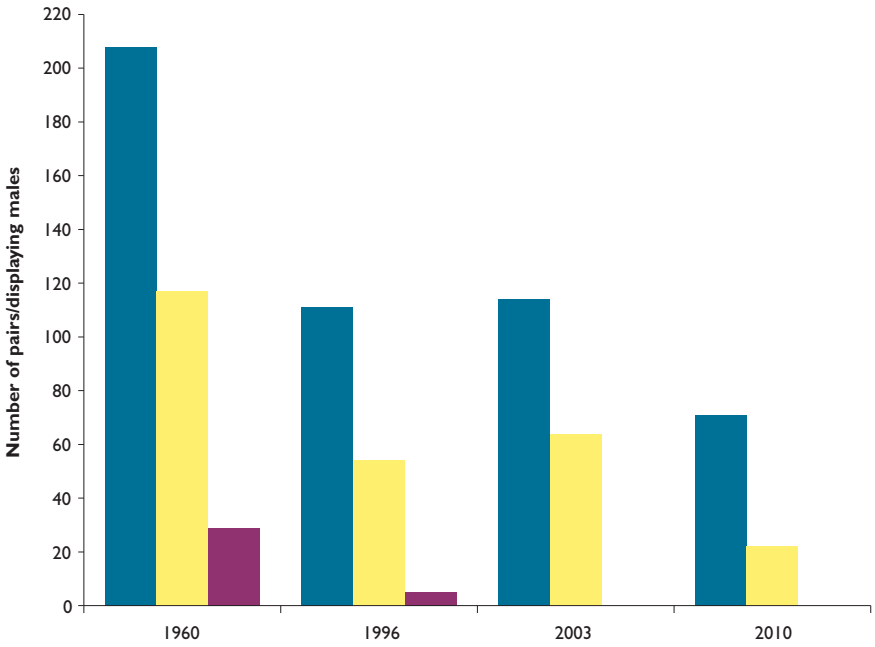


Figure 1

Estimated numbers of breeding pairs of lapwing and redshank, and numbers of displaying male snipe, on 1,300 hectares of wet grassland in the Avon Valley

The same area was surveyed in each of the four years and represents about half of the total wet grassland in the valley

Lapwing

Redshank

Snipe

short swards or rank areas with scrub encroachment, are the most pertinent habitat issues. The change in sward type stems from a large reduction in the number of livestock within the valley during the last 20 years, with a shift from dairy herds to beef cattle. Although farmers experienced some difficulties with ESA prescriptions and there

There has been a shift in the valley from dairy herds to beef cattle. © Andrew Hoodless/GWCT

KEY FINDINGS

- Outside nature reserves breeding waders have declined dramatically during the last 30 years.
- In the Avon Valley not enough lapwing chicks are produced each year and productivity has been too low in recent years to maintain a stable breeding population.
- Environmental Stewardship is producing more favourable wet grassland habitats for waders in the Avon Valley, but to date, habitat improvement alone has not been sufficient to reverse the decline in lapwings.

Andrew Hoodless

We have ringed lapwing chicks to help us understand their breeding success.
© Andrew Hoodless/GWCT

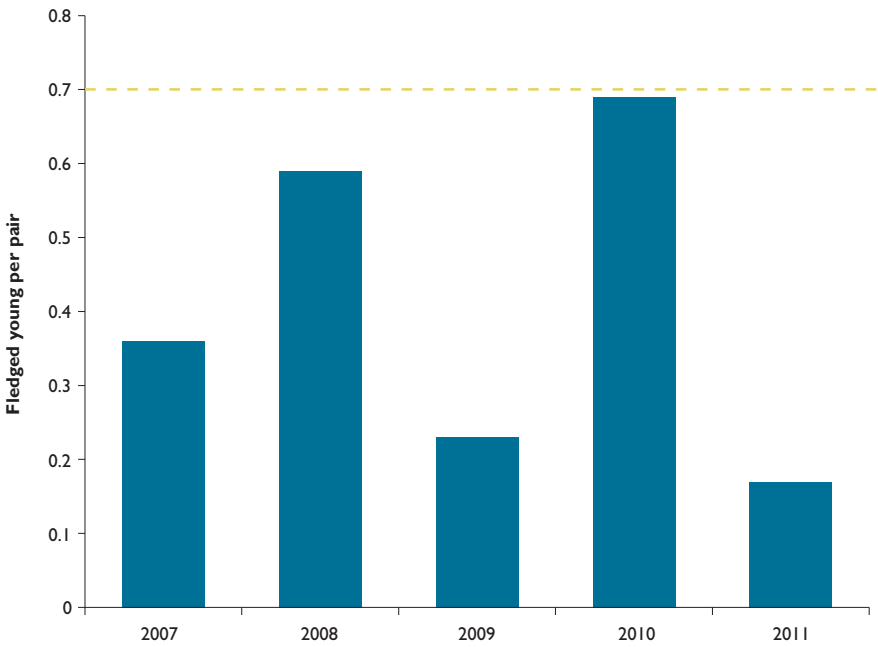
were some issues with compliance, wader densities are currently higher where habitat is being managed under Higher Level Stewardship (HLS). For instance, lapwing densities average 0.25 ± 0.05 (± 1 se) pair per hectare on HLS fields compared with 0.13 ± 0.01 pair per hectare on fields not within the scheme. However, low productivity, even on areas where habitat is more suitable, seems to underlie the on-going declines.

We have studied the lapwing population in the valley in more detail in recent years because, of the three wader species, its breeding success is the easiest to assess. Also, we know from analyses of ringed birds that the driver of lapwing declines is poor productivity and not reduced adult survival. At least 0.70 young fledged per pair, on average, is required to maintain a stable breeding lapwing population, but in the Avon Valley this level of productivity has been achieved just once in the last five years (see Figure 2). We found no statistical difference in productivity between fields managed under HLS and fields not entered in an agri-environment scheme.

Figure 2

Estimated mean annual number of fledged young per pair of breeding lapwings in the Avon Valley during 2007-2011

It was not possible to count fledged brood size accurately for all broods and in 4.3% of cases where a brood was known to have fledged, the annual mean brood size was used. The line indicates the level of productivity required for a stable population



Nest survival averaged 35 ± 3% over the five years and brood survival 31 ± 8%. 2011 was an exceptional year with a very dry spring and lapwing productivity was poor at breeding sites across the country, including nature reserves. Ignoring 2011, brood survival rate was reasonable and nest predation appears to be the main issue. Data from miniature temperature loggers in 39 predated nests revealed, through rapid changes in nest temperature, that 49% of nests were predated at night, and hence were likely to have been taken by mammals, with 41% taken during the day, most likely by corvids or gulls. Only 10% were predated during twilight at dawn or dusk, when both corvids and foxes could be active. Nest predation rates varied appreciably between farms and between years on the same farm, but, on average, they are currently too high for maintenance of a stable lapwing population within the Avon Valley as a whole. We estimate that without immigration of lapwings from elsewhere, the valley population is likely to decline by 50% in the next five years.

Clearly, maintaining or restoring appropriate habitat is essential, but, at least in the short term, some relief from predation seems necessary to enable the valley population to recover. Our aim, if breeding waders are the principal focus of conservation management, should be increasing, not just stabilising, local populations and to achieve this requires productivity well above 0.70 young per pair. We are planning an experimental approach to evaluate the most efficient and targeted solution to reduce wader nest predation in lowland river valleys.

ACKNOWLEDGEMENTS

This work was part-funded by Natural England and contributors to the Breeding Waders Appeal. We are grateful to all the landowners and farmers who provided access for this study. We would like to thank the RSPB who collected some of the survey data in 1990 and 2010.

Without immigration of lapwings from elsewhere, we estimate that the valley population is likely to decline by 50% in the next five years.
© Andrew Hoodless/GWCT

Partridge Count Scheme

Using a vehicle when counting grey partridges allows large areas to be covered easily.
© John Simper/GWCT

KEY FINDINGS

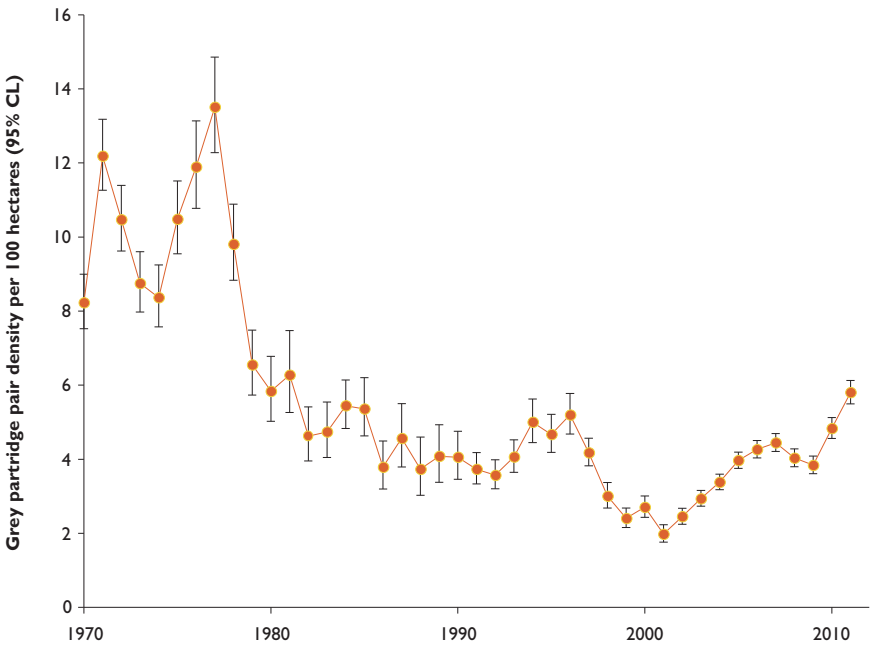
- The 2011 spring pair count of 10,900 grey partridge pairs represented 16% of the estimated UK grey partridge population.
- This showed a 20% increase in density from 2010.
- The number of autumn counts returned was 6% down on autumn 2010.
- Compared with 2010, autumn densities increased in 2011 by over 22% to 26 birds per 100 hectares.
- All regions, except for Wales, had a Y:O ratio above the 1.6 young to every adult bird needed to ensure a stable population.

Neville Kingdon
Julie Ewald

The Partridge Count Scheme (PCS) received 796 spring pair counts in 2011 (a slight increase from the 786 received in 2010). A second cold winter followed by a dry spring meant conditions were not promising for grey partridges and many participants were concerned about how well their birds may have fared over winter. Overall, PCS members counted nearly 10,900 grey partridge pairs over an area of 230,000 hectares (568,000 acres) in spring 2011. This pair count equates to 16% of the estimated wild grey partridge population for the entire UK and illustrates the positive effect that PCS members and their management can have on conserving grey

Figure 1

Trends in UK grey partridge pair density, taking into account the different sizes of areas counted



partridges. The average pair density over all PCS sites increased by 5.1% (see Table 1). When we calculated densities controlling for different count areas (see Figure 1), we found that densities had increased by 20% over the past year from 4.8 to 5.8 pairs per 100 hectares.

In autumn 2011, the PCS received 764 counts (down 6% from the 816 during 2010) (see Table 1). Despite this drop it is most encouraging to report that the total number of grey partridges counted increased from 49,081 birds in 2010 to 57,458 in autumn 2011, an increase of 17%. Nationally, autumn densities increased by over 22% to 26 birds per 100 hectares (up from 22 in 2010). However, this masked wide regional variation. Scotland recorded a 25% decline, having counted more than 1,500 fewer birds than the 5,082 counted in 2010. In addition the autumn increases recorded in southern England during 2010 appear to have made little improvement with a change of 3.5%. In the Midlands, where there was a drier than average summer, bird density rose 27% to an average of 23 birds per 100 hectares. Eastern and northern England saw an equally impressive increase of over 30%, although one must take into account that these regions benefited from good spring pair numbers.

The average young-to-old ratio (Y:O) showed a small increase overall to 2.9 young birds per adult bird from 2.7 in 2010. This was repeated across most regions except southern England where Y:O remained stable, and Scotland where it fell slightly. Importantly, except in Wales, all regions continued to achieve a Y:O ratio above the 1.6 young to every adult bird needed to ensure a stable population. The UK average brood size remained at 6.5 young per covey and indicated that 2011 was a good year for chick production.

HELP EXPAND THE PCS

PCS members are demonstrating that local grey partridge recovery is achievable, but we need to expand this progress to the wider countryside and encourage more farms and shoots to get involved. Together, national recovery in partridge numbers and range expansion is achievable, but we need your help. Please get involved or encourage your friends to do so. Remember 'Every one counts'. Go to www.gwct.org.uk/partridge or contact Neville Kingdon, at nkingdon@gwct.org.uk or call 01425 651066.

TABLE 1

Grey partridge counts

a. Densities of grey partridge pairs in spring 2010 and 2011, from contributors to our Partridge Count Scheme

	Number of sites		*Spring pair density (pairs per 100ha)*		
Region	*2010*	**2011**	*2010*	**2011**	**Change (%)**
South	*113*	126	*1.2*	1.4	16.7%
Eastern	*205*	217	*5.4*	6.2	14.8%
Midlands	*145*	146	*3.5*	3.4	-2.9%
Wales	*2*	0	*0*	-	-
Northern	*195*	186	*4.5*	4.9	8.9%
Scotland	*126*	121	*3.2*	3.1	-3.1%
Overall	*786*	**796**	*3.9*	**4.1**	**5.1%**

b. Densities and young-to-old ratios of grey partridges in autumn 2010 and 2011, from contributors to our Partridge Count Scheme

	Number of sites		*Young-to-old ratio*		*Autumn density (birds per 100ha)*		
Region	*2010*	**2011**	*2010*	**2011**	*2010*	**2011**	**Change (%)**
South	*125*	122	*2.4*	2.4	*11.4*	11.8	3.5%
Eastern	*205*	195	*2.6*	2.9	*28.8*	37.6	30.6%
Midlands	*156*	145	*2.6*	2.9	*18.0*	22.8	26.7%
Wales	*1*	2	*0*	0	*0*	0	-
Northern	*198*	190	*2.8*	3.0	*25.2*	34.4	36.5%
Scotland	*131*	110	*3.2*	2.5	*19.6*	14.8	-24.5%
Overall	*816*	**764**	*2.7*	**2.9**	*21.6*	**26.4**	**22.8%**

The number of sites includes all those that returned information, including zero counts. The young-to-old ratio is calculated from estates where at least one adult grey partridge was counted. The autumn density was calculated from estates that reported the area counted.

The Rotherfield Demonstration Project

Habitat improvements have been made with special focus on nesting, foraging and winter cover habitats. © Francis Buner/GWCT

The Rotherfield Demonstration Project, which started in spring 2010, aims to increase numbers of wild game, in particular grey partridges and pheasants, and wildlife such as brown hare, woodcock and songbirds. Located in east Hampshire, our demonstration is located on a 3,600-acre (1,457-hectare) estate, of which 1,000 acres (405 hectares) are woodland, 670 acres (271 hectares) are grassland and 1,600 acres (647 hectares) are arable. Approximately half of the area is keepered by the Trust's gamekeeper, Malcolm Brockless, and the other half by the estate's keeper, Peter Rose.

On the area managed by the Trust, we have implemented the following management protocols simultaneously: 1. Habitat improvements based on Countryside Stewardship and Entry Level Stewardship schemes with special focus given to nesting, foraging and winter cover habitats (around 17% of the cropped area in 2011); additionally, block cropping has been replaced by a more diverse cropping plan, including a reduction of field sizes. 2. Predator and pest control is carried out all year round with an intensive period from March to July to improve survival and breeding success of wild and released game. Apart from the usual control of foxes, stoats, weasels and corvids using snares, tunnel and Larsen traps, special attention has been given to grey squirrel management. 3. Supplementary feeding from September to April based on around 200 feed hoppers

KEY FINDINGS

- Grey partridge winter survival increased from 18% in 2009/10 to 26% in 2010/11 on the whole area.
- Grey partridge breeding success remained low with only five broods produced among 20 pairs.
- Wild pheasant autumn stock increased 2.8-fold on the whole estate compared with 2010.
- Pheasant shooting on the Trust side resulted in 268 shot across six driven and four walked-up days.

Francis Buner
Malcolm Brockless
Nicholas Aebischer

We counted an encouraging 20 grey partridge pairs across the estate in spring 2011, indicating improved winter survival. © Francis Buner/GWCT

TABLE 1

Game recovery at Rotherfield across the whole estate, 3,600 acres (1,457ha). All partridges were released between August-December and pheasants were released in early August.

Year	Spring pairs	Autumn adults***	Wild broods	Wild young	Birds released
Grey partridge					
2010	24	24	2	19	113 (all reared)
2011	20	27	5	35	81 (20 wild)
Red-legged partridge					
2010	36	48	12	53	0
2011	41	71	12	51	0
Pheasant					
2010	271*	142	40	144	0
2011	350*	288	113	502	600 cocks**

** Spring density for pheasants is the number of females.*

*** The released cocks were easily distinguishable from the resident cock pheasants owing to their much lighter colouring.*

**** Autumn adults do not include released birds in the year given.*

and additional hand feeding of wheat. For further details of the continued management on the rest of the estate, see page 22-25 of our *Review of 2010*.

Game recovery

One of the main aims of the Rotherfield Demonstration Project is to re-establish grey partridges, which have not been seen within or around the project area since the 1990s. To achieve this goal, 760 reared grey partridges (an average of 108 per year) have been released since 2004 in accordance with our re-introduction guidelines. In spring 2011 we counted an encouraging 20 grey partridge pairs across the whole estate (12 on the Trust side and eight on the estate side). This indicated improved winter survival of released and re-established birds with 26% of 2010 autumn stock surviving to spring 2011, compared with 18% for the 2009/10 period. However, breeding success remained very low with only five broods found across the estate in autumn 2011 compared with two broods in 2010. To support the small founder population, we continued to release grey partridges on the estate side in autumn 2011 – three broods of bantam- and parent-reared grey partridge juveniles for fostering (35 individuals) and three parent-reared autumn coveys (26 individuals). Additionally, we translocated 20 wild birds caught in Oxfordshire in December, to the Trust side only. As we are unsure why breeding success remains low, we will continually monitor up to eight nests of released hens during the breeding season in 2012 using cameras.

Across the whole estate, wild hen pheasants in spring increased 1.3-fold from 271 individuals in 2010 to 350 hens in 2011; autumn numbers increased 2.8-fold from 286 wild pheasants in 2010 to 790 in 2011. To demonstrate how the shooting interest can be maintained while the number of wild pheasants and grey partridges are recovering, we released an additional 600 wing-tagged cock pheasants on the Trust side in early August. This was done as a trial using movable pens with 50 cock poults per 10x20-foot pen, which included suitable roosting perches to allow early learning of adequate roosting behaviour.

2011 was our second year at Rotherfield and we held six small driven 'cock only' shoots on the Trust side, with pointer and spaniel trials adding 'spice' to an additional four walked-up days. This resulted in a modest total bag of 300 of which 268 were pheasants. Despite the not unexpected small bags at this early stage of wild game recovery, everyone agreed that the shooting was challenging with a cartridge ratio of 1:4, indicating an excellent quality of birds including the released ones. To add to the variety of sport we also held a hawking day with the British Falconers Club.

As well as six days of driven shooting, we held spaniel and pointer trials on an additional four walked-up days, as well as a hawking day with the British Falconers Club. © Francis Buner/GWCT

Grey partridge winter losses

We are looking at the factors affecting grey partridge losses during the winter. © Francis Buner/GWCT

KEY FINDINGS

- In the early summer, 65% of all radio-tagged partridges remained within 500 metres of their winter location.
- Adults were more site-faithful than juveniles and juvenile cocks dispersed the furthest.
- Only 13% of juveniles moved further than one kilometre.
- 55% of tagged partridges were predated between February and late April.
- Between 30% and 60% of losses were attributed to sparrowhawks.
- A minimum of five sparrowhawk females hunted in the core partridge area, but never simultaneously.

Francis Buner
Nicholas Aebischer

Background

In winter 2008, we began work to investigate the factors affecting grey partridge losses during winter, a period largely ignored by researchers until now. At our Grey Partridge Demonstration Project at Royston, where we managed to increase the density of grey partridges from three to 18 spring pairs in only five years, annual winter losses averaged 58% despite the provision of good winter cover. This reflects the situation at the majority of sites of our Partridge Count Scheme (PCS) members, where losses are generally above 50%. It is our aim to understand better the factors that influence these high losses.

Research results from our first two winters at Royston

In winter 2008/09 we radio-tagged 64 wild partridges on Greys Farm at Royston and a further 97 in the same area of around 250 hectares in winter 2009/10. We caught entire coveys during the day and radio-tagged six individuals per covey (the adult male and female, two juvenile males and two juvenile females). Each radio-tagged bird was tracked once a week from December to May and once every fortnight thereafter.

Dispersal

Overall, across both years, 65% of birds remained within 500 metres of where they were caught in November/December. There was, however, a significant difference between adults and young. None of the adults dispersed further than 900 metres and 82% stayed within 500 metres. Among the juveniles, only 54% stayed within 500 metres of where they were caught and the cocks moved further than the hens. However, only 13% moved further than one kilometre (maximum distance for juvenile cocks was 4,700 metres, for juvenile hens 2,700 metres). All hens dispersed as pairs whereas dispersing cocks were predominantly single. Although adults are more faithful to their winter home range than juveniles, they seem to move further than previously believed.

Mortality

In both winters, mortality was close to zero from November until Christmas and into January until the coveys started to break up. Once paired, however, around 55% of tagged birds were predated between early February and late April, with no detectable differences between sexes, ages and years. In winter 2008/09 around 60% of losses were caused by raptors whereas in 2009/10 it was 30%, indicating large differences between years.

We caught and radio-tagged sparrowhawks to see how many grey partridge kills they were responsible for. © Francis Buner/GWCT

Observations from the first winter led us to suspect that most of the raptor kills were by female sparrowhawks. To confirm this, in the second year we applied for a licence to capture and radio-tag sparrowhawks as well as partridges. We mainly used mist nets in combination with dead pigeons as decoys. What looked like two or three foraging sparrowhawk females initially, turned out to be five or six. We caught and radio-tagged four of them and followed them twice a week until the beginning of the breeding season. At that point they normally become entirely dependent on their mate to feed them and, as expected, no partridges were killed by raptors from May onwards. We also found no evidence for any other kills by raptor species, despite good numbers of buzzards and red kites. The data collected showed that all tagged sparrowhawk females used the same area for hunting partridges, but never did so simultaneously. They spent most of their time around their roosting and later nesting sites outside the core partridge area and foraged for partridges only for a couple of hours per day.

Preliminary management implications

What can make it harder for sparrowhawks to hunt for partridges? Concentrations of partridge pairs around partridge-friendly fields surrounded by badly managed hedgerows may attract sparrowhawks from several kilometres away.

Therefore it is vital to spread suitable permanent winter cover evenly around the farm to avoid creating a predator trap. Suitable wild-bird seed cover strips, such as mixes that contain chicory and kale, planted alongside the hedgerows that are favoured by resident partridges in spring, will help them to escape raptor attacks. Mature hedgerows with no low-growing branches and only grass margins attract spring pairs, but do not provide sufficient cover.

ACKNOWLEDGEMENTS

We are extremely grateful to GCUSA and Greys Farm for their ongoing support of our grey partridge work.

Growing wild-bird seed cover strips (including kale and chicory) alongside hedgerows will provide important escape cover for grey partridges. © Francis Buner/GWCT

Forty years of the Sussex study

Insect samples are taken every year in the third week of June. © Peter Thompson/GWCT

KEY FINDINGS

- The Chick Food Index (CFI), a measure of the annual abundance of insects that are crucial in the diet of young grey partridge chicks, has increased by 30% over the past four years.
- Chick survival rate has increased (70%) over the past four years.
- Two insect groups, aphids and ground and click beetles, which are part of the grey partridge CFI, have declined (by two-thirds and a half, respectively) over the past 40 years.
- Two other insect groups in the CFI, sawflies, butterflies and moth larvae and leaf beetles and weevils, have shown slight increases (45% and 66% higher over the past 10 years).

Julie Ewald
Steve Moreby
Nicholas Aebischer
Dick Potts

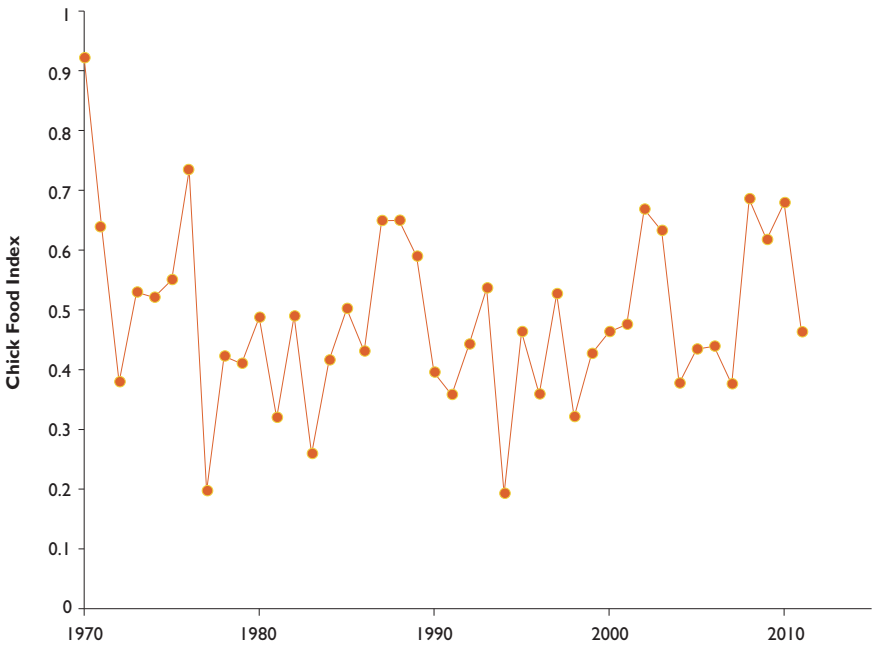
Invertebrate abundance in the cereal crops in the Sussex study area has been monitored every year since 1970 as part of our research into the effects of changes in farming on grey partridges. Every year, in the third week of June, the peak grey partridge hatching period, we take samples in over 100 cereal fields, using a Dvac – essentially a hoover carried on the operator's back. After collection, we bag each sample and freeze it. Later the sample is thawed and we sort through it using a binocular microscope, separating the invertebrates from the soil and vegetation matter. Steve Moreby, our senior research entomologist, then takes several months to identify each invertebrate and the data are then entered into our Sussex study database, allowing us to examine long-term trends in insects and other invertebrates.

Here we examine the long-term trend in the grey partridge Chick Food Index (CFI) and consider how various components of it have fared from 1970 to 2011 (see Figure 1). In previous *Reviews* we have reported on the effects of both weather and pesticide use on the CFI and the subsequent survival of grey partridge chicks. Two bad years stand out, where the CFI was particularly affected by pesticide use – one

Figure 1

Grey partridge annual CFI since 1970 from the Sussex study

Although 2011 was not a good year, the average CFI was 30% higher over the past four years



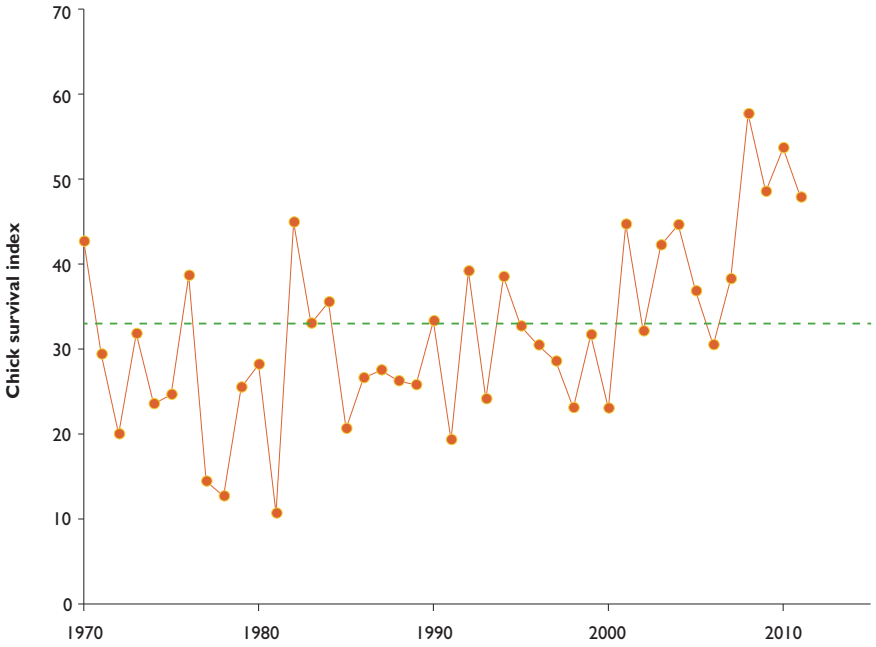


Figure 2

Grey partridge annual chick survival rate across the Sussex study area from 1970 to 2011

The dashed line indicates the value needed for numbers of grey partridges to remain stable

Chick survival rate has been more than 70% higher in the last four years compared with the previous 38 years

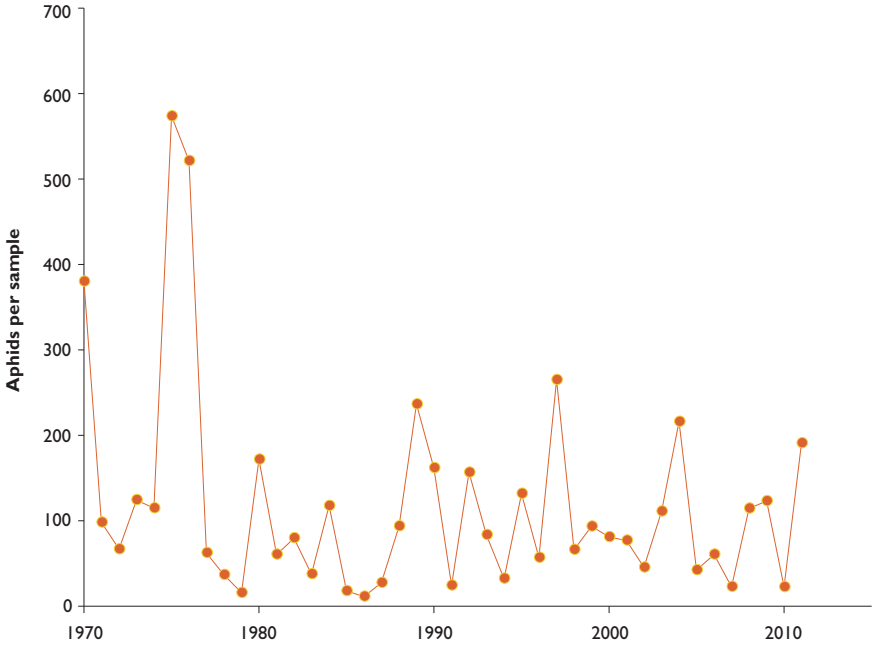


Figure 3

Annual abundance of aphids in cereals, Sussex study 1970 to 2011

Aphid numbers remain low since a high in 1976 and 1977

following the widespread use of aphicides in 1976 and the other in 1994, when there were several years of high summer insecticide use in response to orange blossom midge. Although there were several relatively poor years around 2005, this was most likely because of bad weather since our records indicate low summer insecticide use in those years. As several farms within the study area are undertaking specific habitat improvements directed at grey partridges and other farmland birds, it is encouraging to see that levels of chick food in the period from 2008 to 2011, are 30% higher than the average over the previous 38 years. The grey partridge chick survival rate has been more than 70% higher over the whole area in these four years than the 38-year average (see Figure 2).

The CFI is calculated from the abundance of five separate insect groups that share habitats and life histories in cereal crops. These are aphids, plant bugs and hoppers, leaf beetles and weevils, caterpillars of sawflies, butterflies and moths and ground and click beetles. Although the last few years have been good ones for the CFI in general, several of its components have not fared so well. Aphid numbers peaked during a major outbreak in 1975 and 1976, but have remained at low levels ever since. Their long-term average abundance from 1977 to 2011 is a third of what was found from 1970 to 1976.

From 2008 to 2011 grey partridge chick survival rate has been more than 70% higher than the 38-year average. © David Mason

Figure 4

Annual abundance of ground and click beetles in cereals, Sussex study 1970 to 2011

Ground and click beetle abundance is half of what it was before 1990

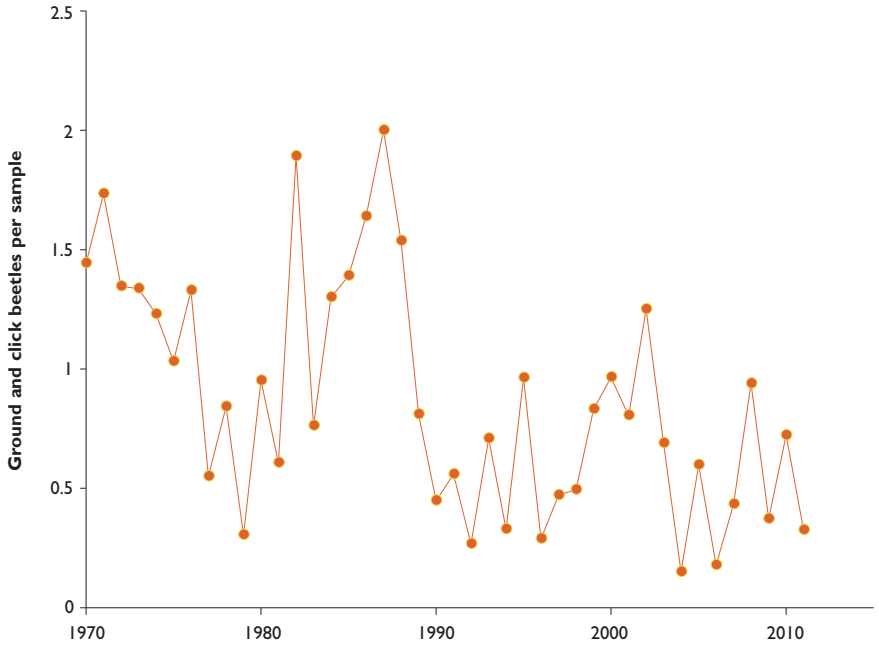
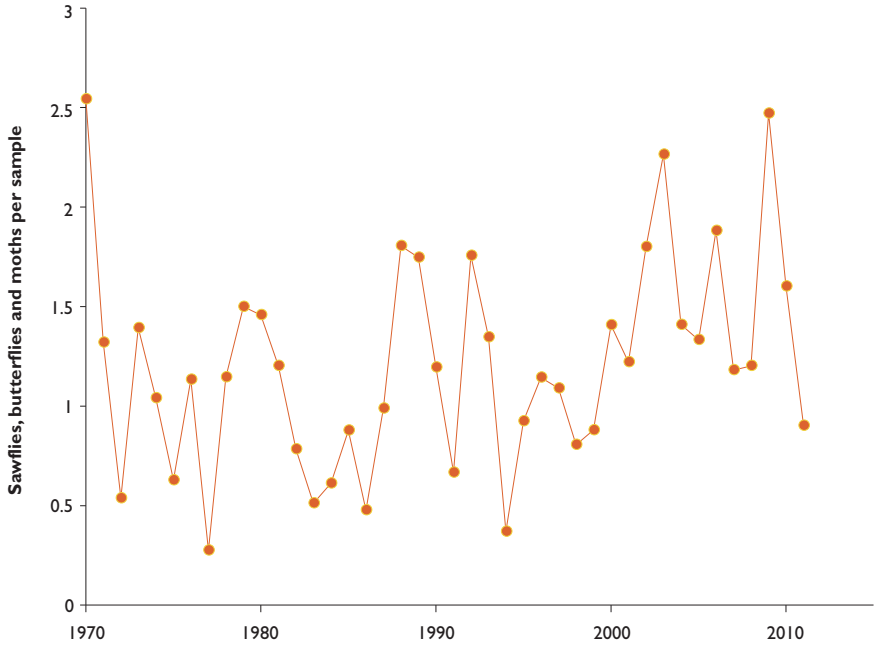


Figure 5

Annual abundance of caterpillars of sawflies, butterflies and moths, Sussex study 1970 to 2011

This has increased by 45% since the mid-1990s, with the abundance in 2009 comparable to that seen in 1970



Beetle banks have been planted to help increase the abundance of ground beetles.
© Peter Thompson/GWCT

Ground and click beetles have also declined in abundance, with numbers since 1990 half of what they were before (see Figure 4). Declines were most pronounced after the aphicide use of the mid-1970s and a widespread use of insecticides in 1989. Another problem for ground beetles could be the loss of hedgerows and grassy banks, areas where they successfully spend the winter, which has taken place mainly in the first 20 years of the study. Since 2002, there has been some progress in reinstating such linear features through the use of beetle banks, as well as new hedgerow plantings, but these may take some time to affect the abundance of ground beetles.

Two other groups within the CFI increased in abundance, particularly since 2001: the larvae of sawflies, butterflies and moths increased by 45% (see Figure 5), and leaf beetles and weevils increased by two-thirds (see Figure 6). Previous research has shown that both of these groups are sensitive to insecticide use, with leaf beetles and weevils also sensitive to spring or summer herbicide application. The use of low-intensity agri-environmental options, especially conservation headlands, may be responsible for some of the increases seen in recent years.

The final insect group in the CFI are the plant bugs and hoppers (see Figure 7). The abundance of this group has varied over the past 42 years, so there is no overall trend. There have been some recent increases, with the 2008-2010 average abundance double the average over the previous 38 years, but in 2011 the average abundance was similar to the long-term average.

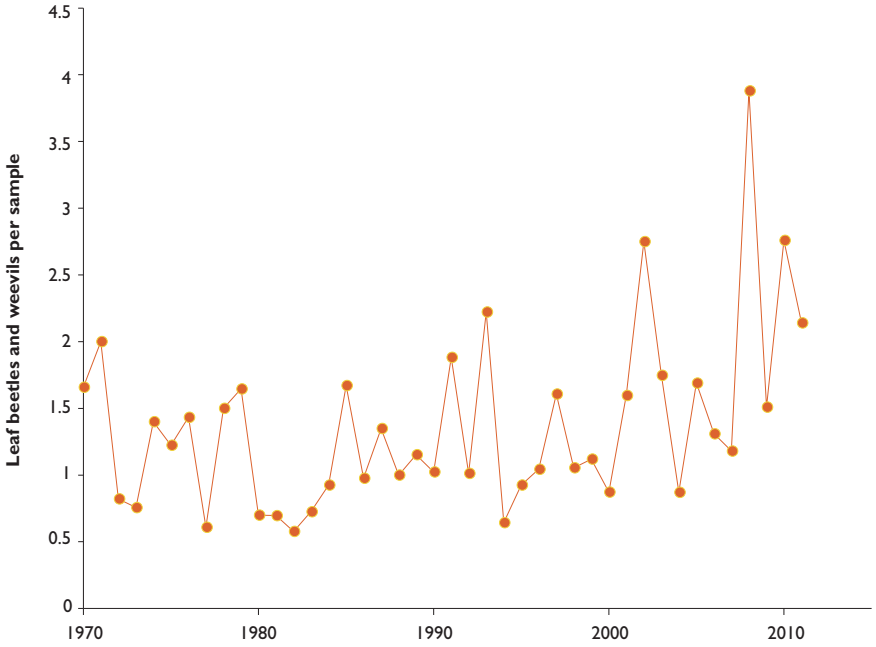


Figure 6

Annual abundance of leaf beetles and weevils in cereals, Sussex study 1970 to 2011

Numbers of beetles and weevils have been 66% higher over the last 10 years than the 1970-2001 average

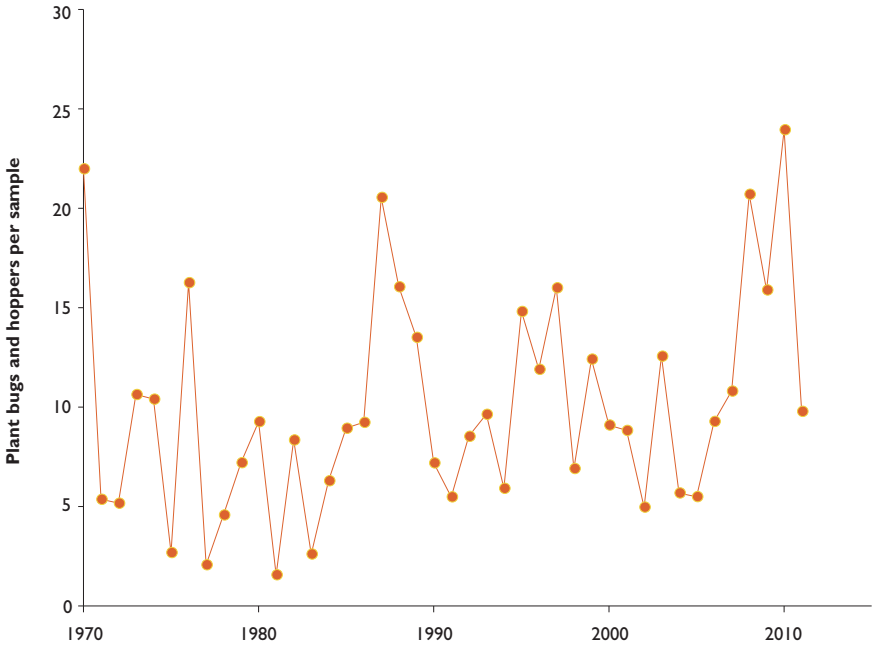
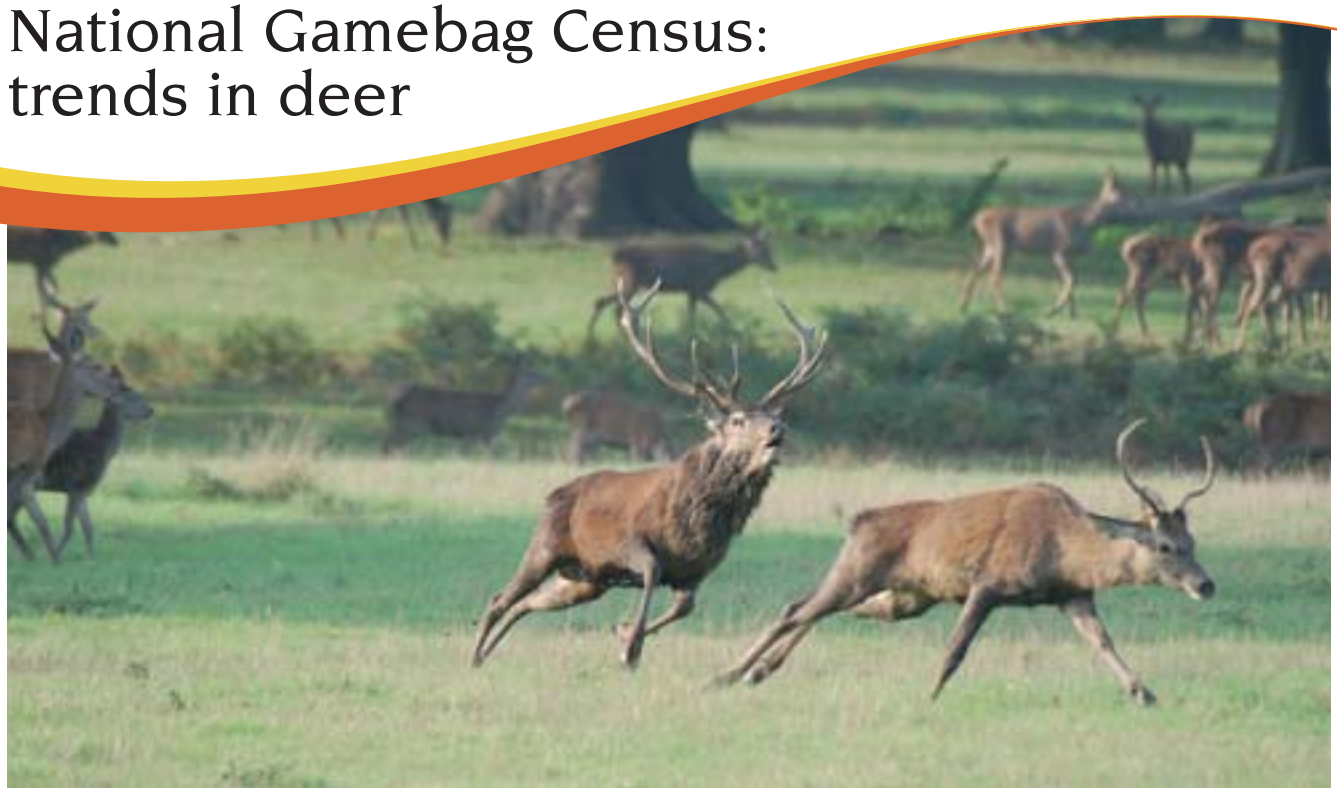


Figure 7

Annual abundance of plant bugs and hoppers in cereals, Sussex study 1970 to 2011

There has been no overall trend in numbers over the past 42 years, though numbers were higher in 2008-2010

National Gamebag Census: trends in deer



UK numbers of red deer were reported at 360,000 in 1995. © Peter Thompson/GWCT

There are six species of deer in the UK, of which only the red and roe deer can be considered to occur here naturally. Both of these species, together with the fallow and sika deer, are traditional quarry species. The remaining muntjac and Chinese water deer are relatively new arrivals in Britain. All six species are shot for sport (stalking), and also to prevent damage to woodland and arable crops. We collect information on the numbers shot by mailing questionnaires to some 900 contributors to the National Gamebag Census (NGC) at the end of January each year. Participation in the NGC is voluntary, and we are most grateful to all of our annual contributors. To calculate trends in numbers shot, we need at least five returns per year, so the start year varies between species from 1961 to 1984. For each species (except water deer, for which returns are still too few), analysis is based on sites that have returned bag records for two or more years, and summarises the year-to-year change within sites as an index of change relative to the start year. In the graphs, this means that the first point is always set to a height of 1. A height of 2 indicates a doubling of numbers since the start year.

KEY FINDINGS

- Since 1961, the numbers of deer shot have risen across all six UK species, reflecting a general increase in abundance and expansion of range.
- For red, sika and fallow deer, numbers shot have increased 2.5 to three times over the monitoring period.
- The numbers of roe and muntjac shot have increased even more spectacularly, by seven and 11 times respectively.

Nicholas Aebischer

Red deer (Figure 1)

The red deer's traditional stronghold is in Scotland, having been driven to extinction in much of England and Wales some 200 years ago. Nowadays it is most widespread on moorland, but is also found in woodland and farmland fringes with UK numbers reported at 360,000 in 1995. Outside Scotland it has concentrations in north-west and south-west England, Hampshire and East Anglia. The bag data show a 2.5-fold increase in numbers shot per unit area since 1961, with stabilisation between 1995 and 2010. This reflects the increasing abundance and expanding range of the species as it recovered lost ground. The increase was probably helped by a combination of under-culling of females, improved food resources through afforestation, milder winters leading to better over-winter survival and reduced competition with hill sheep.

Sika deer (Figure 2)

The sika deer originates from Japan, Taiwan and the adjacent mainland of China. It was introduced into British deer parks from 1860 onwards. Over the past 150 years many have escaped and bred successfully in the wild, especially in areas of acid soils. It is now widespread across northern and western Scotland, the Scottish Borders, Cumbria, Lancashire and Hampshire/Dorset; numbers were reported at 11,500 in 1995. Too few NGC sites reported sika deer to evaluate trends until 1984. Since then there has been a 2.5-fold increase in the number reported shot per unit area. This reflects the on-going range expansion and increasing abundance of this introduced species.

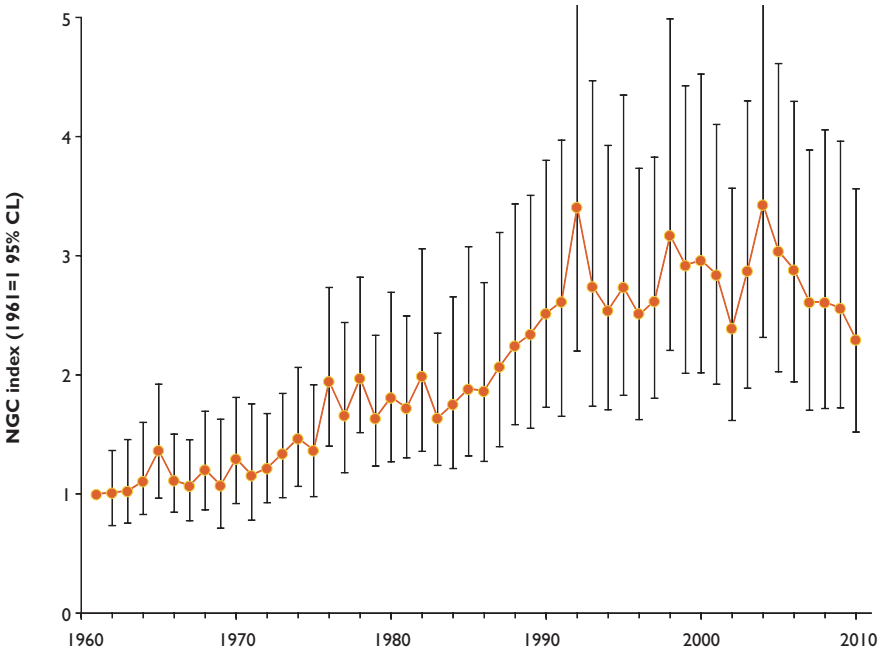


Figure 1

Index of red deer shot per 100 hectares on NGC sites across the UK, 1961-2010

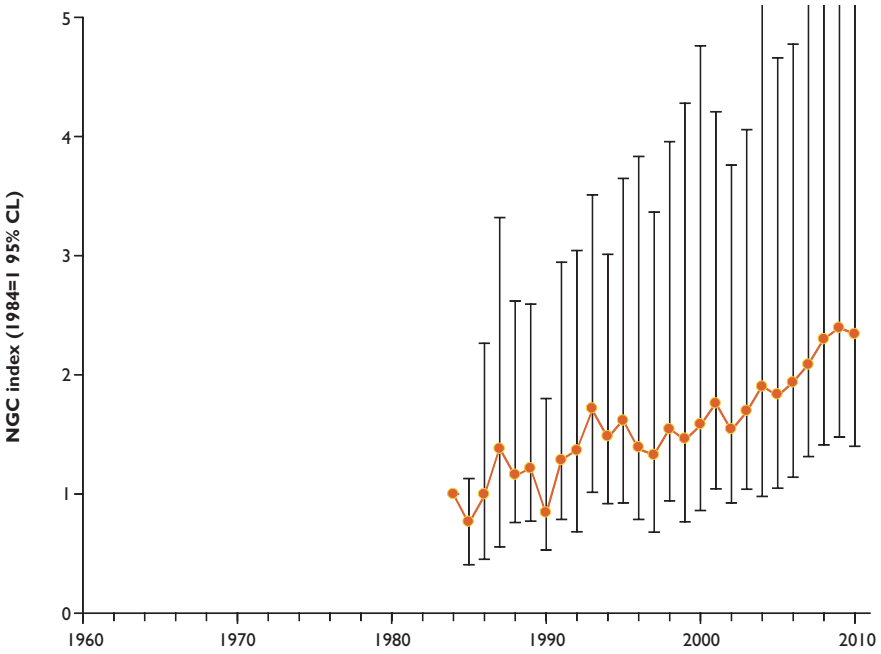


Figure 2

Index of sika deer shot per 100 hectares on NGC sites across the UK, 1984-2010

Sika deer originate from Japan, Taiwan and China.
© Laurie Campbell

Fallow deer were re-established in Britain by the Normans in the 11th century.
© Peter Thompson/GWCT

NATIONAL GAMEBAG CENSUS PARTICIPANTS

We are always seeking new participants in our National Gamebag Census. If you manage a shoot and do not already contribute to our scheme, please contact Gillian Gooderham, the National Gamebag Census Co-ordinator, by telephone (01425 651019) or email (ggooderham@gwct.org.uk).

Roe deer have increased their range and abundance.
© Peter Thompson/GWCT

Fallow deer (Figure 3)

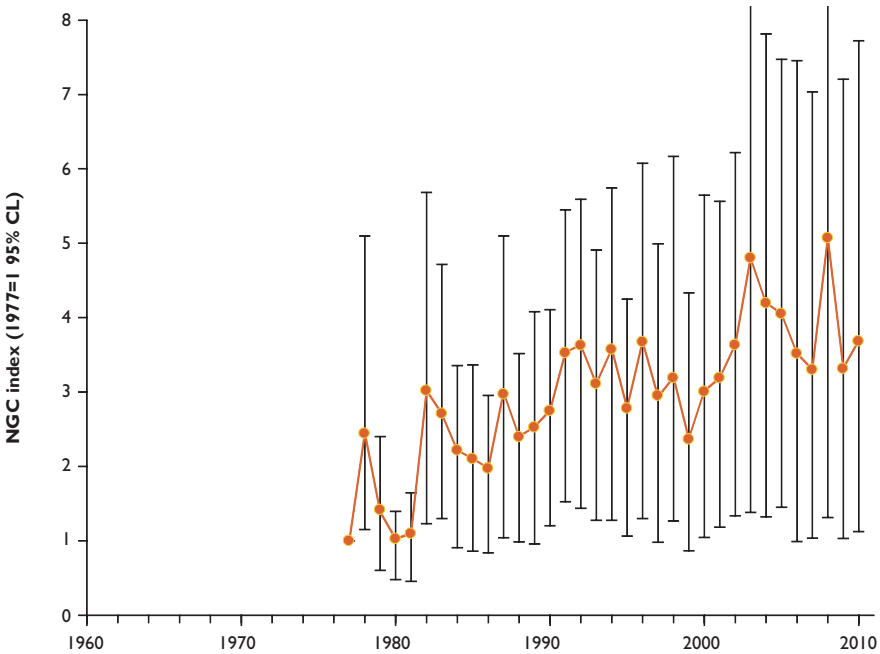
The fallow deer went extinct in Britain during the last Ice Age. It was re-established for hunting by the Normans in the 11th century, and is still expanding its range. Preferring mature broad-leaved or mixed woodlands, it is currently widespread across England and Wales and occurs in isolated pockets of Scotland, mainly in Perthshire and Stirlingshire; numbers were reported at 100,000 in 1995. Too few NGC sites shot fallow deer before 1977 to evaluate trends before that year. Since then, the UK bag index appears to have tripled, although there is little evidence for growth after the early 1990s. The period of increase corresponds to a period of range expansion that slowed after the 1990s.

Roe deer (Figure 4)

The roe deer is the smallest native British deer. It was close to extinction some 300 years ago and was still localised a century ago. Helped by re-introductions, it has steadily expanded its range since the 1960s and is now the most widely distributed deer species in the UK with 500,000 animals reported in 1995. It is found throughout mainland Scotland, northern England, most of East Anglia, most of southern England and is starting to colonise Wales. In terms of bags, there has been a sustained rise amounting to a seven-fold increase since 1961. This corresponds to a spectacular period of range expansion and increasing abundance, probably linked to a combination of habitat expansion (new forestry plantings) and changes in the law (control by snaring and shotgun drives no longer permitted). This led to a greater use of stalking, first for control, then as a source of income.

Figure 3

Index of fallow deer shot per 100 hectares on NGC sites across the UK, 1977-2010



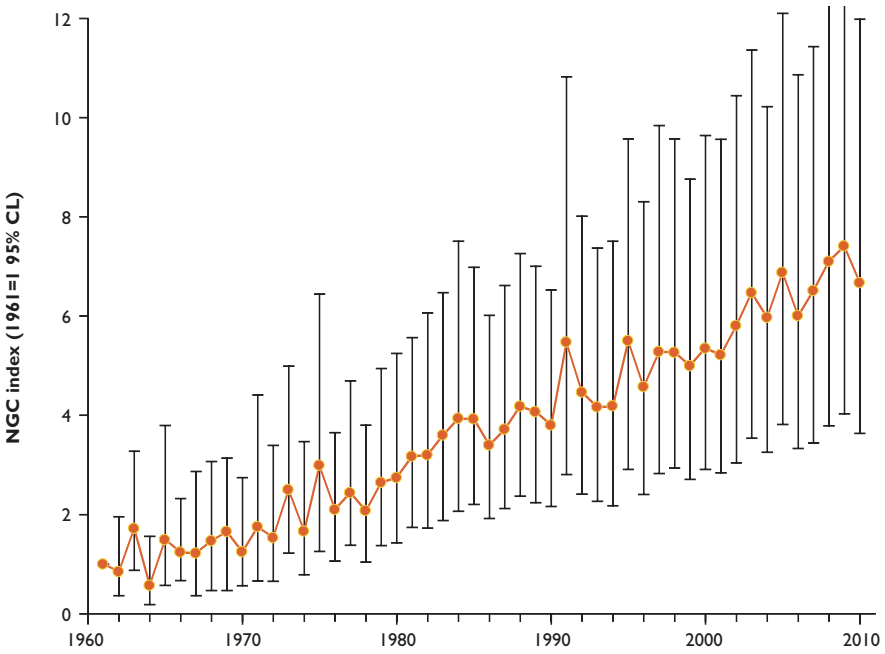


Figure 4

Index of roe deer shot per 100 hectares on NGC sites across the UK, 1961-2010

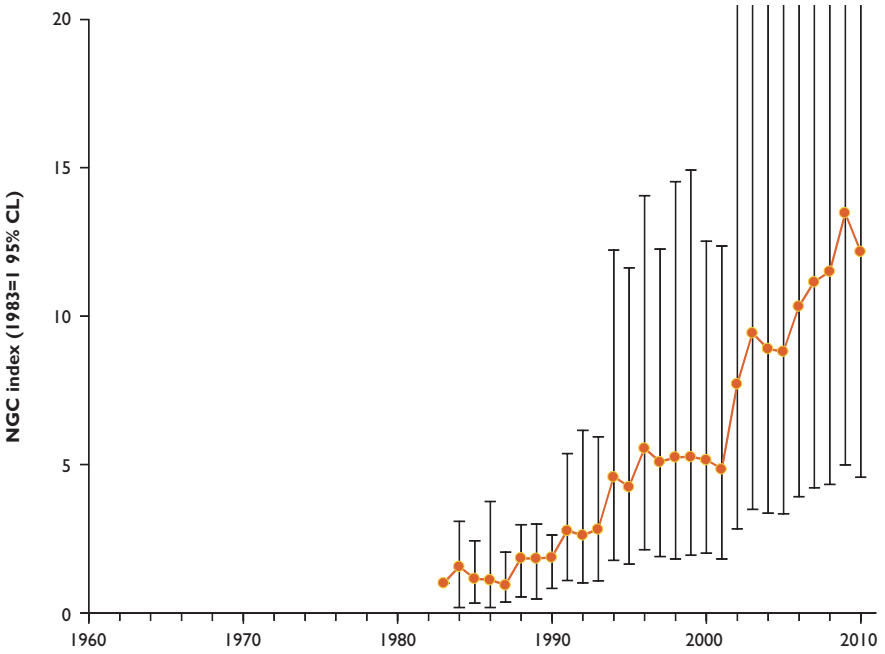


Figure 5

Index of muntjac shot per 100 hectares on NGC sites across the UK, 1983-2010

Muntjac (Figure 5)

The muntjac originates from south-east China and Taiwan and it was introduced to Woburn Park, Bedfordshire, in 1894. Together with other releases and escapes this has resulted in the species becoming established in the wild since the 1930s with 40,000 individuals reported in 1995. The muntjac likes woodland habitats with a dense understory. It is currently present across most of southern and eastern England, and is starting to colonise Wales. Trends in bags can be evaluated since 1983, and show an astonishing 11-fold increase by 2010, with no sign of a slow-down. The majority of NGC records are from the eastern lowlands, reflecting the source of the on-going range expansion of this species.

Chinese water deer

The Chinese water deer originates from China and Korea, and is associated with lush riparian or swampy habitats. It was introduced to Woburn Park, Bedfordshire, in 1896 and Whipsnade Park in 1929-1930. Deliberate releases and escapes have resulted in the species becoming established in the wild since 1945, originally around Woburn then gradually expanding its range. It has now established itself mainly across south-eastern Britain, with strongholds in west Bedfordshire, the Cambridgeshire fens and the Norfolk Broads, with a population size of 2,100 reported in 2005. The water deer was first recorded in the NGC in 1993. Since then, it has been reported from 15 sites, in Norfolk (6), Bedfordshire (3), Suffolk (2), Cambridgeshire (1), Buckinghamshire (1), Oxfordshire (1) and Hampshire (1).

Chinese water deer were introduced to Woburn Park, Bedfordshire, in 1896. © David Mason

Uplands monitoring in 2011

Red grouse densities reached record highs after a good breeding year. © David Mason

KEY FINDINGS

- Red grouse densities reached record highs following widespread use of medicated grit, which has resulted in more record bags on some moors in northern England.
- These high densities have been associated with reports of sick grouse, mostly in the North Pennines.
- Black grouse bred well once again in northern England and have now largely recovered from the catastrophic winter of 2009/10. In Perthshire and Strathspey there were notable increases at spring leks, but brood counts in 2011 were modest.
- Almost three-quarters of the Scottish capercaillie population is now restricted to forests in Strathspey.

David Baines
Dave Newborn
David Howarth

Red grouse in northern England and Scotland

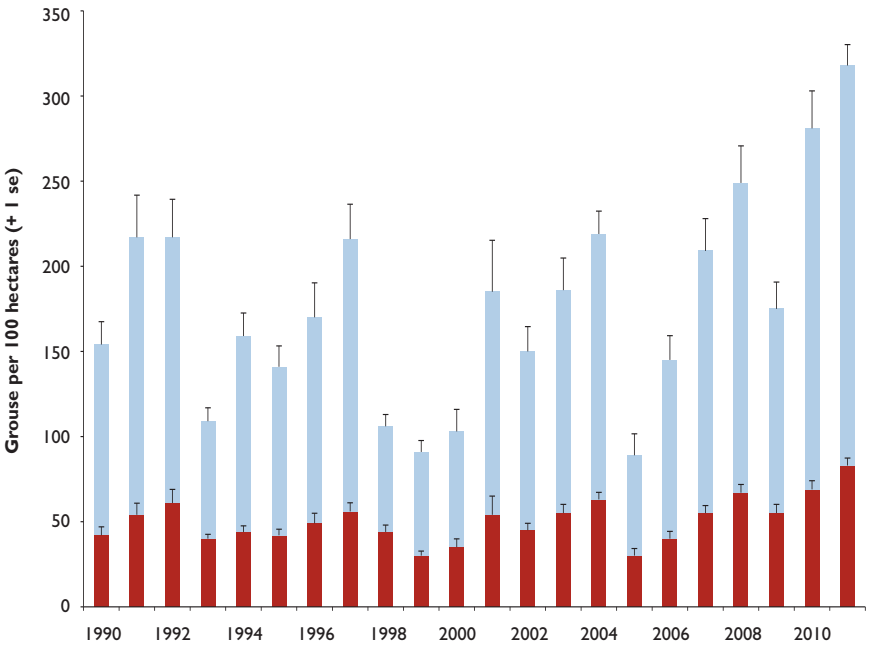
As part of our core monitoring work, we count red grouse in March and April before they breed and again in July and August after breeding. These counts are undertaken with pointing dogs on tracts of heather-dominated moorland, generally 100 hectares in size. The same block of moorland is counted on each occasion. Overall we count 43 blocks in northern England, 25 of which have now been counted annually for the last 25-30 years.

In 2011, spring densities averaged 105 grouse per 100 hectares, an increase of 18% compared with 2010, this despite many estates breaking their annual bag record in 2010. This represents the highest average density we have recorded in 30 years of monitoring. Following a good breeding season, when breeding success averaged 3.0 young per adult, the same value as in 2010, our sample counts in July averaged 318 grouse per 100 hectares (see Figure 1). This was a new record, being 12% higher than in 2010, which in itself had been a record year.

We put much of this success down to the use of the new medicated grit (see *Grouse cycles* article on page 50). The vast majority of our sample moors now

Figure 1

Average density of young and adult red grouse in July from 43 sites across northern England, 1990-2011



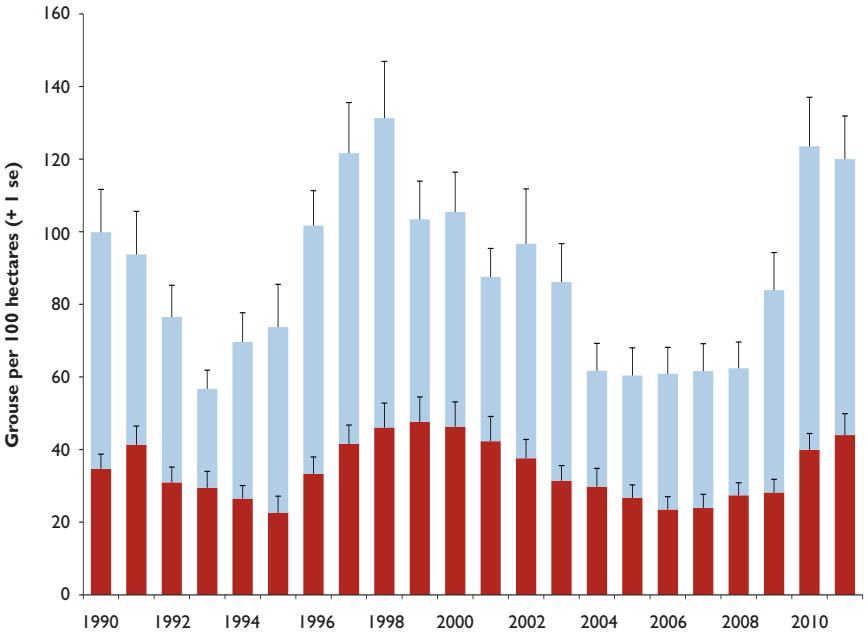


Figure 2

Average density of young and adult red grouse in July from 25 Scottish moors, 1990-2011

Young grouse

Adult grouse

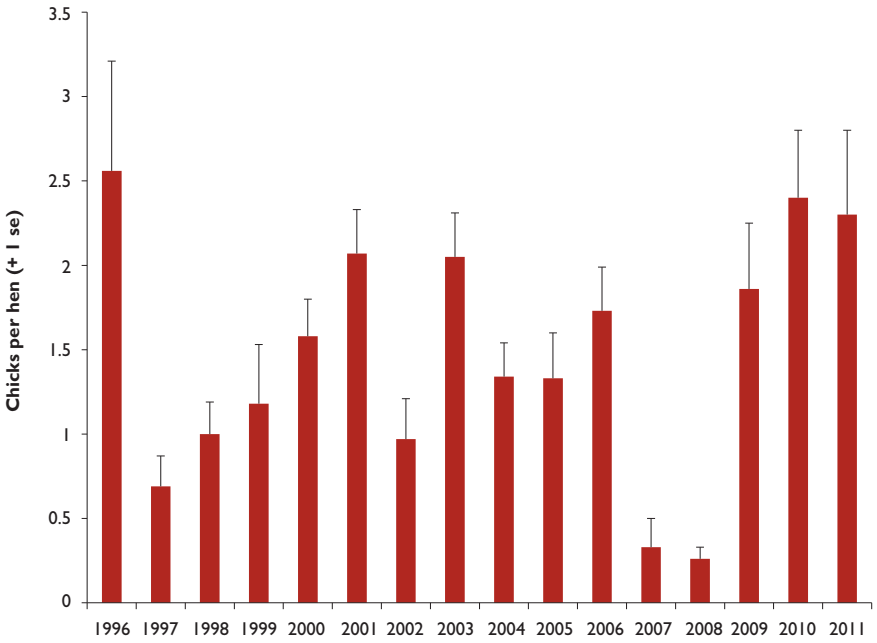
routinely use it and, once again, many estates have broken their shooting bag records in 2011. Record high densities may, however, come at a cost and this year we have seen a variety of health problems in grouse, particularly in the North Pennines. Interim reports from sick birds submitted to Veterinary Investigation Centres suggest sinus infections typical of the *Mycoplasma* pathogen.

In Scotland, we counted grouse at 25 sites. In spring 2011, densities averaged 63 grouse per 100 hectares, an increase of 31% from 2010. In 2011, red grouse did not breed as well as in the previous two seasons in Scotland. The weather in spring 2011 was not nearly as favourable as in 2010. However, this poor performance may well have been mitigated by the on-going efforts of keepers to provide grouse with medicated grit in sufficient quantity and follow best practice with sheep flock treatment to reduce tick numbers. This year grouse produced 1.6 young per adult compared with 1.9 in 2010. This rate of breeding resulted in an average density in July 2011 of 134 grouse per 100 hectares, (see Figure 2) which is similar to 2010.

We counted grouse at 25 sites in Scotland with pointing dogs. © David Howarth/GWCT

Figure 3

Black grouse breeding success in northern England between 1996 and 2011



Black grouse

Following a good breeding season in 2010, the black grouse population in northern England has recovered to an estimated 811 males in spring 2011 from a historic low of 495 in spring 2010 .This summer, breeding surveys in northern England found 41 greyhens, 31 with broods and a total of 94 chicks, an average of 2.3 chicks per hen (see Figure 3). We predict that this level of productivity will result in further increases at leks in spring 2012.

In the Scottish Highlands, sample counts of males attending leks also increased relative to 2010, in Perthshire by 51% and in Strathspey by 37%. These form the highest counts for each region since 2001. Unusually, breeding productivity in Scotland was poor this summer in comparison with northern England (typically black grouse breed better in Scotland). Only 19 of the 53 greyhens had broods, with a total of 46 chicks, an average of 0.9 chicks per hen.

Following a good breeding season, the black grouse population in northern England has recovered to an estimated 811 males. © David Mason

The Scottish population of capercaillie has contracted in range and is now largely restricted to Strathspey. © Laurie Campbell

Capercaillie

Following 21 years of annual monitoring of capercaillie densities and breeding success in the Scottish Highlands, Scottish Natural Heritage did not award us the contract to count in 2011. Our counts were therefore restricted to two of our long-term study forests in Strathspey. Here, capercaillie had a reasonable breeding year and averaged about 0.9 chicks per hen. To date, we are unaware how birds fared elsewhere. Almost three-quarters of the Scottish population is now restricted to Strathspey. This thinning and contraction of range is of huge concern and has been associated with poor breeding success in recent years, especially near the edges of the range in Perthshire and Morayshire.

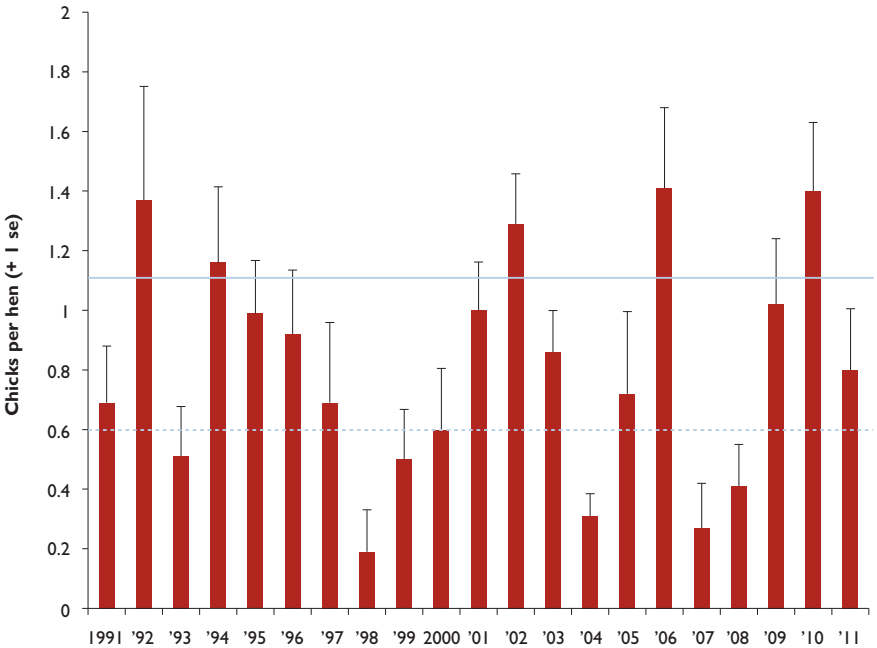


Figure 4

Capercaillie breeding success between 1991 and 2011* sampled from 14-20 forests per year in the Scottish Highlands

Lines indicate levels of productivity required to maintain a stable population under different scenarios (taken from Moss et al. 2000): blue solid line – with fence collision mortality; blue dashed line – without fence collision mortality

** Please note that only the figures for 2003 to 2009 are directly comparable as capercaillie breeding success was derived from a different subset of forest areas each year before this, and in 2010 the number of forest areas was reduced. 2011 counts are from two forests*

Grouse cycles, parasites and grit

Medicated grit is now used on up to 90% of grouse moors in northern England. © Mike Richardson/GWCT

KEY FINDINGS

- The new form of medicated grit is now used on up to 90% of grouse moors in northern England.
- Grit use resulted in 50-fold fewer worms in shot grouse, higher grouse breeding success and £1,200 per 100 hectares more net revenue from shooting.
- On some moors, worm burdens are now so low that we are considering whether the use of medicated grit should be reduced to help guard against the build-up of resistance to the wormer.

David Baines
Dave Newborn

The parasitic nematode worm *Trichostrongylus tenuis* causes fluctuations in red grouse numbers in northern England, producing a regular four-to five-year cycle. This causes unpredictability in harvesting and creates up to two years with little or no shooting in every five. Our research in the 1980s led to the production of a medicated grit, coated with fat impregnated with panacur, a worming drug. By eating grit to help digest the fibrous heather, grouse were self-dosing against their parasites. To avoid the drug entering the food chain, the fat layer melted in temperatures typical of a mild moorland spring, releasing the drug from the grit and thus keeping it away from the birds before they enter the human food chain.

Concerns by moorland gamekeepers over the ability of medicated grit to consistently kill parasitic strongyle worms led to the development of a new product in 2006/07 with a more robust non-slip coating and a new more effective active ingredient. Typically this is delivered in two-chambered boxes, one containing medicated grit, the other plain grit, access to each being regulated by a switch lid. In this way, access to medication by grouse can be denied one month before the start of the shooting season, satisfying the drug withdrawal period. Boxes are placed in a grid system across the moor equivalent to one box per grouse territory.

We have conducted three series of trials in northern England on this new grit and the box delivery system since 2007: 1) We conducted a preliminary trial in 2007 on paired 25-hectare plots (treated and control) on three moors. 2) Between 2007 and 2010, we did an experiment at grouse-beat scale on plots about 400 hectares in Upper Teesdale, Co Durham using two blocks of moorland. Within each block, we randomly assigned two plots as treatment plots and two as control plots, making eight plots in all. 3) We made extensive comparisons of up to 35 moors each year with contrasting use of medicated or plain grit.

We have collected data on parasite burdens in grouse, grouse breeding success and pre-harvesting densities. Following the use of new medicated grit, these studies have shown:

- Reduced parasite abundance from all three studies. Up to 99% fewer worm eggs in spring and up to 50-fold fewer worms in shot grouse in autumn (see Figure 1).
- The proportion of grouse shot in autumn that contained no worms at all has risen from zero in all years prior to 2007, irrespective of whether or not medicated grit was used, to an amazing 45% in 2010 (see Figure 2).
- Higher breeding success (19% in medicated plots from study one, 40% on medicated moors from study three).
- Post-breeding densities of grouse were higher and almost double that on non-medicated moors in study three.
- A cost-benefit analysis suggests that the use of medicated grit brings in about £1,200 (per 100 hectares) more shooting revenue than on equivalent non-medicated moors (based on a 40% harvest rate).

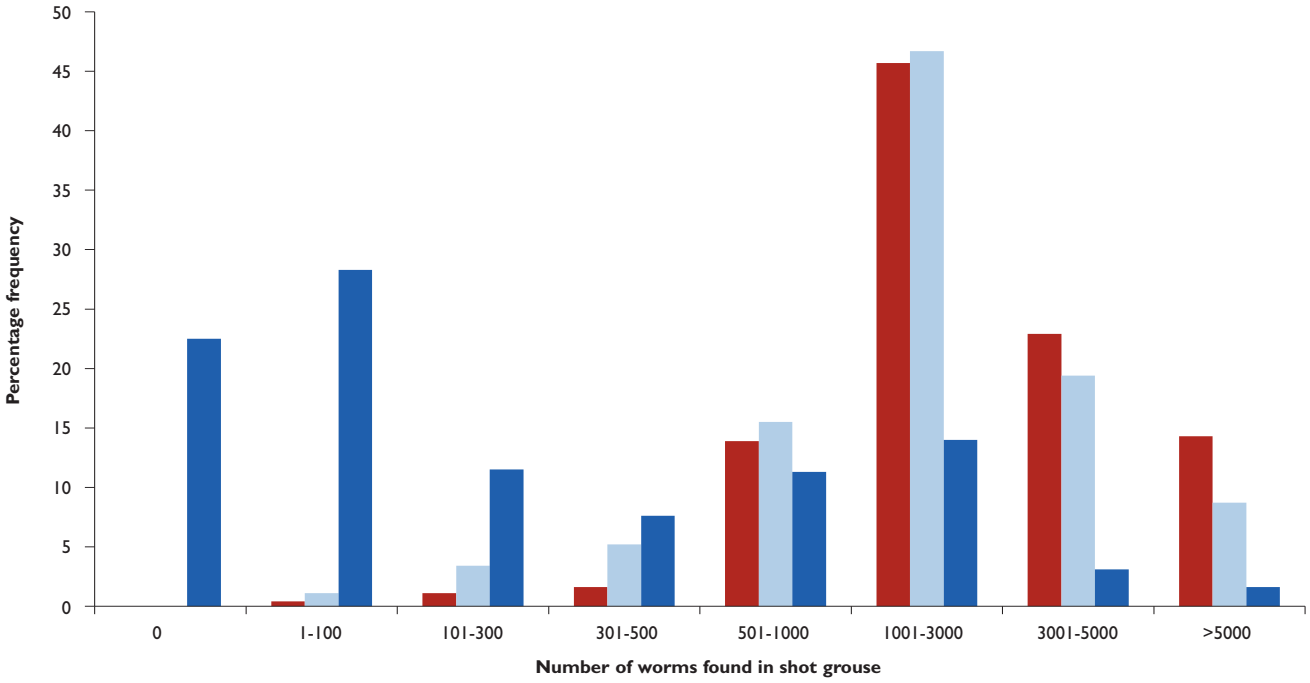


Figure 1

The percentage frequency distribution of *T. tenuis* worm burdens in adult grouse shot from three types of moors

- Moors not using medicated grit (n = 897 birds, 2003-2010)
- Moors using the old version of medicated grit (n = 805 birds, 2003-2006)
- Moors using the current new form of medicated grit (n = 1844 birds, 2007-2011)

We estimate that perhaps 85-90% of managed moors now use medicated grit each year. This year, sampling of worms from shot grouse has shown that on a handful of moors in northern England, grouse have remained effectively worm-free, despite withdrawal of the grit, and hence no access to medication for grouse since July. This raises the question whether once worm burdens are low, medicated grit needs to be used every year. When controlling similar parasitic worms in domestic livestock systems, resistance to the same group of drugs has occurred within three to five years of starting drug use. We have looked for resistance to the old medicated grit eight years ago, but did not detect it then.

Refraining from using medicated grit when worm burdens in grouse are low may help prevent or delay what some expect will be an inevitable build-up of resistance to the worming drug. Therefore, we have asked five moors to stop using medicated grit on one or more of their beats from 2012 onwards to determine how long it takes for worm numbers to recover. Careful monitoring of worm burdens will ensure that carefully timed advice will be available to participating moors to avoid any potential parasite-induced damage to their grouse stocks. We hope to report on how we fare in next year's *Review*.

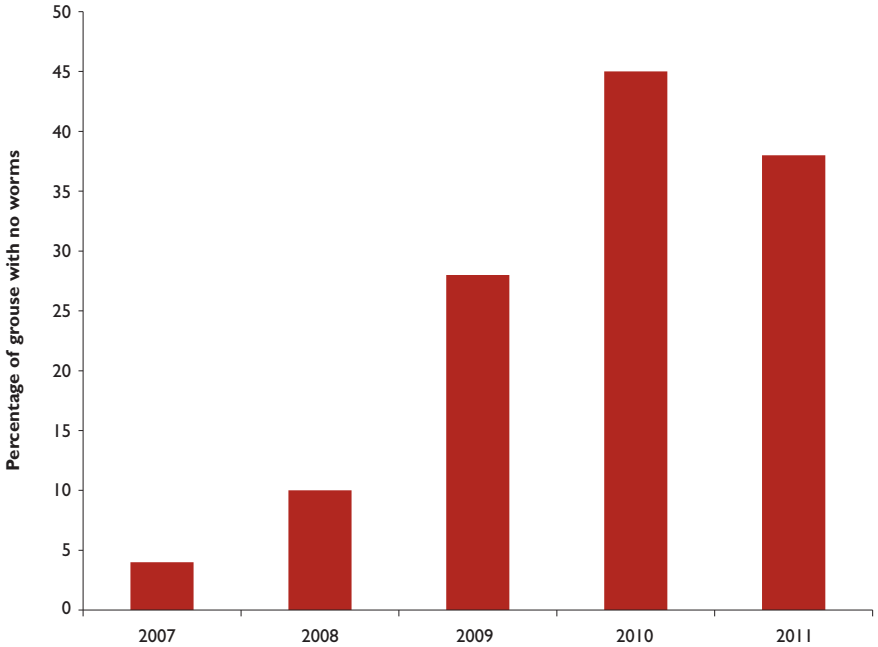


Figure 2

The percentage of red grouse shot in autumn from moors using medicated grit that contained no strongyle worms between 2007 and 2011 (annual sample sizes range from 579 to 800 grouse)

Uplands climate change – are grouse breeding earlier?

Radio-tagged red grouse sitting on her nest.
© Rob Dunn/GWCT

KEY FINDINGS

- Red grouse lay earlier in warmer springs.
- Since 1992 the start of laying in Strathspey in the Scottish Highlands has advanced by 4.5 days.
- We need to find out if this trend is the same in other areas of the UK and determine if earlier laying will, at some point in the future, overlap with the end of the heather burning season.

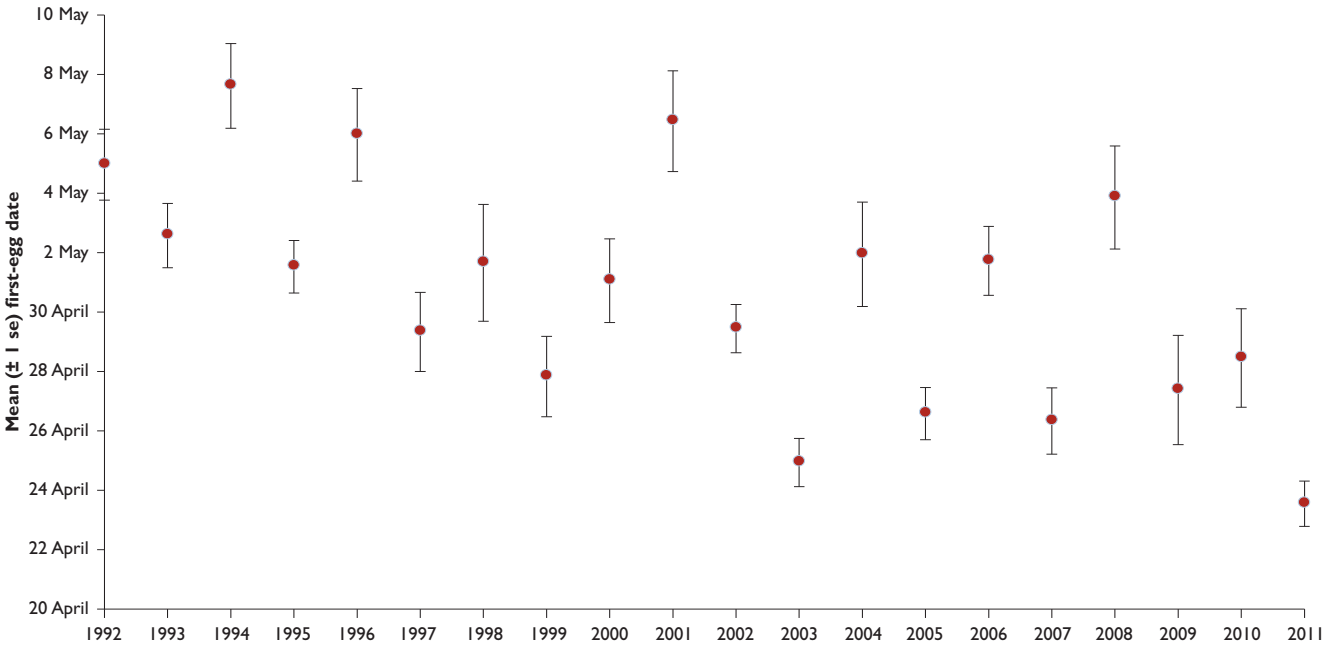
Kathy Fletcher

Changes in our climate have been linked to earlier breeding by several UK bird species, but most studies have been on lowland songbirds. Our long-term research with red grouse gives us an opportunity to look at the timing of breeding of an upland species. As an all-year resident on moorland, grouse are likely to be one of the earlier nesting species and more capable of adapting to climate change than species that over-winter elsewhere such as curlew, golden plover and lapwing. It is particularly important that we look at grouse laying dates on moorland to ensure that management techniques, such as heather burning, do not disrupt earlier breeders.

Since 1992, we have regularly radio-tagged hen grouse in Upper Strathspey as part of our long-term studies. We found nests and visited them, without flushing the hen, on alternate days to estimate the hatching date. Once the hatch date is known, we can calculate when egg laying began by subtracting the incubation period and the number of eggs laid (eggs are laid daily). In this way, we calculated first-egg dates for 497 clutches across a 20-year time span. The first-egg dates and the clutch sizes were compared with spring temperatures recorded at a meterological station located at Dalwhinnie within 16 kilometres of all nests and within six kilometres of three-quarters of nests.

Figure 1

Average first-egg date for red grouse nesting in Strathspey from 1992 to 2011



The spring temperature measure calculated was the average daily temperature for the 30-day period when hen grouse are increasing in weight prior to laying. Between 1992 and 2011 the mean daily temperature in spring varied from 4.1 to 8.9°C, showing a near-significant increase in spring temperature over the 20-year period. Over the same period, the annual mean first-egg date varied between 24 April and 8 May (see Figure 1). In warmer springs, birds laid earlier (see Figure 2), resulting in laying occurring 4.5 days earlier in 2011 than in 1992 at an average change rate of 0.24 days per year. This earlier on-set of laying is at a rate comparable with other UK bird species.

Earlier breeding could be a problem if it meant that significant numbers of grouse laid clutches before the end of the permissible heather burning season. If the trend recorded in Strathspey was to continue, we would predict that it would be at least another 40 years before the earliest 10% of nests were laid before 15 April, the current deadline for heather burning below 1,500 feet.

We plan to extend our studies to compare historic data on laying dates from sites across the UK to determine if the trend recorded in Strathspey is also found in other areas of the UK. We also hope to collate records of burning dates from gamekeepers to find out if self-regulation occurs, ie. gamekeepers stop burning earlier in warm springs because of evidence of grouse breeding or because the heather has become too dry to burn safely.

ACKNOWLEDGEMENTS

This work was undertaken with funds kindly donated to the Trust from The Garnett Trust and The Peter Samuel Trust.

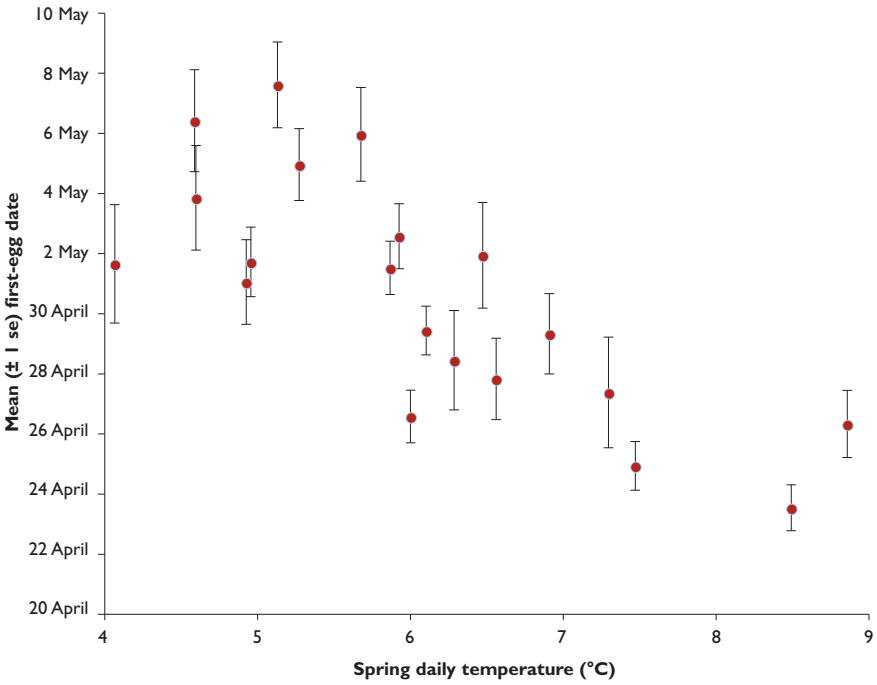


Figure 2

Average first-egg date compared with spring daily temperature

We visited nesting hens on alternate days to estimate the hatching date. © Helen Gray

Black grouse recovery in northern England

We have successfully translocated black grouse to the Yorkshire Dales. © Graham Dunn

KEY FINDINGS

- We have developed a strategic plan to deliver the BAP targets of increasing numbers and range of black grouse in northern England.
- To deliver BAP targets we need to increase breeding productivity and maintain high survival rates.
- To promote range expansion in the Yorkshire Dales we are translocating males to areas where habitat improvements have been made.
- Urgent conservation measures are required in north-west Northumberland to safeguard the remnant population.

Phil Warren

ACKNOWLEDGEMENTS

We would like to thank the Heritage Lottery Fund, Biffaaward, Yorkshire Water and the SITA Trust.

In northern England we have made significant progress towards delivering the black grouse Biodiversity Action Plan (BAP) targets. Numbers have recovered from 773 males in 1998 to 1,026 in 2006 and range increased from 38 to 43 occupied 10x10-kilometre grid squares. Black grouse remain severely threatened owing to their small population size and restricted range, and the English BAP aims to increase numbers to 2,000 males and their range to 61 10x10-kilometre squares by 2030. To achieve this we have developed a strategic plan.

Our research has shown that black grouse recovery in northern England is limited by poor breeding success. The current population is maintained by high survival rates of adults. Range expansion is currently limited by too few recruits joining the adult population, combined with males not moving far and the availability of suitable moor fringe habitats. To deliver the BAP targets we need to increase breeding success, maintain high survival rates, while considering translocating males into areas on the fringe of the range where conditions are suitable.

We predict that increasing breeding success alone from the current average of 1.3 chicks per hen to 1.7 (the average value for Scotland and Wales) would increase the population by 50% in four years. We know that poor breeding is linked to high rainfall when chicks hatch in June, poor-quality habitat with relatively few preferred chick-food insects and clutch predation by stoats. We need further research to quantify whether we can increase key insect availability and chick survival through altering vegetation by cattle grazing and establishing patches of eared willow *(Salix aurita)* scrub. Clutch predation by stoats is also a problem, with a third of clutches being predated. Targeted predator control on the moorland fringe would also improve breeding success. Adult survival is high, except in harsh winters when food sources are covered by snow. Trees provide an important emergency food source, but a third of all leks in northern England have no woodland cover within a kilometre radius. We are currently working to provide pockets of woodland in the vicinity of all leks.

While increasing numbers in the core of the range, we also need to improve conditions on the edge of the range to promote re-colonisation. To identify suitable areas and prioritise management actions, we summarised the key needs of black grouse in terms of a suitable habitat mosaic, sufficient connected habitat, existing predator control by moorland gamekeepers and connectivity with existing leks in northern England. Through this process we have identified the key areas to target conservation efforts as the North Pennines, Yorkshire Dales and north-west Northumberland (see Figure 1).

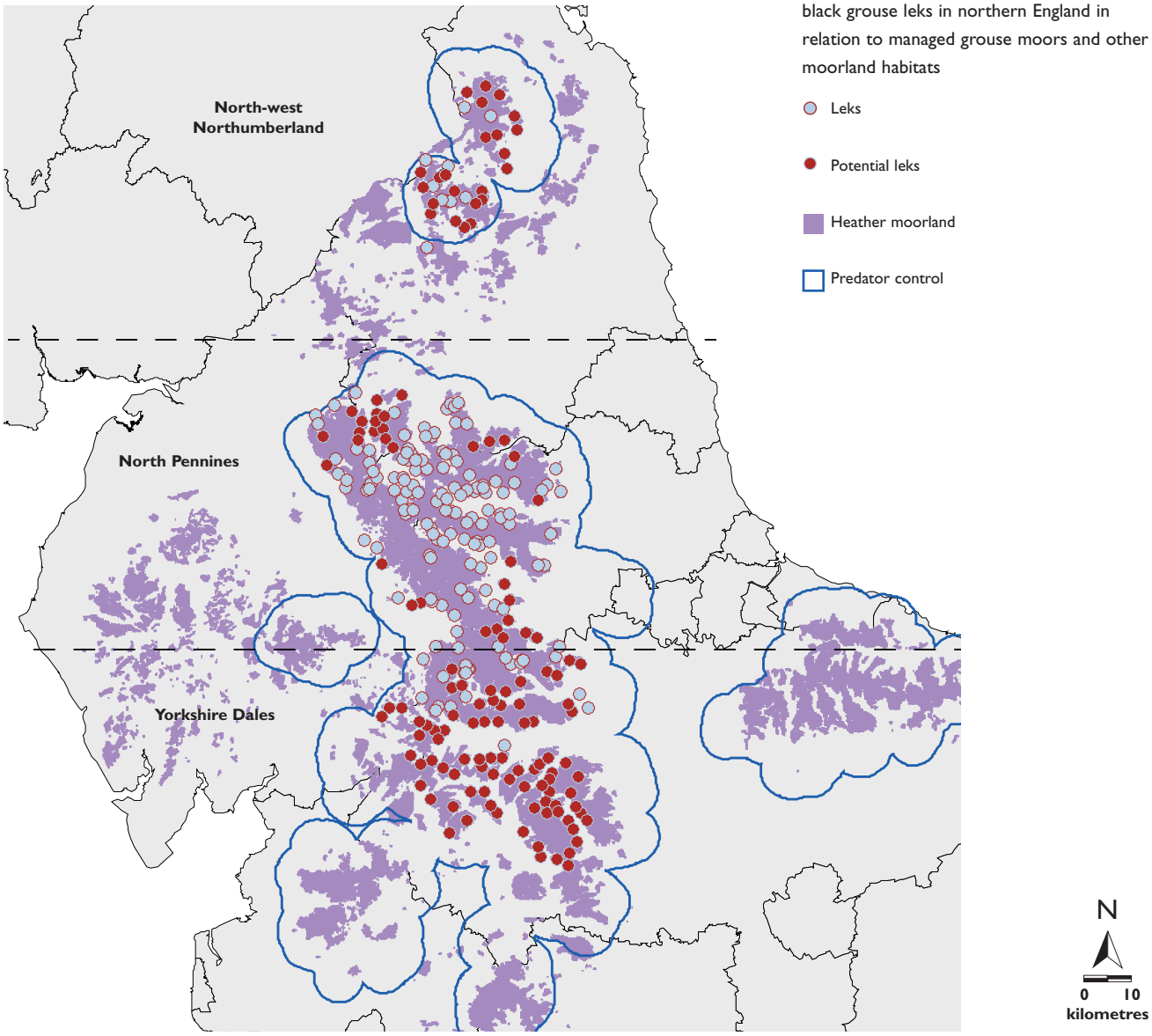
The North Pennines is the core area for black grouse, supporting 80% of all birds. Numbers are stable and birds occupy 80% of suitable habitats. The priority is to increase breeding productivity, thereby providing young birds as recruits to re-colonise neighbouring areas to the south in the Yorkshire Dales and north into north-west Northumberland. In the Yorkshire Dales, numbers have doubled and range has expanded between 1998 and 2009, yet only 21% of moor fringe habitats are occupied and we estimate that there is the potential for a further 81 leks. To re-establish lekking groups here, we are translocating surplus males from leks in the North Pennines to sites where habitat quality has been improved. We are currently considering whether a similar approach may also be feasible in the Forest of Bowland. In north-west Northumberland, numbers have collapsed, with fewer than 20 males remaining, and connectivity with birds both in the North Pennines and in the Scottish Borders has broken down. Remaining moorland habitats have been fragmented by commercial forestry and there are few keepered grouse moors providing predator control. We need to evaluate whether habitat links between this region and the remaining populations in the North Pennines and Scottish Borders can be restored. We need to instigate immediate habitat improvements in conjunction with predator control to safeguard the remnant population and ultimately, to provide conditions for 30-40 lekking groups.

In summary, to deliver the English BAP targets by 2030 we need to do three things: increase the breeding productivity and maintain the over-winter survival of the current population; promote range expansion in the Yorkshire Dales through continued habitat enhancements and the translocation of males to establish leks; instigate immediate conservation measures in north-west Northumberland to safeguard the remaining black grouse and ultimately restore functional habitat links with populations in the North Pennines and Scotland.

To deliver the English BAP targets, we need to translocate male black grouse to suitable areas to establish new leks. © GWCT

Figure 1

The location of existing and possible future black grouse leks in northern England in relation to managed grouse moors and other moorland habitats



Langholm Moor Demonstration Project: year four

© Merlin Becker/GWCT

KEY FINDINGS

- Two pairs of hen harriers nested in 2011, both were successful with five chicks fledging from each nest.
- Our index of over-winter mortality for winter 2010/11 was comparatively high at 60% compared with 50% in 2009/10 and 18% in 2008/09.
- The productivity of red grouse during 2011 was the lowest since the start of the project.

Damian Bubb

The Langholm Moor Demonstration Project is now entering its fifth year. The 10-year project aims to reconcile grouse moor and raptor interests with the core objective of re-establishing Langholm Moor as a driven grouse moor while maintaining a viable population of hen harriers.

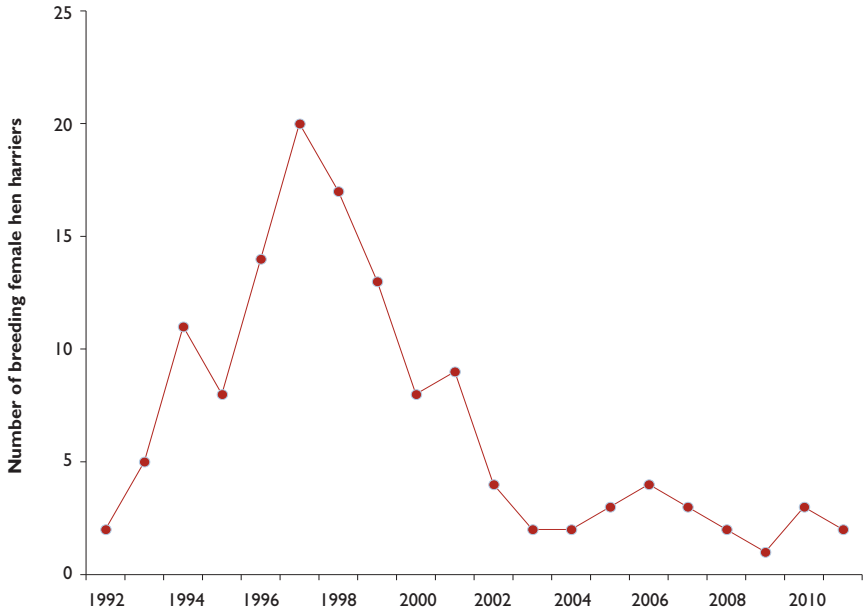
Since 2008, the project has employed a team of five keepers to manage the moor. In addition to predator control, heather burning and the provision of medicated grit to control strongyle worms, all harriers that nest on the moor are provided with diversionary food.

The numbers of harriers nesting at Langholm in the first four years of the project have been low, continuing the trend of recent years (see Figure 1). Conversely, harrier breeding success has been good with an average of 3.8 young fledged per breeding female (2008-2011). In 2011, two females nested and both successfully fledged five young. Since the start of the project we have provided all the harrier nests (six so far) at which eggs have hatched, with dead day-old cockerel chicks and rats as diversionary food. The female harriers from all nests have taken substantial quantities of this carrion. We have watched all the harrier nests to identify prey items delivered to the harrier chicks and have seen a total of 345 items at the six nests combined; of these most were passerines (48%) or diversionary food (33%). We have seen no grouse or grouse chicks being brought to the harrier nests.

Despite the low numbers of harriers breeding on the moor and all nests being provided with diversionary food, the change in numbers of red grouse has been disap-

Figure 1

Number of breeding female hen harriers at Langholm from 1992 to 2011



We are radio-tagging more red grouse to help us look at the causes of winter mortality.
© Merlin Becker/GWCT

pointing (see Figure 2). Following an initial increase in density between 2008 and 2009, neither the pre-breeding (March/early April) nor post-breeding (July/early August) density of red grouse has changed significantly between 2009 and 2011. This raises concerns over the ability of red grouse numbers at Langholm to increase sufficiently for the project to meet the target of shooting 1,000 brace.

In the last two winters our index of mortality derived from subsequent counts of red grouse at Langholm has been high (50% in 2009/10, 60% in 2010/11) compared with 2008/09 (18%). We gathered information on the likely causes of mortality of red grouse by finding carcasses from two sources, namely radio-tagged birds and kill searches. Most of the 270 birds (both radio-tagged and kill searches) that we found over winter (August-March) had been eaten by raptors (89%), with only a small number showing field signs of being eaten by mammals. We are currently conducting additional work this winter to improve our understanding of the causes of winter mortality by radio-tagging a larger sample of red grouse and conducting monthly kill searches. In addition we are repeating raptor vantage point watches that were originally carried out in the 1990s. These will provide information on the relative abundance of raptors present on the moor during winter and provide comparative information with the 1990s.

In addition to the comparatively poor over-winter survival, the breeding success of red grouse at Langholm has also fallen in the last two years. Productivity of red grouse at Langholm in 2011 was the lowest since the start of the project (Young-to-old ratio 2008 1.6, 2009 2.4, 2010 1.9, 2011 1.0). The low productivity in 2011 was due to a combination of a greater proportion of hens with no young and smaller brood sizes.

ACKNOWLEDGEMENTS

The Langholm Moor Demonstration Project is a partnership between the Game & Wildlife Conservation Trust, Scottish Natural Heritage, Buccleuch Estates, RSPB and Natural England. We would also like to thank the Duke of Northumberland and other moor owners.

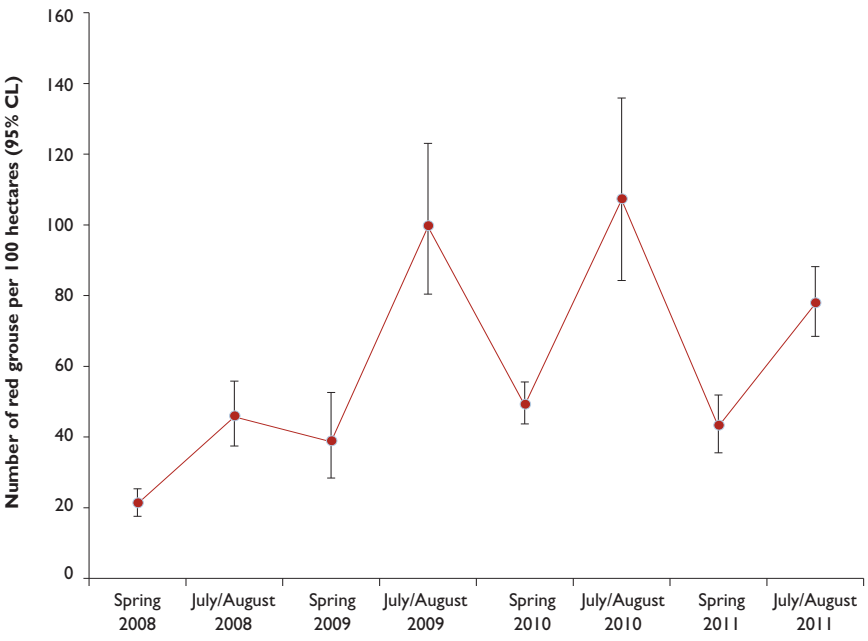


Figure 2

Density of red grouse at Langholm derived from distance sampling transects

Bumblebee nesting sites

Bumblebee entering a nest.
© Gillian Lye/GWCT

KEY FINDINGS

- Artificial nest boxes were not effective as a conservation measure for farmland bumblebees or as a research tool.
- Commercially available bumblebee nest boxes were rarely occupied.
- Complex subterranean nest boxes containing old bank vole nest material were the most likely to be occupied.

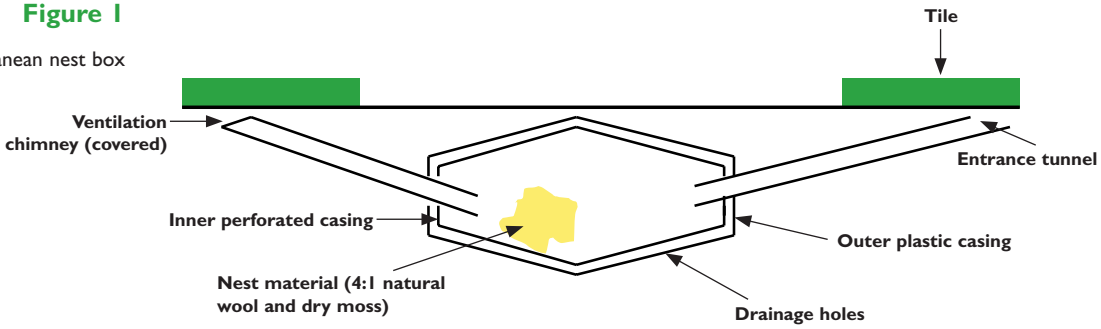
Gillian Lye
John Holland

Bumblebees are vital insects for pollinating crops and wild plants, but are declining severely in both their distribution and abundance. On farmland, insufficient pollen and nectar forage has been highlighted as a possible cause for their decline. This is being rectified through a number of conservation initiatives, and suitable habitats can also be created using agri-environment funding. However, the provision of sufficient and high-quality nest sites may also be limiting bumblebee populations. In 2006, Gillian Lye, one of our research students based at Stirling University, started her PhD investigation into the less well studied aspects of bumblebee ecology, including the provision of nest sites. Unfortunately, bumblebee nests are difficult to locate, yet their abundance and success are good measures of the suitability of the local landscape. Bumblebee species vary in their nest-site preferences. Some species nest below ground in, for example, small mammal holes, others on or just below the surface and a few prefer holes in trees. If nest sites are limiting numbers, the provision of artificial nest boxes may be used to enhance their abundance, attract bees to where they are needed for pollination and act as a monitoring tool. This has been achieved successfully overseas, but previous UK studies reported very low uptake (0-4%).

In our study we tested six different designs, made of different materials, placed above, on the ground or below it. Some were commercially available. We did this in a range of sites (gardens; university grounds; farmland with and without agri-environment schemes) in southern England and central Scotland. The complex subterranean nest box was the most successful (see Figure 1), especially at the botanical garden site, where 45% of boxes of this design showed signs of occupancy by bumblebees, although across all sites occupancy was only 7%. The other designs achieved 3% occupancy or less and none of the commercial nest boxes were occupied. It is unlikely that a lack of queen bees was responsible for poor uptake as many were observed, 814 at the 10 farmland sites. Given the low uptake we could not determine whether nest-site availability was a limiting factor on farmland.

Figure 1

Complex subterranean nest box



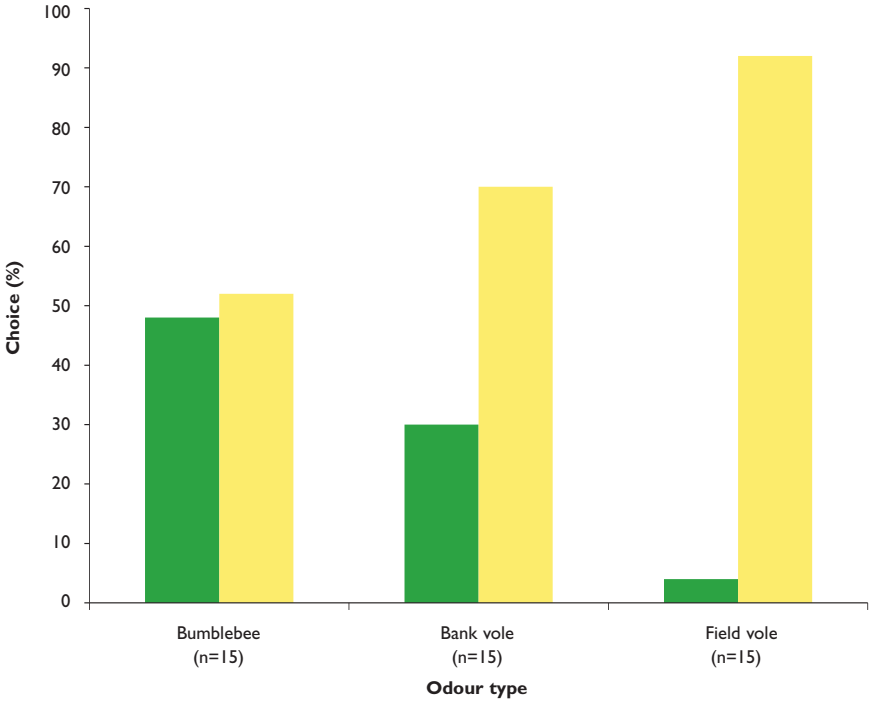


Figure 2

Bumblebee nest preference in 2006

Odour type

Clean air

Choice made by bumblebee queens of B. terrestris *when presented with a y-tube with one arm containing odours associated with bumblebee, bank vole or field vole nest material and the other containing clean air*

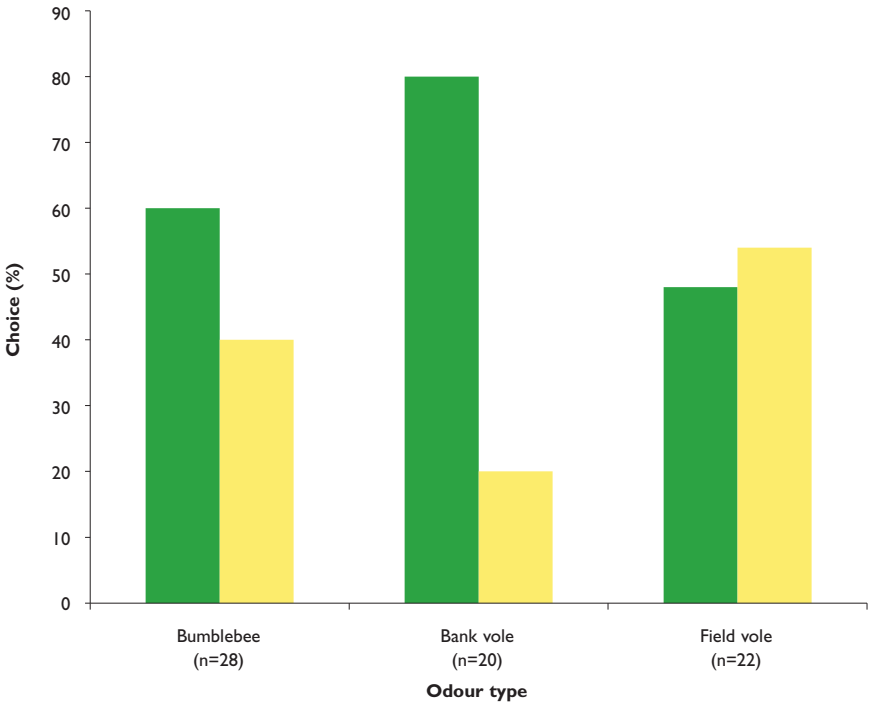


Figure 3

Bumblebee nest preference in 2007

Odour type

Clean air

ACKNOWLEDGEMENTS

Gillian Lye was supported by a studentship from the Natural Environment Research Council.

Bumblebees are thought to use odours to find appropriate sites previously occupied by small mammals or bumblebees. To test this in the field, we compared subterranean traps imitating nest sites containing the nest material of either bank voles, field voles or bumblebees together with empty sites. We used 75 traps of each odour treatment and compared their ability to attract bumblebees in 2006. Field voles nest above ground whereas bank voles nest underground, therefore by using these two species we could test whether bumblebee species with similar nest location preferences responded accordingly. We found no difference between the treatments for the total number of bumblebees caught or for the number caught of the most abundant species *B. terrestris/lucorum,* which nests below ground.

In the laboratory we used a y-tube to examine the behaviour of *B. terrestris* and *B. pascuorum* queens when they were given the odours from the same materials used in the field study. Neither bumblebee species showed a significant response to the odours from the bank vole or bumblebee nest material in 2006 tests, but *B. terrestris* strongly avoided the field vole nest material (see Figure 2). When they were repeated in 2007, with the same now aged nest material, *B. terrestris* showed a positive response to the bank vole nest material (see Figure 3). Thus we concluded that the queens avoided the fresh nest material because this may indicate that a hole is occupied.

Entrance to one of the artificial nests.
© Gillian Lye/GWCT

Value of arable weeds

Dock leaf bug.
© Tom Birkett/GWCT

KEY FINDINGS

- The abundance of insects eaten by farmland birds and grey partridge chicks depended on the percentage cover and type of weeds present.
- At least 10% weed cover by desirable species is needed to ensure enough insect food for grey partridge chicks.

Barbara Smith
John Holland

Ever since the pioneering research conducted in Sussex, we have known that it is predominantly the arable weeds that support chick-food insects in arable crops. Recently a number of conservation agencies have highlighted the importance of the cropped area as a foraging place for birds and as an area with potential for increasing farmland biodiversity. Over the years, we have conducted many studies where we measured the abundance and diversity of weeds and insects in crops, identifying and counting a staggering 2.4 million insects from 435 fields. Funding from the Esmée Fairbairn Foundation has now allowed us to analyse the data from all of these studies. We collated and interrogated the data sets to improve our advice on how best to increase insect chick-food within crops by manipulating the numbers and types of arable weeds. This work will also inform policy makers of the value of arable weeds for biodiversity. We analysed the data using a combination of statistical techniques called meta-analysis and multivariate analysis which allow data from many different studies to be analysed together.

We found that the abundance of insects eaten by farmland birds and grey partridge chicks depended on the area covered by broadleaf and, to a lesser extent, grass weeds. There was a weaker positive relationship between total weed cover and the abundance of pest natural enemies, with grasses being more important. Having a greater number of weed species (diversity) had little effect on these relationships. Further analysis revealed that certain weed species were more important for insects than others (see Table 1). Chickweed, knotgrass and annual meadow grass were identified as key species because they were the species that were most often correlated with insect abundance. These were also the most common species and, although this plays a part in their influence, it is not the whole story. Species that are considered undesirable agronomically were also shown to be influential eg. sterile brome, creeping thistle and cleavers. Some common species (eg. field pansy) were unimportant for insects. There are also a number of species which are known to support insects, but were not selected by our analysis, possibly because they were not abundant enough. These were bent grasses, red and white dead-nettle (also important as early providers of pollen and nectar for bumblebees) and orache. Weed seeds are also an important food source for farmland birds, small mammals and some insects and this should also be taken into account when assessing the desirability of different weeds.

We are often asked how much weed cover is needed to provide sufficient insects for grey partridges. This is a level of 0.7 or above on the grey partridge Chick-Food Index (CFI). We found huge variation in the percentage cover of broadleaf and grass weeds required to achieve this CFI level, but that 10% cover of the desirable weeds was likely to be sufficient (see Table 1). The crop also supported insects, so the time of cultivation and the extent of herbicide inputs also affected the weed assemblage. Consequently, each crop had its own unique composition of insects. However, this did not affect the relationships between weed levels and insects.

TABLE 1

Importance of each weed species for insects and overall desirability based upon agronomic issues, importance to insects and value as seed for birds

Common name	Importance for invertebrates	Overall desirability
Annual meadow-grass	High	High
Knotgrass	High	High
Common chickweed	High	High
Black grass	High	Undesirable
Field pansy	High	Medium
Fool's parsley	Medium	Neutral
Fat-hen	Medium	Medium
Cleavers	Medium	Undesirable
Common field speedwell	Medium	Neutral
Scarlet pimpernel	Medium	Neutral
Sterile brome	Medium	Undesirable
Creeping thistle	Medium	Undesirable
Black-bindweed	Medium	High
Cut-leaved crane's-bill	Medium	Neutral
Scented mayweed	Medium	Medium
Field forget-me-not	Medium	Neutral
Poppy species	Medium	Neutral
Ivy-leaved speedwell	Medium	Neutral
Bent grasses	Some	Neutral
Parsley-piert	Some	Neutral
Meadow brome	Some	Undesirable
Cock's-foot	Some	Neutral
Willowherb species	Some	Neutral
Common cudweed	Some	Neutral
Perennial rye-grass	Some	Undesirable
Redshank	Some	High
Charlock	Some	High
Mustard species	Some	Neutral
Sow-thistle species	Some	Medium
Wall speedwell	Some	Neutral
Speedwell species	Some	Neutral

A sawfly larvae: a key chick-food insect.
© Tom Birkett/GWCT

ACKNOWLEDGEMENTS

We wish to thank the Esmée Fairbairn Foundation for funding this project.

Weed cover is vital to provide enough insect food for grey partridge chicks. (Inset: a Calocoris *plant bug.) © John Holland/Tom Birkett/GWCT*

The effects of burning in the New Forest

Little is known about how the plant community changes after burning.
© David Evershed/GWCT

KEY FINDINGS

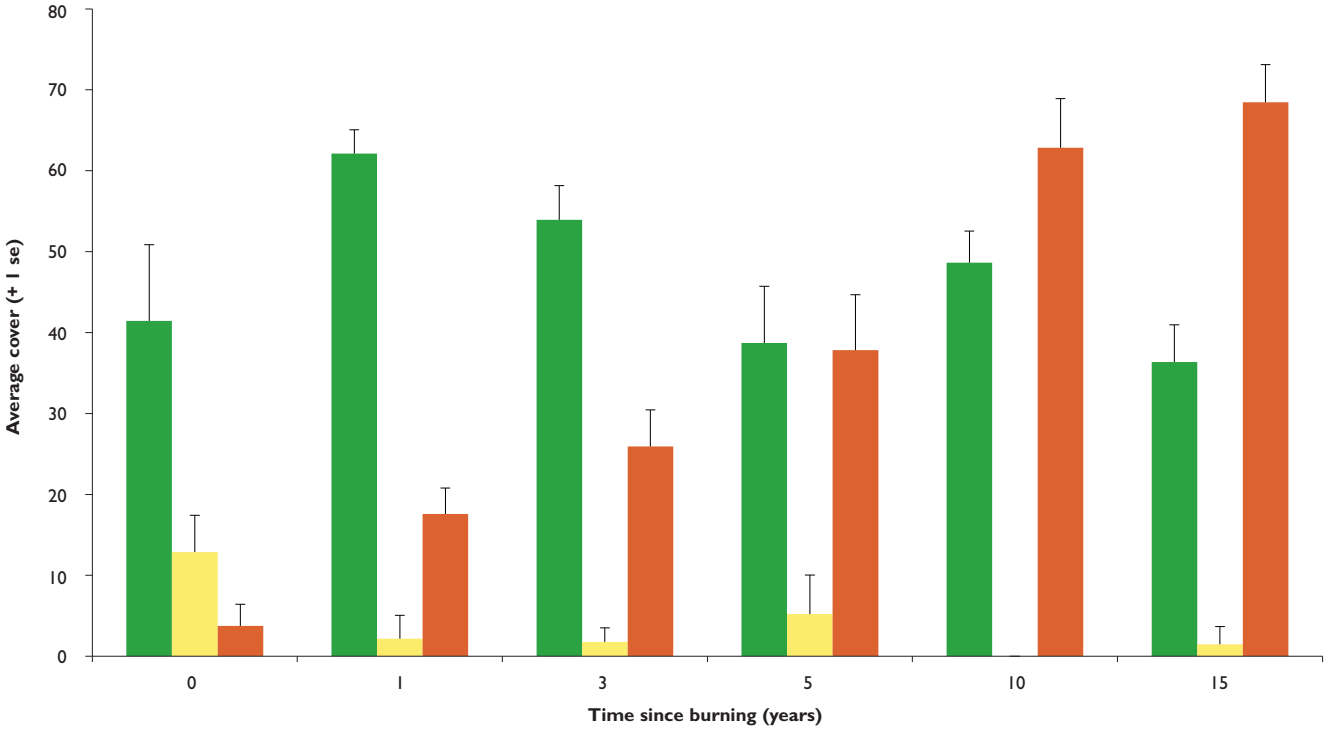
- Following burning, grasses and bracken dominated the vegetation community of humid heath in the early stages, but bracken cover did not persist and the dominance of ling heather was restored. There was no evidence of scrub encroachment.
- At each time stage after burning the vegetation supported a characteristic invertebrate community. Heathland specialists were restricted to the older stands.
- The cycle of controlled burning promoted a mosaic of habitats and contributed to the maintenance of rich biodiversity which is typical of the New Forest.

Barbara Smith

Despite our headquarters being located on the banks of the river Avon at the entrance to the New Forest National Park, we have done little ecological work in the Forest. However, in 2010 we began working in partnership with the Forestry Commission and the New Forest National Park to examine the ecological effects of vegetation management. Traditionally, heathland in the New Forest is managed by a programme of controlled burning to remove old growth and to provide palatable, accessible grazing. However, little is known about how the plant community re-assembles after burning and there is no information on the response of invertebrates. Our aim was to provide an evidence base for land managers and our preliminary study examined successional changes in the vegetation and invertebrate communities following burning. Above-ground vegetation and invertebrates were sampled in 18 stands of humid heath comprising three replicates of sites burnt, zero – the year of sampling – and one, three, five, 10 and 15 years since burning.

In the first season after burning, 25% of the area surveyed was bare ground and the vegetation cover was largely composed of grasses and bracken (see Figure 1). This early flush of grass provided good grazing. Broadleaf species peaked in abundance a year after burning (after which they consistently accounted for less than 3% cover) and comprised acid-tolerant species such as tormentil, heath milkwort and marsh lousewort. Overall, ground cover had increased to 80-90% by the second sampling season (Year 1). By the 10th year, cover was greater than 100%, indicating the development of vegetation layers where low-growing species colonised the ground beneath a heather canopy. The cover of heather species increased progressively, and in stands over five years old, dwarf shrub cover exceeded that of grasses. Bracken in particular was characteristic of recent burns, but did not persist. By the second year bracken cover was below 5% on all sites. Mosses and lichens were absent from earlier age stands, but took time to colonise, increasing in abundance in stands older than three years.

The early stages of succession were characterised by the presence of ants, wolf spiders and rove beetles ie. species that are adapted to open ground. Next to colonise were grasshoppers and ground beetles; the oldest stands supported numerous woodlice, which fed on the dead plant matter that accumulated in older vegetation. Overall, burn age had no effect on the abundance of ground-active invertebrates, but the character of the ground-beetle community changed as time progressed. Ground-beetle diversity peaked in vegetation stands that had been burnt five years previously. Canopy-dwelling species responded strongly to changes in the vegetation and both invertebrate abundance and species diversity increased as the vegetation developed. Total numbers of bugs, canopy-dwelling beetles and money spiders all increased along with stand age. Some invertebrate groups were associated with more recently burnt



sites, for example, frog hoppers occupied sites that had been burnt three years previously. Overall, grasshoppers appeared to peak five years after a burn (see Figure 2), although different grasshopper species responded differently to burn age. For example, numbers of the meadow grasshopper did not differ greatly between years, whereas numbers of the mottled grasshopper peaked three years after a site had been burnt before numbers fell again. No mottled grasshoppers were found on sites that had been burnt more than five years previously, probably because the shorter vegetation and patches of bare ground present in the recently burnt sites provided ideal habitat for this species. In contrast, heather specialists were only recorded in older stands; the small heather weevil and *Ulopa reticulata* (a flightless hopper) were most abundant in 15-year-old stands.

This work demonstrates that humid heath undergoes a series of changes following burning, before the dominance of heather is restored and, crucially, that at each stage the vegetation supports a characteristic invertebrate community. By creating a mosaic of habitats, the burning programme promotes biodiversity in the New Forest as well as providing good grazing. Knowledge of species associated with each stage will inform those tasked with the conservation of diversity in the New Forest.

Figure 1

Average cover of grasses, bracken and dwarf shrubs in relation to stand age

Grass

Bracken

Dwarf shrub

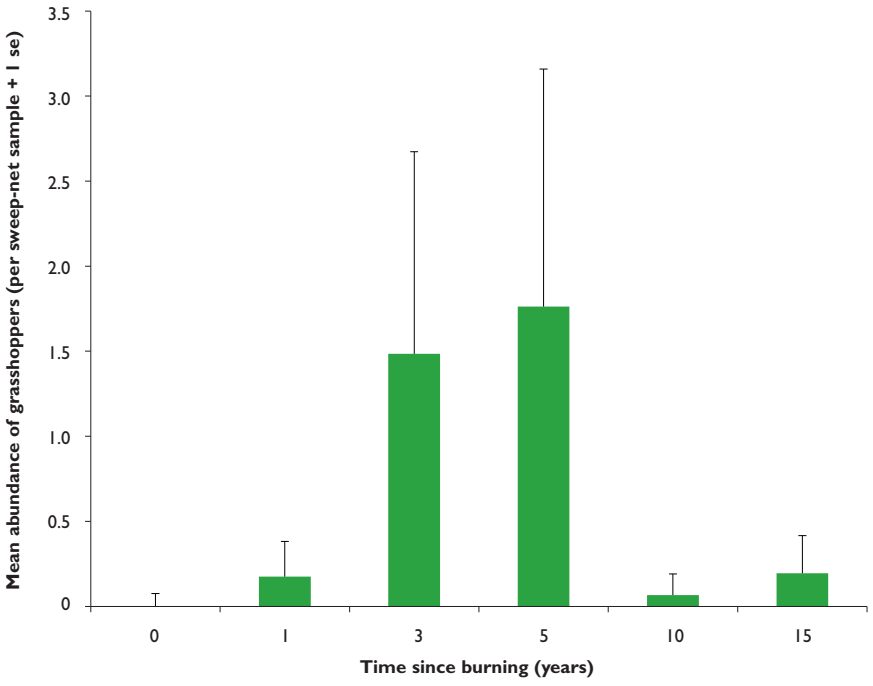


Figure 2

The mean recorded summer abundance of grasshoppers per sweep-net sample in relation to time since burning

ACKNOWLEDGEMENTS

We wish to thank the New Forest National Park for financial support and Sam Cruikshank for conducting the field studies.

Allerton Project: game and songbirds

Our excellent team of beaters. © Alex Butler/GWCT

KEY FINDINGS

- We have demonstrated a clear positive relationship between game management and songbird conservation.
- Some species appear to benefit from predator control (eg. song thrush, spotted flycatcher and bullfinch) and winter feeding (eg. tree sparrow, dunnock and chaffinch).
- 20-30% of the increase in songbird numbers at the Allerton Project farm can be attributed to habitat management.
- Wild pheasant numbers are already benefiting from the new shoot and effects on songbirds will be monitored in future years.

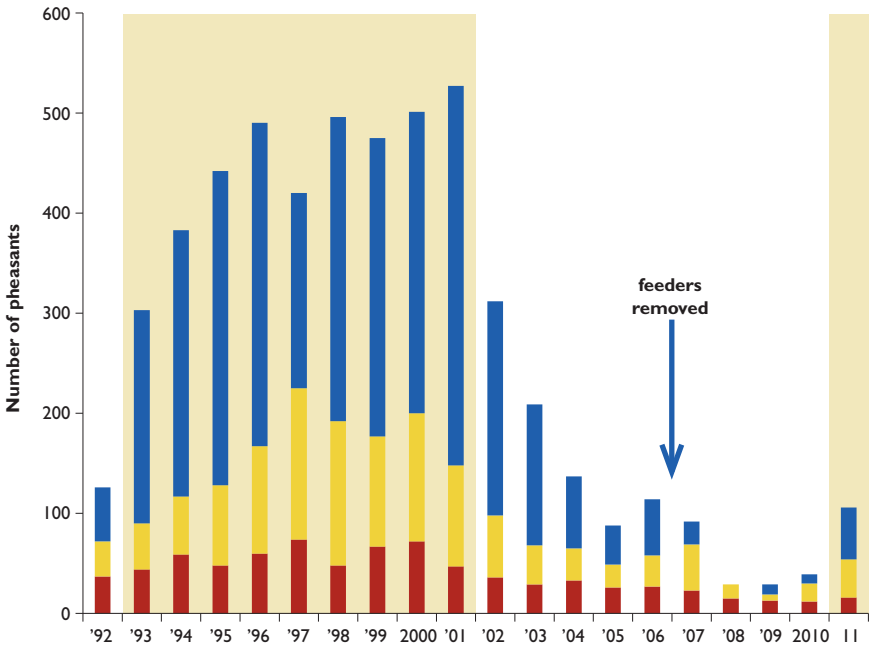
Chris Stoate
John Szczur

In 2011 we held the first shoot day at the Allerton Project farm since 2001. Our new game management system is different from the one we adopted in the early years of the project (1993-2001) when Malcolm Brockless, our full-time keeper, carried out management for wild game, including predator control, habitat management and winter feeding. Those early years demonstrated what could be achieved, but our new system aims to be more widely applicable and to cover its costs, an important consideration in the current economic climate. A part-time keeper, James Watchorn, carries out some management for the breeding gamebirds, but relies more on the release of 1,800 pheasants and 200 red-legged partridges to provide shooting. We are now growing maize as a cover crop, have re-sited many of our Stewardship wild bird seed mixtures to accommodate the shoot and resumed the supplementary feeding of gamebirds.

Wild pheasant numbers declined dramatically when predator control stopped in 2001 and then remained low, with a slight increase in 2011 associated with the new shoot (see Figure 1). Red-legged partridges and hares have followed a similar trend. Songbird numbers also declined when predator control and winter feeding were withdrawn, although this decline was much slower than for gamebirds (see Figure 2). Over the whole project period, autumn pheasant numbers were positively correlated with breeding numbers of songbirds (see Figure 3). This is a clear demonstration of the benefits to songbirds of game management at the Allerton Project.

Figure 1

Autumn wild pheasant numbers from 1992 to 2011



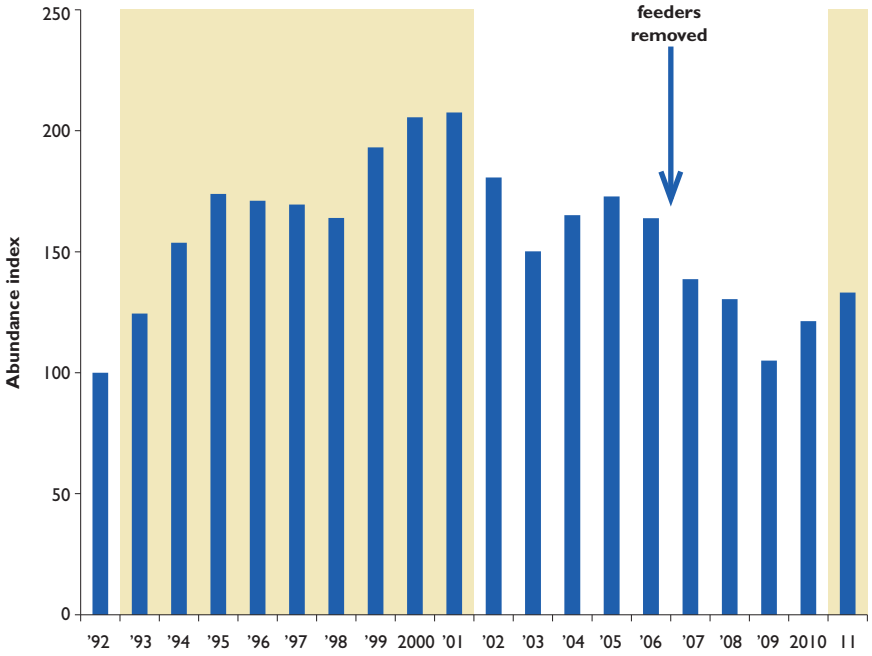


Figure 2

Songbird abundance relative to the start of the project

Keepered period

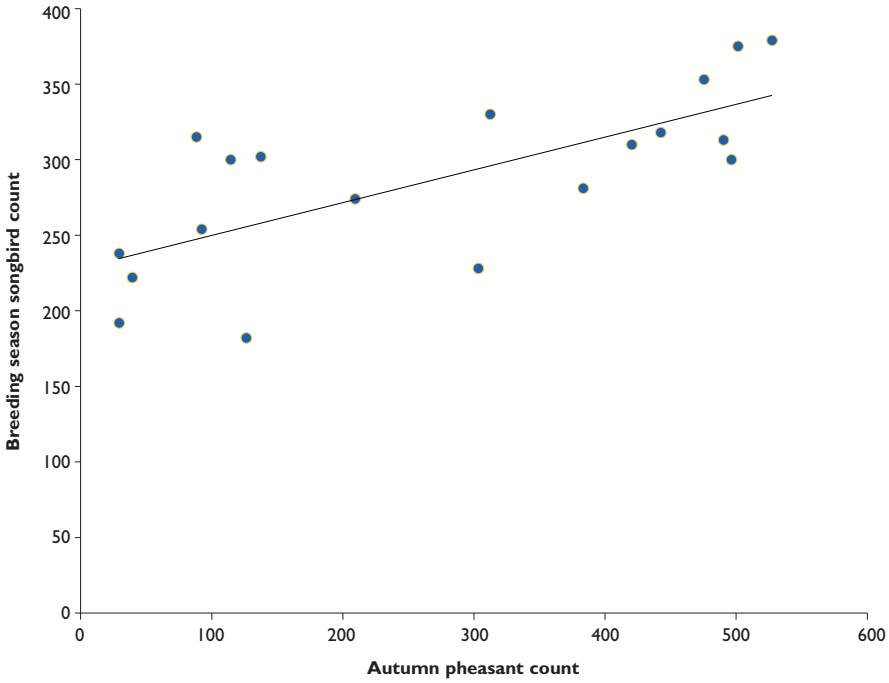


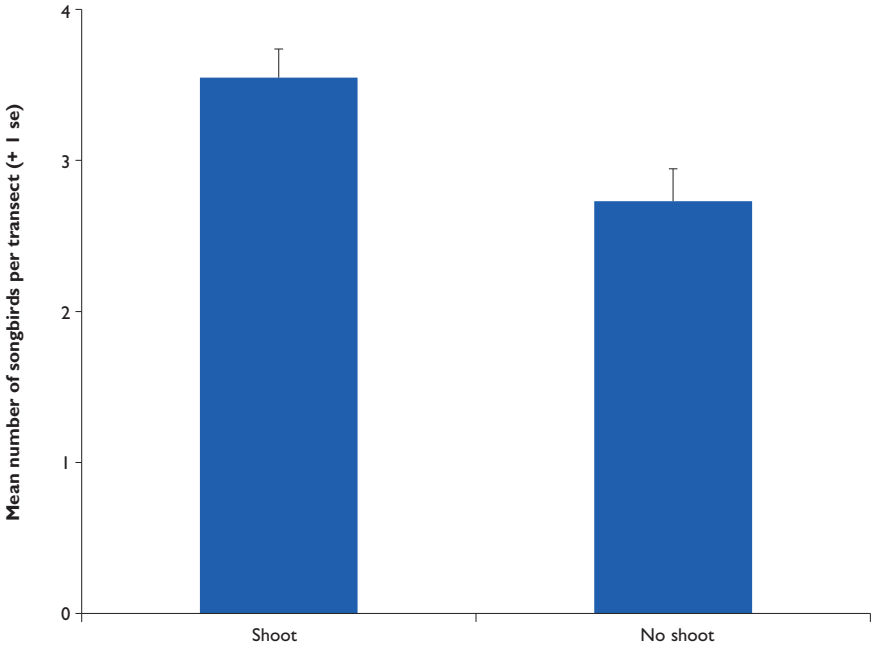
Figure 3

Autumn pheasant numbers are correlated with numbers of songbirds present the following spring

We are now growing maize alongside our Stewardship wild bird seed mixes.
© Louise Shervington/GWCT

Figure 4

Songbird numbers are higher on local farms with shoots than on those without (based on surveys of 34 farms)



In 2011, MSc student Ben Norman surveyed birds on 34 farms in the Eye Brook catchment in which the Allerton Project is located and recorded bird numbers on farms with and without shoots. This revealed that numbers of songbirds on farms with shoots were 30% higher than on those without (see Figure 4).

Following our previous research on songbirds and winter feeding, reported in the *Review of 2010*, the next important question is whether winter feeding affects breeding numbers of songbirds in the following spring. For those species that we know make regular use of our hopper feeders (blackbird, dunnock, robin, chaffinch, yellowhammer and tree sparrow), numbers present in March were positively correlated with those present in the breeding season (see Figure 5). For some species, winter feeding therefore seems to influence breeding numbers.

Since 2001, we have had no predator control on the farm and, since 2006, we have had no winter feeding either. Clearly different bird species were affected by these different management practices. Detailed mapping of individual breeding territories in 1992, 1998, 2001, 2006 and 2010 make this more explicit. Table 1 presents the results for the Biodiversity Action Plan species present on the farm. Based on annual transect counts, in 2010 overall songbird numbers were 20% higher than the baseline in 1992,

TABLE 1

Breeding territories of Biodiversity Action Plan species at the Allerton Project for those years in which territory mapping was carried out. The shaded columns represent years with full game management

Species	1992	1998	2001	2006	2010
Grey partridge	2	7	0	0	0
Turtle dove	1	2	1	0	0
Skylark	36	36	37	33	26
Yellow wagtail	3	5	3	1	2
Song thrush	14	48	64	34	15
Spotted flycatcher	8	11	14	6	1
Tree sparrow*	3	0	7	18	12
Linnet	10	21	25	17	14
Bullfinch	6	11	12	6	11
Yellowhammer	57	55	54	46	41
Reed bunting	3	3	3	5	8

** Based on nest counts.*

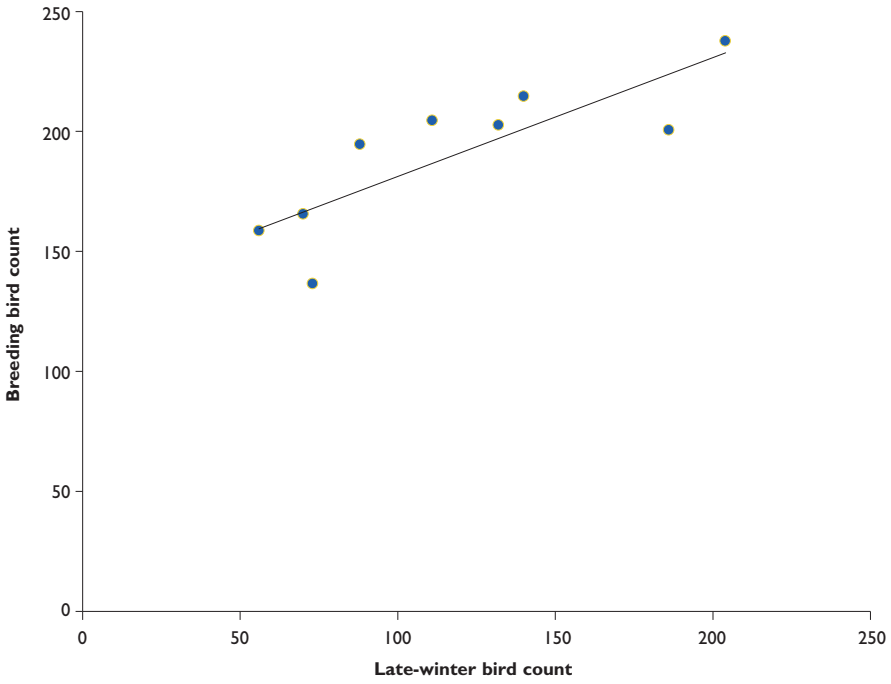


Figure 5

Late-winter abundance of songbird species known to use hopper feeders is correlated with their breeding abundance the following spring at the Allerton Project

and in 2011 they were 30% higher than the baseline. This suggests that 20-30% of the change in abundance can be attributed to the creation and management of habitats on the farm, with the remaining change in numbers being attributed to predator control and winter feeding.

From the very start of the project land has been diverted from crop production to satisfy set-aside obligations and provide wildlife habitats, amounting to 10-19% of the area. The apparently low contribution of habitat to bird conservation at the Allerton Project, despite a relatively large area of land devoted to habitat creation, may be due to the large area of habitat already present, and the amount of woodland on the farm. Woodland provides an excellent habitat for species such as spotted flycatcher, song thrush and bullfinch, but also for predators such as magpies. In the absence of predator control, increases in songbird numbers may be low where the habitat is as good for predators as it is for their prey. Equally, provision of some additional habitats may have little effect on bird numbers where there is already an abundance of it, or where food resources are provided through other mechanisms such as winter feeding. Introducing new habitats to farms that currently lack such habitat, have no winter feeding and low numbers of predators is likely to have a greater impact than has been the case on our farm.

These findings help us plan our future management at the Allerton Project, but also enable us to make recommendations to other farmers who visit us. The findings also feed into the development of agri-environment policy and highlight the important contribution made by various game management practices to conservation of wildlife other than game.

Spotted flycatcher. © Peter Thompson/GWCT

Our research findings enable us to make recommendations to farmers who visit the project. © Peter Thompson/GWCT

The farming year at the Allerton Project

Many of our crops are now sown directly into the stubbles of the previous crop.
© Peter Thompson/GWCT

KEY RESULTS

- Difficult weather patterns challenge cropping.
- New soil cultivation approaches succeed.
- Advanced technology employed.

Alastair Leake
Phil Jarvis

Once again the weather provided us with our biggest challenges this year and this emphasises the need for our farm business to be equipped to react to whatever the weather brings. Because wet weather halts the combine harvester, the machine must be able to achieve high output and operate reliably so that we can take maximum advantage of the good weather. Likewise, there is little we can do when faced with periods of drought as irrigating cereal crops in the UK is not a cost-effective option. However, we can work on a long-term strategy to improve our soil structure and increase soil organic matter to help fields buffer against both extremes.

The last 11 years have seen us move away from intensive soil cultivations based around ploughing to shallower, non-inversion methods. Evidence from the Soil and Water Protection (SOWAP) Project that we ran on the farm showed that this increased soil organic matter, particularly at the surface, gradually improved porosity. In many parts of the world, farmers have abandoned cultivating altogether and have adopted 'zero-till', whereby each crop is sown directly into the stubble and trash left behind by the previous crop. The seed drill is made up of lines of steel discs the size of dinner plates which, when dragged through the soil, cut a slot into which the seed is sown, while the closers which follow consolidate the soil and cover the seed. This means that the soil is

TABLE 1

Arable gross margins (£/hectare) at the Allerton Project 1992-2011

	Average 1992-1997	2008*	2009*	2010*	2011(est)*
Winter wheat	702	566	496	673	783
Winter oilseed rape	539	862	401	799	1,082
Winter/spring beans	516	449§	200§	512§	507§
Winter oats	601	430	387	808	873

**No single farm payment included*
§ spring beans

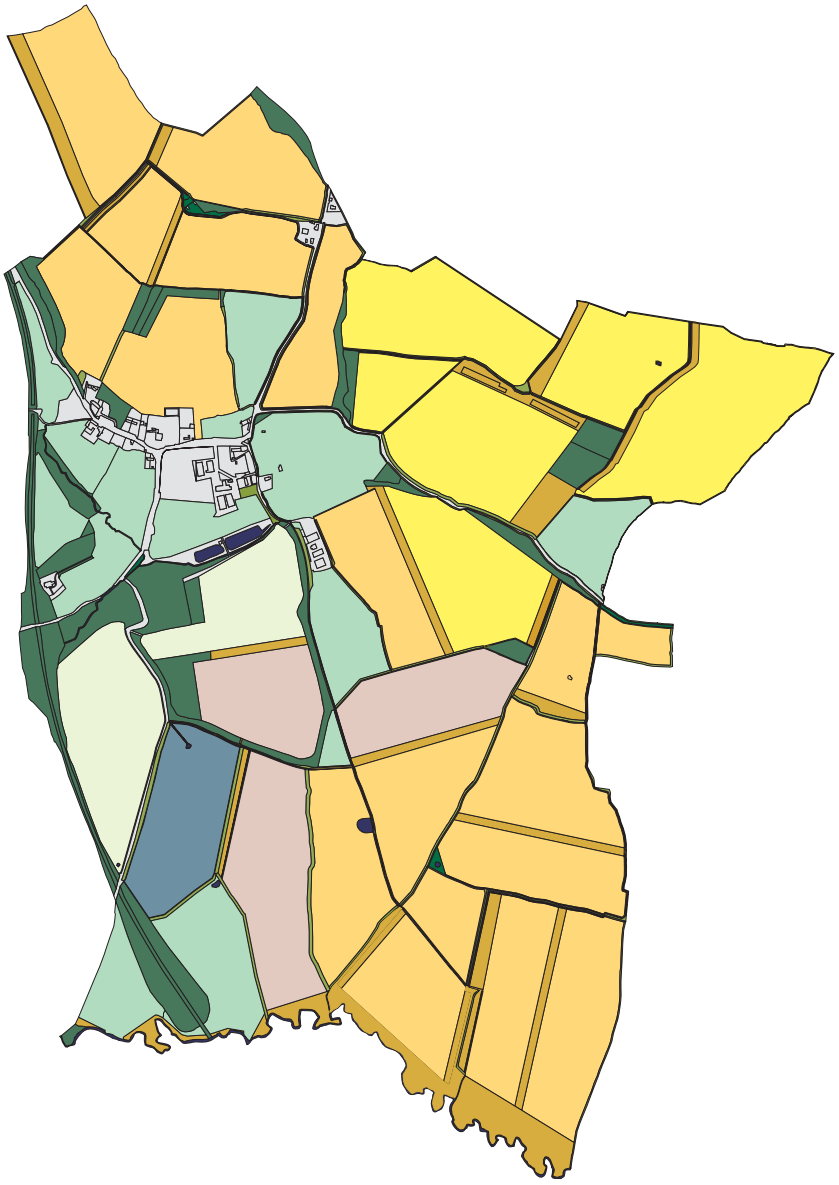


Figure 1

Allerton Project cropping 2010/11

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

always protected from erosion by the growing crop or the residues left behind from the previous one. Where zero-till is practised over a number of years, earthworm numbers build up dramatically, helping to recycle crop nutrients. A study we carried out showed that we had 20 times more worms seven years after moving to zero-till.

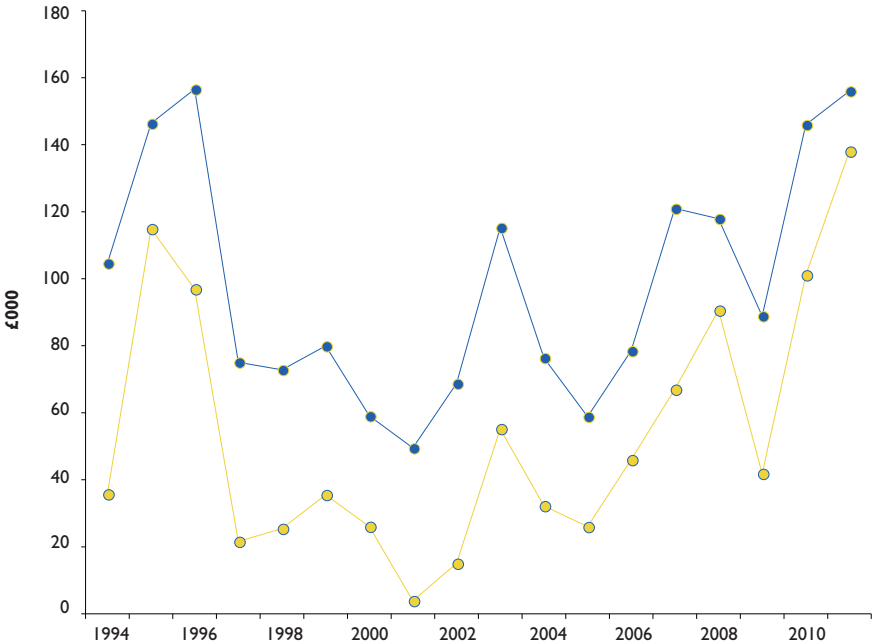


Figure 2

Gross profit and farm profit at the Allerton Project 1994-2011

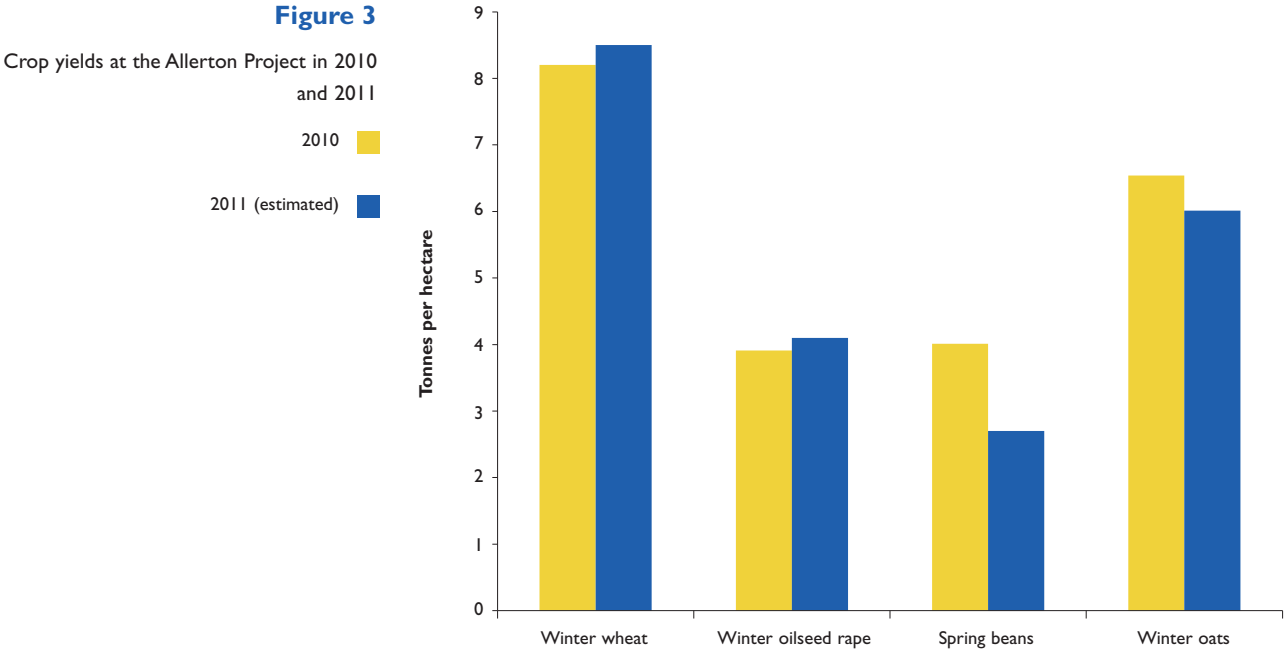
- Gross profit
- Farm profit

Our beans have been drilled on a zero-till field. © Alastair Leake/GWCT

In 2010 we converted a single field to zero-till and began by sub-soiling to break any compaction caused by the previous cultivation regime, followed by a single pass with the seed drill sowing spring beans. This crop is notoriously vulnerable to drought, particularly in the early growth stages, but it was noticeable how much better the germination and development of the crop was compared with the other fields of beans sown following ploughing. Reduced soil disturbance under zero-till ensured that valuable moisture was conserved to the advantage of the crop and also reduced the weed burden since most of our arable weeds have evolved to germinate in response to soil disturbance. At 4.24 tonnes per hectare (t/ha), the crop went on to out-yield the conventional establishment technique by 1.85 t/ha. Whether this was due to soil type, moisture retention, weed pressure or cultivation practice warrants further investigation.

Figure 3

Crop yields at the Allerton Project in 2010 and 2011



Our soil had 20 times more earthworms seven years after moving to zero-till.
© Louise Shervington/GWCT

We have continued to invest in more efficient ways of producing our arable crops. Our joint venture partnership with Oxey Farm has allowed us to share the cost of investment in new technology. Our primary cultivations, spraying, fertiliser and combining operations all have a precision-farming element attached to them. These include Global Positioning Systems for the cultivations, automatic sprayer boom cut-off, combine yield maps and crop scanning for more accurate fertiliser applications.

Despite a challenging year, the oilseed rape yielded 4.70 t/ha, 20% higher than our five-year average and a record for the farm. Yields of winter wheat and oats were slightly below average, but the quality was excellent. Spring beans were the biggest casualty of the dry weather. This emphasises the extent to which the climate affects our cropping, regardless of advanced agronomy and precision-farming techniques. The rise in commodity prices has compensated for some of the lower yields. However, rises in seed, fertiliser and spray costs keep gross margins near our budget. The escalation in the cost of fuel continues to erode farm profitability.

TABLE 2

Farm conservation costs at the Allerton Project 2011 (£ total)

Higher Level Stewardship costs (including crop income foregone)	35,195
Higher Level Stewardship income	-36,296
Woodland costs	22,998
Woodland income	-14,238
Farm Shoot expenses	6,092
Farm Shoot income	-6,092
Grass strips	895
Total profit foregone	
- conservation	**£8,554**
- research and education	**£9,404**
	£17,958

Savings on hedgelaying stakes and binders and woodchip fuel for project not included. In future English Woodland Grant Scheme funding will cover the woodland deficit

Further information on how these costs are calculated is available from the Game & Wildlife Conservation Trust

© Peter Thompson/GWCT

The Eye Brook community project

Loddington sits in the central section of the Eye Brook catchment. © Chris Stoate/GWCT

KEY FINDINGS

- Scientific and local knowledge can be combined to improve rural community understanding of environmental issues and natural resource use.
- Improved awareness of historical land use improves local identity and 'ownership' of environmental problems and opportunities.
- A bottom-up approach, involving farmers, land managers and other local people, strengthens strategies for future land management.
- The project has contributed to wider adoption of this approach locally and across the country.

Chris Stoate

ACKNOWLEDGEMENTS

The Eye Brook Community Project was funded by the Heritage Lottery Fund.

The scientific research carried out at the Allerton Project at Loddington over the years, has provided a sound foundation for developing plans for farmland management to benefit wildlife and the environment. Our research projects on cultivation methods and catchment management have considerable implications for aquatic wildlife as well as terrestrial species, and are also relevant to wider issues such as flood attenuation. Our work has also revealed that it is not just farms that have an impact on the environment; individual households contribute phosphorus to streams from septic tanks, and greenhouse gases from the use of fossil fuels. Local people, whether farmers or other members of the rural community, contribute to environmental problems, but they can also be part of the solution, not least through the considerable local knowledge embedded in community members.

Since 2006, we have co-ordinated a project that brings together the scientific knowledge of the Allerton Project, and the local knowledge of other residents, especially local farmers. The project has also included knowledge of local land-use history as improved awareness of this can strengthen local identity and 'ownership' of environmental problems and opportunities. The aim was to build a shared understanding of the management and use of natural resources in our local catchment, the Eye Brook, with a view to informing its future sustainable management.

Through MSc student projects, contributions from local historians and interviews with elderly members of the farming community, we built up a picture of continually changing land use from the earliest colonisation of the area to the transition into a fossil fuel-based economy in the 1930s. This gave us an improved understanding, not just of the historical changes in the management and use of natural resources, but of current land use, and the implications for us all today. The landscape of the medieval period was one of extensive cultivation, with low yields requiring a large area of land to produce food for local people. Later, land was used almost exclusively for pasture, with, from the 1940s, a substantial switch to arable land again, to achieve greater food security. Such changes would have had major implications for both aquatic and terrestrial wildlife, and for water quality, as well as for the ability of the local community to feed itself.

Agricultural commodities have been traded between countries, almost since Neolithic times, but the industry has become steadily more global, both in terms of commodities produced, and in terms of inputs. At the same time, both the human population and its consumption have increased. We would need just 14% of an Eye Brook parish area to feed its residents, but 110% of the parish area to provide energy from local sources, assuming current levels of production and consumption (see Figure 1).

This takes no account of the wider population, 80% of whom live in urban areas with little access to productive land. There is clearly pressure on the land, whether it is local or global, and such pressures affect the environment and its associated wildlife.

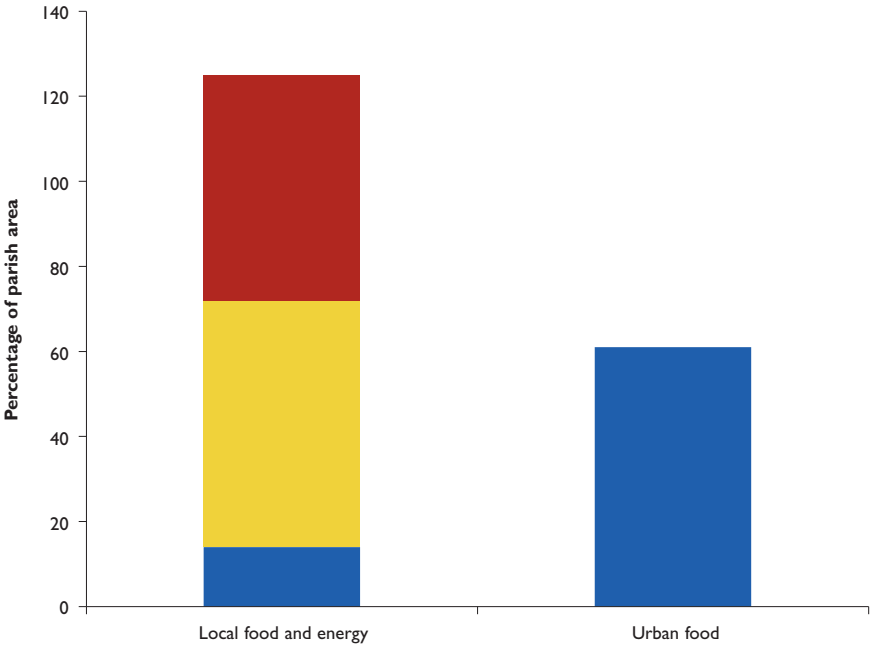


Figure 1

Proportion of land area needed for parish production of food and energy (household and transport) for one Eye Brook parish, assuming current rates of production and consumption

The additional land required to provide food for the urban population is also shown

Food

Household (short rotation coppice willow)

Transport (oilseed rape)

Our scientific research at the Allerton Project served to demonstrate that wildlife underpins much of our own existence. Wild bees are essential pollinators of fruiting trees, beetles reduce crop pests, earthworms and soil fungi improve soil structure and its capacity to retain water, and woodland provides fuel and maintains drinking water quality.

Combining science with local knowledge has enlightened us all. We have shared our experiences through a book, *Exploring a Productive Landscape* but the real legacy of the work done so far will be in the way that local people live within and with their local environment. There is also evidence that our experience in the Eye Brook is influencing the way people think further afield. Our approach has strengthened local commitment to a new and nationally important headwaters catchment project, and it is contributing to plans for improved management of the Welland river basin through Defra's pilot catchment initiative, and further afield, the new Nature Improvement Areas as well.

Exploring a productive landscape *combines science with local knowledge that has enlightened us all.* *© Chris Stoate/GWCT*

Various events throughout the catchment have helped us improve our shared understanding of how it works. © Chris Stoate/GWCT

Wildlife in hemp

Chris Stoate in his hemp crop – hemp has a wide range of uses. © GWCT

KEY FINDINGS

- We assessed the wildlife value of hemp, grown as a cover crop. Hemp had low weed cover scores compared with rape and beans.
- For insects, local farm effects were stronger than effects of crop type in June, but insect abundance in hemp was intermediate between rape and beans in July.
- Bird numbers tended to be lower in hemp than in rape and beans, but some species (especially whitethroat) made considerable use of hemp.
- The moderate value of hemp to wildlife should be set against the considerable wider environmental benefits arising from hemp production.

Chris Stoate
John Szczur
Jamie Partridge

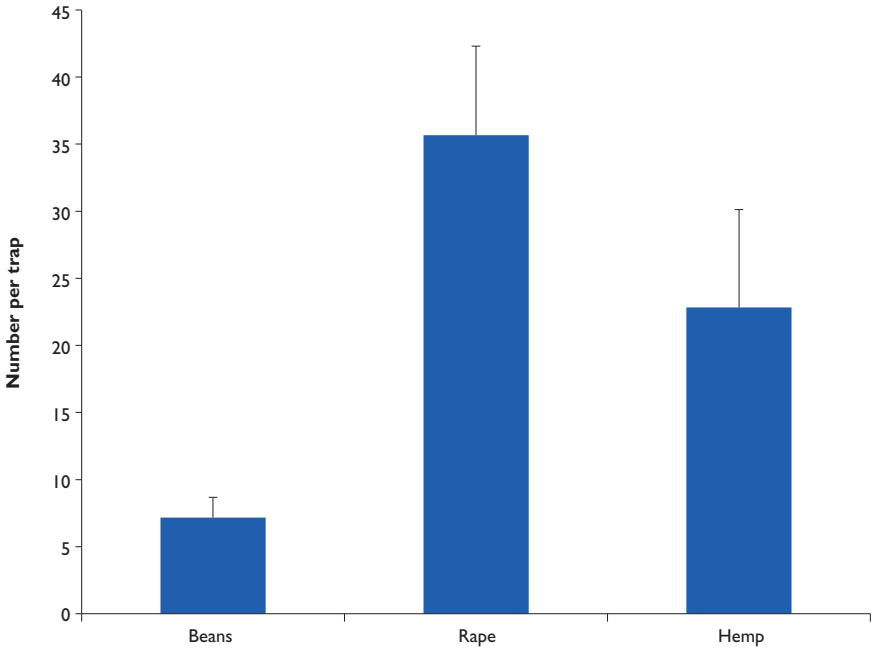
Hemp has a wide range of uses with the outer part of the stem used to produce textiles and components of car body panels. The rest of the stem (the 'shiv') is used as bedding for horses, and as a component of building blocks for the construction industry. Hemp can be mixed with lime mortar to create a strong building material with good insulation properties and has the advantage over conventional, energy-intensive concrete-based materials as it sequesters carbon, both in the plant material, and during the carbonation process of curing lime mortar. Hemp seed and the oil derived from it also have a culinary use.

Hemp requires low fertiliser use, no insecticides and no herbicides once the crop has germinated. Vigorous growth to a height of two to three metres shades out most weeds. In terms of energy use and greenhouse gas emissions associated with production, hemp is comparable with cotton and better than polyester. However, little is known about the ecological implications of hemp crop production. While more widely grown break crops such as oilseed rape and field beans are known to provide good foraging habitats for farmland birds, the relative merits of hemp are unknown. Hemp's ability to suppress weeds, and the lack of associated invertebrates, may reduce food for birds.

We investigated the use of hemp crops by weeds, insects and birds at the Allerton Project and another local site (Halstead), basing our studies on one commercially managed field at each site, and using fields of rape and field beans at each farm for

Figure 1

Relative abundance of bird-food insects in rape, beans and hemp in July



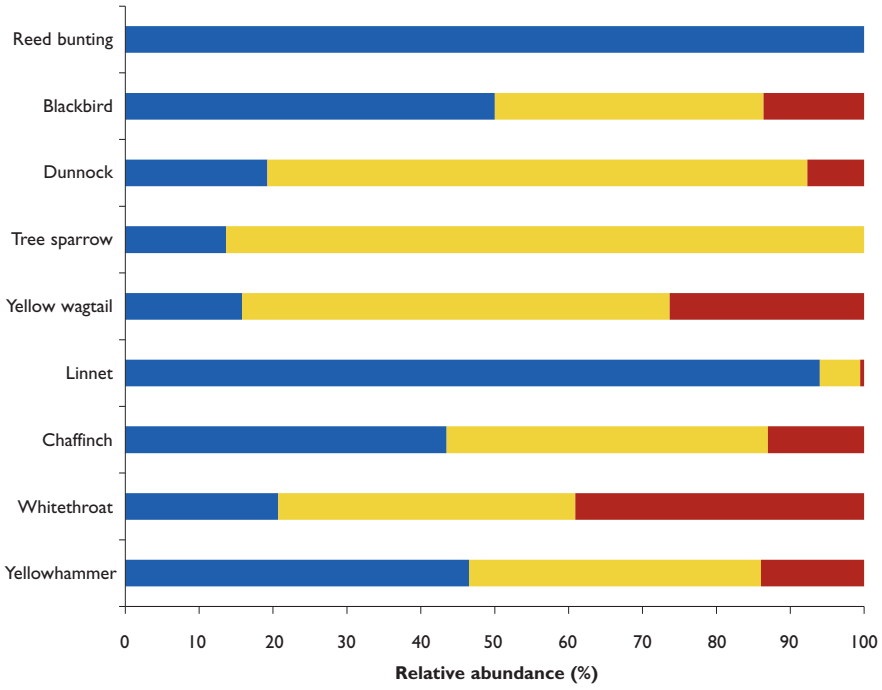


Figure 2

Relative abundance of birds in rape, beans and hemp

Rape

Beans

Hemp

comparisons. We used conventional quadrats to assess weed cover, sticky traps in the crop canopy to sample flying insects and weekly bird counts around the field edges to assess the birds present in each crop.

As expected from its ability to suppress weeds, weed cover in hemp was lower than in rape and beans, but there was a lot of variability between sites. The vigorous growth of hemp was not sufficient to eliminate weeds altogether. In June the numbers of potential bird-food insects were also very variable, but in July insect numbers in hemp were intermediate between those of rape and beans (see Figure 1). Hemp supported consistently lower numbers of birds than rape and beans, with linnets dominating in rape (see Figure 2). Whitethroats dominated the bird community in hemp. The tall, dense upright structure of hemp is likely to have made it unsuitable for many species, and observations of willow warbler and blue tit also suggest that the crop is more suited to woodland than farmland species. On both farms, hemp was also used by roosting swallows, with at least 1,000 recorded at each site. Sand martin, yellow wagtail and reed bunting were also observed roosting in hemp.

Rape and beans have benefits over hemp in terms of value as a habitat for farmland birds, but hemp was used by some species. Low use of inputs such as pesticides and fertiliser also has potential positive implications for wildlife. The wider environmental benefits of hemp in terms of greenhouse gas emissions, and carbon sequestration and storage are considerable, and demonstrate that the environmental implications of each crop should be assessed on the basis of its full life-cycle impact rather than single objectives.

Whitethroats made considerable use of the hemp crop. © Peter Thompson/GWCT

The tall dense upright structure of hemp is likely to have made it unsuitable for many species of birds. © Chris Stoate/GWCT

Fox snares: evidence and conclusions

Good snare design and quality are essential. Swivel failure can lead to cable breakage, with the result that an animal escapes with the noose attached. This can lead to prolonged suffering (inset). © GWCT

KEY FINDINGS

- Two significant recent studies have clarified controversial aspects of fox snaring.
- Well-designed and well-constructed fox snares, operated according to the Code of Practice, pass international humaneness standards for foxes.
- Selectivity can be substantially improved through careful snare design.
- Poorly-designed or badly-made snares, and non-recommended working practices, carry high risks of very poor welfare.
- There is considerable scope for improving both commercially available snares and current working practices.

Jonathan Reynolds

In the last few years, we have been involved in two significant research projects on snares. One was the development and field testing of our own 'breakaway' snare, intended to be practical to use and as selective for the target species as we could devise. The other was a Defra contract, to determine the extent of snare use in the UK and its animal welfare implications. We bid successfully for the latter contract in partnership with the Food & Environment Reseach Agency (Fera), itself a part of Defra, with Fera in this case the lead partner.

In 2004, under a lot of pressure from lobby groups, Defra set up an Independent Working Group on Snares (IWGS), to review available evidence and construct a Code of Practice (CoP). As a member of the IWGS, we contributed the majority of the evidence reviewed, as well as expertise from first-hand experience. The IWGS recognised both that snares had attendant problems of poor selectivity and sometimes very poor welfare, but also that snares were used by scientists to catch foxes alive and uninjured for ecological studies. Its CoP defined a style of use that was expected to minimise the risks. At this time, however, the available evidence was exploratory, and not specific enough to form the recommendations of the CoP. The CoP therefore drew more from experience than from hard evidence.

Defra adopted the CoP without any significant change. Defra intended the Code to become a voluntary standard within what it conceived as 'the industry'. However, it was not compulsory, and without supportive evidence it remained one view of 'best practice' among the diverse opinions of practitioners. The IWGS advised Defra to instigate research to obtain better information; and to explore modifications to hardware that might reduce the acknowledged problems. Having the appropriate expertise in-house, GWCT undertook the latter hardware task on its own with its breakaway snare design. It was not until 2007 that Defra advertised its own research contract.

Robust, unambiguous science is a slow process, both to carry out and to steer through the peer-review process into print. Development of our snare began in 2005, and field trials among gamekeepers took place during 2007-9. The Defra contract was awarded in 2008. Some aspects of the latter proceeded to plan, but the welfare testing had to be conducted under Home Office licence and, because of licence conditions, its progress was halting taking place in 2009 and 2010. After lengthy peer review processes, both studies were published in the first half of 2012.

The chief surprise to emerge from the two studies concerns the nature of the 'industry'. Previous exploratory studies assumed that gamekeepers were the main user group, but the Defra study – conducted by telephoning the owners or occupiers of a large random sample of land-holdings – showed that there were as many farmers using snares as gamekeepers. Among gamekeepers, most had received some kind of training in snare use, and most were aware of the CoP and familiar with its recommendations. Among farmers who used snares, a much smaller percentage had any relevant training, and most were unaware of the CoP. Gamekeepers used more snares, and for longer periods than farmers did. When we attempted to 'ground-truth' telephone survey findings by accompanying a small random sub-sample of respondents when they checked their snares, we found only partial application of the CoP recommendations, even among the more informed gamekeeper group. One understandable reason was that snares which met CoP advice on design and construction were simply not available on the market. However, it was also clear from both studies that snare operators had not adopted CoP-recommended operating practices wholeheartedly.

Experience in other walks of life shows that, Codes of Practice must be supported by training programmes, delivered efficiently to all users, if they are to have satisfactory influence. In the present case, snare users in the farming community have been largely overlooked, whereas training within the gamekeeper community also needs to be extended and updated.

Entanglement with fixed objects brings a high risk of injury or death in captured animals. Fox snares can be used effectively in open locations, avoiding this risk, provided they have a low visual and olfactory profile. © GWCT

Ground-nesting birds, such as this grey partridge, are vulnerable to fox predation at precisely the time of year when vegetation makes shooting a difficult control method for foxes. This is the season when snares are most used by wild bird gamekeepers.
© Mike Short/GWCT

To be persuasive, training itself needs to be supported by evidence. So it is encouraging that both the recent studies of snares produced evidence that strongly supports the recommendations of the CoP. Both studies showed that, when well-designed snares were used following CoP recommendations, injuries to target and non-target species were uncommon. In particular, the Defra study showed that fox snares used by an operator in line with CoP recommendations met the internationally agreed humaneness standards already used by Canada, Russia, the USA and the UK to assess other traps.

Both studies confirmed the importance of snare design, because poor design, components or construction can lead to breakages in use, such that animals escape with the snare loop attached, with a high risk of prolonged suffering. The GWCT study showed that attention to detail in design can substantially improve selectivity, by allowing a high proportion of non-target species to release themselves after capture. The main features allowing this were inclusion of a closely-specified breakaway component in the noose; and increasing the minimum loop diameter allowed by the fixed 'stop'. (The stop itself is not a mandatory requirement in England and Wales.)

However, better hardware alone is not sufficient. When snares are not used according to CoP recommendations, animal welfare problems become significant, no matter what design of snare is used. In particular, our study showed unequivocally that setting any snare where it could become entangled with nearby fixed objects (like fences, brushwood, or an anchor stake protruding above the ground) created a much higher risk of injury or death in captured foxes, badgers and hares. At the same time, although good snares do not guarantee good practice, good practice is possible only with suitable snares. In line with the CoP, every aspect of the GWCT's experi-

mental snare was designed to facilitate use in open locations where entanglement could not occur.

Self-evidently, if snares are used while foxes are absent, only non-targets will be caught. In view of this, the CoP recommends a responsive style of use, setting snares only in response to field evidence of fox activity in the vicinity, and removing them after a week or so without captures or renewed evidence. But it is not easy to strike the right balance. Both recent studies showed that brown hares are regularly caught in fox snares, but also that foxes – when present – are an eager predator of hares. As is common in wildlife management, a trade-off between species conservation and the welfare of individual animals may be unavoidable. The brown hare is a species of conservation concern in the UK and the rest of Europe, having shown a steep decline in abundance as agriculture intensified. Nevertheless, where there is both suitable habitat and effective fox control – including the use of snares – hares can build up their numbers rapidly, with the result that estates managed for wild game alongside agriculture can develop very high densities of this iconic farmland species. Accidental captures of hares in fox snares reflect this. On the other hand, good habitat without fox control produces an equivocal and at best, small increase in hare density.

Public acceptance of snares for their utility in fox control seems more likely if the community of snare users can demonstrate a culture of responsible and careful use. On the face of recent evidence, that will require a significant shift in attitudes and conduct. At the same time, these studies have shown that substantial improvements in selectivity and humaneness are achievable, by using well-designed snares and following CoP guidance on operating practice. It will take some time for all the new evidence to be fully assimilated, so at the time of writing its influence on Government policy in either England and Wales, or in Scotland, is unclear. We look forward to contributing to future discussions.

Bad practice takes many forms, but one of the worst is to set the snare (as in this picture) close to fixed objects with which a captured animal can become entangled. For foxes or badgers caught and held in snares, the probability of injury or death was 40% where snares became entangled with fixed obstacles, compared with 1-5% where entanglement did not occur. © GWCT

Trout stocking – the triploid diploid story so far

Our study showed that stocked fish do not survive very well in spate rivers due to the torrid conditions. © Dylan Roberts/GWCT

In 2002 the Environment Agency (EA) published their *National Trout and Grayling Fisheries Strategy*. An important component of this document focused on trout stocking and particularly the risk of domesticated fertile (diploid) farmed trout inter-breeding with native trout. Following studies and consultation in 2007, the EA announced that all brown trout stocked into rivers must be infertile (triploid) by 2015, hence removing the potential risks from inter-breeding. Native strains of diploid fish could be stocked if reared in a suitable regime.

When the move to triploids was announced, there were concerns from anglers, scientists and the fish farming industry. In particular, there was little evidence of how triploids perform once stocked into rivers compared with their fertile cousins. Are they as catchable and fit for purpose or do they compete more aggressively with native fish for food and space? There were also concerns regarding the production of triploids in some parts of the country as triploids do not fare well when reared in harsher climates. A survey of triploid users and producers by the EA recorded that support on the use of triploids was divided, 38% of individuals and 35% of groups approved the move to triploids whereas 34% and 36% of individuals and groups respectively were against the use of triploids.

We stocked over 2,200 individually marked triploid and diploid brown trout. © Dylan Roberts/GWCT

KEY FINDINGS

- Stocked diploid and triploid trout weighing 1.5lbs performed similarly in the river.
- Both types had little competitive effect on wild trout.

Dylan Roberts

We strongly believe in using science to guide management. Therefore, in partnership with a number of organisations we undertook several studies to shed light on these concerns.

These studies included the stocking of 1,100 individually marked triploid and 1,100 diploid brown trout around 1.5lbs in weight into experimental areas in two upland rain-fed rivers in Herefordshire and four lowland rivers in the south of England for two years. This work demonstrated that site retention was similar but poor for both groups. For example, three months after stocking we estimated that only 5% of triploid and 3% of diploid trout were still present in our stocked upland sites. In our lowland stocked sites, site fidelity was still low but better than in the upland sites: 23% of triploid trout and 14% of diploid trout were still present three months after release. No measurable effects on wild trout growth and abundance were detected.

We studied the interactions of triploid, diploid and wild brown trout during spawning to investigate how triploids behaved around spawning trout given that they are infertile. As expected, they showed little interest in spawning behaviour and we recorded little evidence of them interfering with wild trout. As a result, they were more likely to survive into the following spring given that most losses of fertile trout were caused by predation during spawning.

We also studied the catchability of triploid trout, through a blind trial of marked stocked diploid and triploid trout on the Salisbury and District Angling Association water on the River Avon. This suggested that triploids performed as well as if not slightly better than their fertile cousins. For example, from 186 triploid and 186 diploid fish stocked into the same 500-metre beat, 31 triploids and 21 diploids were caught by anglers.

So far our research on the performance and interactions of triploids (1.5lbs in weight) with wild trout demonstrates that they are unlikely to be more damaging in their effect than diploids of similar size. However, there are still gaps in our knowledge of triploids and their potential effects on native fish, for instance:

- There are still concerns among fishermen about the catchability of triploids. Our limited trial suggested the contrary, but a fully replicated experiment on upland and lowland rivers would provide more insight and greater confidence.
- As triploids are more likely to survive into the spring, will they predate more heavily on newly hatched wild trout?
- A number of fisheries stock much larger trout (between 3lbs and 6lbs). How would these much larger trout compete with smaller wild fish?
- There is still uncertainty about the rates of genetic integration between stocked and native fish.

TRIPLOIDING

Triploiding is achieved by subjecting newly fertilised eggs to a temperature or pressure shock which adds an extra set of chromosomes. This fine-tuned process results in more than 95% of fish becoming sterile. Triploidy occurs naturally; in about one in 5-10,000 fish. However, triploids are not genetically modified as such: this term is normally applied to organisms which receive new chromosomes from different flora or fauna. The animal's existing chromosomes have simply been altered to render it sterile.

ACKNOWLEDGEMENTS

We would like to thank the Environment Agency and Kimbridge Estate on the Test.

Most losses of fertile trout were caused by predation during spawning. © Dylan Roberts/GWCT

River Frome salmon population

The installation of a fish pass at Loud's Mill, Dorchester, has benefited parr numbers. © Bill Beaumont/GWCT

KEY FINDINGS

- An unusually large autumn parr migration led to a lower than expected spring smolt count.
- 2011 was characterised by very low flows.
- River Frome one-sea-winter (grilse) feed off the Icelandic continental shelf.

Anton Ibbotson
Kirsteen MacKenzie

Estimates of September parr numbers in 2010 were nearly as high as those recorded in 2009 and remain close to the highest level seen since these estimates became available (see Figure 1). This is particularly pleasing as the smolt run in 2009 was lower than 2008 (see Figure 2) and confirms the benefits of management measures such as gravel washing and opening the upper River Frome via the installation of a fish pass at Louds Mill in Dorchester. In general, adult salmon returns are showing significant improvement from the lows we reached in 2000 (see Figure 3). It also demonstrates that freshwater production of juvenile fish can be high in spite of lower than average egg deposition, an important principle in modelling and predicting salmon population recovery. If we can improve freshwater habitats to increase survival at all freshwater stages we may find salmon numbers recovering quickly.

The behaviour of the parr in 2010 was unusual in that a much higher proportion migrated into the lower tidal reaches of the river than in previous years. In most years we have 3-4,000 parr leaving the streams where they hatch to undergo this downstream migration. However, in 2010 it was about 8,000. We still do not know what initiated this movement in individual salmon parr, but its consequence was a surprisingly low spring smolt count for 2011 (see Figure 2). This highlights the importance of gaining an estimate of the size of the autumn migration and why it happens. If we had only measured spring smolt abundance we would get a false impression of both the freshwater survival rates and the subsequent mortality rate at sea. We hope that over the next three to four years we will know much more about the initiation of the autumn migration and how it affects survival to the adult stage for individual fish.

Figure 1

Number of salmon parr in the River Frome each September 2002-2010

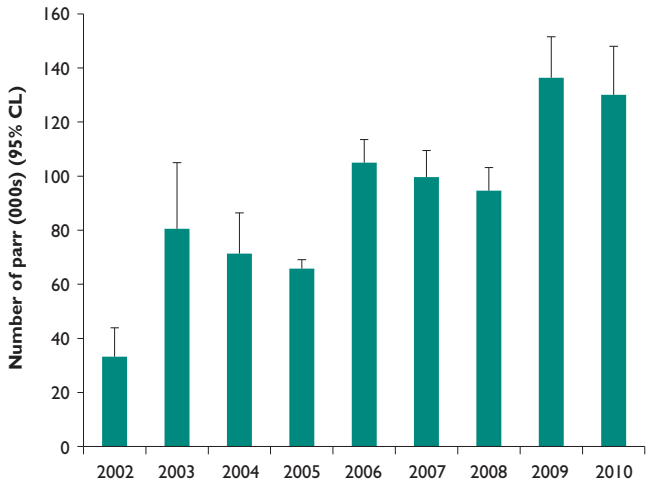
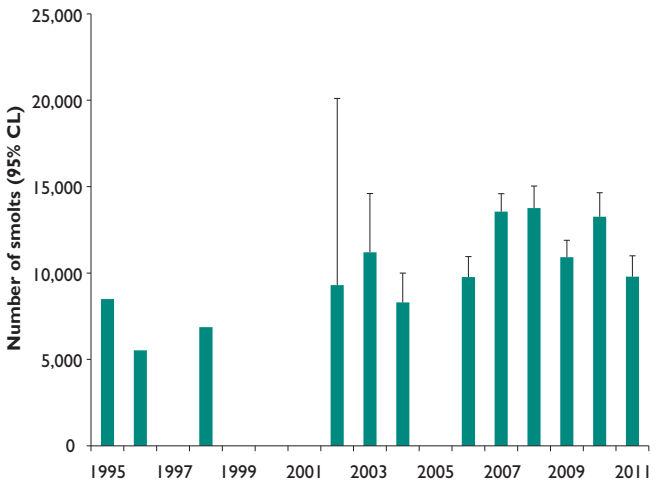


Figure 2

Spring smolt population estimate in the River Frome 1995-2011



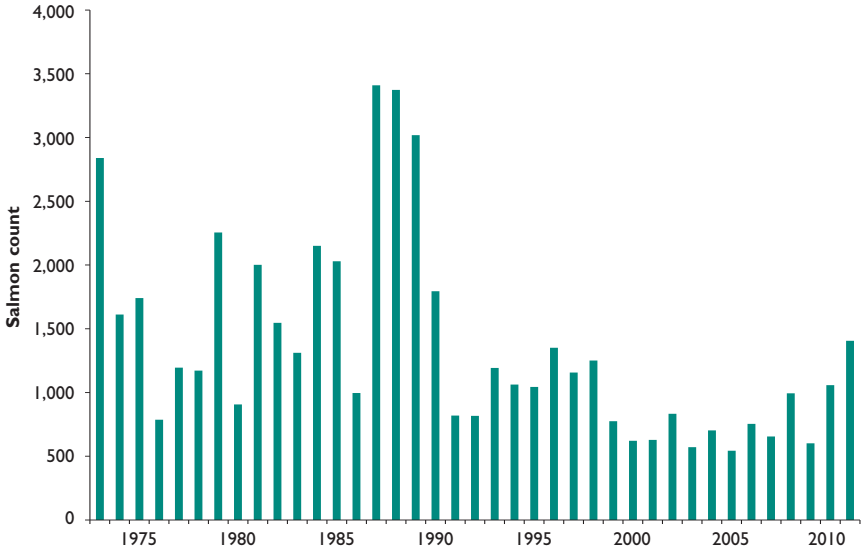


Figure 3

Numbers of returning adult salmon in the River Frome, 1973-2011

In common with other southern English rivers, 2011 was characterised by very low flow levels in the River Frome. This phenomenon started in early spring and essentially lasted all year. The effects of this on the salmon numbers at all stages has yet to be quantified, but one cannot expect it to be good because it will have reduced habitat available for juveniles, resulted in increased predation of smolts and hindered upstream migration by adults. Once the smolt run of 2012 is completed we should be able to quantify some of these effects.

The importance of maintaining a historic archive of salmon scales from the Frome has been demonstrated again as new technologies in the molecular and chemical fields are developed. In 2011, Dr Kirsteen MacKenzie and Dr Clive Trueman of the University of Southampton, National Oceanography Centre Southampton (NOCS), published research showing that marine location can be recovered from the chemistry of fish scales using isotope analysis.

The chemistry of animal tissues reflects the composition of food and water in the area where they live and feed, and can act as a natural tag. Using this idea, the Southampton team, working with scientists from the Trust, the Centre for Environment, Fisheries & Aquaculture Science (Cefas) and NOCS, looked at the isotopes of carbon contained in historical records of scales of Atlantic salmon. The scales grew while the salmon were feeding at sea, so the carbon isotope values of the scales reflect the values of their diet in the feeding grounds. The team compared the scale values through time with satellite records of sea surface temperature across the North Atlantic (see Figure 4). The locations of sea where the time series match best are most likely to be the areas where the fish have been feeding.

For the River Frome fish, one-sea-winter and multi-sea-winter fish feeding grounds were more likely to have been in slightly different areas around the Icelandic continental shelf, opening up interesting questions about the influences of ocean conditions on the Frome population.

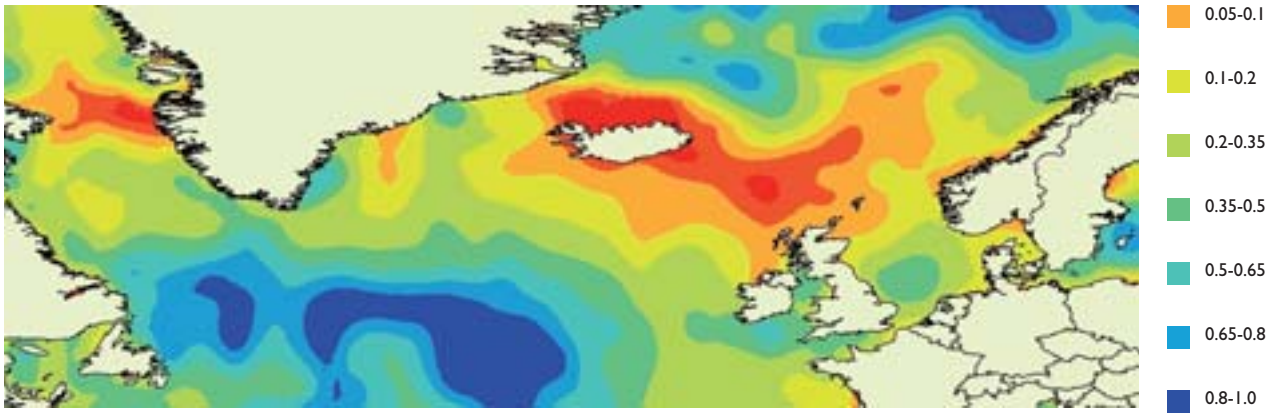
ACKNOWLEDGEMENTS

We would like to thank the Weston Foundation, the Valentine Trust, the Alice Ellen Cooper-Dean Charitable Foundation, Mr Anthony Daniell, Hon Michael Samuel, Lord Iliffe, Mr Rupert Harris, Mr Edward Gallia and family, Lulworth Estate and the Salmon & Trout Association.

Figure 4

Map of River Frome one-sea-winter salmon feeding area

Lowest values represent the greatest correspondence between sea surface temperatures and salmon scale carbon isotope values through time; these are areas where salmon are most likely to have been feeding



Research projects

by the Game & Wildlife Conservation Trust in 2011

WILDLIFE DISEASE AND EPIDEMIOLOGY RESEARCH IN 2011

Project title	Description	Staff	Funding source	Date
Gamebird health	*Disease prevention and control in game and wildlife*	*Chris Davis*	*Core funds*	*1998-2012*

LOWLAND GAME RESEARCH IN 2011

Project title	Description	Staff	Funding source	Date
Pheasant population studies	*Long-term monitoring of breeding pheasant populations on releasing and wild bird estates*	*Roger Draycott, Maureen Woodburn, Rufus Sage*	*Core funds*	*1996- on-going*
Monitoring of East Lothian LBAP	*Monitoring the effects of LBAP measures on bird populations in East Lothian*	*Dave Parish, Hugo Straker*	*Core funds*	*2003- on-going*
Grey squirrels and woodland birds (see page 18)	*Does grey squirrel control increase productivity in woodland birds?*	*Rufus Sage*	*European Squirrel Initiative*	*2007-2011*
Corvids and hedgerow birds	*Does crow and magpie control increase productivity in hedgerow birds?*	*Rufus Sage, John Szczur, Sue Wilson, Tony Powell*	*Songbird Survival*	*2010- on-going*
The management of grass-lands for wildlife and game	*Monitoring the impact of introduced game crops in grassland areas of south-west Scotland*	*Dave Parish, collaboration with SAC*	*SAC, SGRPID*	*2008-2011*
Wild game and cropping	*Productivity in wild game in East Anglia compared with cropping patterns*	*Roger Draycott*	*Felix Cobbold Trust, Chadacre Trust*	*2008-2011*
Wild pheasant mortality (see page 20)	*Investigating survival and productivity of wild pheasants*	*Roger Draycott, Kayleigh Hogg, Nick Hesford, Rebecca Blamey*	*Gayton Estate, Private landowners Sandringham Estate, Oakbank*	*2011- on-going*
Released red-legged partridges	*Fate and dispersal in released red-legged partridges*	*Rufus Sage, Andrew Hoodless, Roger Draycott*	*Core funds*	*2008-2011*
Game marking scheme	*Study of factors affecting return rates of pheasant release pens*	*Rufus Sage, Maureen Woodburn, Roger Draycott, Kayleigh Hogg*	*Core funds*	*2008- on-going*
Impacts of releasing	*Recovery of ground flora in pheasant release pens*	*Andrew Hoodless, Rufus Sage, Vicky Telford*	*Core funds*	*2007-2012*
Arable farming and birds	*Monitoring the response of birds to changes in farmland habitat and management*	*Roger Draycott*	*Sandringham Estate*	*2009- on-going*
Rewilding release shoots	*Factors affecting breeding in free-living reared pheasants*	*Rufus Sage, Roger Draycott, Kayleigh Hogg Nick Hesford, Louise Dean, Rebecca Blamey*	*Guns on Pegs, Core funds Private funds,*	*2010-2013*
PhD: Trade-offs during pheasant growth and development	*Examination of the effects of carotenoid supplementation and parasite infection in early life on adult phenotype*	*Josephine Orledge Supervisors: Andrew Hoodless, Dr Nick Royle/University of Exeter*	*NERC/CASE studentship*	*2007-2011*
PhD: The management of grasslands for wildlife and game	*Autecological studies of granivorous birds in intensive agricultural grasslands of south-west Scotland*	*Dawn Thomson Supervisors: Dave Parish, Dr Davy McCracken/SAC, Prof Neil Metcalfe/ University of Glasgow, Dr Jane MacKintosh/SNH*	*Core funds, SNH, SAC*	*2006-2012*
PhD: Breeding birds in biomass crops	*Breeding success of ground and hedgerow nesting birds in miscanthus and SRC*	*Henrietta Pringle Supervisors: Rufus Sage, Dr Simon Leather/Imperial College*	*NERC/CASE*	*2011-2014*

WETLAND RESEARCH IN 2011

Project title	Description	Staff	Funding source	Date
Woodcock monitoring	*Examination of annual variation in breeding woodcock abundance*	*Andrew Hoodless*	*Shooting Times Woodcock Club*	*2003- on-going*
Woodcock migration routes (see page 26)	*Trial of geolocators to record stopovers and journey times of woodcock on migration*	*Andrew Hoodless Collaboration with ONCFS*	*Woodcock Club*	*2010-2015*
Woodcock winter survey	*Randomised survey of abundance and modelling of habitat use*	*Andrew Hoodless, Chris Heward Jessica Chadwick*	*Core funds*	*2011-2013*
Avon Valley waders (see page 28)	*Monitoring lapwing breeding success in relation to the Higher Level Scheme*	*Andrew Hoodless, Corinne Cox Katy Haynes*	*Core funds, Natural England*	*2007-2012*
Lapwings on fallow plots	*Assessment of lapwing breeding success on AES fallow plots*	*Andrew Hoodless, John Simper Chris Heward, Jessica Hatchett Robyn Silcock*	*Manydown Trust, Hampshire & Isle of Wight Wildlife Trust, The Will Charitable Trust, The John S Cohen Foundation, The D'Oyly Carte Charitable Trust*	*2010-2012*

WETLAND RESEARCH IN 2011 (continued)

DPhil: Origins of over-winter woodcock (see page 22)	*The use of stable isotopes to study woodcock migration and winter movements*	*Adele Powell Supervisors: Andrew Hoodless, Dr Andrew Gosler/Edward Grey Institute/University of Oxford*	*The Countryside Alliance Foundation NERC, Private funds*	*2008-2012*
PhD: Landscape-scale effects of game management	*Evaluation of relative importance of landscape and local management influences on species distribution and abundance*	*Jessica Newman Supervisors: Andrew Hoodless, Dr Graham Holloway – Reading University*	*Core funds, Private funds, Forestry Commission*	*2010-2013*

PARTRIDGE AND BIOMETRICS RESEARCH IN 2011

Project title	Description	Staff	Funding source	Date
Partridge Count Scheme (see page 32)	*Nationwide monitoring of grey and red-legged partridge abundance and breeding success*	*Neville Kingdon, Nicholas Aebischer, Julie Ewald, Dave Parish*	*Core funds*	*1933- on-going*
National Gamebag Census (see page 42)	*Monitoring game and predator numbers with annual bag records*	*Nicholas Aebischer, Gillian Gooderham, Chris Wheatley*	*Core funds*	*1961- on-going*
Sussex study (see page 38)	*Long-term monitoring of partridges, weeds, invertebrates, pesticides and land use on the South Downs in Sussex*	*Julie Ewald, Nicholas Aebischer, Steve Moreby, Dick Potts (consultant)*	*Core funds*	*1968- on-going*
Partridge over-winter losses (see page 36)	*Identifying reasons for high over-winter losses of grey partridges in the UK*	*Francis Buner, Nicholas Aebischer*	*Core funds,*	*2007-2013*
Mammal population trends	*Analysis of mammalian bag and cull data from the National Gamebag Census under the Tracking Mammals Partnership*	*Nicholas Aebischer, Jonathan Reynolds Chris Wheatley, Julie Ewald*	*JNCC*	*2003-2011*
Transactional Environmental Support Systems (TESS)	*Designing an environmental support system across Europe*	*Julie Ewald*	*EU*	*2009-2011*
Arable flora in the CCWWD AONB	*Assessing the distribution of arable plants in the Cranborne Chase and West Wiltshire Downs AONB*	*Julie Ewald*	*CCWWD AONB*	*2011-2011*
NGO survey	*Gamekeepers and wildlife: a new survey: 2011*	*Julie Ewald, Nick Sotherton*	*NGO*	*2011-2011*
Wildlife monitoring at Rotherfield Park (see page 34)	*Monitoring of land use, game and songbirds for the Rotherfield Demonstration Project*	*Francis Buner, Malcolm Brockless, Julie Ewald, John Simper, Peter Thompson*	*Core funds*	*2010-2014*
Spring hunting review	*Review and quantify population impact of spring hunting of migrating quails and turtle doves*	*Nicholas Aebischer*	*Government of Malta*	*2011-2011*
BDS deer survey work	*Repeat of the 2000, 2006 deer survey*	*Julie Ewald, Neville Kingdon, Chris Wheatley, Ryan Burrell, Lizzie Grayshon*	*BDS*	*2011-2012*

UPLANDS RESEARCH IN 2011

Project title	Description	Staff	Funding source	Date
Strongylosis research (see page 50)	*Development of strongylosis control techniques*	*David Newborn, David Baines, Mike Richardson*	*Core funds*	*2006- on-going*
Grouse monitoring (see page 46)	*Annual long-term counts and parasite monitoring*	*David Newborn, David Baines, Mike Richardson, Kathy Fletcher, David Howarth, Graeme Neish*	*Core funds, Gunnerside Estate*	*1980- on-going*
Black grouse research	*Ecology and management of black grouse*	*Philip Warren, Frances Atterton*	*Core funds*	*1989- on-going*
Black grouse range extension (see page 54)	*Black grouse range restoration*	*Philip Warren, Frances Atterton*	*Biffa, SITA Trust*	*1996-2013*
Tick research	*Development of tick control techniques*	*David Baines, David Newborn, Mike Richardson*	*Core funds*	*2011-2015*
Tick control	*Tick control in a multi-host system*	*Kathy Fletcher, David Howarth*	*Various Trusts*	*2000-2012*
Woodland grouse - Scotland	*Ecology and management of capercaillie*	*David Baines, Graeme Neish*	*SNH*	*1991-2012*
Grouse ecology in the Angus Glens	*Roles of parasites, predators and habitat in determining grouse abundance in the Angus Glens*	*Kathy Fletcher, Laura Taylor*	*Core funds*	*2006-2012*
Monitoring Langholm Moor Demonstration Project (see page 56)	*Research data for moorland restoration to-achieve economically-viable driven grouse shooting and sustainable numbers of hen harriers*	*David Baines, Damian Bubb Paula Keane/RSPB, Aly McCluskie/RSPB*	*Core funds, Buccleuch Estates SNH, RSPB, NE*	*2008-2018*
Mountain hares	*Developing a reliable method for estimating mountain hare numbers*	*Scott Newey/MLURI Rob Raynor/SNH, David Baines*	*SNH, MLURI*	*2008-2011*
Spatial habitat use by black grouse in commercial plantation forests in Scotland	*Radio-tracking study of black grouse habitat use in and around plantations in Perthshire to derive forest-based management prescriptions*	*David Baines, Patrick White*	*SNH, Cairngorms National Park Authority, Forest Enterprise Scotland*	*2009-2012*
Conservation of grey partridges in the upland fringes	*Survey of the status, recent trends and habitat use by grey partridges in the upland fringes of northern England*	*Philip Warren, Tom Hornby*	*SITA Trust, Co Durham Environment Trust*	*2009-2012*

FARMLAND RESEARCH IN 2011

Project title	Description	Staff	Funding source	Date
Farm4Bio	*Comparing different ways of managing uncropped land for farmland wildlife and to identify the proportion of land needed*	*John Holland & Rothamsted Research, BTO, The Arable Group, Tom Birkett, John Simper*	*Defra, HGCA, Bayer CropScience Ltd, BASF Ltd, Cotswolds Seeds, Dow AgroSciences Ltd, Du Pont, PGRO, Syngenta Ltd*	*2006-2011*
Perennial brood-rearing habitat	*Developing perennial brood-rearing habitat for grey partridges*	*Barbara Smith, Caitlin Potter*	*Core funds*	*2007-2012*
Conservation Grade	*To develop sustainable, multi-purpose, farmland wildlife crops*	*John Holland, Thomas Wood*	*Conservation Grade Ltd*	*2010-2015*
Invertebrates on arable weeds (see page 60)	*A meta-analysis of arable weeds and their associated invertebrate fauna*	*Barbara Smith, Caitlin Potter*	*Esmée Fairbairn Foundation*	*2010-2011*
New Forest heather management (see page 62)	*To investigate rate of recolonisation of sites managed by burning*	*Barbara Smith, Caitlin Potter*	*New Forest National Park*	*2010-2011*
Natural enemies	*Review of ecosystem services from Environmental Stewardship that benefit agricultural production*	*John Holland*	*Natural England (sub-contract to FERA)*	*2011-2011*
Invertebrates in uncropped land	*A review of the invertebrate fauna of uncropped land at risk from spray drift in Europe*	*John Holland, Barbara Smith*	*Syngenta*	*2011-2011*
Sainfoin	*To investigate the potential of sainfoin* (Onobrychis viciifolia) *as a resource for wildlife*	*Barbara Smith, Tom Birkett, David Evershed*	*Core funds*	*2011-2012*
Chick-food in perennial habitats	*Evaluating potential of uncropped habitats on farmland to provide chick-food*	*John Holland, Tom Birkett, Steve Moreby*	*Core funds*	*2010-2012*
River Avon invertebrates	*Long-term monitoring of River Avon aquatic invertebrates*	*Tom Birkett*	*Core funds*	*2011- on-going*
PhD: The population genetics of sawflies	*The impact of population dynamics on genetics and the implications for habitat management*	*Nicola Cook Supervisors: Dave Parish, Dr Steve Hubbard (University of Dundee) Dr Joanne Russell & Dr Alison Karley/ Scottish Crop Research Institute*	*BBSRC/CASE studentship, Scottish Crop Research Institute*	*2007-2011*

ALLERTON PROJECT RESEARCH IN 2011

Project title	Description	Staff	Funding source	Date
Effect of game management at Loddington	*Effect of ceasing predator control and winter feeding on nesting success and breeding numbers of songbirds. Use of feed hoppers.*	*Chris Stoate, Alastair Leake, John Szczur*	*Allerton Project funds*	*2001- on-going*
Monitoring wildlife at Loddington (see page 64)	*Annual monitoring of game species, songbirds, invertebrates, plants and habitat*	*Chris Stoate, John Szczur, Alastair Leake, Steve Moreby, Barbara Smith*	*Allerton Project funds*	*1992- on-going*
Soil and Waste Management	*Training for farmers in the understanding of Soil Management Plans and the EU Waste Directive*	*Alastair Leake, Phil Jarvis*	*Course fees, Defra, Environment Agency*	*2005- on-going*
ClimateWater	*Climate change impacts on water as a resource and ecosystem*	*Chris Stoate*	*EU*	*2008-2011*
Metaldehyde in water	*Assessment of metaldehyde in field drain water and streams*	*Chris Stoate, John Szczur*	*Anglian Water*	*2011-2012*
Wildlife in hemp (see page 74)	*Abundance of birds, insects and plants in hemp, relative to other break crops*	*Chris Stoate, John Szczur, Jamie Partridge*	*Hemp Technology*	*2011-2012*
Collaborative conservation in agri-environment schemes	*Collaboration between neighbouring farmers to deliver landscape scale wildlife conservation*	*Alastair Leake, Chris Stoate*	*RELU*	*2011-2012*
Rural communities adapting to climate change	*Interaction between national/regional policy and local perceptions and practice influencing domestic and landscape climate change adaptation and mitigation*	*Chris Stoate*	*RELU*	*2011-2012*
MOPS2: Mitigation options for phosphorus and sediment	*Development of constructed wetlands to reduce diffuse pollution*	*Chris Stoate, John Szczur*	*Defra*	*2009-2013*
Reducing risks associated with autumn wheeling of combinable crops	*Replicated field treatments looking at reducing compaction and increasing soil cover in tramline crop wheelings*	*Alastair Leake, Martyn Silgram (ADAS), John Quinton (University of Lancaster), Julian Hasler (HGCA/NFU)*	*ADAS, Chafer Machinery, Michelin, Simba*	*2009-2013*
Albrecht Soil Survey Technique	*Field-scale testing of the Albrecht Soil Survey Technique of nutrient management compared with conventional crop nutrition*	*Alastair Leake, Phil Jarvis*	*Royal Agricultural Society of England, the Glenside Group*	*2009-2012*
Water Friendly Farming	*Baseline data collection for diffuse pollution control project in headwater catchments*	*Chris Stoate, Jeremy Briggs, Penny Williams (Pond Conservation)*	*Environment Agency Syngenta*	*2010-2011*
Birds on Eye Brook farms	*A landscape assessment of bird abundance around Loddington*	*Chris Stoate, Ben Norman*	*Allerton Project funds*	*2011-2011*
Greenhouse gas audits of Eye Brook farms	*Assessment of greenhouse gas balances and recommendations for mitigation amongst six local farms*	*Chris Stoate, Miguel Astudillo*	*Allerton Project funds*	*2011-2011*

ALLERTON PROJECT RESEARCH IN 2011 (continued)

Eye Brook land-use change (see page 72)	*An assessment of connectivity associated with potential future land-use change*	*Chris Stoate, Boris Eremin*	*Allerton Project funds*	*2011-2011*
Welland Sediment Project	*Assessing sediment impacts in the upper river Welland and advocating mitigation*	*Chris Stoate, Kathryn Carr Partnership with Welland Rivers Trust*	*Environment Agency*	*2009-2011*
Slug control	*Efficacy of ferric phosphate as a slug control agent*	*Alastair Leake, Phil Jarvis, Anthony Thevenot*	*Omex Agriculture*	*2009-2011*
Soil conditioner	*The feasibility of anaerobic digestate as a soil conditioner*	*Alastair Leake, ADAS*	*Biffa, Leicester City Council*	*2009-2011*
PhD: Game as food	*Rural networks and processes associated with the use of game as food*	*Graham Riminton Supervisors: Chris Stoate, Dr Carol Morris & Dr Charles Watkins/University of Nottingham*	*ESRC/CASE studentship Supported by the BDS*	*2007-2012*
PhD: Environmental learning careers of farmers	*An investigation into how farmers learn about effective environmental management through their active participation in agri-environment schemes*	*Susanne Jarratt Supervisors: Chris Stoate, Dr Carol Morris/ University of Nottingham*	*ESRC/NERC studentship*	*2009-2013*

PREDATION RESEARCH IN 2011

Project title	Description	Staff	Funding source	Date
Fox control methods (see page 76)	*Experimental field comparison of fox capture devices*	*Jonathan Reynolds, Mike Short*	*Core funds*	*2002- on-going*
Tunnel traps	*Experimental field comparison of tunnel traps and methods of use*	*Jonathan Reynolds, Mike Short*	*Core funds*	*2008- on-going*
PhD: Pest control strategy	*Use of Bayesian modelling to improve control strategy for vertebrate pests*	*Tom Porteus Supervisors: Jonathan Reynolds, Prof Murdoch McAllister/University of British Columbia, Vancouver*	*Core funds, University of British Columbia*	*2006-2012*

FISHERIES RESEARCH IN 2011

Project title	Description	Staff	Funding source	Date
Fisheries research	*Develop wild trout fishery management methods including completion of write-up/reports of all historic fishery activity*	*Dylan Roberts, Dominic Stubbing*	*Core funds*	*1997- on-going*
Monnow habitat improvement project	*Large-scale conservation project and scientific monitoring of 30 kilometres of river habitat on the River Monnow in Herefordshire*	*Dylan Roberts*	*Defra, Rural Enterprise Scheme, Monnow Improvement Partnership*	*2003-2011*
Releasing trout fry (see page 80)	*Survival of domesticated triploid farmed trout fry stocked from incubator boxes in chalk streams and their impacts on wild trout*	*Dylan Roberts, Dominic Stubbing*	*Core funds*	*2008-2012*
Survival of native trout fry	*Survival of native trout fry stocked from incubator boxes on the Candover Brook*	*Dylan Roberts, Dominic Stubbing*	*Vitacress Conservation Trust, EA, Core funds*	*2008-2011*
Small-scale hydro and salmon	*Impact of run of river hydro on salmon smolts – Pilot study*	*Anton Ibbotson, William Beaumont, Luke Scott*	*S&TA, Bindon Estate Core Funds*	*2010-ongoing*
Salmon life-history strategies in freshwater (see page 82)	*Understanding the population declines in salmon*	*Anton Ibbotson, Dylan Roberts, William Beaumont, Luke Scott, Dominic Stubbing*	*Core funds, EA, CEFAS, Valentine Trust, Alice Ellen Cooper Dean Charitable Trust, AST, S&TA, Garfield Weston Foundation*	*2009- on-going*
Salmon smolt rotary screw trap assessment	*Calculating the effects of rotary screw traps on salmon smolts*	*Anton Ibbotson, Dylan Roberts, Luke Scott William Beaumont, Dominic Stubbing*	*CEFAS*	*2009- on-going*
Avon demonstration test catchment project	*Impact of farm practice mitigation measures on fish*	*Dylan Roberts, Anton Ibbotson, Luke Scott Dominic Stubbing William Beaumont,*	*Defra*	*2010-2014*
PhD: Pike and weed management in lowland rivers	*Impact of pike removal and weed management on brown trout*	*Sui Phang Supervisors: Dylan Roberts, Anton Ibbotson, Dr R Gozlan & Dr R Britten/University of Bournemouth*	*Core funds, University of Bournemouth*	*2009-2013*
PhD: Water temperatures and salmonids	*Micro habitat use by salmonids in relation to temperature*	*Frances Mallion Supervisors: Dylan Roberts, Anton Ibbotson, Dr P Kemp/University of Southampton*	*University of Southampton, Core funds, EA, CEH*	*2009-2013*
PhD: Atlantic salmon, climate change and human exploitation	*Assessing the sustainability of Atlantic salmon across the southern part of their European range in the light of climate change and human exploitation*	*Charles Ikediashi Supervisors: Dr Jamie Stevens, Dr Dylan Bright, WCRT, Anton Ibbotson*	*Exeter University, AST, S&TA, . WCRT, Core Funds*	*2011-2014*

Key to abbreviations: AST = Atlantic Salmon Trust; AONB = Area of Outstanding Natural Beauty; BBSRC = Biotechnology and Biological Sciences Research Council; BDS = British Deer Society; CASE = Co-operative Awards in Science & Engineering; CCWWD = Cranborne Chase and West Wiltshire Downs; CEFAS = Centre for Environment, Fisheries & Aquaculture Science; CEH = Centre for Ecology and Hydrology; Defra = Department for Environment, Farming and Rural Affairs; EA = Environment Agency ESRC = Economic & Social Research Council; EU = European Union; FERA = Food and Environment Agency; HGCA = Home-Grown Cereals Authority; JNCC = Joint Nature Conservation Committee; MLURI = Macaulay Land Use Research Institute; NE = Natural England; NERC = Natural Environment Research Council; NGO = National Gamekeepers' Organisation; PGRO = Processors and Growers Research Organisation; RSPB = Royal Society for the Protection of Birds; RELU = Rural Economy & Land Use; S&TA = Salmon & Trout Association; SAC = Scottish Agricultural Colleges; SGRPID = Scottish Government Rural Payments and Inspections Directorate; SNH = Scottish Natural Heritage; WCRT = Westcountry Rivers Trust.

Scientific publications

by staff of the Game & Wildlife Conservation Trust in 2011

Beaumont, WRC (2011) *Electric Fishing: A complete guide to theory and practice.* Game & Wildlife Conservation Trust, Fordingbridge, Hampshire.

Beaumont, WRC, Scott, L & Ibbotson, AT (2011) *Salmon research report 2010.* Salmon & Trout Research Centre, Game & Wildlife Conservation Trust, Wareham, Dorset.

Bisi, F, Newey, S, Nodari, M, Wauters, LA, Harrison, A, Thirgood, S & Martinoli, A (2011) The strong and the hungry: bias in capture methods for mountain hares *Lepus timidus*. *Wildlife Biology,* 17: 311-316.

Bond, AJ, Dockerty, T, Lovett, A, Riche, AB, Haughton, AJ, Bohan, DA, Sage, RB, Shield, IF, Finch, JW, Turner, MM & Karp, A (2011) Learning how to deal with values, frames and governance in sustainability appraisal. *Regional Studies*, 45: 1157-1170.

Buner, FD, Browne, SJ & Aebischer, NJ (2011) Experimental assessment of release methods for the re-establishment of a red-listed galliform, the grey partridge *(Perdix perdix)*. *Biological Conservation*, 144: 593-601.

Bunnefeld, N, Reuman, DC, Baines, D & Milner-Gulland, EJ (2011) Impact of unintentional selective harvesting on the population dynamics of red grouse. *Journal of Animal Ecology*, 80: 1258-1268.

Chambers, B, Goulding, K & Leake, AR (2011) *Simply sustainable soils. Six simple steps for your soil to help improve the performance, health and long-term sustainability of your land.* Asda and LEAF (Linking Environment and Farming), Stoneleigh Park, Warwickshire.

Cook, N (2011) *Population genetics of the farmland sawfly* Dolerus aeneus *(Hymenoptera, Symphyta)*. Unpublished PhD thesis. University of Dundee, Dundee.

Cucherousset, J, Acou, A, Blanchet, S, Britton, JR, Beaumont, WRC & Gozlan, RE (2011) Fitness consequences of individual specialisation in resource use and trophic morphology in European eels. *Oecologia,* 167: 75-84.

Davey, JS (2010) *Intraguild predation among generalist predators in winter wheat.* Unpublished PhD thesis. University of Cardiff, Cardiff.

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Firbank, L, Bradbury, R, McCracken, D & Stoate, C (2011) Enclosed farmland. In: *UK National Ecosystem Assessment Technical Report:* 197-239. United Nations Environment Programme World Conservation Monitoring Centre (UNEP-WCMC), Cambridge.

Gilljam, D, Thierry, A, Edwards, FK, Figueroa, D, Ibbotson, AT, Jones, JI, Lauridsen, RB, Petchey, OL, Woodward, G & Ebenman, B (2011) Seeing double: size-based and taxonomic views of food web structure. *Advances in Ecological Research*, 45: 67-133.

Höglund, J, Larsson, JK, Corrales, C, Santafé, G, Baines, D & Segelbacher, G (2011) Genetic structure among black grouse in Britain: implications for designing conservation units. *Animal Conservation,* 14: 400-408.

Iannetta, P, Hubbard, S, Karley, A, Smith, B, Squire, G & Watson, C (eds) (2011) Agricultural ecology research: its role in delivering sustainable farm systems. *Aspects of Applied Biology,* 109. Association of Applied Biologists, Warwick.

Ibbotson, AT, Beaumont, WRC & Pinder, AC (2011) A size-dependent migration strategy in Atlantic salmon smolts: small smolts favour nocturnal migration. *Environmental Biology of Fishes*, 92: 151-157.

Kenward, RE, Whittingham, MJ, Arampatzis, S, Manos, BD, Hahn, T, Terry, A, Simoncini, R, Alcorn, J, Bastian, O, Donlan, M, Elowe, K, Franzén, F, Karacsonyi, Z, Larsson, M, Manou, D, Navodaru, I, Papadopoulou, O, Papathanasiou, J, von Raggamby, A, Sharp, RJA, Söderqvist, T, Soutukorva, A, Vavrova, L, Aebischer, NJ, Leader-Williams, N & Rutz C (2011) Identifying governance strategies that effectively support ecosystem services, resource sustainability and biodiversity. *Proceedings of the National Academy of Sciences of the United States of America*, 108: 5308-5312.

Knox, OGG, Leake, AR, Walker, RL, Edwards, AC & Watson, CA (2011) Revisiting the multiple benefits of historical crop rotations within contemporary UK agricultural systems. *Journal of Sustainable Agriculture,* 35: 163-179.

Leake, AR (2010) Different soil cultivation systems and their implications for nutrient planning and energy use. *Proceedings International Fertiliser Society,* 676: 1-16.

Leake, AR, Thompson, PGL & Jarvis, PE (2011) Agri-environment Stewardship; improving performance and agronomic management through manipulating the rotation of in-field options. *Aspects of Applied Biology,* 113: 9-14.

Lye, GC, Park, KJ, Holland, JM & Goulson, D (2011) Assessing the efficacy of artificial domiciles for bumblebees. *Journal for Nature Conservation,* 19: 154-160.

MacKenzie, KM, Palmer, MR, Moore, A, Ibbotson, AT, Beaumont, WRC, Poulter, DJS & Trueman, CN (2011) Locations of marine animals revealed by carbon isotopes. *Scientific Reports,* 1/21: 1-6. DOI: 10. 1038/srep00021.

Oaten, H (2011) *Local and landscape effects of field margins on aerially dispersing beneficial insects and spiders.* Unpublished PhD thesis. Imperial College London, London.

Orledge, JM *(2011) Consequences of trade-offs during growth and development in pheasants* (Phasianus colchicus). Unpublished PhD thesis. University of Exeter, Exeter.

Parish, DMB, Hirst, D, Dadds, N, Singleton, R, Hackett, N & Blake, K (2010) The impact of agri-environment schemes on Scotland's biodiversity. In: *Proceedings Crop Protection in Northern Britain* 2010: 21-26. The Association for Crop Protection in Britain, Dundee.

Porteus, TA, Richardson, SM & Reynolds, JC (2011) The importance of survey design in distance sampling: field evaluation using domestic sheep. *Wildlife Research,* 38: 221-234.

Redpath, S, Amar, A, Smith, A, Thompson, D & Thirgood, S (2010) People and nature in conflict: can we reconcile hen harrier conservation and game management? In: Baxter, JM & Galbraith, CA (eds) *Species Management: Challenges and Solutions for the 21st Century:* 335-350. TSO (The Stationery Office).

Riley, WD, Ibbotson, AT, Beaumont, WRC, Pawson, MG, Cook, AC & Davison, PI (2011) Predation of the juvenile stages of diadromous fish by sea bass *(Dicentrarchus labrax)* in the tidal reaches of an English chalk stream. *Aquatic Conservation: Marine and Freshwater Ecosystems,* 21: 307-312.

Sage, RB, Hoodless, AN, Hewson, CM, Wilson, S, le Clare, C, Marchant, JH, Draycott, RAH & Fuller, RJ (2011) Assessing breeding success in common woodland birds using a novel method. *Bird Study,* 58: 409-420.

Sánchez-García, C, Alonso, ME, Pérez, JA, Rodríguez, PL & Gaudioso, VR (2011) Comparing fostering success between wild-caught and game farm bred captive red-legged partridges *(Alectoris rufa, L.). Applied Animal Behaviour Science,* 133: 70-77.

Sotherton, NW & Parish, DM (2011) Sustainable farming systems: integrating research with educational strategies and Government policy. *Aspects of Applied Biology,* 109: 93-100.

Stoate, C (2011) A social learning approach to raising environmental awareness at the catchment scale: the Eye Brook England. In: Ban, M, Duić, N & Guzović, Z (eds) *6th Dubrovnik Conference on Sustainable Development of Energy, Water and Environment Systems:* 1-9. International Centre for Sustainable Development of Energy, Water and Environment Systems, Zagreb.

Stoate, C (2011) Biogeography of agricultural environments. In: Millington, AC, Blumler, M & Schickhoff, U (eds). *The SAGE Handbook of Biogeography:* 338-356. SAGE Publications Ltd, London.

Stoate, C (2011) Can wildlife deliver the goods? Ecosystem services and wildlife conservation. *British Wildlife*, 22: 169-174.

Teuber, K, Schiller, J, Jakop, U, Lüpold, S, Orledge, JM, Blount, JD, Royle, NJ, Hoodless, AN & Müller, K (2011) MALDI-TOF mass spectrometry as a simple tool to determine the phospholipid/glycolipid composition of sperm: pheasant spermatozoa as one selected example. *Animal Reproduction Science,* 123: 270-278.

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Note: the publications listed as 2010 did not appear in print before the Review of 2010 went to press. For a complete record of the scientific publications by staff of the Game & Wildlife Conservation Trust, we therefore include them here.

Financial report
for 2011

KEY POINTS

- Overall funds increased by £667,361.
- There was deficit of £262,569 on the General Fund.
- Expenditure on research again exceeded £3 million.
- Endowment funds increased by nearly £1m as a result of the receipt of the Underwood Fellowship fund.

The summary report and financial statement for the year ended 31 December 2011, set out below and on pages 92 to 93, consist of information extracted from the full statutory Trustees' report and consolidated accounts of the Game & Wildlife Conservation Trust and its wholly-owned subsidiaries Game & Wildlife Conservation Trading Limited and Game Conservancy Events Limited. They do not comprise the full statutory Trustees' report and accounts, which were approved by the Trustees on 17 April 2012 and which may be obtained from the Trust's Headquarters. The auditors have issued unqualified reports on the full annual accounts and on the consistency of the Trustees' report with those accounts, and their report on the full accounts contained no statement under sections 498(2) or 498(3) of the Companies Act 2006.

The Trust's financial performance in 2011 to a large extent reflected the deterioration in the financial climate, with fundraising proving more difficult than we had anticipated and the investment returns being disappointing. As a result of the generosity of our supporters the Trust's general and restricted income increased by around 2.6% and we were also very grateful to receive an endowment of £1,000,000 to fund what will be known as the Underwood Fellowship. Expenditure increased by less than income but unlike 2010 the gap was not filled by gains on the Trust's investments, resulting in a decrease of £265,207 in the General Fund.

The unrestricted investments performed reasonably with positive total returns in a declining market. The endowed investments showed a decrease in value of 4%.

The Trustees continue to keep the Trust's financial performance under close review and to take appropriate measures to protect the Trust against the inevitable uncertainty in fundraising in the current climate. They continue to be satisfied that the Trust's overall financial position is sound. The Trust's reserves policy is that unrestricted cash and investments should exceed £1.5 million and must not fall below £1 million. While the reserves are currently below the target, they are above the minimum. Reflecting the fact that the reserves are below their target the Trustees have put in place a plan for returning the reserves to the target figure over the next five years.

Plans for future periods

The Trust continues to work to the aims set out in its five-year business plan, which are as follows:

1. To focus on three areas of work: species recovery, game and wildlife management and wildlife-friendly farming.
2. To strengthen our ability to deliver the results and implications of that science to our three audience groups – the public, policy makers and practitioners.
3. To maintain the financial security of the Trust.
4. To improve the profile of the Trust and to make it a more relevant organisation to a broader range of stakeholders.

The Trust's strategy of promulgating practical conservation methods based on sound scientific research will continue to make our work even more relevant in the future.

I Coghill
Chairman of the Trustees

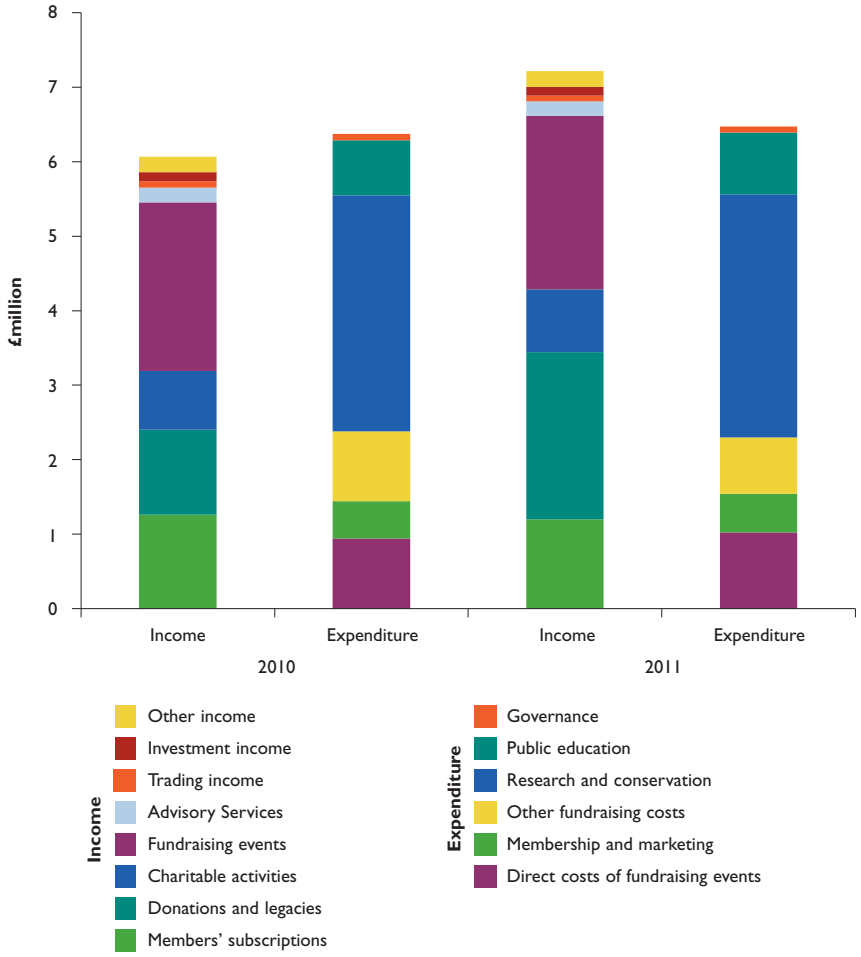

Figure 1

Total incoming and outgoing resources in 2011 (and 2010) showing the relative income and costs for different activities

Independent auditors' statement

to the Trustees and Members of the Game & Wildlife Conservation Trust (limited by guarantee)

We have examined the summary financial statement for the year ended 31 December 2011 which is set out on pages 92 and 93.

Respective responsibilities of Trustees and Auditors

The trustees are responsible for preparing the summarised Financial Report in accordance with applicable United Kingdom law. Our responsibility is to report to you our opinion of the consistency of the summary financial statement with the full annual financial statements and the Trustees' Report, and its compliance with the relevant requirements of section 427 of the Companies Act 2006 and the regulations made thereunder.

We also read the other information contained in the summarised Financial Report and consider the implications for our report if we become aware of any apparent misstatements or inconsistencies with the summary financial statement. The other information comprises only the Review of Financial Performance.

We conducted our work in accordance with Bulletin 2008/3 issued by the Auditing Practices Board. Our report on the Trust's full annual financial statements describes the basis of our opinion on those financial statements.

Opinion

In our opinion the summary financial statement is consistent with the full annual financial statements of the Game & Wildlife Conservation Trust for the year ended 31 December 2011 and complies with the applicable requirements of Section 427 of the Companies Act 2006 and the regulations made thereunder.

FLETCHER & PARTNERS
Chartered Accountants and Statutory Auditors
Salisbury, 30 April 2012

Consolidated

Statement of financial activities

	General Fund £	Designated Funds £	Restricted Funds £	Endowed Funds £	**Total 2011 £**	Total 2010 £
INCOME AND EXPENDITURE						
INCOMING RESOURCES						
Incoming resources from generated funds						
Voluntary income						
Members' subscriptions	1,197,874	-			**1,197,874**	1,262,132
Donations and legacies	473,911	-	772,185	1,000,000	**2,246,096**	1,140,231
	1,671,785	-	772,185	1,000,000	**3,443,970**	2,402,363
Activities for generating funds						
Fundraising events	2,311,046	-	18,400	-	**2,329,446**	2,262,217
Advisory Service	193,144	-	-	-	**193,144**	200,415
Trading income	75,625	-	-	-	**75,625**	84,441
Investment income	18,712	-	97,369	1,126	**117,207**	120,480
Incoming resources from						
Charitable activities	172,209	-	671,221	-	**843,430**	788,993
Other incoming resources	191,145	-	21,986	-	**213,131**	208,216
TOTAL INCOMING RESOURCES	4,633,666	-	1,581,161	1,001,126	**7,215,953**	6,067,125
RESOURCES EXPENDED						
Costs of generating funds						
Direct costs of fundraising events	1,022,815	-	-	-	**1,022,815**	942,814
Membership and marketing	507,831	13,023	-	-	**520,854**	500,111
Other fundraising costs	753,459	-	-	-	**753,459**	938,571
	2,284,105	13,023	-	-	**2,297,128**	2,381,496
Activities in furtherance of the charity's objects						
Research and conservation - Lowlands	1,095,125	-	335,150	-	**1,430,275**	1,513,458
Research and conservation - Uplands	525,825	-	274,412	-	**800,237**	747,321
Research and conservation - Allerton Project	38,013	-	638,175	4,150	**680,338**	578,068
Research and conservation - Fisheries	199,653	-	154,433	-	**354,086**	326,661
	1,858,616	-	1,402,170	4,150	**3,264,936**	3,165,508
Public education	679,756	-	141,983	6,918	**828,657**	741,799
	2,538,372	-	1,544,153	11,068	**4,093,593**	3,907,307
Governance	73,758	8,120	-	-	**81,878**	82,044
TOTAL RESOURCES EXPENDED	4,896,235	21,143	1,544,153	11,068	**6,472,599**	6,370,847
NET INCOMING/(OUTGOING) RESOURCES	(262,569)	(21,143)	37,008	990,058	**743,354**	(303,722)
OTHER RECOGNISED GAINS AND LOSSES						
Realised gains/(losses) on investments	(2,964)	-	-	1,147	**(1,817)**	(1,210)
Unrealised gains/(losses) on investments	326	-	-	(74,502)	**(74,176)**	297,364
NET MOVEMENT IN FUNDS	(265,207)	(21,143)	37,008	916,703	**667,361**	(7,568)
BALANCES AT 1 JANUARY 2011	2,408,574	157,635	378,803	4,366,307	**7,311,319**	7,318,887
BALANCES AT 31 DECEMBER 2011	£2,143,367	£136,492	£415,811	£5,283,010	**£7,978,680**	£7,311,319

Consolidated

Balance sheet

as at 31 December 2011

	2011		2010	
	£	£	£	£
FIXED ASSETS				
Tangible assets		3,350,383		3,124,179
Investments		4,266,682		3,380,949
		7,617,065		6,505,128
CURRENT ASSETS				
Stock	239,604		228,963	
Debtors	711,258		915,380	
Cash at bank and in hand	408,213		702,426	
	1,359,075		1,846,769	
CREDITORS:				
Amounts falling due within one year	590,327		636,994	
NET CURRENT ASSETS		768,748		1,209,775
TOTAL ASSETS LESS CURRENT LIABILITIES		8,385,813		7,714,903
CREDITORS:				
Amounts falling due after more than one year		407,133		403,584
NET ASSETS		£7,978,680		£7,311,319
Representing:				
CAPITAL FUNDS				
Endowment funds		5,283,010		4,366,307
INCOME FUNDS				
Restricted funds		415,811		378,803
Unrestricted funds:				
Designated funds	136,492		157,635	
Revaluation reserve	378,871		469,835	
General fund	1,718,431		1,889,112	
Non-charitable trading fund	46,065		49,627	
		2,279,859		2,566,209
TOTAL FUNDS		£7,978,680		£7,311,319

Approved by the Trustees on 17 April 2012 and signed on their behalf

I COGHILL

Chairman of the Trustees

Staff

of the Game & Wildlife Conservation Trust
in 2011

CHIEF EXECUTIVE	Teresa Dent BSc, FRAgS
Personal Assistant	Wendy Smith *(p/t until August)*; Lindsay Watson BSc, MSc
Head of Finance	James McDonald ACMA
Finance Assistant - Limited	Lin Dance
Accounts Assistant (p/t)	Suzanne Hall
Accounts Assistant (p/t)	Charlotte Ferguson BSc *(until March)*
Head of Administration & Personnel (p/t)	Ian Collins MCIPD, BA *(p/t from January)*
Administration & Personnel Assistant (p/t)	Jayne Cheney Assoc CIPD
Head Groundsman (p/t)	Craig Morris
Headquarters Cleaner (p/t)	Rosemary Davis
Headquarters Janitor (p/t)	Chris Johnson
Head of Information Technology	James Long BSc
DIRECTOR OF COMMUNICATION & PUBLIC AFFAIRS	Tom Oliver MA, Dip.LA, FRSA
Head of Media	Morag Walker MIPR
Head of Publications	Louise Shervington
PR Assistant (p/t)	Jane Bushnell
DIRECTOR OF RESEARCH	Nick Sotherton BSc, PhD
Personal Assistant (p/t)	Lynn Field
Head of Fisheries Research	Dylan Roberts BSc
Fisheries Biologist	Dominic Stubbing HND, MIFM, PhD, Ch. Env *(until December)*
Placement Student *(University of Hull)*	Niall Freemen *(April)*
Placement Student *(University of Worcester)*	Edward Noyes *(August-September)*
Head of Salmon & Trout Research Centre	Anton Ibbotson BSc, PhD
Senior Fisheries Scientist	Bill Beaumont MIFM
Research Assistant	Luke Scott
PhD Student *(University of Bournemouth)* - pike removal and weed cutting	Sui Phang BSc, MSc
PhD Student *(University of Southampton)* - thermal refrugia for salmonids	Frances Mallion BSc
PhD Student *(University of Exeter)* - salmon genetics	Charles Ikediashi BSc
Head of Lowland Gamebird Research	Rufus Sage BSc, MSc, PhD
Ecologist - Pheasants, Wildlife (p/t)	Maureen Woodburn BSc, MSc, PhD
Senior Ecologist - Partridges, Pheasants	Roger Draycott HND, MSc, PhD
Research Assistant	Kayleigh Hogg BSc, MSc *(May-December)*
Bird Surveyor	Sue Wilson BA *(April-July)*
Bird Surveyor	Tony Powell *(April-July)*
PhD Student *(Imperial College, London)* - birds and miscanthus	Henrietta Pringle BSc
MSc student *(Imperial College, London)* - birds and miscanthus	Ed Boyle BSc
MSc student *(University of Reading)* - wild pheasants	Rebecca Blamey BSc
Placement Student *(Bath University)*	Louise Dean *(from July)*
Placement Student *(University of Cardiff)*	Nick Hesford *(until October)*
Head of Wetland Research	Andrew Hoodless BSc, PhD
Research Assistant	John Simper BSc, MSc *(from February)*
Research Assistant	Chris Heward BSc
PhD Student *(University of Exeter)* - pheasant growth and development	Josie Orledge BSc *(until March)*
DPhil Student *(University of Oxford)* - woodcock migration	Adele Powell BSc, MSc
PhD Student *(University of Reading)* - game landscapes	Jessica Neumann BSc
MSc Student *(University of Exeter)* - lapwings on fallow plots	Robyn Silcock BSc
MSc Student *(University of East Anglia)* - lapwings on fallow plots	Jessica Hatchett BSc
MSc Student *(University of Reading)* - lapwings on wet grassland	Corinne Cox BSc
MSc Student *(University of Reading)* - lapwings on wet grassland	Katy Haynes BSc
MSc Student *(University of Exeter)* - snipe habitat use	Neil Duffield BSc
MSc Student *(University of Newcastle)* - floral recovery in pheasant release pens	Vicky Telford BSc
MSc Student *(University of Reading)* - woodland birds and game management	Chris Foster BSc
Placement Student *(University of Plymouth)*	Jessica Chadwick *(from October)*
Senior Scientist - Scottish Lowland Research	David Parish BSc, PhD
PhD Student *(University of Glasgow)* - yellowhammer ecology	Dawn Thomson BSc
PhD Student *(University of Dundee)* - population genetics of sawflies	Nicki Cook BSc
PhD Student *(University of St Andrews and John Hutton Institute)* - small mammal ecology on farmland	Amanda Wilson BSc
Head of Wildlife Disease & Epidemiology	Chris Davis BVM&S, MRCVS
Head of Predation Control Studies	Jonathan Reynolds BSc, PhD
Senior Field Ecologist	Mike Short HND
Research Assistant	Thomas Porteus BSc, MSc
Research Assistant	Suzanne Richardson BSc, MSc *(until July)*
Head of Farmland Ecology	John Holland BSc, MSc, PhD
Senior Ecologist	Barbara Smith BSc, PhD
Senior Entomologist	Steve Moreby BSc, MPhil
Entomologist	Sue Southway BA *(seconded Plantlife)*
Ecologist	Tom Birkett BSc, PgC
Ecologist	John Simper BSc, MSc *(until February)*
MSc Student *(University of East Anglia)* - chick food in margins	Thomas Wood BSc
Placement Student *(University of Durham)*	David Evershed *(from September)*
Placement Student *(University of York)*	Caitlin Potter *(until September)*
Director of Upland Research	David Baines BSc, PhD
Office Manager, The Gillett	Julia Hopkins
Senior Scientist	Phil Warren BSc, PhD
Project Assistant - Black Grouse	Frances Atterton BSc, MSc

Research Assistant	Michael Richardson BSc
Research Assistant - Partridge	Tom Hornby BSc
Research Ecologist Langholm	Damian Bubb BSc, PhD
Placement Student *(University of York)*	Jemma Grant *(until August)*
Placement Student *(Harper Adams)*	Eleanor Healey *(until August)*
Placement Student *(Harper Adams)*	Matthew Howarth *(from August)*
Senior Scientist - North of England Grouse Research	David Newborn HND
Senior Scientist - Scottish Upland Research	Kathy Fletcher BSc, MSc, PhD
Research Assistant - Scottish Upland Research	David Howarth
Research Assistant - Scottish Upland Research	Graeme Neish
Woodland Grouse Research Scientist	Patrick White BSc, PhD
Project Scientist - Angus Glens	Laura Taylor BSc
MSc Student *(University of Reading)* - black grouse breeding ecology	Courtney Kennedy BSc
MSc Student *(University of York)* - black grouse breeding ecology	Ben Crossman BSc
Placement Student *(University of York)*	Phoebe Morton *(until August)*
Placement Student *(University of Bath)*	Holly Stevens *(until until August)*
Placement Student *(Harper Adams)*	Merlin Becker *(from August)*
Placement Student *(University of Bath)*	Gemma Jenkins *(from August)*
DIRECTOR OF POLICY & THE ALLERTON PROJECT	Alastair Leake BSc (Hons), MBPR (Agric), PhD, FRAgS, MIAgM, CEnv
Secretary (p/t)	Natalie Augusztinyi
Head of Research for the Allerton Project	Chris Stoate BA, PhD
Ecologist	John Szczur BSc
PhD Student *(University of Nottingham)* - game as food	Graham Riminton BSc
PhD Student *(University of Nottingham)* - farmers' environmental learning	Susanne Jarratt BSc
MSc Student *(Nottingham University)* - birds on Eye Brook farms	Ben Norman BSc *(from May)*
MSc Student *(Cranfield University)* - greenhouse gas audits of Eye Brook farms	Miguel Astudillo BSc *(from May)*
MSc Student *(University College London)* - Eye Brook land use change	Boris Eremin BSc *(from May)*
MSc Student *(Graduate Intern)* - agri-environmental research	Nicola Winning BSc *(until February)*
Placement Student *(Harper Adams)*	Matthew Sadler *(until August)*
Farm Manager	Philip Jarvis MSc
Farm Assistant	Michael Berg
DEPUTY DIRECTOR OF RESEARCH	Nicholas Aebischer Lic ès Sc Math, PhD
Secretary & Librarian	Gillian Gooderham
Senior Conservation Scientist	Francis Buner Dipl Biol, PhD
Head of Geographical Information Systems	Julie Ewald BS, MS, PhD
Partridge Count Scheme Co-ordinator	Neville Kingdon BSc
Biometrics/GIS Assistant	Chris Wheatley BSc *(from August)*
Placement Student *(University of Reading)*	Katrina Beach *(until September)*
Placement Student *(John Moores University, Liverpool)*	Laura Murdoch *(until September)*
Placement Student IT *(University of Ulster)*	David Pepper *(from June)*
Placement Student *(University of Bath)*	Ryan Burrell *(from September)*
Placement Student *(University of Cardiff)*	Lizzie Grayshon *(from September)*
DIRECTOR OF FUNDRAISING	Edward Hay
Personal Assistant	Matilda Harden BA *(until February)*; Adelaide Greenwood *(from February)*
National Events Co-ordinator	Mel Dellow
London Events Assistant	Felicity Cranfield BA *(until October)*; Lucinda Pearson *(from October)*
Northern Regional Fundraiser (p/t)	Sophie Dingwall
Southern Regional Fundraiser	Max Kendry
Eastern Regional Fundraiser	Lizzie Herring
North West Regional Organiser (p/t)	Rebecca Fifield
Regional Organiser (p/t)	Sally Read BSc *(until November)*
Regional Organiser (p/t)	Gay Wilmot-Smith BSc *(from January)*
Regional Organiser (p/t)	Charlotte Meeson BSc *(from November)*
Fundraiser - Scotland	Andrew Dingwall-Fordyce
DIRECTOR OF MEMBERSHIP & MARKETING	Andrew Gilruth BSc
Head of Database	Corinne Duggins Lic ès Lettres
Database Assistant (p/t)	Beverley Mansbridge
Head of Membership and Marketing	Sarah Felix-Rogers HND
Membership Assistant	Angela Hodge
Administrator (p/t)	Suzanne Fairbairn
Head of Telesales	Joanne Hilton
DIRECTOR SCOTLAND	Adam Smith BSc, MSc, DPhil
Secretary - Scottish HQ (p/t)	Irene Johnston
Head of PR & Education - Scotland (p/t)	Katrina Candy HND
Policy Officer Scotland	Gemma Davis MA *(from November)*
Senior Scottish Advisor & Scottish Game Fair Chairman	Hugo Straker NDA[1]
DIRECTOR OF ADVISORY & EDUCATION	Ian Lindsay BSc[2]
Co-ordinator Advisory Services (p/t)	Lynda Ferguson
Advisor/Development Officer	Alex Butler
Field Officer – Farmland Ecology	Peter Thompson DipCM, MRPPA (Agric)
Head of Education	Mike Swan BSc, PhD[3]
Regional Advisor - North East	Henrietta Appleton BA, MSc
Advisor Grouse Technical Services	Craig Jones
Game Manager – Rotherfield	Malcolm Brockless
Game Manager – Allerton Project	James Watchorn *(from January)*

[1] Hugo Straker is also Regional Advisor for Scotland and Ireland;
[2] Ian Lindsay is also Regional Advisor - Wales, Midlands; [3] Mike Swan is also Regional Advisor for the South of England.

Notes

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