# Review
## of 2013

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

Game & Wildlife
CONSERVATION TRUST

www.gwct.org.uk

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## Issue 45

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

*Produced by*: Game & Wildlife Conservation Trust
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*Front cover picture*: Black grouse by Dave Kjaer
*Photography*: The Game & Wildlife Conservation Trust wishes to thank the photographers who have contributed to this publication. Their details can be obtained from Louise Shervington.



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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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# Council

as of 1 January 2014

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# Rising to the challenge

by Ian Coghill, Chairman and Teresa Dent, Chief Executive

*(L-R) Teresa Dent; Owen Patterson, Secretary of State for Environment, Food and Rural Affairs; and Andrew Hoodless, our senior wader scientist at the CLA Game Fair. © Jon Farmer*

As chairman and chief executive, we spend our time looking forward, aiming to be one step ahead, to anticipate the next challenge and the next opportunity. Writing this piece for the *Review,* however, makes us face the other way. When we look back, perhaps we see most clearly how much has changed.

There has been a fundamental shift in policy in the last three years. The GWCT has always espoused a policy of wildlife management, and this is the very policy now adopted in Scotland, England and increasingly in Wales. It replaces simple species protection – and we use the word 'simple' deliberately. There is nothing wrong with species protection. Why would we not want to protect our wildlife? But on its own, it is not enough. Perpetual and universal species protection can mean that we lose vulnerable birds and animals because we failed to protect them from others. Indeed, one of the most noticeable recent shifts is that everyone in the conservation world now seems to accept that we cannot achieve species recovery for ground-nesting birds unless we protect them from predation.

We have always taken the view that to protect everything and rely on predators and prey finding their own natural balance within our entirely man-made and managed landscape is not possible. Simply protecting the water vole did nothing to save it from mink predation, which was quite clearly the cause of its alarming decline. The only thing that made a difference was to control mink efficiently and humanely; we invented the GWCT Mink Raft to do exactly that. The mink raft was such a success that it is now used by nearly every Wildlife Trust in the country, and where it is used in accordance with our approach, we know, and have demonstrated, that we can achieve water vole recovery, either by natural repopulation or releasing and recolonisation.

This policy change is profound. It means that we move from the passive to the active; from expecting nature to find a balance to making informed choices about the balance we want; from stepping back to stepping up and taking responsibility; from waiting until we have all the answers to going with what we have; and from making a fuss about the problem to enacting a solution.

Governments can try to protect wildlife by simply passing laws. But a Government that decides to manage wildlife is entering a partnership with the people who live on, own and manage land. After all, it is the people who work on the ground who end up making the difference for wildlife.

The GWCT exists to research and put into practice the solutions that will achieve our mission of a thriving countryside, rich in game and wildlife. It is our job to persuade everyone on the ground to do the right thing for nature.

The fact that we can look back over the last few years and see such a profound change is an enormous tribute to the hard work and professionalism of our staff, to the commitment and generosity of our individual supporters and donors, to the companies that sponsor us, and to the partner organisations with which we work. As a charity, we live in challenging times, but we should all be proud of how the Trust has risen to these challenges and the effect it has had.

*Ian Coghill chairing a debate at the CLA Game Fair. © Jon Farmer*


# Maximising biodiversity

by Ian Lindsay, Director of Advisory and Education

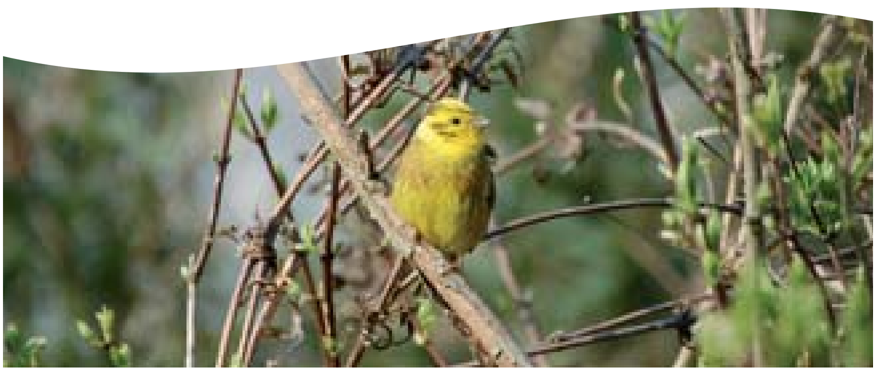
*Ian Lindsay launching our Campaign for Game at the CLA Game Fair. © Jon Farmer*

For more than 80 years, maximising the biodiversity benefits from game management has been at the heart of the Trust's existence. What originated as pioneering research on grey partridges, undertaken as virtually the only UK research organisation focused on the ecology of the farmed landscape, is now firmly embedded in agri-environment schemes. The recent *State of Nature* report highlighted a number of continuing declines of important species, which has led to other proactive game management techniques, from predator control to supplementary feeding, being introduced as wildlife management tools.

It is worth remembering that before the development of these schemes in the 1980s, it was game management interests, almost in isolation and at no cost to the taxpayer, which were providing habitats, supplementary feeding and freedom from predation for farmland birds. Since the mid-1980s, we have seen the number of pheasants released each year double and numbers of red-legged partridges released quadruple. This has led to allegations of damaging environmental impacts by some conservation organisations, resulting in a growing challenge to the environmental credentials of game management in the UK. We believe, therefore, that it is essential for all shoots to demonstrate a net biodiversity gain from their game management activities.

In 2013 we launched our 'Campaign for Game' and with it a new shoot Biodiversity Assessment aimed at individual shoots. These intend to increase biodiversity gain and allow shoot owners and managers to take ownership and be aware of the beneficial effects of their management on other species. It provides a bespoke assessment of current game management to minimise potentially damaging local effects and identify which wildlife species might be 'championed' as local beneficiaries of shoot management.

Gamebird management in the UK is among the most advanced in the world, enjoyed by a wide range of people, and it delivers proven benefits to many other species. For the future, its wider defence and the ability to demonstrate sustainability will depend on the positive effects on declining species such as yellowhammers and lapwing at the individual shoot level.



*Yellowhammers are just one of many birds that benefit from game management. © Peter Thompson/GWCT*

# Gaining traction with conservation policies

by Alastair Leake, Director of Policy and Adam Smith, Director Scotland

*Langholm Moor project staff and directors. (L-R) Sonja Ludwig, Simon Lester, Mark Oddy, Duncan Orr Ewing, Graeme Dalby, Susan Davies (now moved to RESAS and replaced by Ron MacDonald), Teresa Dent. © Adam Smith/GWCT*

## England

Sir Don Curry in his report on the *Future of Food and Farming,* following the foot and mouth outbreak of 2001, advocated a 'broad and shallow' agri-environment scheme that paid farmers to care for the environment. In it he envisaged a scheme open to all, largely based on trust and not unduly onerous. From this vision, the Entry Level Stewardship scheme was born and figures issued by Natural England show that around 70% of English farmland is now cared for under some form of environmental scheme. I do not believe there is anywhere else in Europe which can boast such success and we should praise our farmers for taking up the challenge. But this success is tempered by the failure of many farmland bird species to increase their populations. Given the knowledge our scientists have amassed over many decades on the effect of habitat enhancement, chick-food insects, seeds in winter and the management of predators, it seems remarkable that we are not doing better.

Consequently, during 2013, our main priority has been to sit down with Natural England and Defra, and with other partners and stakeholders, and help them to design the New Environmental Land Management Scheme (NELMS). This has involved three visits to our Allerton Project demonstration farm during the year. Getting the right balance between introducing measures that deliver a real benefit for wildlife – but are not too difficult to implement – is critical, particularly considering the farmers' primary objective is food production. Money will be moved from the Basic Farm Payment to fund the new scheme and we hope, too, that funds will be available for farmers to seek expert advice when putting their scheme applications together.

Much of our policy work in 2013 has evolved around ensuring that the tools for conservation management remain available for farmers and landowners to use. Our Conservation Management course is recognised as the 'must have' qualification for Stewardship advisors; we helped the Bracken Control Group secure an emergency authorisation for the use of the herbicide asulam; we have been involved in preparing the risk assessments on the effect of lead ammunition on wildlife and the environment. This work will be considered during 2014 by the Lead Ammunition Group (LAG) and passed to Ministers. We have been involved in consultations with the English Law Commission on the reform of wildlife law and the introduction of Conservation Covenants, a scheme that will allow private landowners to benefit wildlife without being designated as a Site of Special Scientific Interest (SSSI).

## Scotland

The need for our efforts to inform Scottish Government policy has never been greater as we saw the continuing drive for countryside productivity through tractors, turbines and timber. There is no question that many species are now struggling; this year the number of curlews reached their lowest point ever and the capercaillie remains perilously close to extinction. But as environmental challenges squeeze more species, be they partridges or bumblebees, is legislation making it more difficult to actually reduce the pinch? We had to spend considerable time ensuring snare users in Scotland were well trained and licensed, ensure the continued ability to treat grouse diseases, and were involved in developing practice and licences that regulate corvid control.

We invested time and effort in retaining these tools because our core message is that we have a cost-effective solution: use the incentive and techniques originally developed for sporting management to deliver effective landscape-scale conservation among these other important activities. Having a solution relies on knowing who to tell, where and when, and we made great efforts in 2013 to improve our work in this area.

We are more involved than ever before in Scottish policy-making and now have a seat on both the Biodiversity Strategy and a seat on the Common Agricultural Policy stakeholder group deciding the next generation of all-important agri-environment packages for Scotland's moor managers and farmers. We met the Environment Minister five times last year: he was our guest at the Scottish Game Fair to celebrate the Year of Natural Scotland, at Langholm, and at our farm demonstration site at Whitburgh to discuss sparrowhawk predation on grey partridges.

Our strategic focus on a balanced approach to management that is cost effective and focused on outcomes is attractive to many policymakers. We have had an important role in assisting Scottish Natural Heritage adopt their 'Wildlife Management Framework', which adopts the ethos and need for many of the land management activities that shoots regard as standard. Our partnership work on the Langholm Moor Demonstration Project has allowed us to illustrate this approach to many bodies involved in addressing the conflict between birds of prey and gamebirds, notably Scotland's law officers.

Throughout the year, Scottish Government has been focused on some big policy issues, notably Land Reform and the Independence Referendum. This has rather stifled decision making so we used 2013 to prepare the ground for policy support for studies on the effect of pine martens on capercaillie; to design the predator control options for Scottish agri-environment schemes; to consider the effect of forest expansion and wind farms on black grouse and to allow for future sustainable management of mountain hares on grouse moors.


*Graeme Dey MSP in the education area at our Scottish Game Fair and helping us to celebrate the Year of Natural Scotland. © GWCT*

## Conclusion

Over the decades, our scientists have developed beetle banks, conservation headlands, medicated grit and new types of traps and snares. Each concept was thought out, tested, refined and costed. The policy teams continue to support this practical research into conservation and ensure that policymakers understand that ecosystem conservation means wildlife and habitat management, not just species and habitat protection.

*We turn our research into practical conservation such as beetle banks and conservation headlands, and ensure that policy makers understand ecosystem conservation. © GWCT*

# Communicating our messages

by Tom Oliver, Director of Communication and Public Affairs

*Our APPG meeting: (L-R) Ian Coghill (GWCT chairman); the Rt Hon Nicholas Soames MP, (APPG chairman); Barry Gardiner MP; Tom Oliver (GWCT) and Andrew Clark (NFU). © Morag Walker/GWCT*


Feathers fly over raptor controls

MARK CARWARDINE

*We continued to achieve high levels of broadcast, national and regional press coverage.*

Our All Party Parliamentary Group (APPG) secured visits from both the front benches in 2013. In July, Barry Gardiner MP chose our AGM as the opportunity for his first statement on Labour's policy intentions, including the review of wildlife legislation, shortly after he was appointed to the shadow environment portfolio. Then, in November, George Eustice MP, the new Under Secretary for Agriculture, spoke to the group on the Government's latest priorities for Common Agricultural Policy reform and agri-environment schemes. Our parliamentary meetings are well attended, and attract MPs and peers from all parties and of all opinions. These very valuable qualities contribute to the reputation and influence of game management and conservation in Government and the opposition. We are very grateful for the continued support of our APPG chairman, the Rt Hon Nicholas Soames MP, and vice-chairman, Roger Williams MP.

We continued to achieve high levels of national and broadcast media coverage during the year. BBC Radio 4's *Farming Today* and *Saving Species* ran stories covering our work on woodcock, grey partridges and salmon. Other national stories included black grouse conservation and the benefits of grouse moor management for hen harriers. We also achieved considerable coverage in specialist media, including regular columns in *Crops Magazine, Shooting Times* and *Modern Gamekeeping,* whose audiences are directly involved in managing the land. At a regional and local level, our activities are reported by a huge number of local newspapers and journals.

Our 'Campaign for Game' was launched to great effect at the CLA Game Fair. We contributed to a well-informed piece in *BBC Wildlife Magazine* on the question of culling, including our work on snaring and mink control. Meanwhile, our contribution to national dialogue on key questions surrounding farming, conservation and game was sustained in the letters columns of national newspapers and magazines.


# Crucial support from our members

by Andrew Gilruth, Director of Membership and Marketing

The GWCT is nothing without its members and supporters. As the year drew to a close we enjoyed the support of 20,098 people like you. As a member, your support has played a crucial part in everything we have achieved, and all that we aim to do in the future. We received a resounding message from the 672 members that completed their autumn membership survey that they felt our three main priorities are, in order: conducting research to the highest standard; informing Government policy; and ensuring a fair representation in the media.

Without question our recruiting effort worked much better than recent years, but our membership numbers did fall by 1.6%. Andy Harvey joined in March to implement plans to completely revise our network of face-to-face recruiters in time for both the GWCT Scottish Game Fair and the CLA Game Fair. We also successfully stepped up our online recruitment activity after Rob Beeson started at the end of June. Towards the end of the year James Swyer, who also started in June, supported this effort by writing to lapsed members.

In November we switched on the new GWCT website, which is edited by Oliver Dean who took responsibility for content migration when he started in July. It is split into four main subject areas – fishing, farming, game and wildlife – making it much easier to navigate. Monthly e-newsletters are now distributed to those that have sent us their email address. Opening rates for these updates of our most important and interesting stories remain a very healthy 34%. Our woodcock website and blog **www.woodcockwatch.com** continues to drive significant online interest in our work with more than 26 woodcock tagged and tracked over three years.

Members continued to support the GWCT through appeal donations, to both our woodcock research and the work of the lowland gamebird unit. Purchases of Christmas cards and raffle tickets also remained very strong, and a further 106 members wrote to let us know that they intended to remember the work of the charity in their will. Thank you to all of you for your support throughout the year, and that of the two members of staff who left the team during the year: Joanne Hilton and Suzanne Fairbairn.

*We are continuing to attract new audiences with our groundbreaking woodcock tracking work.*
*© Jon Farmer*

# A record breaking year

by Edward Hay,
Director of Fundraising

*The Sussex committee's 'Fabulous Four Raffle' raised a staggering £50,000. (L-R)The keepers from the four shoots: Rob Smallman (Cocking Shoot), John Newton (Goodwood Estate), Phillip Harkness (Springhead Estate) and Len Ireland (Angmering Estate). © Helen Tinner*

2013 has seen some amazing success stories from the fundraising team despite a continuing tricky economic climate.

In November, GCUSA held its annual auction in the presence of The Earl Spencer in New York. Some fierce bidding took place for the wonderfully generous auction lots helping to raise a staggering $400,000.

London continued to build on its success in previous years and the Le Gavroche dinner, kindly hosted by Michel Roux Jr, was no exception, helping to raise a record £77,000. Ball chairman Caspar Hobbs, with the support of his excellent committee, organised a dazzling Grouse Ball totalling a huge £170,000.

The GWCT Spartan Sporting Challenge run over 5km and 10km was well supported by more than 23 members this year and encouraged younger people to get involved with our work, have great fun and feel a real sense of achievement and pride as they completed the gruelling race.

His Royal Highness the Prince of Wales allowed both the Oxfordshire and Wiltshire committees to hold garden walks at Highgrove followed by dinner and an auction, helping to raise a joint total of £60,000. Oxfordshire managed to beat the previous Highgrove fundraising record, raising over £37,000.

Chris and Julia Butterfield hosted a glorious Country Fair at Widmerpool, together with the Nottinghamshire committee, and raised an impressive £50,000. The fair was a real showcase for many action-packed countryside-themed activities including falconry, a parade of hounds, fly fishing and shooting.

Chillingham Castle in Northumberland provided the perfect setting for Christopher Ussher's flamboyant tales of hunting and fishing in far-flung corners of the globe, with the evening raising more than £12,000. This helped the Northumberland and County Durham committee raise a record £32,915 in 2013.

The Sussex committee launched its 'Fabulous Four Raffle' at Knepp Castle helping to raise £50,000, with a 10% donation to other specific local charities nominated by the individual shoots. A huge thank you to Goodwood, Springhead, Cocking and Angmering Park Estates for donating their best drive for this raffle.

The fundraising team are looking forward to an exciting year in 2014 and would like to thank everyone who has supported us.

# 25 year high for black grouse

by Nick Sotherton
Director of Research

*Our upland researchers studying black grouse, which bounced back from a disastrous breeding year in 2012 to a 25-year high in 2013.*
*© Pat White/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.

The 2012 *Review* predicted some gloomy breeding results for birds following the extremely poor weather during the 2012 breeding season. This has indeed translated into lower breeding densities in spring 2013 (see grey partridge data on page 26). Predicting poor figures is one thing, but they still hurt when they actually accrue. However, not all is doom and gloom. Our red grouse continue to thrive (see page 34), thanks to the successful deployment of medicated grit and its role in suppressing the effects of strongylosis.

Most pleasing are the black grouse data. We have gone from a 25-year low in chicks per hen in 2012, to a 25-year high a year later (see page 36). Equally encouraging are our results on research to expand the range of this species (see page 42). Our translocation programme works, but it's not for the faint-hearted.

Also in the uplands, we report on our grey partridge study on the moor edge, which taught us a great deal about this popular species well away from its usual farmland habitats. No chicks were produced in the poor summer of 2012, but a greater understanding of their nesting and brood cover requirements will help us formulate conservation advice for upland farmers and moor owners (see page 40).

Hot off the press are the results of the 2013 National Breeding Woodcock Survey (see page 20). We estimate about 69,000 males present in the UK, a figure slightly down on 2003 and showing notable range declines in Wales and southern England. We also noticed a decline that started in 2008. Hopefully a deeper analysis of our database will shed more light on the reasons for this change.

In our *Review,* we periodically report on findings from our long-term datasets. This year Nicholas Aebischer presents 50-year trends in data on five mammal species reported in our National Gamebag Census (see page 30). Mammals are notoriously difficult to count and bag records are increasingly being accepted as indicators of trends in their numbers over time, in our case 50 years.

Finally, our research team published 35 scientific papers this year, including the publication and defence of two PhD studies with students at Bournemouth and Nottingham universities. Congratulations to them as they take their first steps on a career in scientific research.

# General Licences

## Adam Smith and Mike Swan review a case of research and advice interacting to deliver conservation policy

GWCT research has shown the effect of predatory species such as crows on the population performance of game and wading birds. What is not commonly appreciated is that the fieldwork to support the research into crow predation has been done under licence. These have not been special research licences, but rather General Licences (formerly Open Licences). This suite of key licences in each of the devolved countries of the UK authorises activities related to the control of certain bird pest species including crows, gulls and pigeons. These are the same licences that land managers operate under when controlling birds for 'the conservation of flora and fauna (including wild birds)' or 'the prevention of serious damage to livestock and crops'. Users don't need to apply for a personal licence; hence they are 'general'.

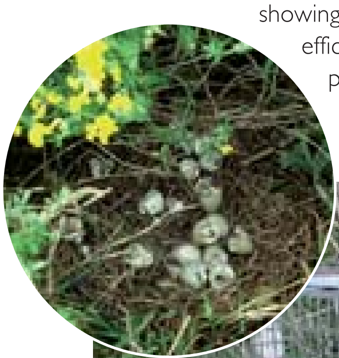
Over many years, our research has provided critical information on effectiveness and selectivity that underpins whether it is considered appropriate to make such licences generally and publicly available. Starting in the 1980s with the Salisbury Plain Experiment, and subsequently the Upland Predation Experiment at Otterburn (2000-2008) and the Allerton Project (since 1992), we have demonstrated the impact of corvids (crow, magpie, jackdaw and rook) and the effectiveness of mitigating that impact by their removal. It is now generally accepted that the timely suppression of corvids along with other common predator species significantly improves the chances of ground-nesting birds breeding successfully.

In the 1980s, we pioneered research into the use of the Larsen trap, invented by a Danish gamekeeper, showing that its use with a decoy was efficient and highly selective. We persuaded the regulators that use of Larsens could reasonably be permitted under a General Licence, exempting it from prohibitions that would otherwise apply, and we published guidelines on responsible use. Survey data including our National Gamebag Census strongly suggest that controlling corvids has not adversely affected their conservation status. These findings have underpinned the licences ever since.

At every review we discuss the terms of these licences with the representatives of each national conservation agency (Scottish Natural Heritage, Natural England, Natural Resources Wales) to ensure that changes in species' conservation status are considered, unclear wording is improved and new techniques are accommodated. Recently, discussions have considered the removal of herring gulls from the licences (we were not in favour because there is no evidence of a negative effect by culling them, though neither is the evidence strong for a general need for control on conservation grounds), the type of bait that should be used and the emergence of new trap designs. An important issue has been how to improve both the clarity and practitioner awareness of these licences. Failure to follow their conditions is a breach of the law, and a prosecution prevents the individual from operating under them in the future. For this reason we repeatedly remind gamekeepers and others about the licences and the conditions for their use in the training courses that we run, and when we write in sporting magazines.

Our interactions with General Licences are a good example of how GWCT research, advice and policy work in unison. Our aim is to ensure that Government and practitioners have confidence in the practical conservation tools needed in a changing world, even as increasing corvid numbers, falling wader and farmland bird numbers, and fewer people with corvid control as a key part of their job present some fundamental future challenges. Furthermore, regulators are increasingly considering restrictions on how and when licence users might act to control corvids. We feel there have not yet been proper assessments of the impacts of the proposed changes, so we are urging an evidence-led approach to refining and increasing the efficiency of how people operate under these licences. This would initially be achieved by reviewing the design and use (eg. location, season, number of decoys) of corvid traps, and offering impartial best-practice advice when it is sought.

More information can be found at **www.gwct.org.uk/generallicences**



*(Far left) Larsen 'Pods' can be effective corvid traps; best-practice design and use is now our focus.© GWCT/ Mike Short*

*Predatory species such as crows can have a big effect on populations of gamebirds and waders. Our predation control training courses include the correct use of Larsen traps. © Mike Swan/GWCT*

# Working together for wildlife

## Peter Thompson, our biodiversity advisor, charts the journey of the farmers who are championing the 'bottom up' approach

*Farmers are now working together to manage wildlife and habitats on a wider landscape scale. © Peter Thompson/ GWCT*

It is often said that farmers are the 'custodians of the countryside' and yet it appears from a constant media bombardment that many farmland habitats have been damaged or lost and the majority of wildlife seems to be plummeting to extinction. So what is the true picture and what role are farmers and land managers playing in conserving the British countryside?

It is true that not everything is rosy on our farmland. Long-term statistics show that there have been substantial losses of both habitat and wildlife. But I am interested in the present day and want to look at a current snapshot to see what is happening.

Statistics also show that three quarters of farmers in England are in a Stewardship scheme, yet when I ask an audience made up of the general public how many farmers they think are in a scheme, the answer is always the same – between 10 and 20%. So the general perception is that farmers are not doing that much for wildlife.

We have long believed that many farmers have a strong altruistic side to their nature and that they care deeply about the land that they manage. But collectively we have often struggled to convince others, including Defra, that this might be the case.

However, Teresa Dent, our chief executive, did manage to coax a Defra civil servant out of London to attend a meeting of the 'Grasshoppers', a farmer discussion group based in Wessex. She then asked the farmers one question: "What wildlife do you want on your farm?" There then followed a rather embarrassingly long pause, before eventually one or two began to name their favourite species. A full and fascinating discussion then took place, which does seem to have resulted in a turning point within the Defra mindset.

Incidentally, when we asked the farmers later why they had taken so long to answer the question, they said: "Well, we have never ever been asked that question before". Perhaps that speaks volumes about the way we engage with the people who actually manage the countryside on our behalf.

Some time later, the Government asked groups to gather together to form potential pilot Nature Improvement Areas (NIAs). These pilot areas would investigate how best to manage wildlife and their habitats on a wider landscape scale. An amazing 72 groups applied, but only 12 could be funded, one of which was a farmer-led group, some of whom had been at the Grasshopper meeting. As a result, the Marlborough Downs NIA is now up and running and is very much a

### NIA Tree Sparrow villages

The Marlborough Downs NIA has put up nesting boxes in small groups for tree sparrows as they like to nest in loose colonies. Farmers grow nearby areas of insect-rich flowers and plant lots of shrubs and small trees to provide foraging areas. This all has to be established within a maximum of 600 metres from the nesting boxes, because this is as far as the adults want to fly to forage for food. This work is paying off as last summer there were 142 pairs of tree sparrows nesting in the North Wiltshire Downs, and 72 of those pairs were using the boxes and raised 397 chicks. The NIA pays for the nest boxes and also the supplementary grain that the farmers will use to ensure that the sparrows have plenty to eat through the hungry gap.
www.mdnia.org.uk

### GWCT Partridge Count Scheme

Our Partridge Count Scheme has been running since 1933 and is the largest farmer-led volunteer count scheme in Europe. We believe that the best way to ensure the future of wild grey partridges rests with farmers effectively managing their land to benefit the birds. Counting them twice a year is vital to determine the success of their efforts and we offer free advice and help to farms wishing to get involved. Despite Government figures showing a continuing decline in farmland birds, many species are thriving on farms taking part in the scheme, with 24% more songbirds counted and on average five more species recorded per farm than on farms with no management for partridges.
www.gwct.org.uk/pcs

### Northamptonshire cluster farm

One of the pilot cluster areas is based around Mears Ashby, where nine farmers have come together covering 4,000 hectares in total. It is likely that this part of Northamptonshire will not feature as a target area within the new Stewardship scheme as it does not harbour an outstanding array of 'wanted' species. However, it is clearly apparent that there is a wonderful selection of habitats and species to be found in this area. By working together across this wider landscape rather than on individual farms, the group could quickly see that there might well be some substantial benefits from joining forces to manage not just wildlife, but soil and water too. Also, farmers will have a better chance of gaining Stewardship payments in the future.

'bottom up' project with farmers themselves, working alongside conservationists, deciding how and what they are going to do.

Looking to the future, we can see that there will be less funding available for conservation work and it will also be more targeted to certain areas. So what happens to other less favoured areas, and can we use this limited funding more wisely on the ground?

We have spent a lot of time thinking about these questions and have written a report for Natural England, which proposed that this bottom-up approach, coupled with getting individual farmers to work more closely with their neighbours, could well result in a more coherent, joined-up, landscape-scale conservation management plan. Natural England could also see the sense behind this thinking and gave us a small amount of funding to pilot this idea in four different areas.

Although 'cluster farms', as this pilot scheme has become known, are in their early stages, what has already become clearly apparent is that farmers welcome this approach. So often they have been told what to do and then left largely to their own devices, with little or no feedback. However, as cluster farmers they congregate to discuss working together, look at a map of their locality to see how best to link their habitats up across farm boundaries and talk about the different species they feel are important in their area.

Money is vital to help fund this conservation work on the ground, but it is not just money that gets results. Having created the four cluster farm pilot areas, other farmers have heard about the initiative and have approached us to set up their own.

Farmers in the Avon Valley, near to our headquarters in Hampshire, have problems with water levels and grazing regimes, and are also acutely aware of the demise of lapwings, snipe and redshank within the valley. Making changes to tackle these problems as individuals is almost impossible, but as a group who knows what can be achieved?

It is, of course, early days, but farmers do genuinely appear to be motivated by this bottom-up approach. Because three quarters of Britain is farmland, working closely with them is absolutely key to future success for wildlife recovery.

*These schemes could ensure that corn marigolds, turtle doves, barn owls and shepherd's needle don't disappear from our countryside.* *© Peter Thompson/ GWCT*


# Pheasant chick behaviour and diet

© Martin Clay

## KEY FINDINGS

- This PhD study looks at early learning by reared pheasants and how we can modify their behaviour to help them survive better in the wild.
- Giving chicks insects or wild seeds can improve foraging behaviour during the rearing and post-release periods.

Rufus Sage
Mark Whiteside
Joah Madden

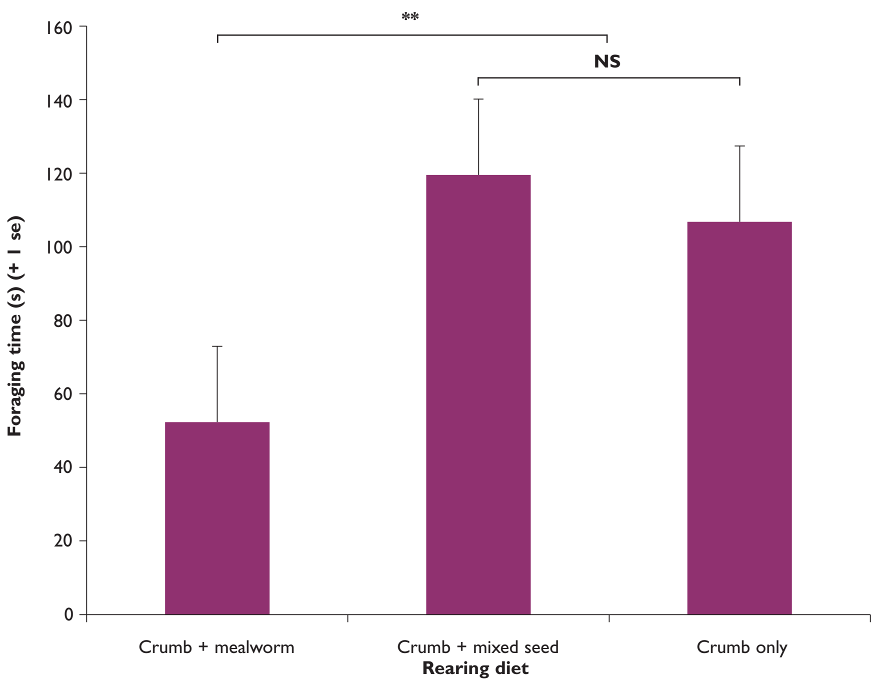
Pheasant chicks destined for release-based shoots are usually reared in groups without adult birds, in a system of heated huts and outdoor pens, before being subjected to a 'soft release' into the wild at about seven weeks old. They are fed pelleted food and cereal grain plus water *ad lib*, a diet very different to what they would feed on in the wild. In this study Mark Whiteside, a PhD student from the Centre for Research in Animal Behaviour at the University of Exeter, used this pheasant-rearing system to investigate whether simple changes to the chicks' diet during early development affected behaviour both during the rearing process and post-release. This is the first year of his study and the provisional results presented here are a sample of what he found.

For Mark and his supervisor at Exeter (Dr Joah Madden), pheasant rearing provides an excellent model system to test how artificial interventions may help correct the development of behavioural processes in hand-reared birds generally. This study also provides the opportunity to look at ways of improving the quality of released pheasants during rearing, to enable them to survive and thrive following release, and if not shot, to contribute to a breeding population.

### Figure 1

Time taken for a chick reared under one of three diets to eat a live cricket once it had been detected (n=117)

*** indicates a statistically significant difference at the 1% level. NS = not statistically significant*



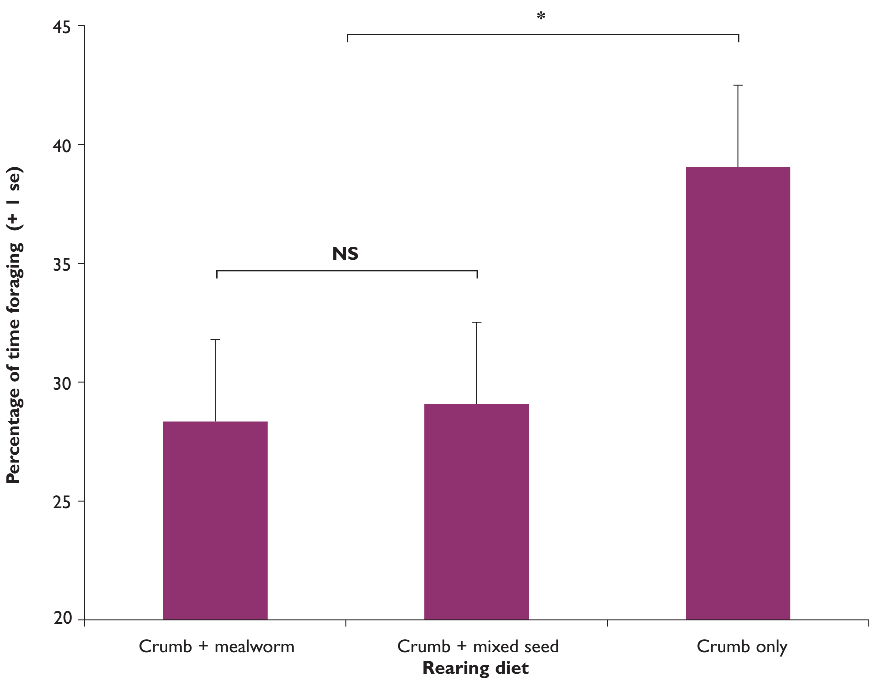



**Figure 2**

The effect of treatment on the percentage of time spent foraging in the wild (n=209)

** indicates a significant difference at the 5% level.*
*NS = not statistically significant*

We marked 900 one-day-old pheasants and randomly allocated them to one of 10 replicates of three feeding treatments: (1) standard rearing crumb; (2) as (1) plus 5% commercial mixed seed; (3) as (1) plus 1% mealworms. Chicks were housed in groups of 30 in a heated house (130cm x 130cm) for the first two weeks. For the next five weeks they also had access to an open grass run (130cm x 680cm).

Following these treatments, we recorded aspects of the chicks' foraging behaviour during rearing and following release into the wild. During rearing, we presented 117 chicks aged four weeks with a cricket tethered to a food bowl to measure the bird's observation and food-handling skills. We randomly selected individuals and placed them into an arena (130cm x 130cm) before revealing the cricket. The results of this test were striking, with birds that were fed mealworms being twice as quick at catching and eating the tethered crickets after detection as the other birds (see Figure 1). In autumn, we observed 209 of the released pheasants, individually identified by their wingtag, for two hours in the morning and for two hours before going to roost. We recorded the total time observed, the time spent foraging and the number of foraging bouts they undertook, and found that the birds fed standard chick crumb spent a third more time foraging than birds on a supplemented diet (see Figure 2).

These results suggest that adding mealworms or mixed seeds to the diet of reared chicks leads to significant improvements in feeding behaviour of poults and adults. Reduced foraging time suggests that they are better at finding what they need during the winter. Catching insects is also a crucial skill for a surviving released hen bird to teach its own offspring. Improved foraging efficiency may increase time that can instead be spent being vigilant or under cover, and so reduce exposure to predators. The next phase of this project is to explore the effects of habitat complexity during rearing, and longer-term effects of these treatments on survival and reproduction.

## ACKNOWLEDGEMENTS

We are grateful to the Middleton Estate Shooting Syndicate and Exeter University for providing financial support for this study. We also appreciate the support from Middleton Estate for providing accommodation, a rearing field, access to the shoot areas and invaluable advice from the Estate's keepers.


*All chicks were identified by their wing tag.*
*© Rufus Sage/GWCT*

# The causes of wild pheasant mortality

*Preparing catchers for hen pheasants. Fifty hens were radio-tagged in 2013.*
*© Carlos Sanchez/GWCT*

## KEY FINDINGS

- Parasites, kidney disease and predation were the main causes of mortality in a population of wild pheasants in Norfolk.
- In 2011, 25% of hens survived the breeding season, compared with 50% in 2012 and 2013.

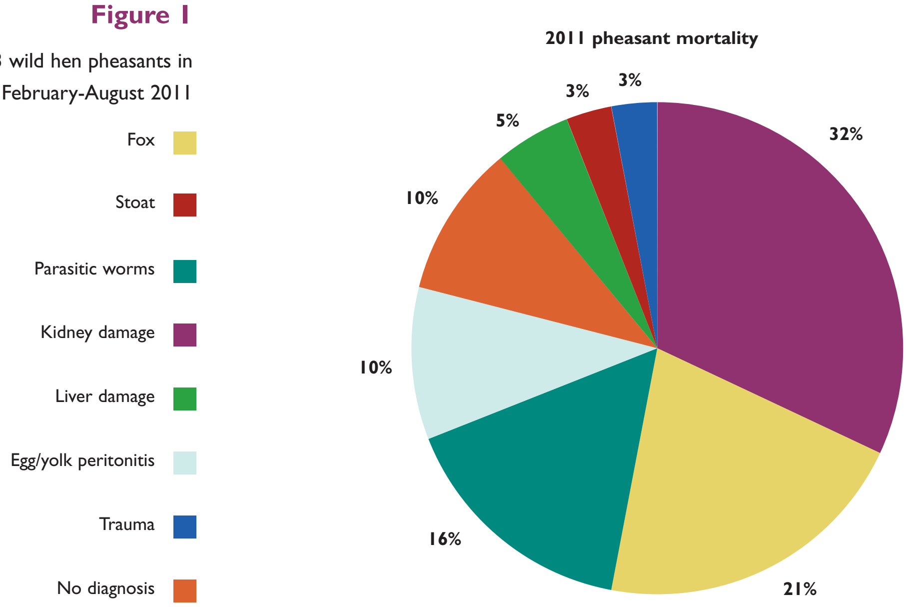
Roger Draycott

East Anglia has always been a stronghold for wild pheasants. However, reports of poor survival of breeding hens in recent years led to the initiation of a research study in 2011 to determine the causes of the high mortality rates. After the shooting season had finished, we radio-tagged 50 hen pheasants each year between 2011 and 2013 and monitored them closely through the breeding season. We reported the findings from the first two years' work in last year's *Review* (*Review of 2012* page 22) and summarise the findings below. The radio-tags had in-built mortality switches that helped us to recover dead birds before they decomposed or were scavenged by predators, allowing us to determine the cause of death more accurately. We located hens at least three times a week between April and July and we also collected detailed information on the nests of tagged birds. With all the birds that died, if the carcass was found intact, we sent it to a specialist gamebird diagnostic veterinary practice.

We caught birds in late winter for radio-tagging and examined them to determine their body condition and weight. All the birds were in good body condition and exhibited no sign of disease or other health problems. Survival was very good for the first few weeks after tagging in 2011 and 2012, but in 2013 several hens were predated by foxes in the first few weeks. In all years, we lost some birds to predation

**Figure 1**

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



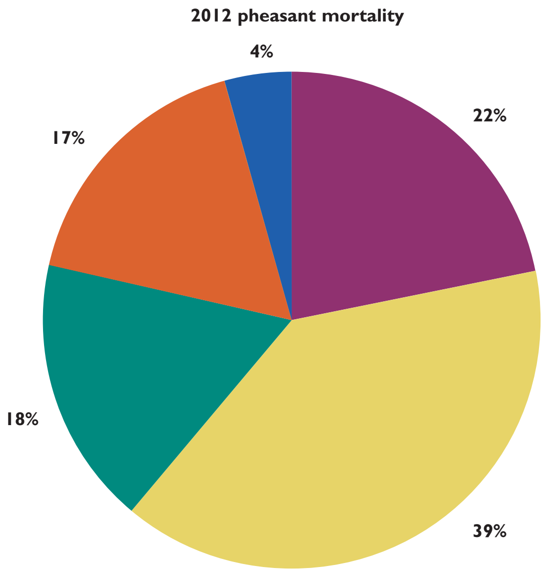



**Figure 2**

Causes of death of 20 wild hen pheasants in Norfolk, February-August 2012

- Fox
- Parasitic worms
- Kidney damage
- Trauma
- No diagnosis

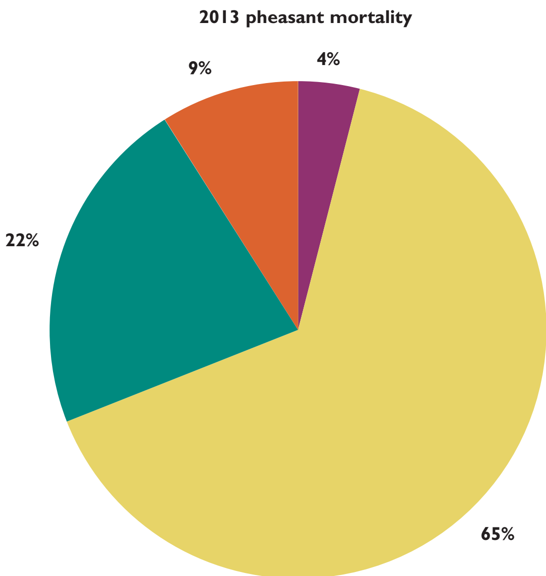



**Figure 3**

Causes of death of 22 wild hen pheasants in Norfolk, February-August 2013

- Fox
- Parasitic worms
- Kidney damage
- No diagnosis

during the nesting season, but losses were comparable with other GWCT radio-tracking studies of wild pheasants. What was unusual was the high mortality that we recorded from mid-May to mid-June, particularly in 2011. We retrieved 57 dead birds, which were often in an emaciated state and showing no signs of predation. All these birds were sent for post-mortem examination, with the main causes of mortality shown in Figures 1-3. Kidney damage was a common clinical sign, and a likely cause of this damage was a corona virus infection. Another significant cause of mortality was parasitic infection, particularly by gape worms. Although we identified higher than expected levels of mortality for a managed wild pheasant population, levels of predation on both birds and nests were relatively low. In 2011 only 25% of hens survived the breeding season, whereas 50% survived in 2012 and 2013. Our previous studies of wild pheasants indicate that around 60% survival of hens through the breeding season is required to maintain numbers.

Mid-May to mid-June is a period of high physiological stress for hen pheasants – they will have had a first nesting attempt and probably a second if the first had failed. It is likely that this physiological stress increases the chances of succumbing to a parasitic or viral infection that they would otherwise be able to resist. It is also likely that there is a complex interaction between parasites, disease and predation that is causing the high mortality rates – eg. birds with a high parasite burden may be more vulnerable to predation or more likely to succumb to a viral or other infection. In 2014 we plan to investigate this in more detail by undertaking an experimental parasite removal trial to test whether survival improves in the absence of parasites. If it does, it would offer a potential means of reducing the problem.

## ACKNOWLEDGEMENTS

We are grateful to Crowshall Veterinary Practice, Oakbank Game & Conservation Ltd, Lord Romney, Sandringham Estate and all the other landowners who provided financial support for this study.

# The status of breeding woodcock in Britain

© Laurie Campbell

### KEY FINDINGS

- In 2013, we conducted a repeat survey of breeding woodcock with the British Trust for Ornithology (BTO) to determine current population size and change in distribution and abundance since 2003.
- 820 randomly selected sites were surveyed for roding woodcock by more than 700 volunteer surveyors.
- We recorded a decline in overall site occupancy since 2003 of 19%, with the largest decline in Wales, but a small gain in northern England.
- We estimate the breeding woodcock population for Britain as 69,390 males, representing a reduction of 11% in the last 10 years.

Andrew Hoodless
Chris Heward

The woodcock was 'amber-listed' as a bird of conservation concern in 2002 because of an apparent long-term decline in breeding numbers (-76%, 1974-1999) and range (-31% 1968/72-1988/91), estimated from general bird surveys organised by the British Trust for Ornithology (BTO). However, the species' population size was unknown at the time and a crude estimate suggested just 5,000-12,500 'pairs'. Consequently, in 2003 we teamed up with the BTO to conduct the first national survey of breeding woodcock, employing a species-specific counting method. Our earlier work had shown that by recording the number of passes of roding male woodcock in a given

### TABLE 1

**Change in site occupancy by roding male woodcock at randomly selected sites surveyed in both 2003 and 2013**

| Region | Number of sites surveyed in both years | % change in occupancy between 2003 and 2013 |
|---|---|---|
| Northern Scotland | 20 | -20.0 |
| Southern Scotland | 21 | -25.0 |
| Northern England | 33 | +15.8 |
| Eastern England | 37 | -11.5 |
| East Anglia | 61 | -12.1 |
| North Midlands | 67 | -13.8 |
| Wales | 18 | -66.7 |
| South Midlands | 48 | -25.0 |
| South-West England | 43 | -7.1 |
| Central Southern England | 95 | -18.5 |
| South-East England | 102 | -38.1 |
| **Britain** | **545** | **-19.4** |

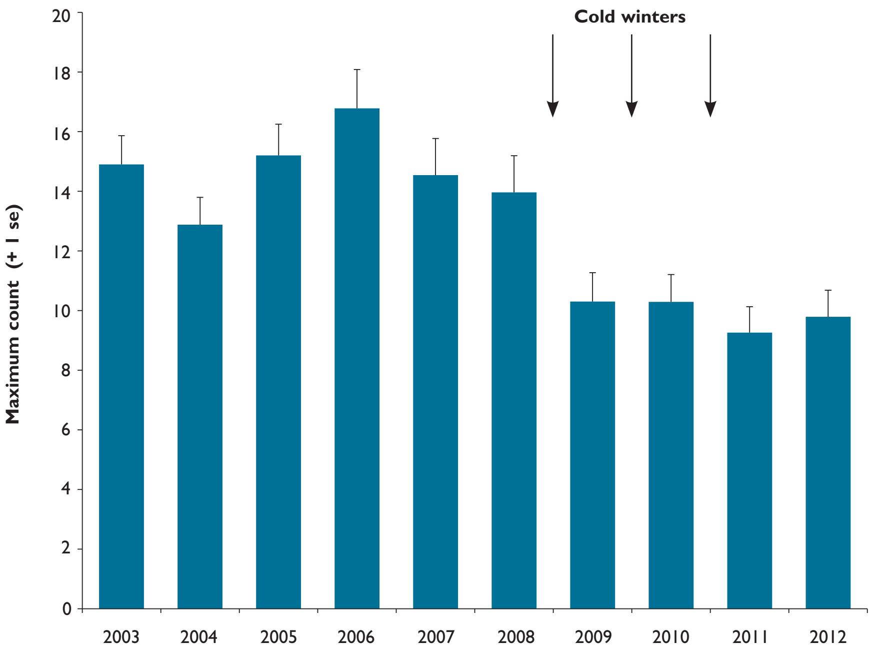



**Figure 1**

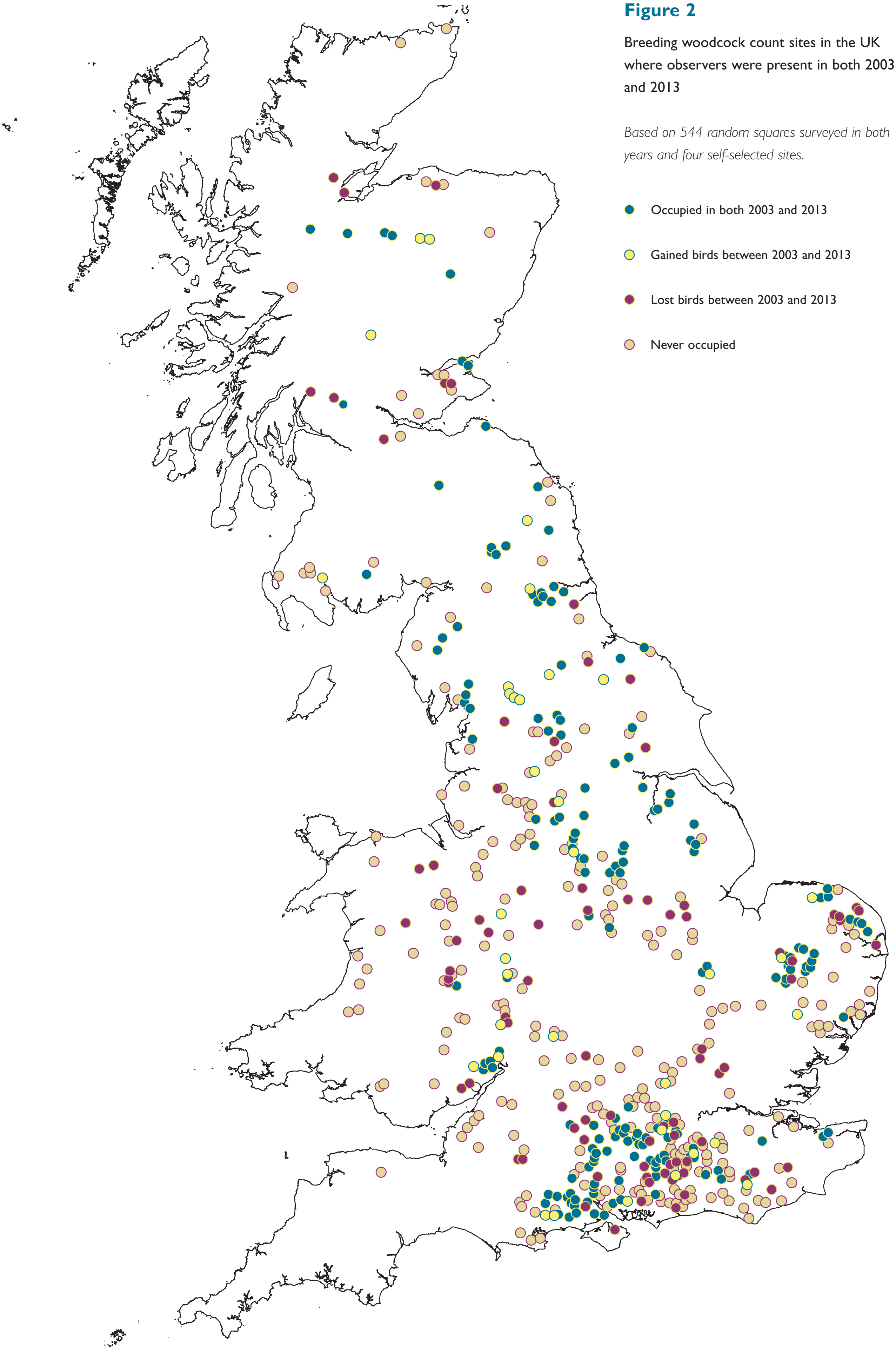
Trend in annual woodcock roding counts, based on an average of 33 sites per year across 24 counties

*Values are means of the maximum count per site. Arrows denote cold winters.*

time, abundance could be calculated using a calibration equation describing the relationship between roding activity and the number of individual males present (identified on a computer from recordings of their calls). This survey gave a population estimate of 78,350 males for Britain, dispelling concern that the woodcock was a rare breeding bird.

However, we were still concerned about the likely trend in woodcock numbers and so we have co-ordinated annual counts by keen volunteers at a sample of some of the better sites first surveyed in 2003. These suggest a stable trend until 2008 but a decline thereafter, with an overall average decline of 2.5% per year (see Figure 1). Coupled with the finding, from the BTO's *Bird Atlas 2007-11*, of a further range contraction of 29% since 1988-91, we had an indication of problems with our resident, breeding woodcock population and hence we decided that it was important to repeat the national survey in 2013.

*More than 800 volunteers helped count roding woodcock in woodland across the UK. © Chris Heward/GWCT*



## Figure 2

Breeding woodcock count sites in the UK where observers were present in both 2003 and 2013

*Based on 544 random squares surveyed in both years and four self-selected sites.*

- Occupied in both 2003 and 2013
- Gained birds between 2003 and 2013
- Lost birds between 2003 and 2013
- Never occupied

In 2013, volunteers visited 820 random 100-hectare squares during the breeding season (see Figure 2). Surveys were widely spread across the UK and for the first time included sites in Northern Ireland. Overall, roding woodcock were encountered at just under one third of woodlands surveyed (33%). Northern Scotland, northern and eastern England remained stronghold areas, with between 46% and 68% of woods greater than 10 hectares supporting at least one roding woodcock. The lowest occupancy levels were recorded in Wales (13%), south Midlands (16%) and south-west England (18%). It is now particularly noticeable in southern England that sites occupied by breeding woodcock are clustered in areas with extensive blocks of woodland, such as the Forest of Dean, the New Forest and Thetford Forest.

Comparison with 2003 suggests a decline in overall site occupancy of 19% in the last 10 years. We observed declines in site occupancy in 10 of 11 regions, with the most severe reduction of 67% in Wales, albeit based on a small sample of sites. A small gain was recorded in northern England (16%) (see Table 1).

We estimate the current breeding woodcock population in Britain to be 69,390 males (95% confidence interval 50,855-87,850). This represents an 11% decline in numbers from the 2003 estimate of 78,350 (95% confidence interval 61,720-96,495), although the confidence intervals of both estimates are large and overlap. Numbers in Scotland are unchanged since 2003, at close to 40,000 males, but those in England are down from 37,330 in 2003 to 27,490 in 2013. Wales continues to support only low numbers of breeding woodcock with 1,770 recorded in 2003 and 910 recorded in 2013.

From our early radio-tracking studies in the late 1980s to the early 1990s, we know that woodcock have very specific habitat requirements during the breeding season and are sensitive to habitat change. During 2014, we will undertake further analyses using data on landscape composition around survey sites and information on habitat structure collected during the 2003 and 2013 surveys to understand better their influence on breeding woodcock distribution. We don't yet understand the factors driving the decline in our breeding woodcock, but they are likely to include declining woodland management, increased browsing by deer, drying out of woods, maturation of conifer plantations, increased recreational disturbance and increased predation. We do not think that the changes have been caused by shooting, but that's an article for another *Review*. As far as possible, we hope to quantify the effects of these influences in the coming years.

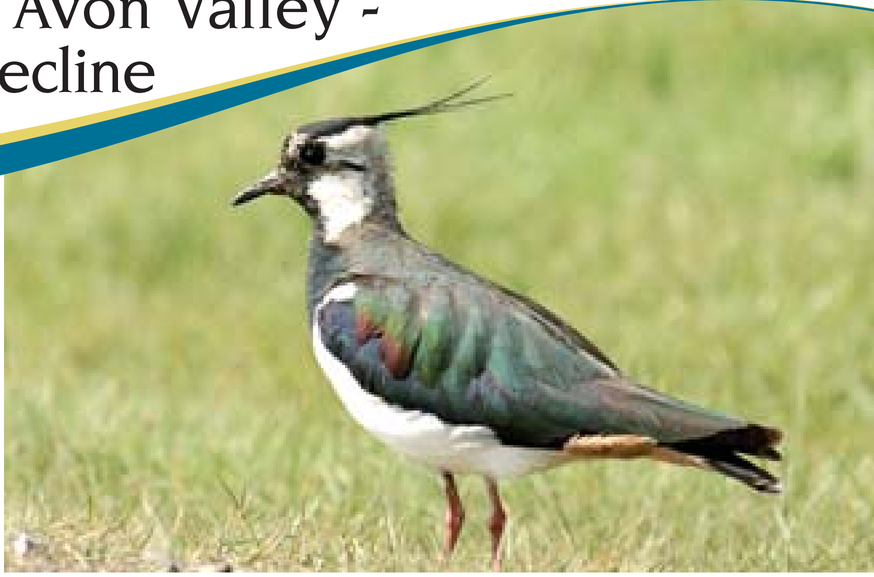

## ACKNOWLEDGEMENTS

We are grateful to Greg Conway, Iain Downie and Rob Fuller of the BTO for their assistance in designing and running the survey. We thank the volunteers, BTO and GWCT members who participated, and we are particularly grateful to the small group of dedicated enthusiasts who have surveyed a site annually between 2003 and 2013.

To follow the migrations of our satellite-tracked woodcock, visit the Woodcock Watch website www.woodcockwatch.com


*Comparison with 2003 suggests a decline in overall site occupancy by woodcock of 19% in the last 10 years. © Chris Heward/GWCT*

# Lapwings in the Avon Valley - addressing the decline



*Lapwings are now red-listed as a bird of conservation concern. © Andrew Hoodless/GWCT*

## KEY FINDINGS

- Lapwing pairs in the Avon Valley have declined by 66% over 10 years.
- The reason is an insufficient number of fledged chicks, linked to high nest predation.
- To date, habitat improvements alone have not been sufficient to reverse the lapwing decline and a new farmer-led initiative aims to address issues of sward management, water level control and predation.

Andrew Hoodless

The lapwing is a well known but rapidly declining farmland bird, whose numbers have fallen by 50% since 1983, and is now 'red-listed' as a bird of conservation concern. Analysis of adult survival rate based on UK ringing data found no appreciable change during this period, indicating that low productivity of fledged chicks is the main driver of lapwing declines. Based on annual survival rates of 83% and 60% for adults and first-year birds respectively, it has been estimated that each pair needs to fledge on average 0.7 young each year to maintain a stable population.

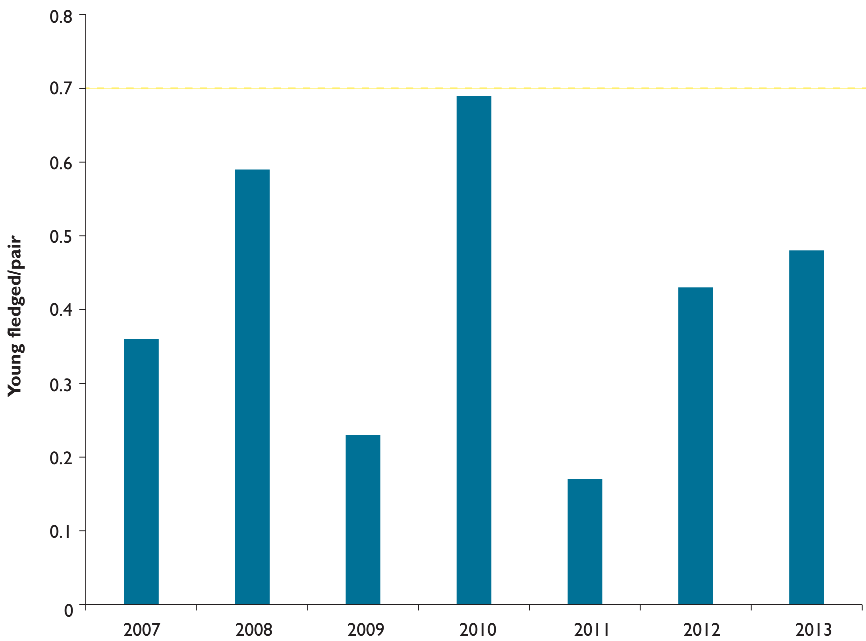
Historically, wet grassland sites, including many river valleys, have been important strongholds for lapwings in the lowlands. However, at many of these sites, particularly those not managed as nature reserves, changes in landscape character and agricultural management have resulted in declining populations. We have conducted periodic surveys of waders in the Avon Valley between Salisbury and Christchurch since 1990 and from 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 Avon Valley (1,300 hectares) suggest that between 1990 and 2010 lapwing numbers declined from 208 to 71 pairs. Lapwing densities are currently higher where a field is managed under the Higher Level Stewardship (HLS) agri-environment scheme, with an average of 0.25 ± 0.05 pairs per hectare (ha) on HLS fields compared with 0.13 ± 0.01 pairs/ha on fields not within the scheme. However, sufficient numbers of fledged chicks have only been produced once in the last seven years (see Figure 1) and there has been no appreciable difference in productivity between fields managed under HLS and fields not entered in an agri-environment scheme. Our monitoring suggests that survival

### Figure 1

Estimated mean annual number of fledged young per pair of breeding lapwings in the Avon Valley during 2007-2013

*It was not possible to count fledged brood size accurately for all broods and in 41% 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*



## TABLE 1

**Causes of clutch loss of lapwing nests across 15 farms in the Avon Valley during 2008-2012**

| Cause of loss | Number of clutches | Percentage of lost clutches |
|---|---|---|
| Predation | 129 | 81.6 |
| Flooding | 14 | 8.9 |
| Trampling by livestock | 6 | 3.8 |
| Mowing | 2 | 1.3 |
| Unknown | 7 | 4.4 |
| **Total** | **158** | |

of broods to fledging is reasonable, but that low nest survival averaging 32 ± 4% is driving the lapwing decline.

Although flooding has been important at certain sites in particular years, predation is the principal cause of nest loss (see Table 1). Data from temperature loggers in predated nests have indicated that similar proportions of nests are predated by day and night and, combined with field signs, suggest that eggs are taken by a variety of generalist predators including foxes, badgers, corvids and possibly gulls. It is apparent that nest predation rates can vary between farms and years depending on local conditions.

In the short-term, some relief from predation is essential to ensure that the lapwing decline is at least halted, and we are exploring which measures are most appropriate in different parts of the floodplain. Maintaining or restoring habitats to optimal condition is undoubtedly important and appropriate management under HLS may, in the longer term, result in greater concentrations of lapwings, which are better able to fend off nest predators by themselves.

In late summer 2013, we invited all the farmers and landowners in the valley to a meeting to discuss their views on the lapwing decline and the management required to reverse it. The response was very positive and demonstrated a clear desire to tackle issues of sward management, water control and predation. Consequently, we are now developing a farmer-led initiative to demonstrate how lapwing recovery can be achieved through collaboration between farmers, increased levels of advice and training (from GWCT and Hampshire & IOW Wildlife Trust) and greater dialogue with Natural England and the Environment Agency.

## 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. Some of the survey data in 1990 and 2010 were collected by the RSPB.

*We think that low nest survival is driving the decline of lapwing numbers. © Andrew Hoodless/GWCT*

# Partridge Count Scheme

*The breeding density of grey partridges was reduced after the bad weather of 2012. © David Mason*

## KEY FINDINGS

- Following the very poor breeding season of 2012, the average pair density over all PCS sites decreased by 39%.
- Autumn densities increased by 37% compared with 2012, despite low chick-food availability during June.
- The national average young-to-old ratio of 2.4 was double the 2012 value and just over the average across the previous 10 years.

Neville Kingdon
Julie Ewald

The Partridge Count Scheme (PCS) received 717 counts in spring 2013 (a 12% decrease from the 818 received in 2012). Most PCS members adopted a voluntary ban on shooting greys during winter 2012/13 because of the minimal breeding success in 2012. This resulted in a national average over-winter survival rate of 46%, slightly above the survival rates of the previous four years (37%-43%), and it will certainly have contributed to retaining breeding birds on PCS sites. With a cold and dry spring, 7,506 pairs were counted across nearly 218,000 hectares (ha) (538,000 acres), compared with 13,414 pairs counted across 245,000ha (604,600 acres) last year. Over all PCS sites, the average spring pair density decreased by 39%, with the density decreasing in all regions (excluding the single return from Wales). The long-term index of grey partridge density (see Figure 1) illustrates just how much breeding density was reduced by the bad weather of summer 2012. Nationally, both long-term and new sites saw pair density indices fall by 43% and 36% respectively, very disappointing after the high values recorded in 2012. This is a heavy blow to all PCS members, given their success over the last decade.

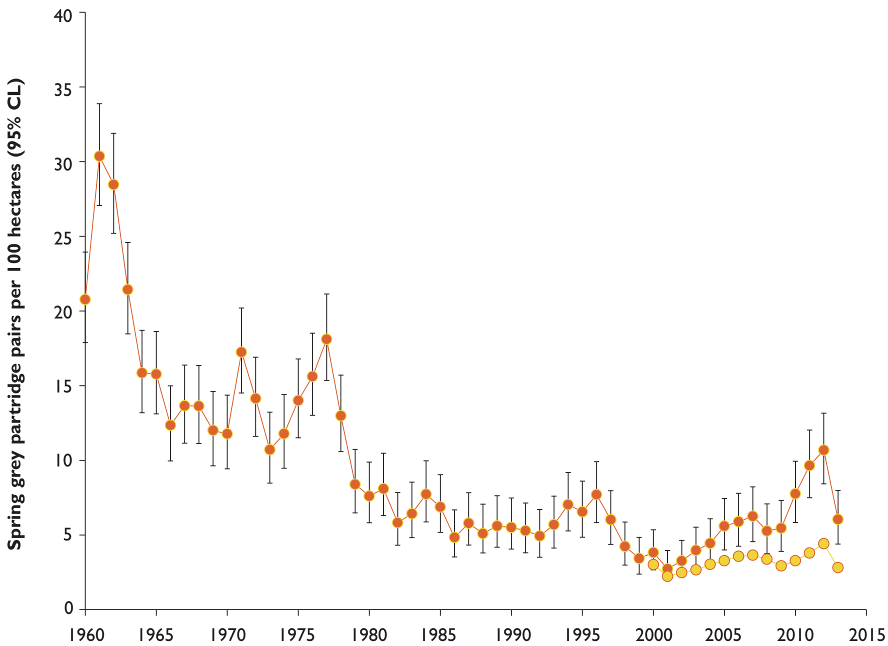
The cold April and May of 2013 affected the abundance of chick-food insects in some areas. The weather across the country was fairly dry during chick hatching in June across all regions and generally rather cool in England and Wales, with Scotland slightly warmer than average. July's heatwave offered hope that the summer would see a distinct improvement. Unfortunately, these enjoyable conditions were too late to improve the emergence of chick-food insects.

**Figure 1**

Trends in the indices of grey partridge density, controlling for variation in the different count areas

Long-term sites

New sites




## ACKNOWLEDGEMENTS

We are extremely grateful to GCUSA for their on-going support of our grey partridge work.

The PCS received 639 autumn counts, 7% fewer than autumn 2012 (see Table 1). The total number of partridges recorded nationally was 27,700. The good news was that, although 2013 was not the best partridge year, it was better than 2012. Autumn density reached 16.9 birds per 100ha (up from 13.4 birds per 100ha in autumn 2012), an increase of 26%.

Anecdotal evidence indicated that many of the larger coveys were late or second broods that exploited insects produced in July and August. Overall the young-to-old ratio (Y:O) averaged 2.5 (double the 2012 value and slightly higher than the 10-year average of 2.3 Y:O). All regions except the south exceeded the level of 1.6 Y:O required for a stable population.

Even though the Met Office summarised the summer as 'seasonally average', and it was certainly an improvement on last year, productivity was again affected by weather, but this time prior to broods hatching. Thankfully, there were habitats in place to provide chick-food insects when conditions improved. Had there been less chick-food or brood-rearing habitats, the 2013 productivity would have been much worse. More farms and shoots throughout the country (not just those involved in the PCS) need to address this aspect of the grey partridge life-cycle and put in place the habitats required to improve their brood survival, in good years or bad.

### 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 possible, but we need your help. If you have grey partridges on your land or close by, please get involved and encourage your friends to do so. Go to www.gwct.org.uk/partridge or contact Neville Kingdon on 01425 651066.

### TABLE 1

**Grey partridge counts**

***a. Densities of grey partridge pairs in spring 2012 and 2013, from contributors to our Partridge Count Scheme***

| | *Number of sites* | | *Spring pair density (pairs per 100ha)* | | |
|---|---|---|---|---|---|
| **Region** | *2012* | **2013** | *2012* | **2013** | **Change (%)** |
| South | *133* | 116 | *1.7* | 1.3 | -24% |
| Eastern | *239* | 198 | *7.7* | 4.7 | -39% |
| Midlands | *165* | 129 | *4.3* | 3.3 | -25% |
| Wales | *4* | 1 | *1.9* | 7.1* | 247%* |
| Northern | *198* | 168 | *5.5* | 3.0 | -46% |
| Scotland | *79* | 105 | *3.3* | 2.2 | -42% |
| **Overall** | *818* | **717** | *5.0* | **3.1** | **-39%** |

** Note fewer returns*

***b. Densities and young-to-old ratios of grey partridges in autumn 2012 and 2013, from contributors to our Partridge Count Scheme***

| | *Number of sites* | | *Young-to-old ratio* | | *Autumn density (birds per 100ha)* | | |
|---|---|---|---|---|---|---|---|
| **Region** | *2012* | **2013** | *2012* | **2013** | *2012* | **2013** | **Change (%)** |
| South | *115* | 103 | *1.2* | 1.5 | *6.8* | 8.6 | 26% |
| Eastern | *195* | 160 | *1.3* | 2.4 | *19.3* | 22.3 | 16% |
| Midlands | *132* | 121 | *1.1* | 2.4 | *11.4* | 14.7 | 29% |
| Wales | *0* | 0 | - | - | - | - | - |
| Northern | *177* | 166 | *1.0* | 2.7 | *14.6* | 21.3 | 46% |
| Scotland | *70* | 89 | *1.3* | 3.2 | *8.8* | 11.7 | 32% |
| **Overall** | *689* | **639** | *1.2* | **2.5** | *13.4* | **16.9** | **26%** |

*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

*Arable margins have encouraged rare arable flowers such as the cornflower. © Francis Buner/GWCT*

## KEY FINDINGS

- Eighteen grey partridge spring pairs produced 40 chicks from six broods in 2013.
- Autumn numbers of pheasants in 2013 were 2.3 times higher than when the project began.
- High-value farmland habitat for game and other wildlife increased 1.8-fold from 2010 to 2013.

Francis Buner
Malcolm Brockless
Nicholas Aebischer

The Rotherfield Demonstration Project is situated in an area typical for lowland England in east Hampshire and began in spring 2010 with the ambitious aim of re-establishing wild grey partridges where they had previously gone extinct, alongside the recovery of wild pheasants and other wildlife. To achieve these goals, the Rotherfield Estate has created a wide range of optimal wildlife habitats under the Higher Level Stewardship (HLS) scheme. Since the project began, the amount of high-value brood-rearing, nesting and foraging habitat increased 1.8-fold, covering 5.8% of the arable area. In particular wild-bird seed cover (HF12) increased from 9.9 to 25 hectares (ha), followed by cultivated uncropped arable margins (HF20) (2.1 to 7.8ha),

## TABLE 1

**Game recovery at Rotherfield, 3,600 acres (1,457ha), split between the Trust and Estate side. (Fbr) fostered bantam-reared grey partridges released in August; (Br) bantam-reared family groups, (Pr) parent-reared family groups both released in November; (Wild) translocated in three coveys in December 2011 and five pairs in January 2012; and cock pheasants released in groups of 50 from movable pens in early August. Pheasant autumn adult numbers do not include released cock birds from the same year**

| Year | Spring pairs | | Autumn adults | | Wild broods | | Wild young | | Birds released | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Trust | Estate | Trust | Estate | Trust | Estate | Trust | Estate | Trust | Estate |
| **Grey partridge** | | | | | | | | | | |
| 2010 | 17 | 7 | 14 | 10 | 1 | 1 | 7 | 12 | 59 Br | 22 Fbr/32 Br |
| 2011 | 12 | 8 | 17 | 10 | 3 | 2 | 5 | 8 | 21 Fbr/20 wild | 14 Fbr/26 Pr |
| 2012 | 14 | 8 | 19 | 5 | 1 | 0 | 6 | 0 | 10 wild | 16 Fbr/63 Pr |
| 2013 | 8 | 10 | 9 | 9 | 4 | 2 | 35 | 5 | 0 | 68 Pr |
| **Red-legged partridge** | | | | | | | | | | |
| 2010 | 26 | 10 | 38 | 10 | 8 | 4 | 20 | 33 | 0 | 0 |
| 2011 | 30 | 11 | 54 | 17 | 1 | 11 | 45 | 6 | 0 | 0 |
| 2012 | 30 | 28 | 42 | 16 | 1 | 0 | 2 | 0 | 0 | 0 |
| 2013 | 24 | 10 | 35 | 19 | 7 | 5 | 15 | 19 | 0 | 0 |
| **Pheasant** | | | | | | | | | | |
| **Year** | **Spring adults*** | | **Autumn adults*** | | **Wild broods** | | **Wild young** | | **Released (cocks only)** | |
| | **Trust** | **Estate** | **Trust** | **Estate** | **Trust** | **Estate** | **Trust** | **Estate** | **Trust** | **Estate** |
| 2010 | 98/171 | 88/100 | 40/32 | 45/25 | 17 | 23 | 87 | 57 | 0 | 0 |
| 2011 | 179/286 | 103/64 | 73/129 | 45/41 | 69 | 44 | 303 | 199 | 600 | 0 |
| 2012 | 188/252 | 135/158 | 95/115 | 52/26 | 53 | 27 | 112 | 89 | 600 | 0 |
| 2013 | 118/191 | 100/63 | 94/100 | 54/42 | 69 | 42 | 254 | 129 | 600 | 0 |

** Numbers given as cocks/hens*

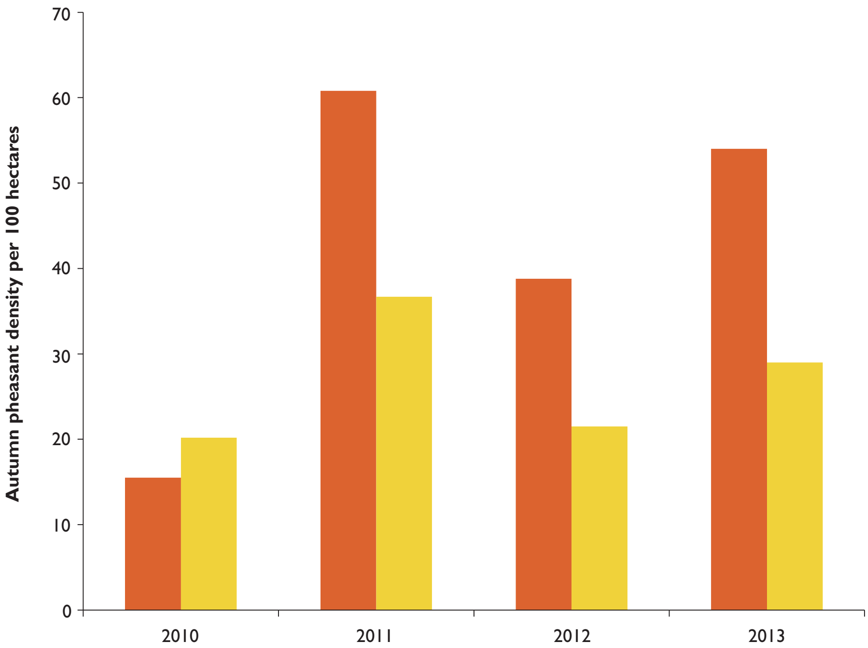



**Figure 1**

Pheasant autumn densities per 100 hectares (adults and young combined) on the Trust and Estate side of the Rotherfield Demonstration Project since 2010 (released cock pheasants are not included)

Trust side

Estate side

pollen and nectar mixes (HF4) (1.0 to 3.3ha) and beetle banks (HF7) (2.3ha unchanged). Further enhanced habitats include grass margins (HE1-3) and floristically enhanced grass strips (HE10), species-rich grassland, over-wintered stubbles (HF6) and extended over-wintered stubbles (HF22), lapwing plots (HF13) and field corner management (HF1). All the habitats together amount to 24.5% of the farmed area. Additionally, two gamekeepers are managing the 1,457-hectare (3,600-acre) estate, split into an Estate and Trust side, the latter having a smaller amount of woodland than the former and being managed by our gamekeeper, Malcolm Brockless.

It was clear from the beginning that our goals were not going to be achieved easily. Nowhere in the UK has the grey partridge recovered from local extinction and only a few estates have managed to build and maintain a wild pheasant shoot that keeps a full-time keeper in his job. It is therefore not surprising that this project is not showing the same quick game recovery results as our previous demonstration projects (the Allerton Project and the Grey Partridge Recovery Project at Royston), but we are steadily making progress.

After 2012, the worst lowland gamebird breeding season of the past 100 years, the 2013 spring numbers of partridges and pheasants at Rotherfield fell back to 2010 levels or even lower (see Table 1). The cold 2013 spring, followed by warm summer weather from June onwards, provided an adequate, but far from perfect, breeding season. The pheasant autumn stock increased to 673 individuals, a 2.3-fold increase compared with the number in 2010 but still lower than the figure in 2011. On the Trust side of the estate, numbers increased 3.5-fold since 2010; on the Estate side the increase was 1.4-fold (see Figure 1).

A modest breakthrough seems to have occurred among our re-established, but still very fragile, grey partridge population. An encouraging 58 individuals were counted across the estate in autumn 2013. On the Trust side, four out of eight spring pairs produced a total of 35 young, whereas on the Estate side two out of 10 pairs produced only five young. All spring pairs on the Estate side were parent-reared released birds, whereas on the Trust side, six out of eight pairs consisted of wild birds that were either translocated the year before or hatched on site. This supports our previous research that showed that the breeding success of reared birds is much lower than that of wild birds (see *GWCT Guidelines for re-establishing grey partridges through releasing*). We have released a further 68 parent-reared birds only on the Estate side in November 2013, allowing us to continue to compare the performance of released reared birds with re-established wild birds on the same area. For the second year in a row we released no grey partridges on the Trust side. The number of red-legged partridges increased compared with 2012, but remains lower than when the project began in 2010 (see Table 1). There were seven lapwing broods in 2012, of which six fledged two young each; one brood failed owing to the predation of hatched chicks.

*Winter to late spring feeding reduces the amount of time that birds spend foraging. © Markus Jenny*

*Grey partridges and hares are benefiting from the extra management put in place. © Markus Jenny*

# National Gamebag Census: rabbits, foxes and mustelids

*Rabbit bags have halved since the mid-1990s.*
*© Dave Kjaer*

**KEY FINDINGS**

- Rabbit bags have halved since their peak in the mid-1990s, possibly because of the effect of rabbit haemorrhagic disease on rabbit numbers.
- Fox bags have increased three-fold since 1961, though the rate of increase has slowed since about 1994.
- Since 1961, stoat bags have doubled whereas weasel bags have halved. Their dynamics are probably related to changes in rabbit and vole numbers.
- American mink bags increased 10-fold in the 15 years since 1961, but have since dropped by half, perhaps because of competition with otters or mink control.

Nicholas Aebischer

Through our National Gamebag Census (NGC), we monitor the bag sizes not only of game, but also of a wide range of mammalian predator species. These data are of interest because several of the species are shy, nocturnal or easily overlooked, so are difficult to monitor alive. For instance, small mustelids (stoat, weasel, American mink) are seen each year by recorders on 1% or fewer of the 3,000-odd squares monitored by the British Trust for Ornithology (BTO) – this is too infrequent to measure trends. Furthermore, the BTO has been surveying mammals only since 1995, whereas the NGC has been collecting predator records since 1961, yielding trends that extend back for over 50 years.

We review below the UK trends for rabbit, fox and small mustelids. For each species, we base the analysis on shoots that have returned bag records for at least two years. The analysis standardises the bag data to unit area to allow for differences in shoot size, then summarises the year-to-year change within sites relative to the start year. This gives a series of annual bag indices that begins with a value of 1. Subsequent indices show the relative change over time, so an annual value of 2 represents a doubling of bag size since 1961.

### Rabbit (Figure 1)

Rabbit bags were still low in the 1960s, following the introduction of myxomatosis in 1953, which devastated the UK rabbit population. As resistance to the *Myxoma* virus developed and spread, rabbit numbers recovered until, by the mid-1990s, bags had increased 16-fold relative to 1961. In 1992 a new illness, rabbit haemorrhagic disease, arrived in the UK. First detected in domesticated rabbits in the south of England, it spread to wild ones and reached Scotland in 1995. The 50% decline in rabbit bags observed since the mid-1990s coincides with the spread of this disease, and also with the expansion of the common buzzard – both factors may have played a role in the decline.

### Fox (Figure 2)

The fox is a generalist predator that is common throughout the UK. The bags indicate that numbers culled approximately tripled between 1961 and the early 1990s, with a further 15% increase to the present day. The on-going rise is possibly due to increasing fox numbers in suburban districts spreading into rural areas. However, there have also been changes in fox culling methods over the last 30 years that may have contributed to increasing the bags. The de-licensing of the gassing agent Cymag in the mid-1980s will have shifted effort towards methods that produce a visible 'body count'. These include the adoption of night-shooting with spotlights from the early 1980s, and more recently of night-vision scopes and acoustic attractants.

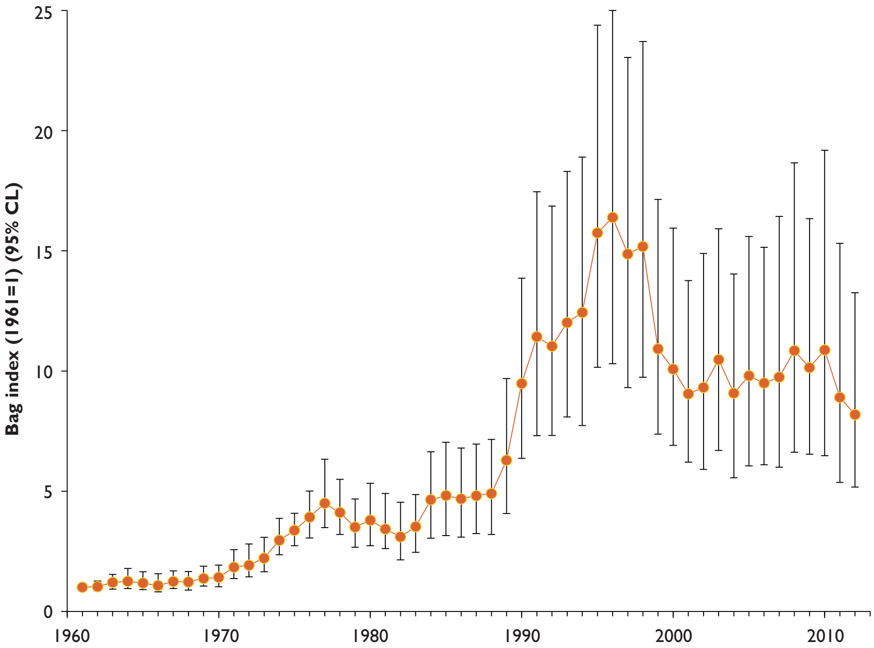



**Figure 1**

Rabbit index from NGC bags

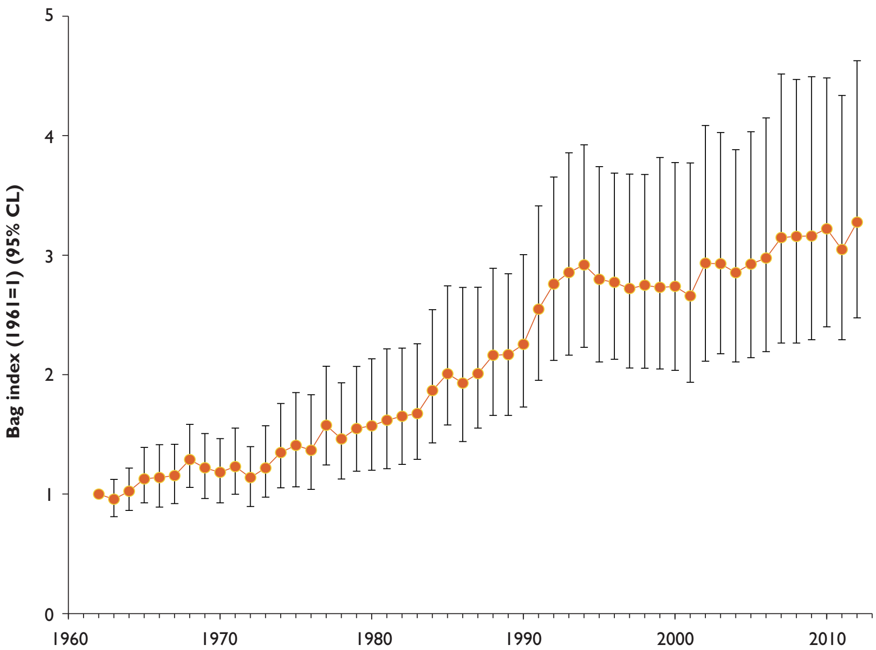



**Figure 2**

Fox index from NGC bags

*Fox bags tripled between 1961 and the early 1990s and are still increasing. © Dave Kjaer*

*Stoat numbers dropped when myxomatosis devastated the rabbit population. © Dave Kjaer*

### Stoat (Figure 3)

The stoat is widespread across Britain. Its main prey is the rabbit and numbers of stoats dropped when myxomatosis devastated the British rabbit population in the 1950s and 1960s. Since 1961, stoat bags have approximately doubled, but with a broad-based dip during the 1980s followed by recovery during the 1990s. The two increase phases match the two periods of most rapid increase in rabbit bags, whereas the decrease phase matches a period when rabbit bags were roughly stable and fox bags were increasing. It is thus possible that the bags reflect predator-prey interactions, but if so, it is not clear why stoat bags have remained high in recent years despite a fall in rabbit abundance and a high fox abundance.

### Weasel (Figure 4)

The weasel is also widespread and its diet consists mainly of field voles. As the bags reflect, weasel abundance was high in early years because voles benefited from ungrazed grassland arising from the lack of rabbits caused by myxomatosis. As rabbits

**Figure 3**

Stoat index from NGC bags

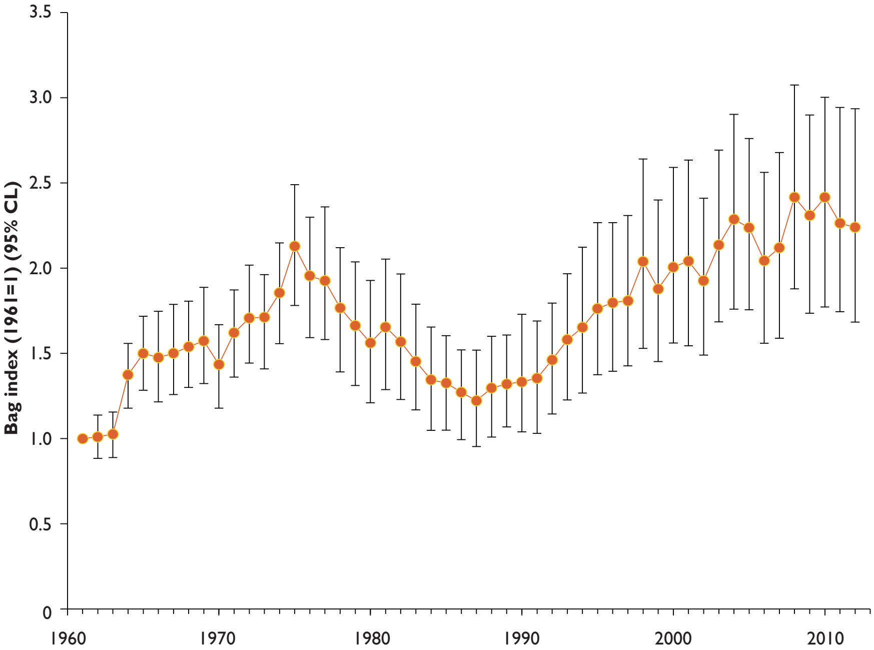
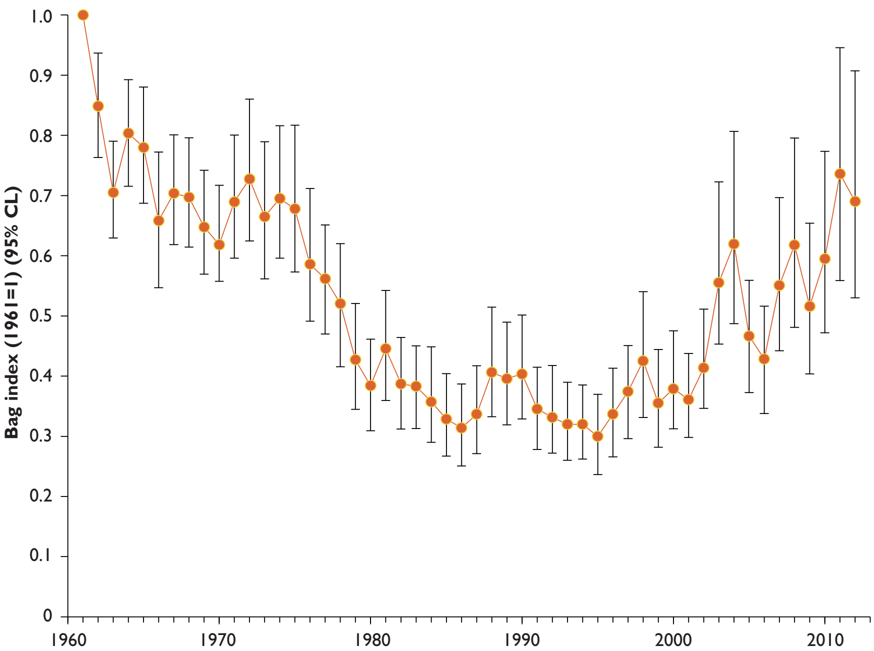



**Figure 4**

Weasel index from NGC bags




*Weasel. © Dave Kjaer*

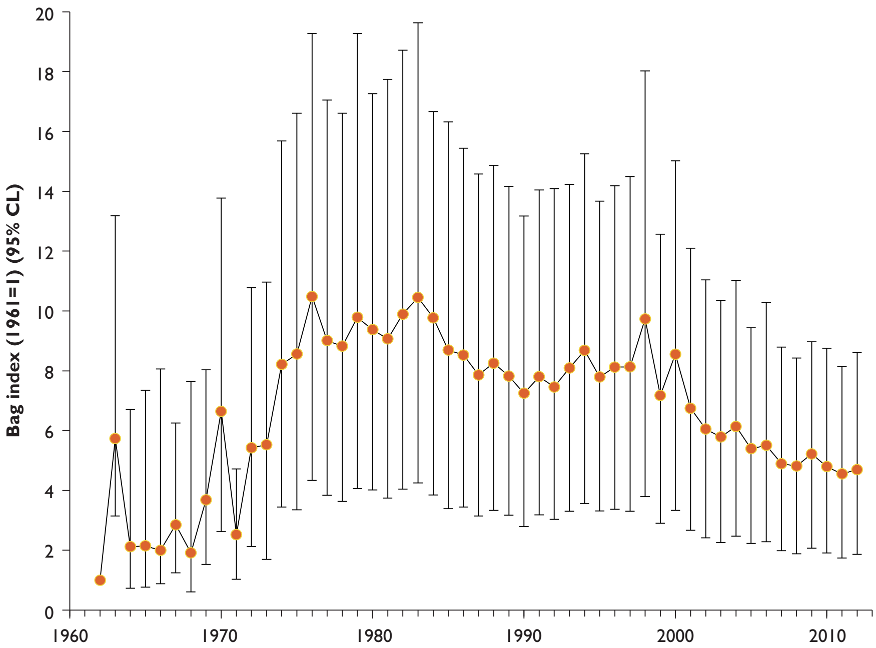



**Figure 5**

American mink index from NGC bags

recovered, so weasels declined, with a 70% fall in bags between 1961 and 1995. Since 1995, the situation has reversed: rabbit bags have halved and weasel bags have approximately doubled. It is possible that voles have again responded to under-grazing by rabbits, but during this period Stewardship schemes have encouraged the establishment of grass margins in the countryside, which are also likely to have benefited voles.

### American mink (Figure 5)

American mink spread into the wild from animals escaping from fur farms, with the first recorded instance of wild-bred young in Devon in 1956. As mink became established across Britain, mink bags on NGC estates increased 10-fold between 1961 and the mid-1970s. This was followed by a period of approximate stability that lasted for around 20 years. Over the last 15 years, however, mink bags have almost halved. It is possible that the lack of population growth suggested by the bags is associated with the recovery of otter numbers, as it is widely believed that otters exclude mink. The recent decline may also partly reflect the successful deployment of the GWCT Mink Raft in many parts of Britain in the last 10 years to control mink for water vole conservation.

### 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**

*Over the last 15 years mink bags have almost halved. © Dave Kjaer*

# Uplands monitoring in 2013

*In northern England, red grouse densities reached unprecedentedly high levels. © Dave Kjaer*

## KEY FINDINGS

- Red grouse post-breeding densities reached unprecedentedly high levels in northern England, although densities were similar to last year in Scotland.
- When used in the prescribed manner, the current single-dose medicated grit effectively killed strongyle worms in red grouse.
- In contrast with recent years, black grouse and capercaillie bred well in 2013. Black grouse chick survival in northern England was the highest recorded since our records started in 1989.

David Baines
Dave Newborn
David Howarth
Philip Warren

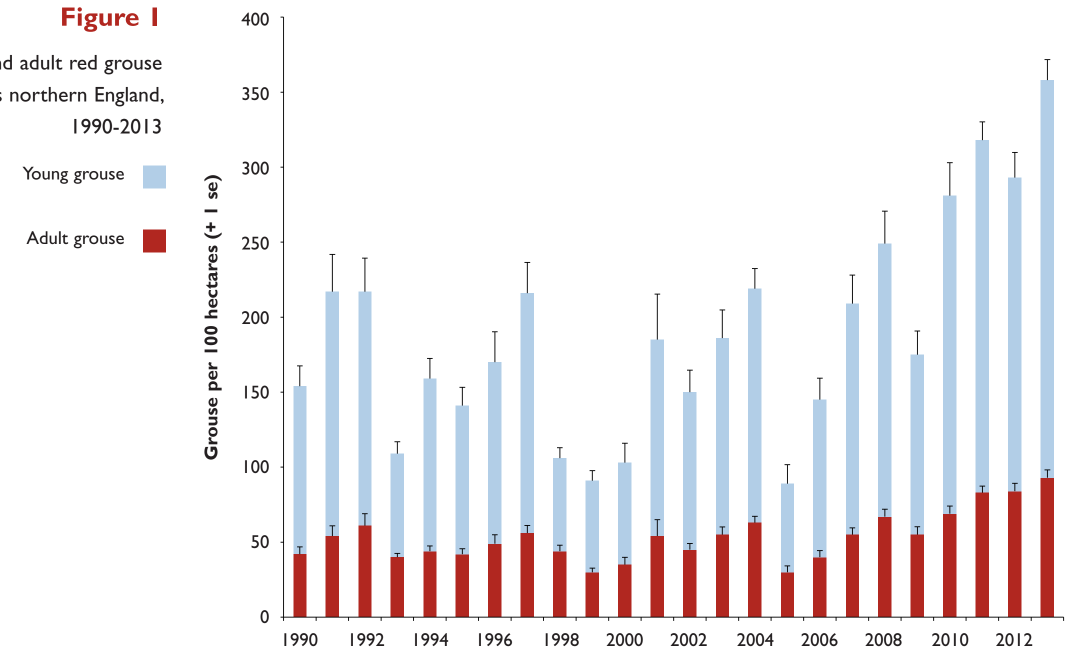
### Red grouse in northern England and Scotland

One of our main long-term monitoring efforts centres on two sets of red grouse counts conducted in spring and summer, using pointing dogs on areas of heather of approximately 100 hectares (ha). The spring count is to assess potential breeding pairs, whereas the summer one is to estimate breeding performance. Spring 2013 will be remembered for the unseasonal prolonged cold, with snow persisting to mid-April on high ground. Our spring grouse counts were delayed and, for the first time in 30 years, were not completed. Large areas of heather, particularly on lower sites and east-facing slopes not protected by the snow, were damaged by the freezing winds.

In northern England, grouse densities were very similar to 2012, with a mean 100 grouse per 100ha. Poor spring weather was compensated for by excellent warm, dry brood-rearing conditions. These conditions were associated with high breeding success of 2.8 chicks per adult in 2013 compared with 2.5 chicks in 2012. Accordingly, July densities averaged 358 birds per 100ha, the highest ever, up from 293 in 2012 (see Figure 1). All these increases, including record bags, point to the phenomenal success of the new, improved medicated grit. When viewing the cyclical nature of the historic grouse populations, 2013 should have been a crash year driven down by strongyle worms. This, like 2009, the predicted previous crash, was not the case on moors where

**Figure 1**

Average density of young and adult red grouse in July from 25 sites across northern England, 1990-2013



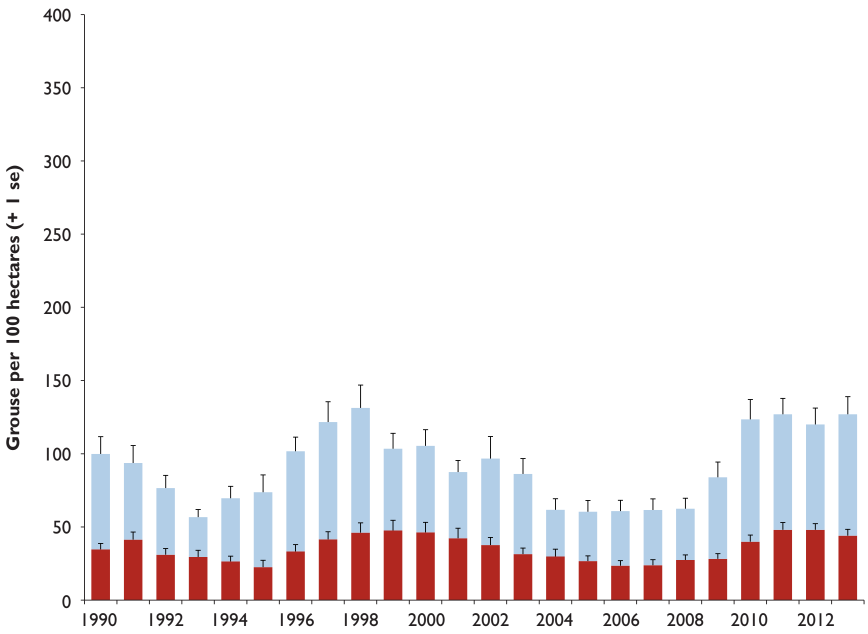



**Figure 2**

Average density of young and adult red grouse in July from 24 sites on Scottish moors, 1990-2013

Young grouse

Adult grouse

medicated grit was used. However, on the Moorhouse National Nature Reserve in the North Pennines, where there is no worm control, the grouse once again crashed. Escalating grouse densities without appropriate and equal responses in harvesting can, however, bring their own set of problems. New diseases and specifically respiratory cryptosporidiosis in red grouse are discussed in this *Review* (see page 38).

In Scotland we counted 24 long-term core grouse monitoring count sites. In spring 2013, densities averaged 56 grouse per 100ha, a decrease of 18% compared with 2012. This year red grouse bred better than in the previous two seasons in Scotland, at 1.9 young per adult compared with 1.5 in 2012. This rate of breeding resulted in an average density in July 2013 of 127 grouse per 100ha, showing little change from the figure of 126 in 2012 (see Figure 2). However, average July densities have more than doubled since 2008. Some Scottish estates were shooting into November, indicating a year better than expected, with reports of young birds showing better later on.

## Strongyle worm burdens in northern England and Scotland

Strongyle worm burdens are monitored across a sample of core sites in both northern England and Scotland. As more estates use the improved medicated grit in

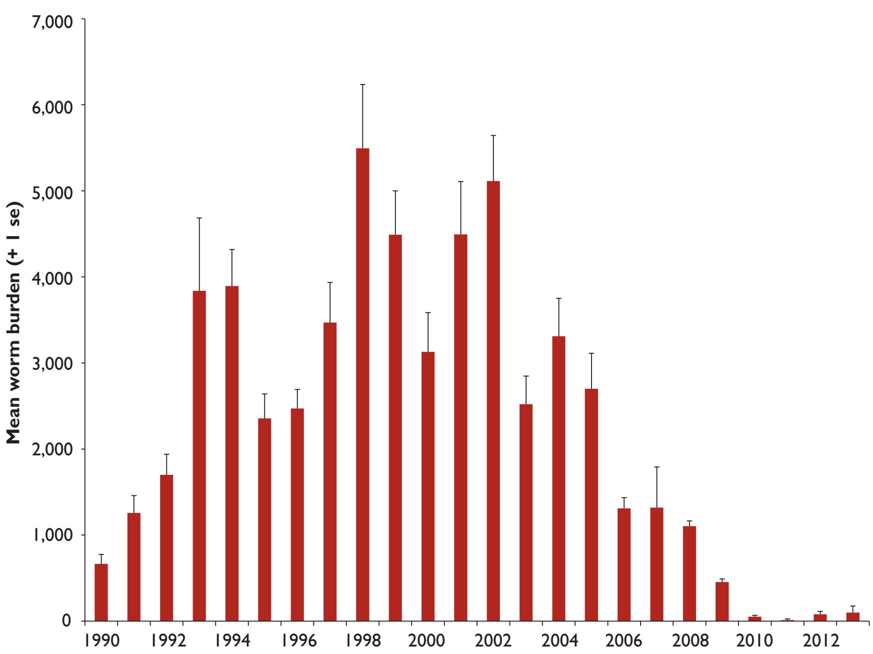



**Figure 3**

Average annual worm burden for autumn-shot adult grouse from between 8-15 sites across northern England, 1990-2013

*2013 was the best breeding year for black grouse and enabled black grouse numbers to recover from the appalling breeding season of 2012. © Dave Kjaer*

the prescribed manner, average worm burdens have fallen year on year since 2007 (see Figure 3), and in recent years we are, for the first time, recording zero worm counts. In northern England 5% of shot birds examined contained no worms in 2007; this rose to a high of 45% in 2010. It was 23% in 2013. Similar trends in worm burdens have been found in Scotland: since 2010 the annual average numbers of worms per shot grouse was fewer than 200 worms and in 2013, 34% of the samples had zero worms.

With the majority of moors managed for grouse shooting now using the improved medicated grit in the prescribed manner, the control of strongyle worms in grouse is a great success story.

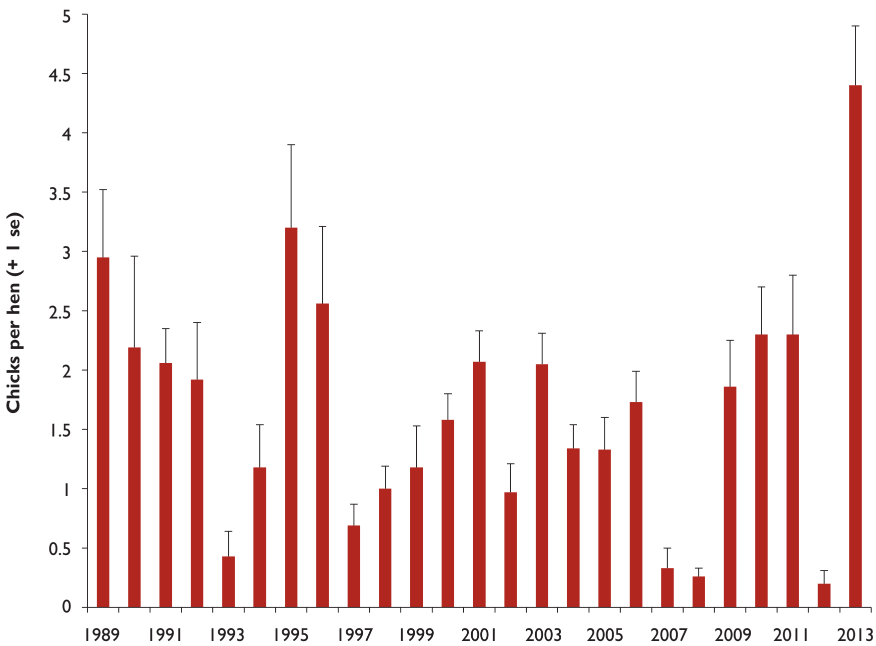
## Black grouse

In spring 2013 we surveyed black grouse at 56% of known leks in northern England. The numbers attending leks was 19% down on the previous year and we now estimate the population size at around 770 males. This decline in numbers is due to a lack of recruitment following very poor breeding in 2012.

This summer's breeding surveys in northern England using pointing dogs found 40 greyhens, of which 36 had broods totalling 174 chicks, an average of 4.4 chicks

**Figure 4**

Black grouse breeding success in northern England between 1989 and 2013



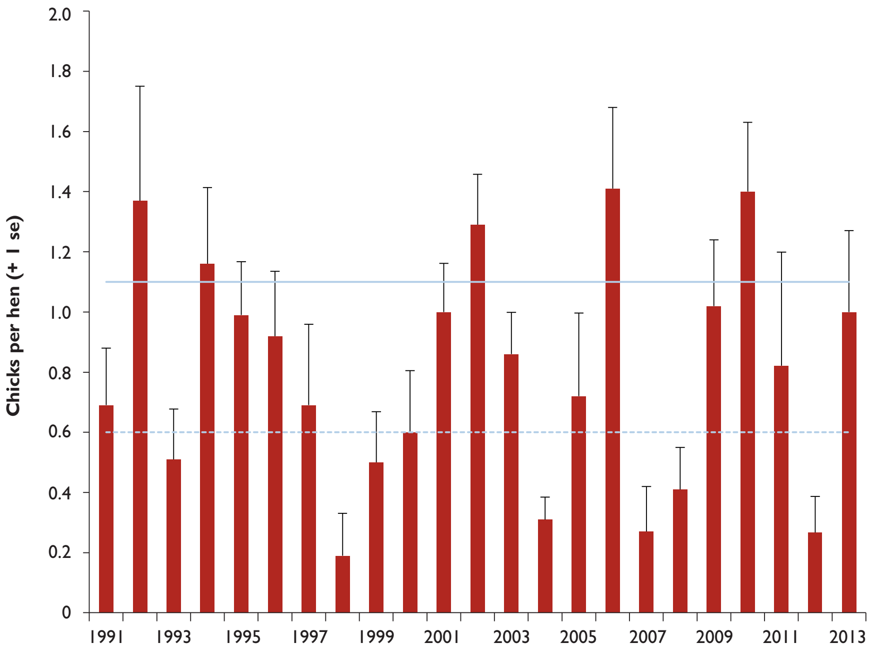



**Figure 5**

Capercaillie breeding success between 1991 and 2013* 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: blue solid line-with fence collision mortality; blue dashed line-without fence mortality.*

** Please note that only 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 since 2010 the number of forest areas surveyed has been reduced.*

per hen (see Figure 4). The summer of 2013 was the best breeding year since annual surveys began in 1989 (see Figure 1) and we also encountered the largest brood seen in England, with one hen having 11 chicks. This was in stark contrast to last summer, when of the 35 hens found, only four had broods totalling seven chicks, owing to the cold and wet weather.

In the Scottish Highlands, numbers of males at leks that we help count in Perthshire had fallen by 18% and in Strathspey by 21%. Breeding productivity in the Scottish Highlands this summer was much improved compared with recent years: we found 26 greyhens, 18 with broods and a total of 57 chicks, giving an average of 2.2 chicks per hen (1.0 chicks per hen in 2012).

## Capercaillie

Our counts were restricted to four of our long-term study forests, three in Strathspey and one in Morayshire. Across these sites, capercaillie had a reasonable breeding year and averaged about 1.0 chicks per hen (see Figure 5). Although brood sizes were high in 2013, we still found 66% of hens without a brood. To date, we are unaware of how birds fared elsewhere. Almost three quarters of the Scottish and UK population is now restricted to Strathspey. This 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.

*Although brood sizes of capercaillie were high in 2013, we still found 66% of hens without a brood. © Dave Kjaer*

# The spread of *Cryptosporidium baileyi* in red grouse

*Red grouse have been diagnosed with* Cryptosporidium baileyi, *a respiratory disease, with young birds particularly prone to infection.* *© Dave Kjaer*

In autumn 2010, the first case of respiratory cryptosporidiosis in red grouse was diagnosed from six individuals caught on a moor in the North Pennines. The cryptosporidia were diagnosed as *Cryptosporidium baileyi*. There followed a second diagnosis again from the North Pennines in autumn 2011. Prompted by further records from several moors of grouse exhibiting typical symptoms (swollen eyelids and mucal discharge from the nasal passage and infraorbital sinuses), we circulated a questionnaire in winter 2012 among grouse moor managers in northern England to gauge how many moors had observed infected grouse. The questionnaire asked whether grouse exhibiting typical 'bulgy eye' symptoms had been observed on the moor, in what year they were first observed and whether infected birds had been submitted to Veterinary Investigation Centres for diagnostic testing. If so, we asked what were the subsequent results and the estimated prevalence of infected birds on the moor.

**KEY FINDINGS**

- *Cryptosporidium baileyi* infection was first diagnosed in red grouse in northern England in autumn 2010.
- In three years, outbreaks have occurred in almost half of all English moors and in 80% of moors in the North Pennine Dales.
- We have initiated studies that consider the impact of infection on grouse population dynamics and we continue to track the course of this disease.

David Baines
Mike Richardson
Dave Newborn

*© Laurie Campbell*

We received responses from 102 out of an estimated 150 grouse moors (68%) in northern England by spring 2013. Responses were split into five regions: Trough of Bowland, North York Moors, South Pennine Dales, North Pennine Dales and north Northumberland. Of the 102 moors, symptoms were reported from 49 (48%), with all but three of the moors situated in the Pennines. Of the moors reporting symptoms, only 13 submitted seemingly infected birds for diagnosis. Of those, 10 (77%) were confirmed as hosting infections of *C. baileyi* following histopathological examination of samples at the Animal Health and Veterinary Laboratories Agency – Lasswade. These comprised all eight moors in the North Pennine Dales and two in the South Pennine Dales. The three remaining samples, one each from the North York Moors, Trough of Bowland and southern Dales, were diagnosed as non-pathogenic mycoplasma. Thus *C. baileyi* outbreaks were chiefly confined to the Pennines, with 80% of North Pennine moors and 22% of South Pennine moors seemingly infected. Of those moors reporting infected birds, their prevalence in the shooting bag averaged 1.6%, but ranged from a single individual to 10% of shot birds.

The transition from a first diagnosis of respiratory sinusitis at a Pennine moor in 2010, to 48% of moors reporting symptoms of infection in their grouse three years later, constitutes a rapid spread. In the North Pennine Dales, symptoms were first reported from two of the 50 moors in 2009, the year previous to diagnosis, followed by symptoms reported from a further four, 11 and 15 moors in 2010, 2011, 2012 and 2013 respectively. This represents a cumulative annual total of 12%, 34% and 64% and 80% of the moors.

Respiratory cryptosporidiosis is a seemingly new disease in red grouse. Young birds appear particularly prone to infection, and natural dispersal amongst high densities of young birds, together with driving birds for several kilometres for shooting, are likely to have contributed to high rates of disease transmission and spread. The first confirmed Scottish record was reported from the Lammermuir Hills in 2013. We have embarked on a programme of research and monitoring that includes effective screening for disease, new diagnostic tests and a comparison of survival and breeding capability between infected and healthy individuals. We are also working in close collaboration with practising vets and Government veterinary staff to understand this disease better.

*Driving red grouse for shooting is likely to have contributed to high rates of disease transmission and spread. © Richard Faulks*

# Grey partridges in the uplands

*Upland grey partridges are often found on grasslands on the fringes of grouse moors.*
*© Henrietta Appleton/GWCT*

**KEY FINDINGS**

- Rushes were the preferred nesting habitat for grey partridges in northern England, but these nests were vulnerable to waterlogging in wet summers.
- Beetles, sawfly larvae and ants formed the main components of chick diet.
- The poor weather in 2012 led to no chicks being produced.

Philip Warren
Tom Hornby
Dave Baines

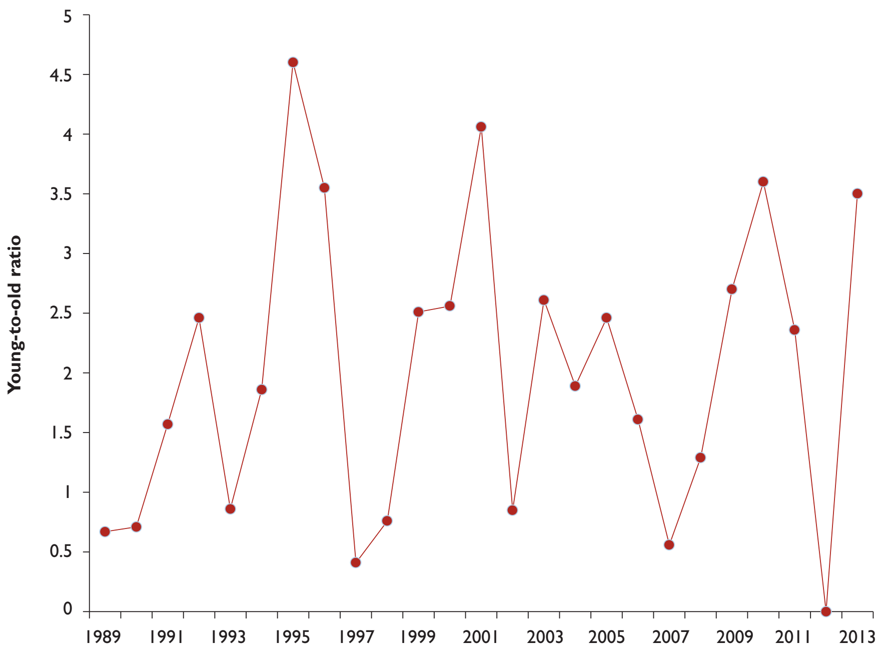
In the uplands of northern England, grey partridges frequent extensive grasslands on the fringes of grouse moors, made up of rough pastures and hay meadows, with arable farming absent. Substantial numbers persist here, but in contrast to birds in lowland agricultural landscapes, little is known of their population dynamics or habitat requirements. To enable us to provide management recommendations to conserve grey partridges in these landscapes, first we needed more detailed information on how they use upland farms, where they breed, what their chicks eat and what limits abundance. A three-year project funded by the SITA Trust and the County Durham Environment Trust began in spring 2010.

We caught and radio-tagged 72 grey partridges (36 cocks and 36 hens) in Upper Teesdale, County Durham. We checked birds weekly to find nests and monitor outcomes. To investigate the diet of chicks, we collected droppings from their night-time roosts.

Following pre-breeding losses, we followed 26 pairs where we tagged the hen through the breeding season. They nested in rush pastures (38%), grass moorland (42%), meadows (8%) and roadside verges (12%). Half of the nests were located in

**Figure 1**

Annual breeding productivity of grey partridges on upland farms in northern England, 1989-2013



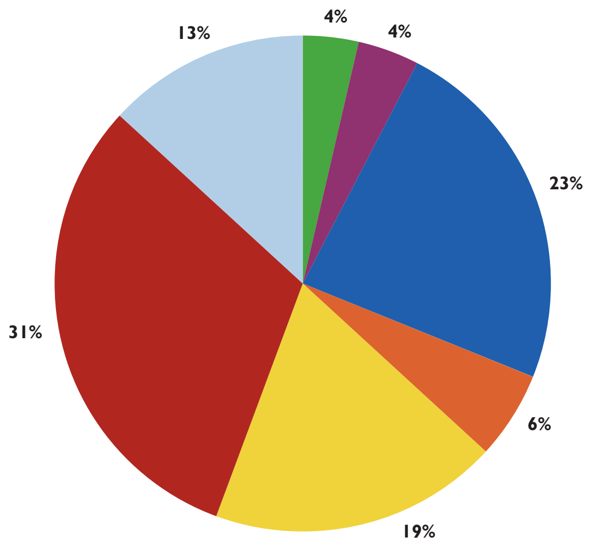



**Figure 2**

Diet of grey partridge chicks on upland farms in northern England from 14 broods

rushes. Overall breeding productivity differed between years, with hens rearing 6.3 chicks per hen in 2010, 2.5 in 2011, but none in 2012.

Breeding failure in 2012 was caused by a cold, wet June, which was the second wettest on record with more than double the average rainfall falling in the dale. The prolonged wet weather affected grey partridges throughout the breeding period. Nesting success was only 20% compared with 50% in 2010 and 45% in 2011. Similarly, hatching success was only 34% compared with 100% and 76% in the previous two years. The preferred nest sites of radio-tagged hens were in rushes. However, rushes flourish in the wetter areas leaving nest sites vulnerable to waterlogging. This was a particular problem in 2012 (n=10 hens) when three hens abandoned flooded clutches mid-way through incubation. Two hens were also found dead, one mid-incubation and the other shortly after hatching. Post-mortem examination showed no clear signs of worms or disease in either bird. Possibly the increased effort invested in incubation, having to spend longer on the nest and less time away feeding, may have resulted in poor condition and ultimately death. This was despite supplementary food made available from wheat-filled hoppers until mid-March. Only two hens hatched a clutch and both lost their chicks within the first week after hatching.

The poor breeding observed in the small sample of radio-tagged hens was widespread in the study area, with our summer counts finding no chicks from 53 adult birds. Annual breeding productivity of grey partridges on upland farms in northern England has been monitored since 1989. On average the young-to-old ratio was 2.1 (range 0-4.6). Breeding productivity in 2012 was the lowest recorded during this period (see Figure 1).

We collected chick droppings from eight pairs where we had the hen tagged and six where we had only the cock tagged. In 2010, we sampled broods every four days until they were four weeks old, collecting droppings from 15 brood roosts from the four pairs. In the following years, this was reduced to a minimum of one brood roost from each pair within two weeks of hatching, with 11 roosts from seven pairs collected in 2011 and three roosts from three pairs in 2012. For analysis, we pooled samples from each brood. Overall, beetles (31%), sawfly larvae (23%) and ants (19%) were the main chick prey items (see Figure 2). Only sawfly larvae in the diet varied between years, comprising 32% in 2010, 16% in 2011 and 9% in 2012. Sawfly larvae are a rich source of protein for growing chicks, and the low proportion in chick diet in 2012 suggests that the availability of this chick prey item was also affected by the inclement weather.

In the uplands, grey partridge breeding productivity is strongly weather-dependent. On upland farms, rushes provide nesting cover but are vulnerable to waterlogging in wet summers. To maintain partridge numbers, it is important to pursue extensive management of grassland habitats, combined with predator control, so that when weather conditions are good, birds breed well.

*Supplementary food was provided for the grey partridges using feeders. © Tom Hornby/GWCT*

# Black grouse translocation: expanding their range

*Our trial successfully established new leks by translocating males into areas to attract dispersing females. © Dave Kjaer*

## KEY FINDINGS

- Survival rates of translocated wild male black grouse have been good.
- Translocation has led to the establishment of new leks in areas from which black grouse had disappeared.
- Females have been attracted to new leks and have subsequently settled and bred.
- Translocation appears to be a successful mechanism for re-establishing range.

Frances Atterton
Philip Warren
David Baines

In northern England, black grouse numbers increased from 773 males in 1998 to 1,029 in 2006. Despite this increase, the occupied range of the species remained constant, so our conservation effort has now focused on delivering the English Biodiversity Action Plan target to increase the range from 42 to 61 occupied 10x10-kilometre (km) grid squares by 2030.

Range expansion is thought to be limited by the low dispersal capacity of males, which only move an average of 0.8km compared with 9.3km by juvenile females. Observations suggest that yearling females may re-colonise areas of suitable habitat on the fringe of the current range, but where they fail to breed because there are no males present. To stimulate range expansion, we instigated a trial to establish new leks on the fringe of the range by translocating males into these areas to attract dispersing females. The first phase of the work (2006-10) was undertaken at two sites, one in Wensleydale on the southern fringe of the range, the second in Lunedale, County Durham, situated between two existing lekking groups. This was then rolled out to two further sites in Upper Nidderdale and Coverdale for the second phase (2011-14). The success of the project will be evaluated using the following criteria: (a) the establishment of new lekking groups; (b) the persistence of these lekking groups; (c) natural recruitment into the lek through successful local breeding.

The trial was developed according to the International Union for the Conservation of Nature and Natural Resources (IUCN) guidelines on re-introduction. We selected release sites that had suitable mosaics of rough grazing, meadows and pockets of scrubby woodland on the fringes of grouse moors where gamekeepers control predators, and were within the average dispersal distance of juvenile females coming from existing leks. The donor moors were in the core North Pennines range and were deemed suitable if they contained leks with more than 10 males. Birds were translocated only following good breeding years. We caught males at night and transported them immediately to the release sites where they were released into areas of tall vegetation. All birds were equipped with necklace radio-transmitters to allow us to

## TABLE 1

**Numbers of male black grouse released each year at the four sites 2006-2013**

| Release site | 2006/07 | 2007/08 | 2008/09 | 2009/10 | 2010/11 | 2011/12 | 2012/13 | 2013/14 |
|---|---|---|---|---|---|---|---|---|
| A | 7 | 8 | | 2 | | | | |
| B | 5 | 2 | | | | | | |
| C | | | | | | 7 | 3 | 4 |
| D | | | | | | 8 | 2 | 6 |

**TABLE 2**

**Numbers of displaying male black grouse at the release areas in spring before and following release (numbers of radio-tagged males observed are in brackets)**

| Release site | 2002 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
|---|---|---|---|---|---|---|---|---|---|---|
| A | 2 | 0 | 0 | 8 (6)* | 5 (5)* | 3 (2)* | 5 (2)** | 9 | 14 | 7 |
| B | 0 | 0 | 3 | 6 (2)** | 3 (2) | 5 (1) | 5 | 4 | 4 | 3 |
| C | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 9 (9)* | 7 (7)** |
| D | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 (3) | 3 (3) |

** Hens observed in attendance ** Breeding reported*

follow movements, survival and lekking behaviour. We monitored numbers of males attending leks at the donor sites to verify that there was no effect of removing males on the donor population.

During the first phase of the project, 24 males (20 adults, four juveniles) were released (see Table 1). Successive poor breeding years following wet summers in 2007 and 2008 meant that releases in 2008/09 were postponed. The planned release for 2009/10 was also postponed owing to the severe winter weather which led to high mortality at the donor moors (only two males were moved prior to the onset of bad weather). Following a recovery in numbers, the second phase of the project started in 2011, with 30 males (17 adults, 13 juveniles) moved to date.

In the first phase of the study, we found during the first winter releases that three adult males returned to their capture locations, two a distance of 5.5km and one 14km. Subsequently all males have been moved a minimum of 15km. From our observations, males following release roamed widely around the release area either in search of other males or females, before settling, often on previously occupied leks. Provisional analyses suggest that adult males are likely to move more than juveniles and we are currently increasing the sample of juveniles moved to assess whether they settle better. The survival rates of males in the first year following release were good at 0.67 (0.48-0.81, 95% confidence limits).

Annual lek surveys prior to translocation (in 2005) found no males at any of the recipient sites (see Table 2). Following the first phase of releases in 2006/07, eight males were observed lekking at site A in spring 2007, which increased to 14 males in 2012. At site B, six males were observed in 2007 and males have been observed in all years since. Following the second phases of releases in 2011/12, nine males were observed in 2012 and seven in 2013 at site C. Three males have been observed in both years at site D.

Females were observed in the first spring following release at three of the release sites. Successful breeding was confirmed at site A with 11 juvenile males observed in autumn 2010, and at Site C in summer 2013, 19 chicks have been observed with four females.

The study has produced encouraging results, but is costly to deliver and is dependent on the availability of surpluses from the core population. We now need to conduct this on a larger scale for it to be considered as a viable conservation technique.

## ACKNOWLEDGEMENTS

The first phase of this work was funded by the Sita Trust (2006-10), with the second phase funded by Biffa Award, Yorkshire Water and a private landowner (2011-14). We would also like to express our thanks to all landowners at donor moors for donating birds to facilitate this project.

*Male black grouse are translocated only if there is a surplus from the core population. © Laurie Campbell*

# Effectiveness of sheep tick mops

*Acaricide treatment of sheep to reduce ticks is a priority. © Kathy Fletcher/GWCT*

## KEY FINDINGS

- Sites with the highest tick burdens were those with the lowest grouse productivity.
- Tick burdens found on young grouse chicks were highest on sites with longer intervals between successive treatments of sheep and higher on those sites with red deer.
- Grouse productivity was lowest on sites with the highest deer densities, but hare density, sheep treatment interval and sheep density were not found to influence productivity.

Kathy Fletcher

Sheep ticks are known to have a serious effect on grouse chick survival and are increasing in many parts of the Scottish Highlands. Our research in northern England has shown that regular treatment of sheep with acaricides can reduce tick numbers on grouse chicks, reduce the prevalence of Louping Ill virus and improve shooting bags. The tick host system is simple in northern England, with the main hosts being grouse and sheep. In many parts of Scotland it becomes complicated by the presence of red deer and mountain hares as alternative tick hosts. This may reduce the effectiveness of treated sheep used to 'mop' up ticks. The best way to assess the effect of alternative hosts on the efficacy of sheep tick mops would be through replicated field experiments. In the absence of such trials, we adopted a correlative approach. By comparing hare and deer abundance indices with tick burdens on grouse chicks and grouse productivity on the same areas, we sought to determine if there was a level of these alternative tick hosts which rendered the sheep tick mops ineffective.

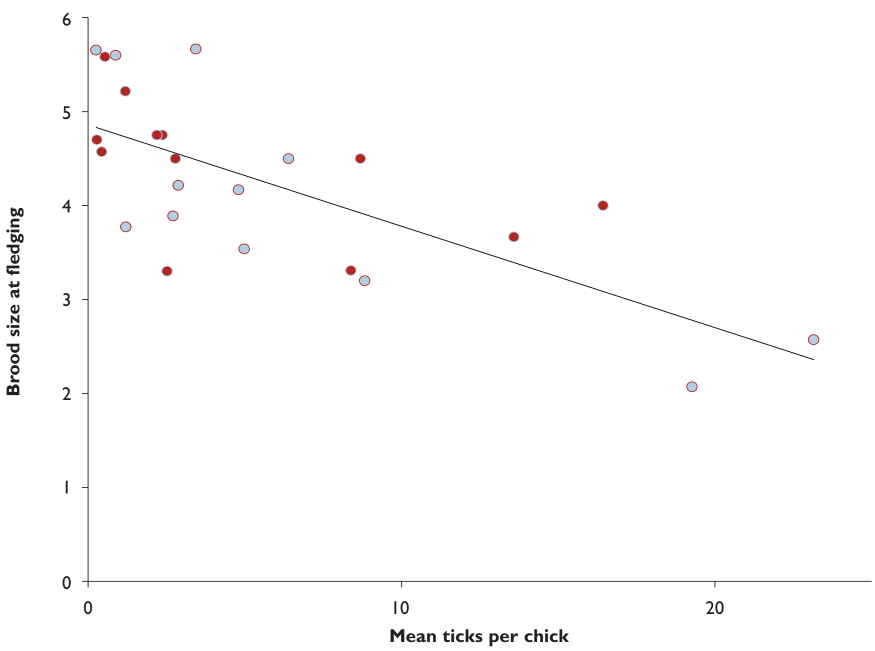
We monitored 12 sites where sheep management was being undertaken to reduce ticks, but with a range of hare and deer densities. Estate staff provided estimates of sheep numbers on the moor (range eight to 71 sheep per 100 hectares) and the interval between successive acaricide treatments (range six to 10 weeks). The density of deer recorded during counts in late winter was used as a proxy for deer density during the summer (six sites with no deer, remaining sites range 0.7 to 39 deer per 100 hectares). An abundance index for mountain hares was calculated as the number of hares seen during our grouse counts in July (range 0 to 3.6 hares per kilometre). We caught 10 or more grouse broods per site when chicks were approximately five to 25 days old to assess tick burdens per chick. Our July counts with dogs allowed us to measure average brood size at fledging.

Looking at ticks of all life stages, the mean tick burden for each site varied from 0.3 to 23.2 ticks per chick and sites with higher tick burdens were also those with the lower grouse productivity (range 2.1 to 5.5 young per brood at fledging, see Figure 1). Average

**Figure 1**

Relationship between the brood size at fledging and tick burdens on grouse chicks

2013 ●
2012 ○

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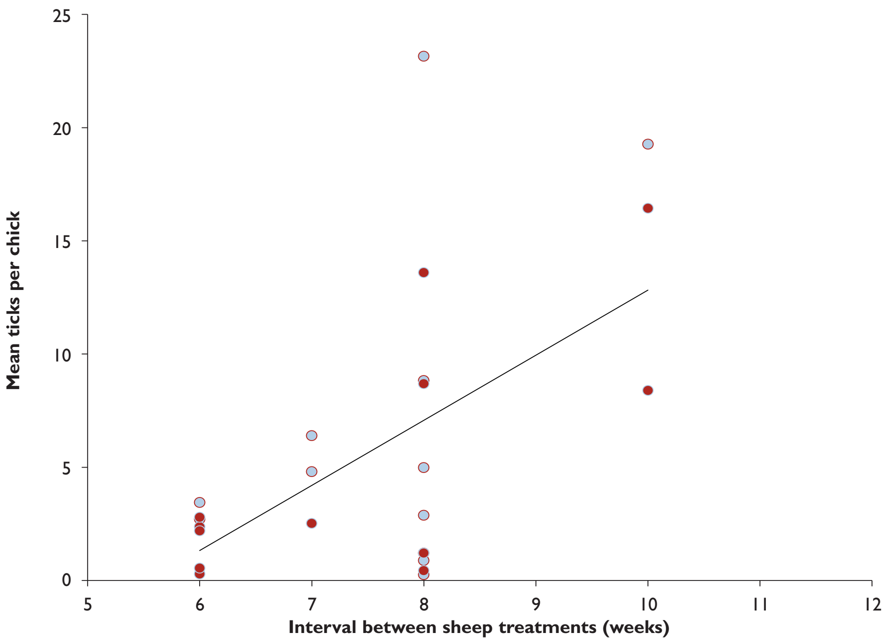



## Figure 2

Relationships between tick burden and the interval between sheep treatments

- 2013
- 2012

© Henrietta Appleton/GWCT

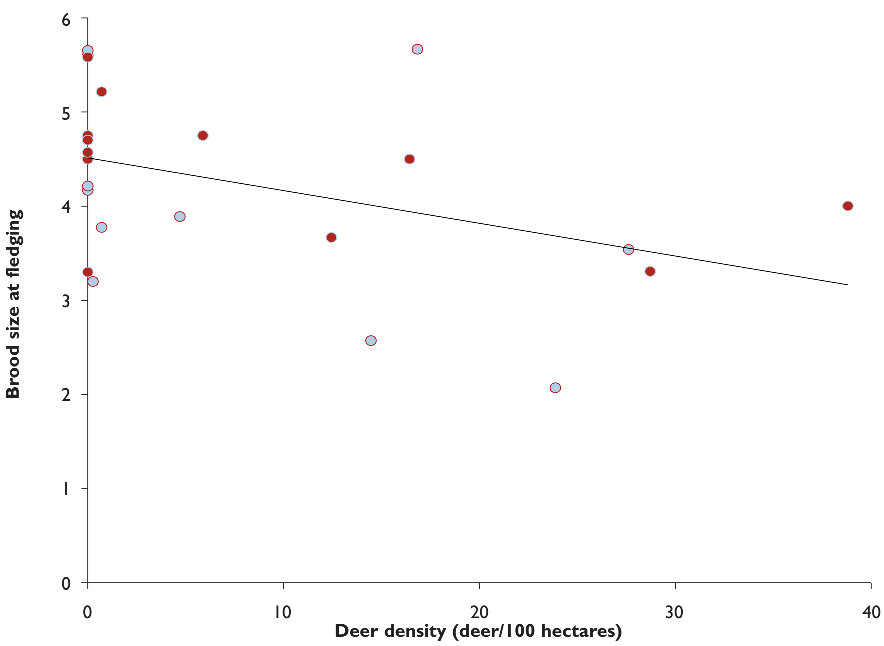
tick burdens were three times higher on sites with deer (mean 8.3 ticks per chick) than on sites with no deer (mean 2.5 ticks per chick), and tick burdens showed a positive correlation with the interval between successive sheep treatments (see Figure 2).

Grouse chick survival (brood size at fledging) was on average lowest on sites with the highest deer densities (see Figure 3), but did not appear to be influenced by hare abundance or intensity of sheep management.

Mathematical modelling to look at the effectiveness of sheep tick mops in the presence of deer has previously suggested that sheep mops remain effective until a certain threshold deer density is reached, with this threshold being dependent on the comparative tick burden on the sheep and deer. In our field study, we did not detect a threshold in the deer density. Although the highest recorded tick burdens were all on sites with greater than six deer per 100 hectares, some of the high density sites also had similar tick levels to those recorded at lower densities. This confirmed the complex nature of the management required to reduce ticks. Our advice on reducing ticks remains that acaricide treatment of sheep is a priority, followed by a reduction in deer density should sheep management alone not work. Only after both these options have been explored should culls of mountain hares be considered.

## ACKNOWLEDGEMENTS

We are grateful to all the estates that hosted this study and the associated donations.




## Figure 3

Relationship between brood size at fledging and the density of red deer

- 2013
- 2012

© Laurie Campbell

# Acaricide-impregnated neck collars on sheep

*Sheep were examined and ticks counted before we randomly assigned them to three equal-sized groups. © Robyn Owen/GWCT*

## KEY FINDINGS

- Tick collars on sheep out-performed conventional pour-on treatments and were effective over the whole tick-questing period.
- Commercial manufacture, licensing and moor-scale trials are now required.

David Newborn
Mike Richardson
Dave Baines

Sheep ticks are vectors of a number of pathogens that affect sheep and wildlife hosts. To control ticks, sheep are treated with an acaricide pour-on at regular intervals between April and October while ticks are questing for a blood meal. The most effective pour-on has a persistency of eight to 12 weeks. To provide continuous protection throughout the questing period, sheep need repeat applications. Repeated gathers of sheep are costly in handling time and may disturb ground-nesting birds at critical times. An alternative control technique without the need for repeated treatments would be invaluable. There are neck collars for dogs whose manufacturers claim effectiveness against ticks for six months. If similarly effective on sheep, one collar could last the entire tick questing period and remove the need to gather and treat sheep repeatedly.

We performed a two-year trial to measure the effectiveness of acaricide-impregnated collars fitted to sheep in killing ticks. A 100-hectare (ha) rough grazing paddock in the North York Moors was provided for this trial, together with sheep and a shepherd. We examined all the sheep and counted ticks on each animal before the trial began. Once we had collected these baseline data, we randomly assigned each sheep to three equal-sized groups (16 sheep per group in 2012; 30 sheep per group in 2013) corresponding to three treatments:

1. Fitted with a tick collar for large dogs, which contained 1g of deltamethrin.
2. Treated with a pour-on (Crovect), containing 1.25% w/v cypermethrin, applied at a rate of 10ml per 20kg live weight of sheep. Sheep were re-treated in week 12 of the trial in 2012, and week 10 in 2013.
3. An untreated or control group with no acaricide treatment.

Sheep were gathered fortnightly between mid-April and early October. A standardised search for ticks was undertaken on bare areas of skin at the top of both front and back legs and on the head.

We measured fortnightly tick abundance per sheep for each treatment, from week 0 (late April) to week 22 (27 September) in 2012, or week 24 (8 October) in 2013 (see Figure 1 and 2). In each year, Crovect performed better than the untreated controls for only two to four weeks following the first round of pour-on treatment, but for six to eight weeks following the second application. Sheep fitted with dog collars showed greater tick kill rates and longer persistence than the Crovect group. In 2012, effective tick kill, relative to the control group, declined from 93% after two weeks to

## ACKNOWLEDGEMENTS

We would like to thank the owner, shepherd, agents and keepers on Westerdale & Rosedale Estate.

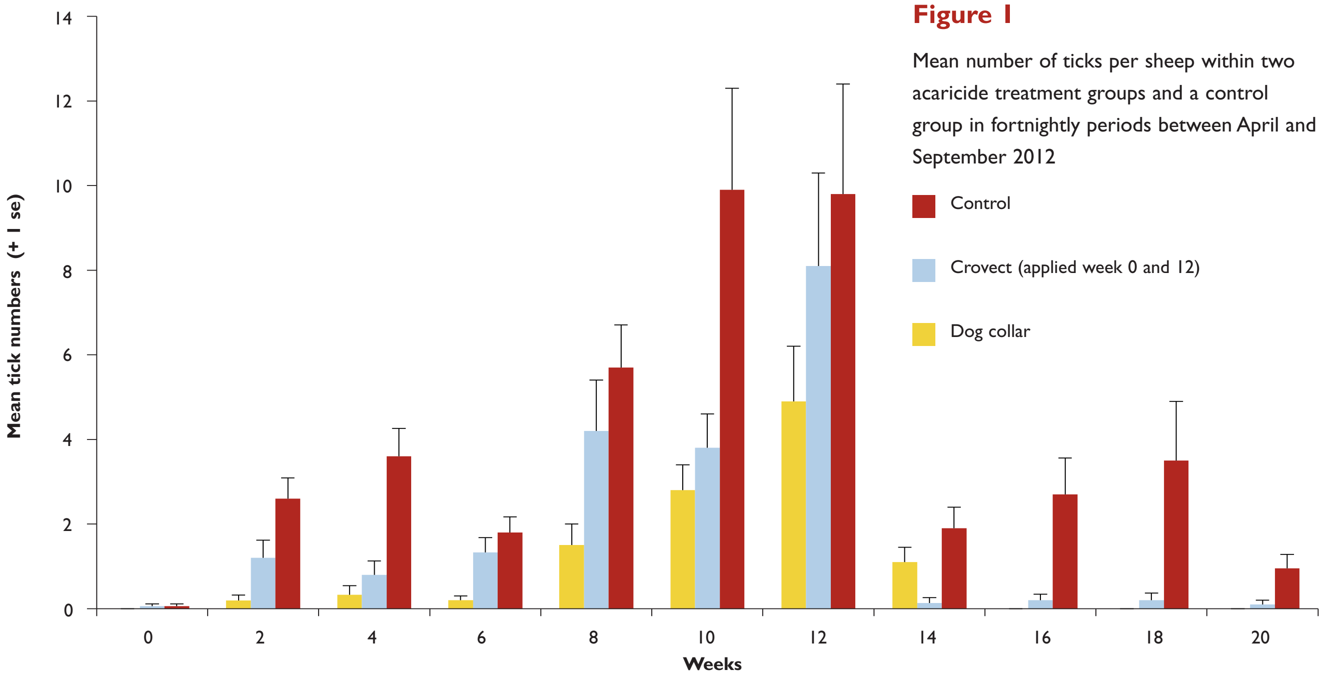



**Figure 1**

Mean number of ticks per sheep within two acaricide treatment groups and a control group in fortnightly periods between April and September 2012

Control

Crovect (applied week 0 and 12)

Dog collar

37% after week 14, after which no further ticks were found on sheep fitted with dog collars (mean reduction 78%, standard deviation (sd): 23, range 37-100%). In 2013, tick reduction in the collar group again averaged 78% over the same period, but showed lower variation in kill rates between gathers (sd: 7, range 70-90%). We found too few ticks in weeks 22 and 24 in each year respectively, so the trial was ended.

Deltamethrin-impregnated dog collars fitted to sheep were an effective means of killing ticks. In 2012 collars lasted 10 weeks, faltered for four weeks, before resuming effectiveness to 18-20 weeks. We don't know why this occurred, but no such lapse happened in 2013. Whether the product was effective beyond 20 weeks could not be determined owing to a seasonal paucity of ticks. These data give us confidence in the effectiveness of dog collars throughout the main tick questing period. The next steps are to consider commercial production of collars specifically for sheep and extensive trialling at the moor level.

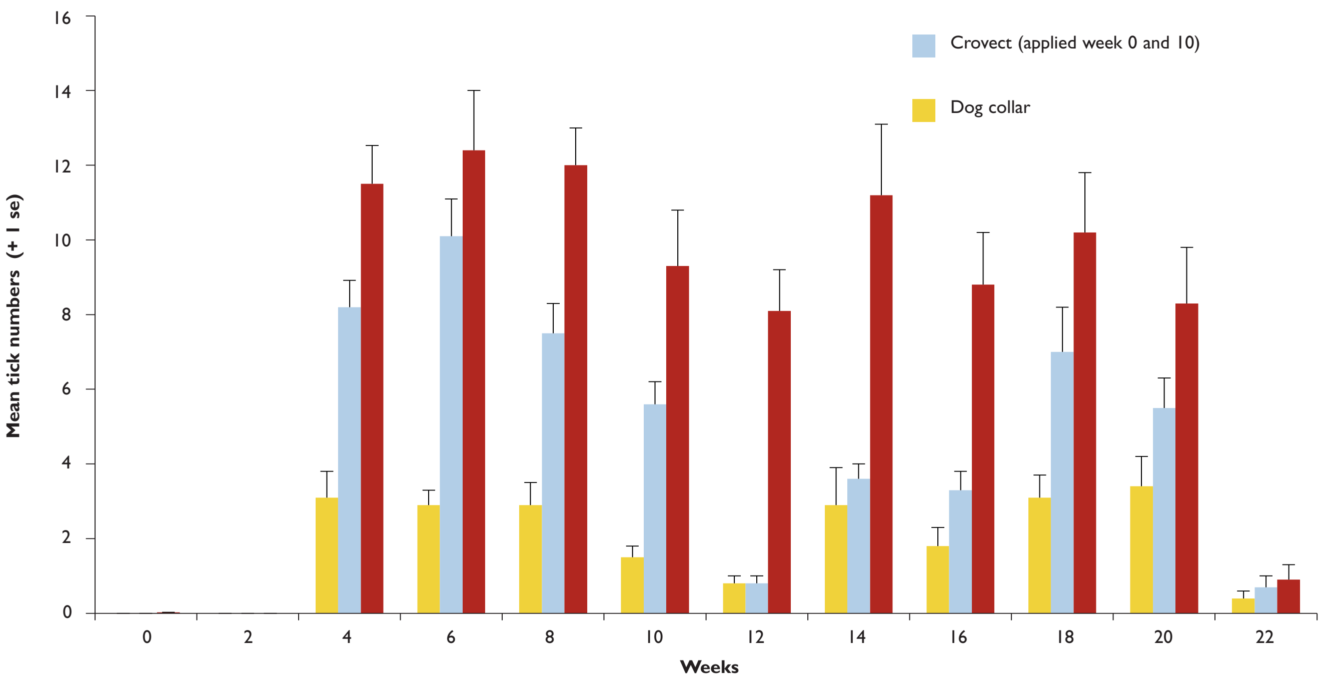
**Figure 2**

Mean number of ticks per sheep within two acaricide treatment groups and a control group in fortnightly periods between April and September 2013

Control

Crovect (applied week 0 and 10)

Dog collar



# Diet of breeding buzzards on Langholm Moor

*When field voles declined, buzzards switched to hunting prey such as rabbits. © Dave Kjaer*

## KEY FINDINGS

- Field voles are a key prey for breeding buzzards on Langholm Moor.
- When vole abundance declined, buzzards switched to hunting prey associated with the moorland periphery such as shrews, moles, rabbits and corvids.
- Grouse constituted a smaller proportion of buzzard diet when vole abundance declined, suggesting that grouse might be predated incidentally by buzzards when hunting for voles on the moor.

Richard Francksen
Dave Baines

The Langholm Moor Demonstration Project is carrying out a study to assess the diet and foraging habits of common buzzards. In the UK, field voles constitute a major part of the diet of common buzzards. For this reason, this study aims to assess variations in the diet and foraging patterns of buzzards during the breeding season on Langholm Moor in relation to the natural vole cycle. Previous monitoring of small mammals has shown that the vole cycle lasts three to four years at Langholm.

Between 2011 and 2013, we collected data on buzzard diet from a total of 44 nests found on Langholm Moor and within two kilometres of the Project boundary. We assessed diet using two methods:

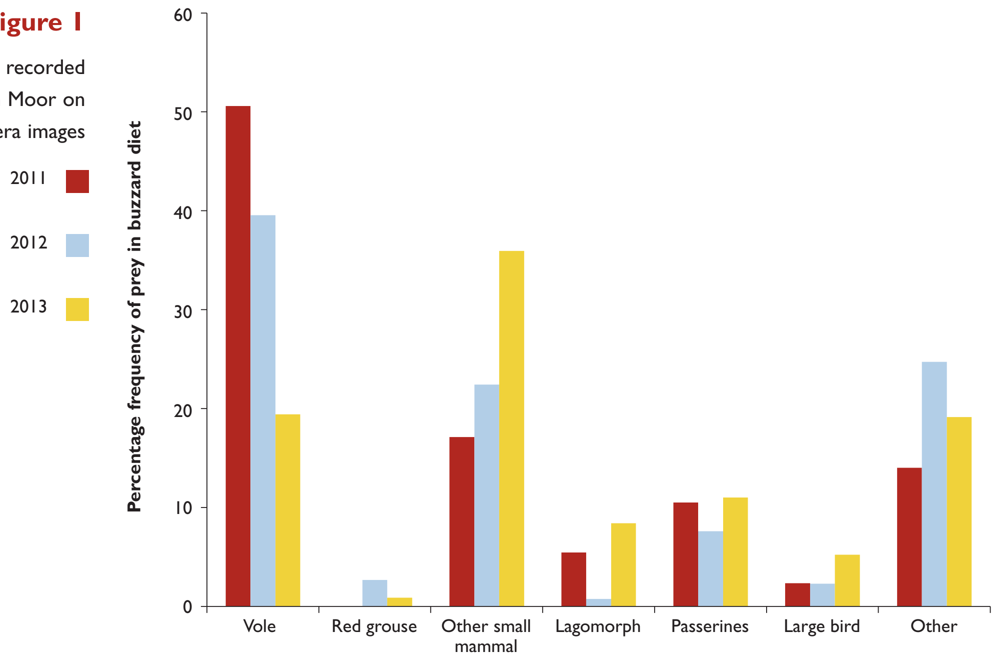
1. Placing motion-triggered cameras at buzzard nests to record prey deliveries by adults to chicks.
2. Collecting prey remains and pellets from within and around each nest. Prey items found in searches for remains and in pellet analysis have been combined here.

Individual items of prey were identified to species level when possible, and the percentage that each group contributed to the diet in each breeding season was calculated. Shrews, moles and mice were grouped into 'other small mammals' and pheasants, corvids and pigeons were grouped into 'large birds'. Lagomorphs consisted predominantly of rabbits, but also included young brown hares. We also assessed foraging patterns by conducting vantage-point watches over the moor between May and July of each year.

During this period, we also monitored vole abundance by using snap-trapping. Ten lines of 50 unbaited traps were placed out for two nights in March of each year. Vole abundance was expressed as the number of voles caught per 100 trap-nights.

**Figure 1**

Percentage of total frequency of prey recorded at 44 buzzard nests on Langholm Moor on camera images



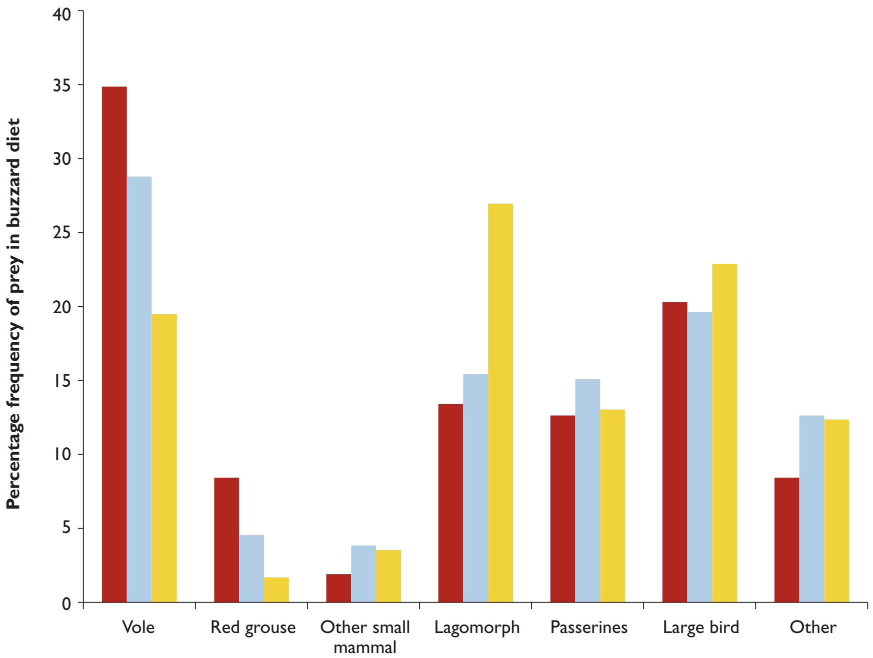



**Figure 2**

Percentage of total frequency of prey recorded at 44 buzzard nests on Langholm Moor from prey remains and pellets combined

Vole abundance declined during the study as part of the natural vole cycle (mean/100 trap nights: 6.7 in 2011, 3.5 in 2012, 0.6 in 2013). Both methods of assessing buzzard diet showed that voles were brought to chicks in decreasing proportion with declining vole abundance (see Figure 1 and 2). In camera images, a greater proportion of buzzard diet consisted of 'other small mammals' when vole abundance declined. In prey remains and pellet data, lagomorphs increased as a proportion of total diet when vole abundance declined. In each of the three breeding seasons, red grouse comprised less than 10% of buzzard diet, with variation between year and dietary assessment method.

Notably, red grouse formed a smaller proportion of buzzard diet in prey remains and pellets when voles declined. This suggests that buzzards at Langholm switched their foraging areas and prey choice when the abundance of field voles declined. This response was confirmed by results from vantage point watches, which recorded fewer sightings of buzzards on the moor during the low vole year (3.3 sightings per 100 visual scans in 2013) than in 2012 (6.2 sightings per 100 visual scans).

With declining vole abundance, buzzards switched to predating more small mammals and lagomorphs, apparently to compensate for declining availability of voles. Red grouse formed a smaller proportion of buzzard diet when vole abundance was low. Our results would seem to suggest that grouse are predated opportunistically when buzzards are hunting for voles on the moor.

*Buzzard chick at the nest. © Ayla Paul/GWCT*

*Each nest was checked for prey remains and pellets. © Ayla Paul/GWCT*

**ACKNOWLEDGEMENTS**

This study was undertaken as part of a PhD study at Newcastle University with support from The Langholm Moor Demonstration Project.

# Langholm Moor Demonstration Project: year six

*We fitted red grouse chicks with small radio transmitters to monitor chick survival. © Sonja Ludwig/GWCT*

**KEY FINDINGS**

- 2013 was a better breeding season for red grouse than the previous two years.
- We radio-tagged grouse chicks for the first time and found their survival was high in 2013 compared with previous years.
- No eggshells were found in pellets of juvenile ravens, but grouse feathers were detected in 19% of pellets.

Sonja Ludwig
Dave Baines

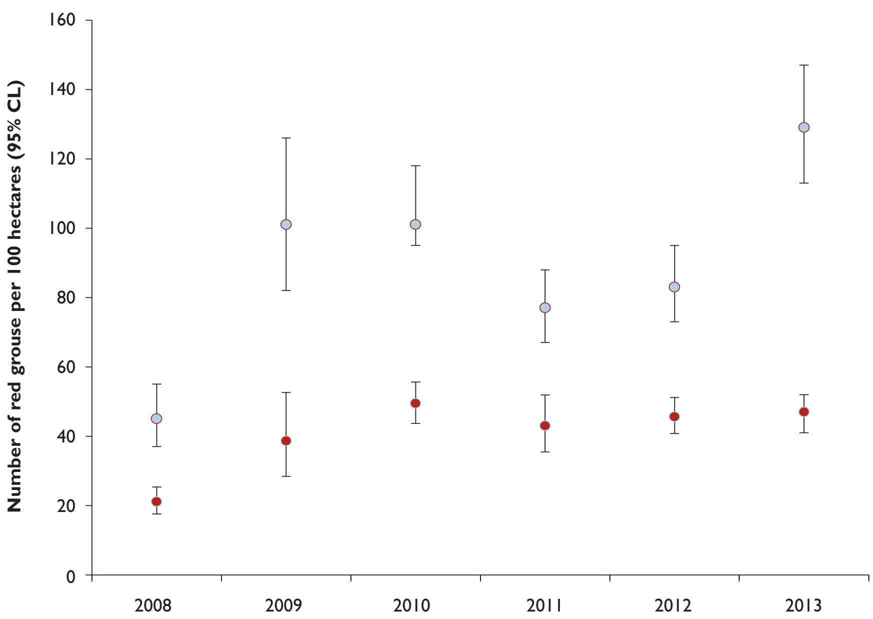
The Langholm Moor Demonstration Project aims to reconcile grouse moor and raptor conservation interests with the core objective of re-establishing Langholm Moor as a driven grouse moor, while maintaining a viable population of hen harriers under Special Protection Area (SPA) guidelines. Since 2008, the 10-year project has employed a team of five gamekeepers to manage the 40,000-hectare moor. In addition to predator control, heather management and the provision of medicated grit to control strongyle worms, all harriers that nest on the moor are provided with diversionary food.

This year has been relatively successful for red grouse breeding at Langholm, with 4.5 chicks produced per hen in July. After two years with productivity well below average (2.1 and 2.6 chicks per hen), the good weather may have contributed to the highest July grouse density since the start of the project with 129 grouse per 100 hectares (ha) (see Figure 1). Because of the low breeding success in previous years, this year's focus was to identify the main causes of clutch failure and chick mortality. With the help of Kirstie Hazelwood, an MSc student from Imperial College London, we fitted 20 grouse nests with thermologgers (to record whether clutch predation or desertion occurred by day or night) and dummy eggs (which show diagnostic teeth or bill marks) to identify the type of predator. We additionally fitted 12 nests with a nest camera. However, this year we had a record nest success rate of 90% with only two failures: a fox predated one hen and another hen incubated infertile eggs.

To monitor chick survival in the critical first three weeks after hatching, we fitted 26 chicks with small radio-transmitters soon after hatching. We monitored chick survival at regular intervals using a pointer dog. We lost only eight chicks during the life-time of the transmitters (approximately 20 days): we found three predated (two showing signs of being killed by a raptor, one by a mustelid) and for five we lost the

**Figure 1**

Density of red grouse at Langholm derived from distance sampling transects



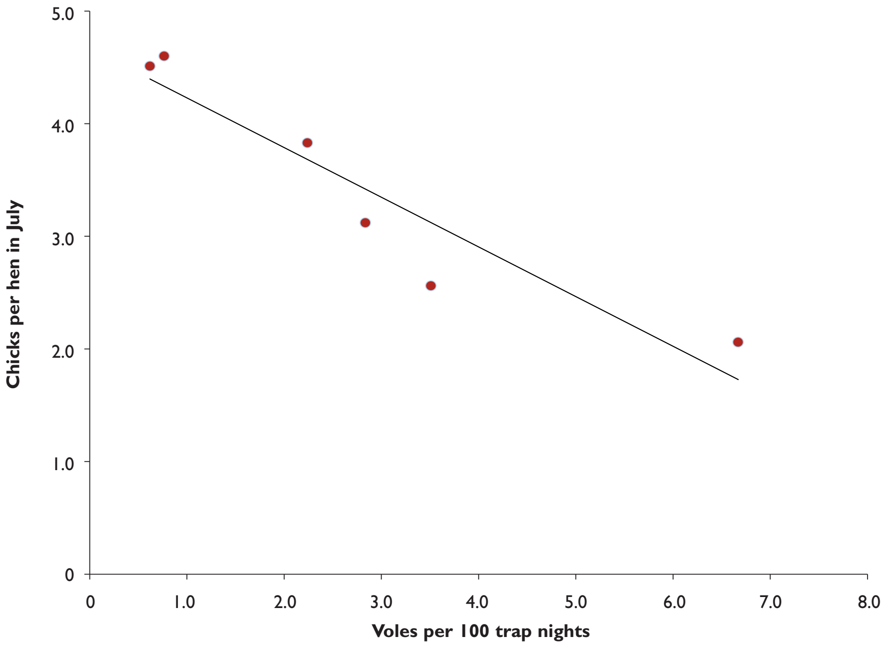



**Figure 2**

Relationship between red grouse productivity and vole abundance

signal, indicating that they were either predated and carried off, or that the tag failed. The probability of radio-tagged chicks surviving the first 10 days was 0.91, which dropped to 0.55 after 20 days. This was similar to overall chick survival, which was 52% after 20 days, and considerably higher than in 2012, when only 16% of chicks survived the first 20 days. However, owing to the low number of radio-tagged chicks found dead we were not able to determine the main causes of chick mortality.

Grouse breeding success was higher in years with lower vole abundance (see Figure 2), which might be linked to buzzards adjusting their hunting behaviour in relation to vole abundance (see *Diet of breeding buzzards,* page 48-49).

We also started to evaluate the influence of ravens on grouse nesting success, because predation by unidentified corvids was responsible for 39% of all nesting failures of radio-tagged hens in previous years. We fitted five nestling ravens from two broods with radio-transmitters and followed their movements from fledging until dispersal from the project area. After leaving the nest in early May, the juveniles remained with their siblings in the first two months and used areas of, on average, 70ha (May) and 340ha (June). In July, the sibling groups started to break up and the juveniles explored the area around their natal territory, covering on average 1,100ha until their dispersal between mid-August and late September. Pellets collected at roost sites indicated that the biggest proportion of their diet (75% of prey items) comprised small mammals, invertebrates and sheep/goat carcasses; 19% of the pellets also contained some grouse feathers (9% of prey items), either from adult birds or large poults. However, we found no eggshell fragments.

## ACKNOWLEDGEMENTS

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

*We looked at the influence of ravens on grouse nesting success. © Sonja Ludwig/GWCT*

# QuESSA - the benefits of nature

*Flower margins are perfect habitat for predatory beetles and parasitic wasps. © John Holland/GWCT*

Nature can provide a multitude of hidden benefits for humans and these can be clearly seen in food production. For example, bees pollinate flowering crops whereas crop pests are largely kept in check by their natural enemies such as predatory beetles and parasitic wasps. Soil organisms recycle nutrients, break down pesticides and improve the soil structure. An attractive landscape is also recognised as contributing to our well-being. All these benefits are known as 'ecosystem services' and are worth many billions every year in each European country. The exploitation of such services can help make farming systems more sustainable while also helping to justify the three billion euros spent annually in the EU on supporting biodiversity and preserving semi-natural habitats through agri-environment schemes.

**KEY FINDINGS**

- Our hedgerows and woodlands support 'ecosystem services' such as crop pollination and natural pest control.
- There are opportunities to exploit and improve 'ecosystem services' to make farming more sustainable and profitable.
- The QuESSA project will help to identify how better to exploit 'ecosystem services' derived from semi-natural habitats.

John Holland
Barbara Smith
Tom Birkett
Steve Moreby
Amy Smith & Laura Kor

*Pan traps used to collect pollinators and pest natural enemies. © John Holland/GWCT*

*Bees are important pollinators.*
*© Peter Thompson/GWCT*

*Insect prey items mounted on card to measure rates of removal by important predators as an 'ecosystem service'. © John Holland/GWCT*

*Weed seeds mounted on card used to measure seed consumption as an 'ecosystem service'. © John Holland/GWCT*

In 2013 we started a new study that looks at how we can better exploit those 'ecosystem services' that derive from semi-natural habitats such as hedgerows and woodland on farmland. The project is called Quantification of Ecological Services for Sustainable Agriculture (QuESSA) and the GWCT is the lead partner. We have 13 other partners from Estonia, France, Germany, Hungary, Italy, Netherlands and Switzerland. The field-based research will be conducted in 16 case studies in eight countries that represent the predominant cropping systems in Europe. Each case study involves using at least 18 landscape sectors. In the UK we will look at wheat and oilseed rape.

This year we identified the main semi-natural habitats in our landscape sectors and surveyed the vegetation, pollinating insects and natural enemies within them. Our next objective is to identify those plants in the semi-natural habitats which best support each type of ecosystem service that we investigate. From this we will generate a score for each type of semi-natural habitat. For example, a habitat with flower species that provide high levels of nectar or pollen will score highly for pollination. These scores will then be used to generate a score for each landscape type and ecosystem service based upon the proportion of cover of each type of semi-natural habitat. Over the next two years we will measure the actual levels of ecosystem service provision in the crops to verify and modify our predictions. Our sampling systems aim to provide an indication of, for example, levels of pest predation or seed consumption (see photos).

The data collected from all the case studies will be used to develop simulation models to explore how the amounts, type and location of semi-natural habitat influence ecosystem services from a farm to a landscape level. Models will also be used to explore how different semi-natural habitats and their arrangement in the landscape affect provision of the different ecosystem services, as there may be some that complement each other, whereas others may be antagonistic. We will also quantify the economic benefits and non-monetary value of selected ecosystem services. The outputs will include a web-based advisory tool for land managers to assess and improve the provision of ecosystem services on their farms.

For further information on QuESSA see **www.quessa.eu**

## ACKNOWLEDGEMENTS

QuESSA

is funded by:

*through the*

# Allerton Project: game and songbirds

*Our crops provide a wildlife habitat and cover for game. © Kings*

**KEY FINDINGS**

- The new shoot (650 hectares) held 11 days of driven shooting based on released pheasants.
- Wild pheasant numbers have remained low since we started the shoot.
- Grey partridges have shown a positive response to the new management system.
- We recorded our lowest ever songbird numbers probably as a result of poor weather conditions, especially in 2012.
- We are exploring ways of reducing economic and food production costs of game crops and wild bird seed mixtures.

Chris Stoate
John Szczur

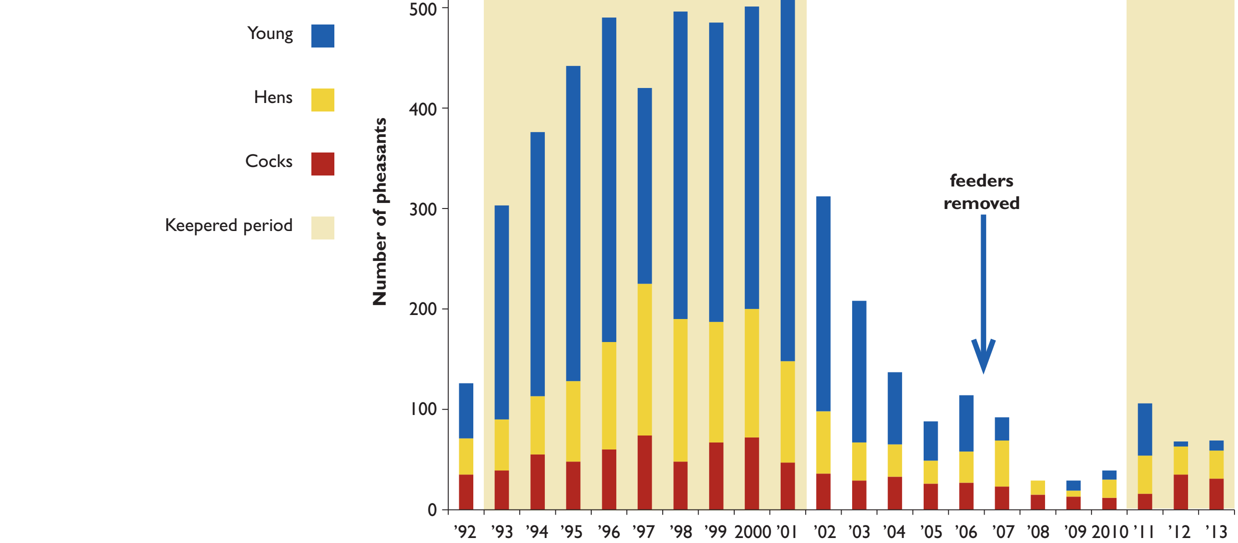
More than two decades of monitoring provides a valuable dataset that allows us to explore the effect of our changing farm and shoot management on game and wildlife. 1992 was our baseline year in which we made no changes on the farm. After 1992, we introduced a management system, including habitat management, predator control and winter feeding, which was designed to build up numbers of wild gamebirds and saw songbird numbers double. From 2001, we withdrew the predator control, and from 2006, we withdrew the winter feeding and continued to monitor effects on game species and songbirds. From 2011, we introduced a new management system, concentrating mainly on the release of reared pheasants, but with some management of the wild gamebirds. The aim is to create a successful shoot which achieves financial break-even and maximises wild bird production and the environmental benefits associated with this.

The new shoot, taking in additional land to the north of Loddington, now covers about 650 hectares (1,600 acres), has involved the release of 3,400 pheasants and resulted in 11 days of driven shooting, five species days and a dog trial day. We achieved a creditable 46% return rate. Most days are auctioned nationally, whereas others are sold locally, ensuring that a wide range of people are able to come and shoot. The shoot generally has a policy of buying in cock chicks for rearing and releasing, but this did not apply in 2012. Similarly, the shoot adopts a cocks-only policy on shoot days, but this was relaxed in 2012 owing to the large number of hens released.

Although we have provided a sequence of successful shoots, the number of wild pheasants recorded in the spring and autumn is lower than in most of the period without predator control and winter feeding (see Figure 1). The very poor breeding success experienced across the country in the wet summer of 2012 is likely to have contributed to low numbers in the following spring. Low numbers in spring are also likely to have been influenced by shooting of wild hens in the previous shooting

**Figure 1**

Autumn wild pheasant numbers from 1992 to 2013



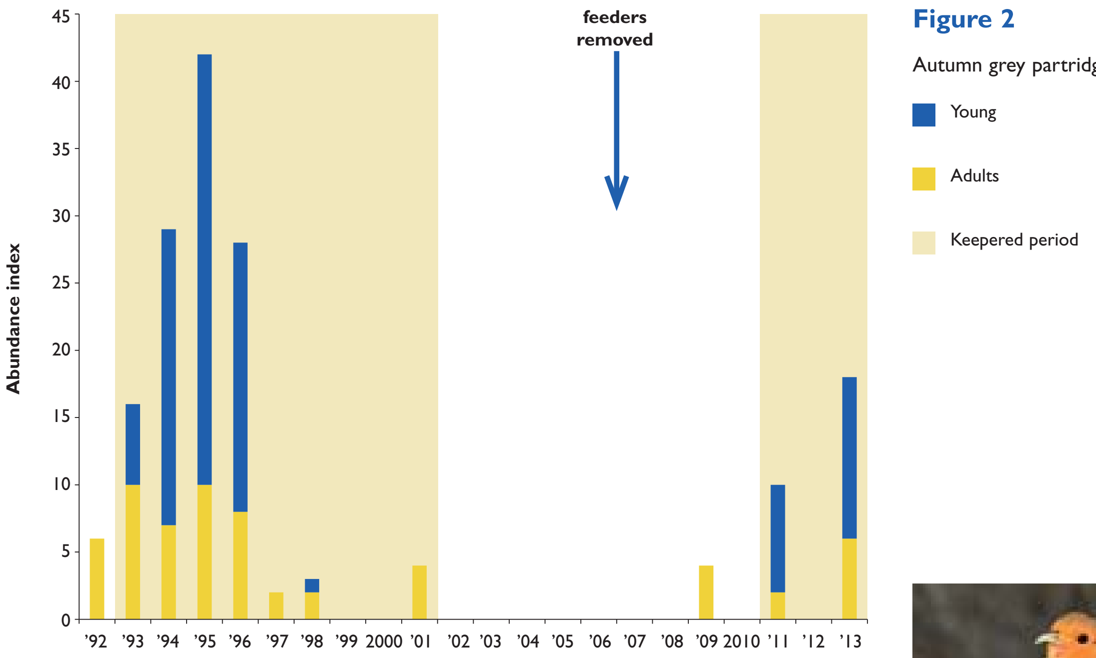



**Figure 2**

Autumn grey partridges

season, and in turn, this may have contributed to the low productivity of the remaining breeding population. The data for red-legged partridges relay a similar story, but grey partridges are performing better than in the period without predator control and feeding, with the highest autumn numbers since 1996 (see Figure 2). Songbird numbers, meanwhile, are at their lowest since the project began (see Figure 3). At least in part, this is likely to be due to low nesting success in 2012, as with the pheasants, and to poor survival during prolonged snow the previous winter.

Habitat management includes wild bird seed mixtures within our Environmental Stewardship agreement, as well as maize-based game crop mixtures for the shoot. The shoot compensates the farm for income forgone from the land used for game crops. However, wild bird seed crops and game crops result in a reduction in crop production, equivalent to approximately 56 tonnes of wheat across the farm. To minimise both lost food production and the cost to the shoot, we are working with Kings Game Cover and Conservation Crops to adopt game crops that meet multiple objectives, providing a wildlife habitat as well as cover for game. This enables them to be incorporated into our Stewardship agreement and reduces the non-funded area that they occupy. This reflects an established policy of developing and establishing multi-functional habitats and will become increasingly important as we need to increase food production and reduce the costs of our conservation work.

*Grey partridges are now responding with the highest autumn numbers since 1996. © Laurie Campbell*

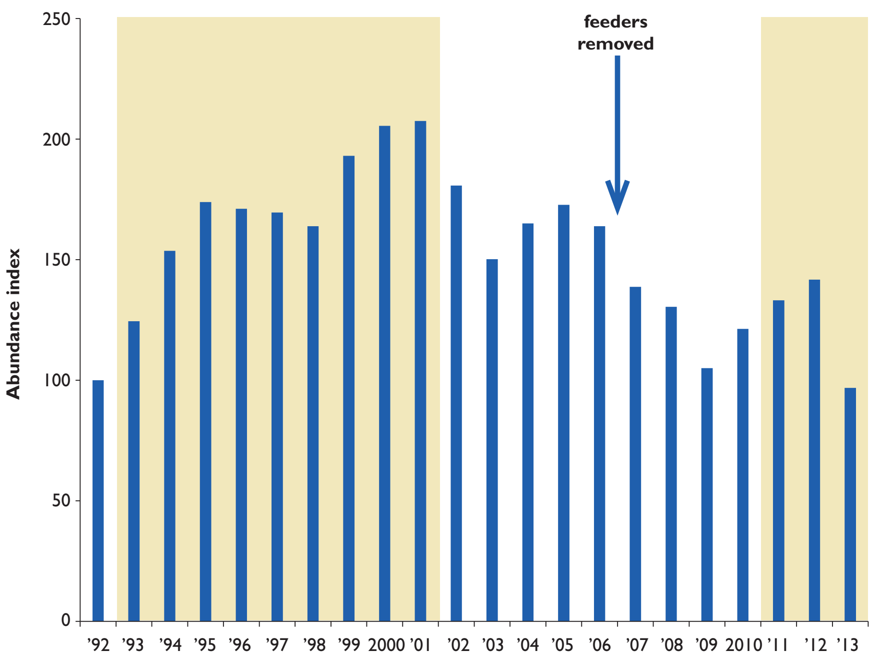



**Figure 3**

Songbird abundance relative to the start of the project

# The farming year at the Allerton Project

*The introduction of cover crops and direct drilling a larger acreage on the farm increases our soil's resilience to both drought and flooding. © Kings*

Food production and financial stability are essential cornerstones of our approach to farming sustainably on our Allerton Project farm at Loddington. As an integral part of our rural landscape we take our environmental responsibilities seriously, balancing protection of soil, water and wildlife. However, we faced many challenges last year in pursuing this sustainability model. The weather continued to prove that it can be both farmer's friend and foe. A cold, late spring followed by a relatively dry summer meant our winter crops grew surprisingly well after the miserable wet autumn of 2012. On our heavy Leicestershire clays, lower than average rainfall is a far better proposition than the wet conditions that have prevailed at important times over the last 12 months.

Both crop yield and quality improved in 2013, but some unplanned spring cropping and patchy winter crops combined with falling commodity prices meant that gross margins struggled to reach the dizzy heights of 2011 (see Table 1). The backdrop of Common Agricultural Policy (CAP) reform and the complexities of getting a European agreement on greening food production systems has been an interesting debate. Engaging rural stakeholders in this process is essential, and we need to create wins for both farmers and the environment. If the rules on 'Greening' are too onerous, growers will seek simpler options. However, if they can be used to

## KEY RESULTS

- Weather and price volatility were major drivers of our decision-making in 2013.
- Black-grass resistance remains a challenge and affects our rotation.
- As part of our soil management plan we increased the area that was direct-drilled.
- CAP reform is a major influence on our farming decisions.

Alastair Leake
Phil Jarvis

## TABLE 1

**Arable gross margins (£/hectare) at the Allerton Project 2008-2013**

| | 2008* | 2009* | 2010* | 2011* | 2012* | 2013 (est)* |
|---|---|---|---|---|---|---|
| *Winter wheat* | 566 | 496 | 673 | 783 | 255 | 567 |
| *Winter oilseed rape* | 862 | 401 | 799 | 1,082 | 490 | 162§ |
| *Spring beans* | 449 | 200 | 512 | 507 | 817 | 580 |
| *Winter oats* | 430 | 387 | 808 | 873 | 676 | 570 |

**No single farm payment included*
*§ spring oilseed rape*

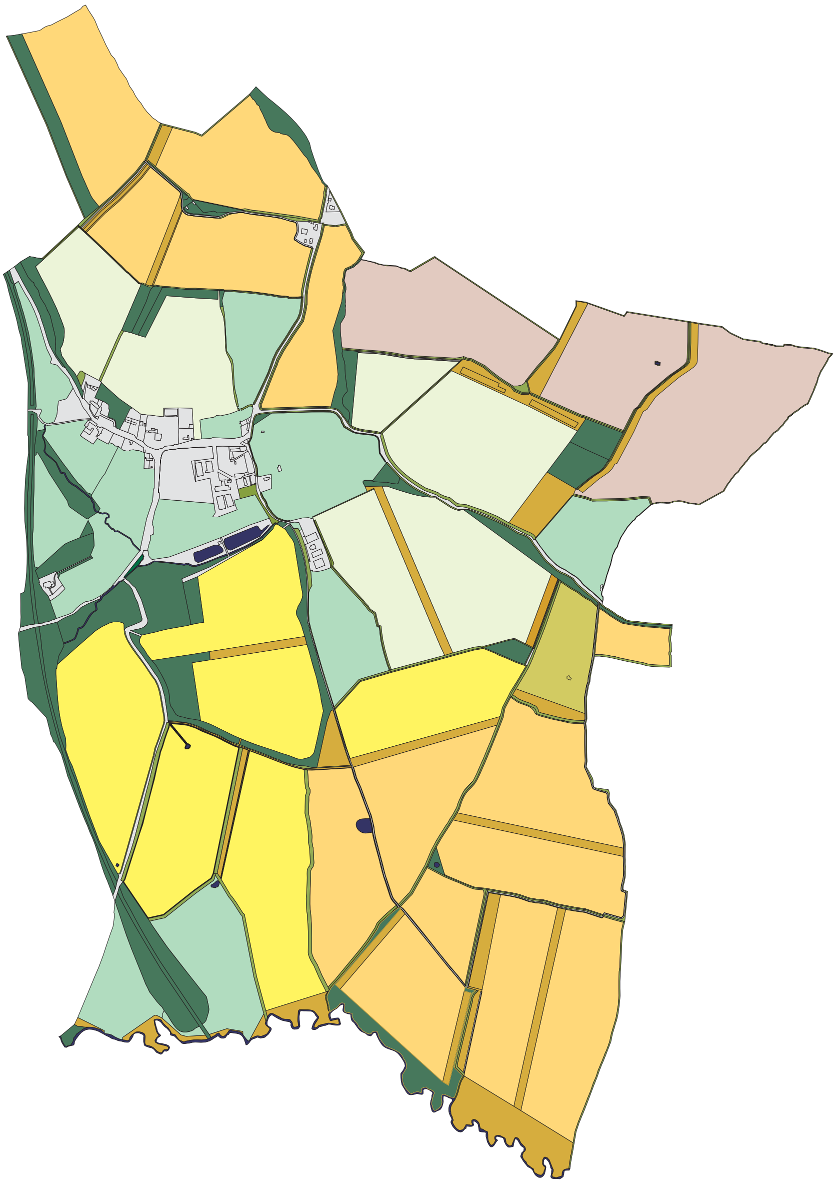


**Figure 1**

Allerton Project cropping 2012/13

- Woodland
- Permanent pasture
- Winter wheat
- Spring beans
- Spring oilseed rape
- Spring barley
- Winter oats
- Stewardship and shoot cover
- Hedgerow/verge

benefit the farm ie. increasing pollinators and predatory insects while assisting weed control, then their adoption might be more widespread. Our Higher Level Stewardship agreement entered its third year during 2013. It is an agreement that we were happy to implement, but we hope that it continues without a plethora of changes caused by the new Pillar 1 support conditions.

*Engaging with the local community at events such as Open Farm Sunday is very important. © GWCT*

*To help reduce soil disturbance we use tracked tractors. © Alex Butler/GWCT*

The spread of resistant black-grass has led us to make several changes to our arable husbandry. We are looking at sowing both winter beans and spring oats to assist our herbicide strategy; we have introduced short-term grass and clover leys and have delayed winter wheat drilling to allow longer time for stale seedbeds. This decreases our dependence on herbicides which are becoming less and less effective against this problem weed. The leys will not only help with weed control but improve soil fertility, structure and organic matter content.

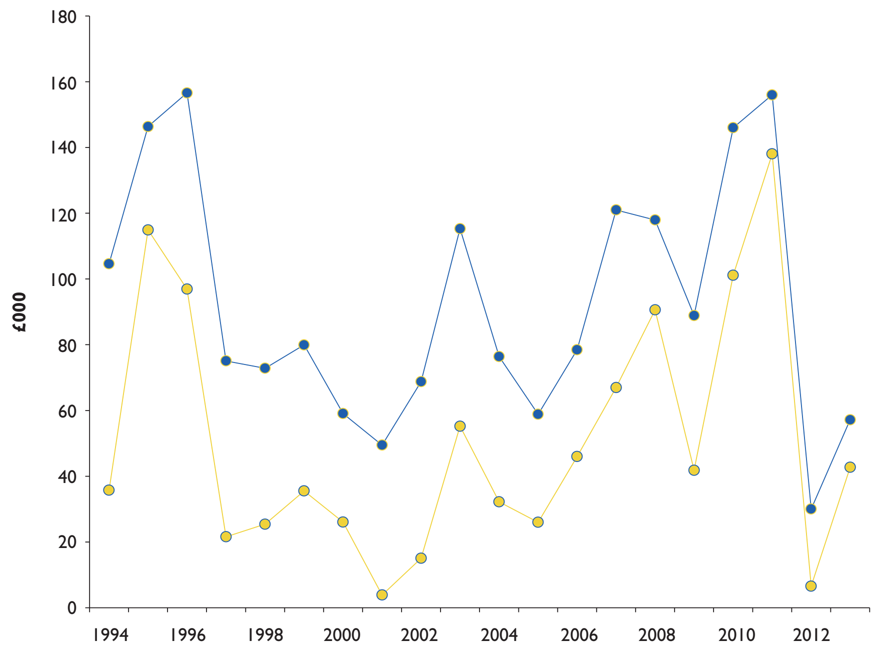
The introduction of cover crops and direct-drilling a larger acreage on the farm will increase our soil's resilience to both drought and flooding. The sowing of cover crops containing oats, which help to hold soil together over the winter period, and deep-rooting oil radish, which will improve the structure of our soil, is a new development in our winter soil management plans. We continue to review our cultivation system and our transition towards less soil disturbance has seen us sow this season's crops with a six-metre Claydon Hybrid drill. Our New Holland CR 9070 combine has tracks to

**Figure 2**

Gross profit and farm profit at the Allerton Project 1994-2013

Gross profit

Farm profit



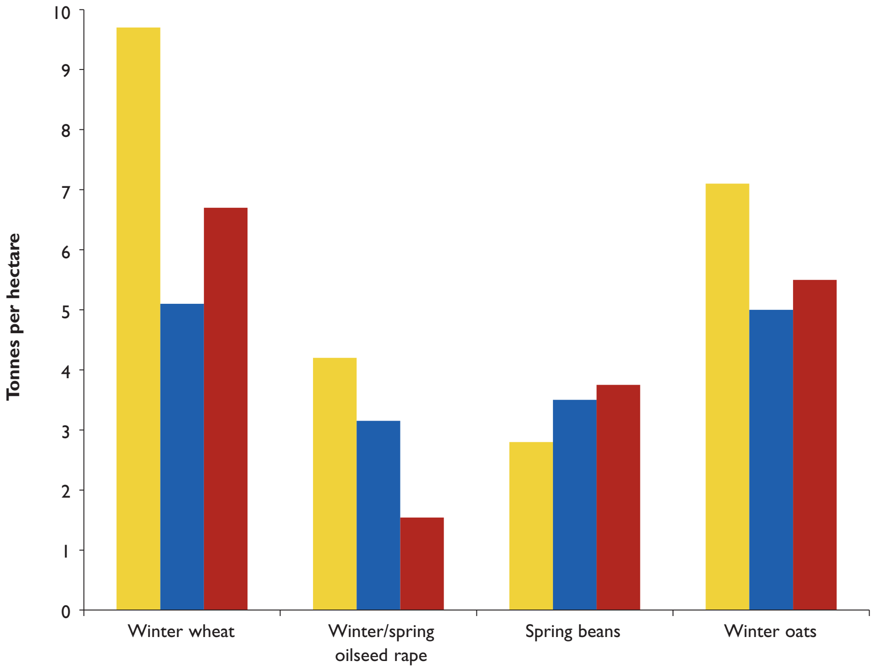



**Figure 3**

Crop yields at the Allerton Project in 2011, 2012 and 2013

*Spring oilseed rape was sown in 2013*

reduce compaction, and chopped straw is raked to germinate weeds and seed shed during the previous harvest. This also helps to reduce slug numbers.

The recent wet weather has highlighted the need for some drainage improvement to older systems that were put in over 50 years ago. There are a number of ditches that need clearing and we will continue to mole plough where conditions allow.

The new visitor centre reached its first birthday and our relationship with our neighbours is very important. Volunteers from a local school have helped with our wetland work and the Loddington Women's Institute continues to assist us with the community orchard, which produced its first apples in 2013. The wider community has helped with LEAF's Open Farm Sunday and we will see community engagement growing during 2014, with wool spinning a regular event in the visitor centre and archaeological digs in our fields.

The issues of 2013 have given greater focus to our farming, environmental and social commitments and we will continue to develop a positive, sustainable blueprint for landscape management.

**TABLE 2**

**Farm conservation costs at the Allerton Project 2013 (£ total)**

| | |
|---|---|
| Higher Level Stewardship costs (including crop income forgone) | -30,654 |
| Higher Level Stewardship income | 26,222 |
| Woodland costs | -4,807 |
| Woodland income | 2,436 |
| Farm Shoot expenses | -4,871 |
| Farm Shoot income | 4,871 |
| Grass strips | 589 |
| **Total profit forgone** | |
| **- conservation** | **-6,803** |
| **- research and education** | **-7,659** |
| | **£14,462** |

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

*The local Women's Institute helped us celebrate the first anniversary of our visitor centre.*
*© Morag Walker/GWCT*

# School Farm – a demonstration of ecosystem services

*The arable area of the catchment produces about 310 tonnes of wheat each year. © Chris Stoate/GWCT*

## KEY FINDINGS

- We have established a research platform to explore and demonstrate how a lowland landscape 'works'.
- There is considerable integration between the multiple objectives for the farmed environment.
- Chemical and biological data collected at the bottom of the catchment can be used as indicators of resource use efficiency and 'health' of the catchment as a whole.

Chris Stoate

The concept of 'ecosystem services', the benefits provided to society by the environment, is well embedded in Government policy and in academia, but is often dismissed as nebulous jargon in the wider world. At Loddington, we have developed a farm-scale (155-hectare) catchment as a practical setting for exploring the issues identified by the ecosystem services approach. As the catchment is agricultural, the main activity of the area is food production, both arable crops for human consumption and livestock, and meat production from sheep-grazed pasture. The area also contains small farm woods, and at the head of the catchment is a larger piece of ancient semi-natural woodland designated as a Site of Special Scientific Interest (SSSI). There is a network of hedges and ditches, a rural road and a few houses. There are also the Environmental Stewardship habitats that we have created and are managing for wildlife, as well as game crops for our shoot.

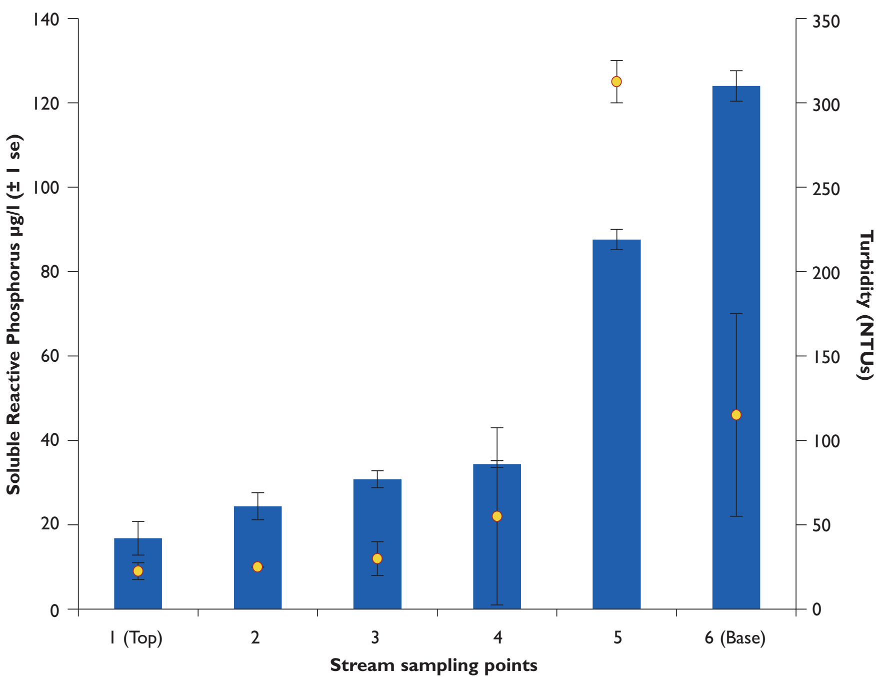
**Figure 1**

Winter storm event turbidity and summer phosphorus concentration at six sampling points along the School Farm stream

*Turbidity reflects sediment from arable land, and is measured as Nephelometric Turbidity Units. Phosphorus is associated with septic tanks and is measured as microgrammes per litre.*

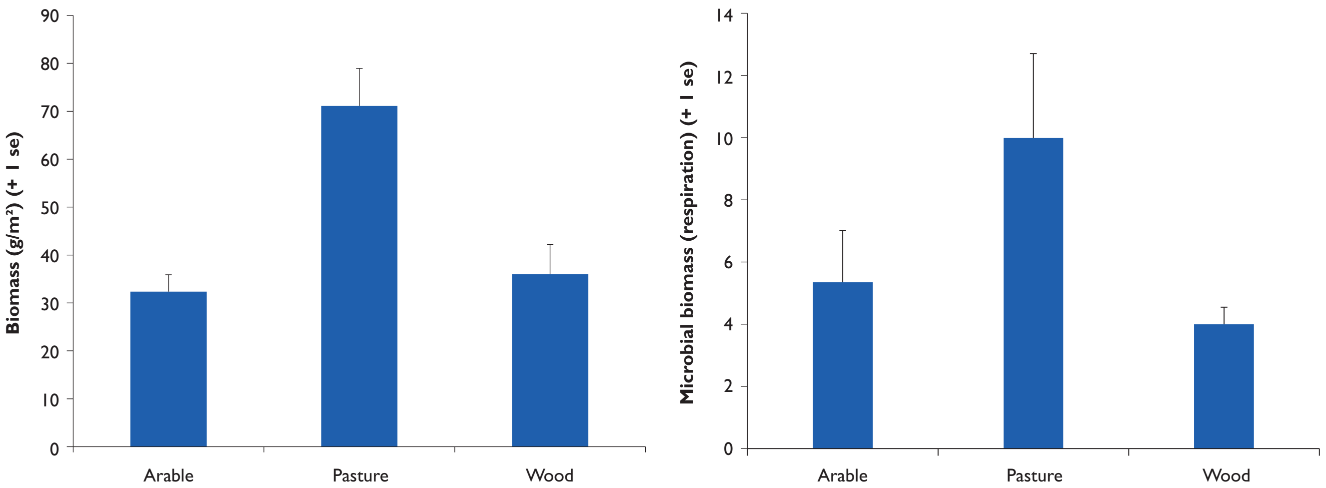
Turbidity

Soluble reactive phosphorus



## Figure 2

Earthworm biomass (left) and microbial biomass (right) in relation to land use in the School Farm catchment




The arable area produces an equivalent of about 310 tonnes of wheat each year, while nearly eight tonnes of lamb are produced from the pasture. Additional pasture is grazed by horses for recreational use, and two footpaths cross the catchment. As well as monitoring water quality continuously at the base of the catchment, we took a set of three water samples from six sampling points along the length of the stream, once during summer base flow conditions when the samples were analysed to measure soluble reactive phosphorus, and once during winter rain when we measured turbidity (correlated with sediment and phosphorus concentrations). In common with most of lowland England, periods of rain are associated with run-off and erosion, especially on arable land, resulting in peaks in sediment and nutrients flowing into the stream. Sediment and nutrient concentrations also rise with increasing distance down the stream as the influence of the arable grows (see Figure 1). Septic tanks also contribute nutrients to the stream.

The farming industry as a whole is under pressure to reduce this effect on water to meet Water Framework Directive targets for the chemical and ecological status of watercourses. At the Allerton Project, we have addressed this issue by reducing the intensity and frequency of cultivations. We have adopted reduced-tillage and no-tillage approaches to crop establishment, and introduced grass/legume leys into the farming rotation. Such approaches lead to reduced crop establishment costs and use cultural methods to control grass weeds such as herbicide-resistant black-grass. Reduced soil disturbance reduces erosion risk so is expected to have benefits for nutrient leaching and water quality. In particular, increasing earthworms and soil fungi can be expected to improve water infiltration and retention, and reduce the amount of sediment in run-off, as well as improve nutrient uptake by crops. Our baseline datasets will enable us to evaluate this process.

Cranfield University MSc students, Michael Weeks and David Stella, have revealed that earthworm biomass and species richness, and microbial biomass, are all significantly higher in pasture than in arable land or woodland, with soil organic matter being highest in woodland. Figure 2 presents the results for earthworms and microbial biomass, based on analysis of soil samples taken to 20cm depth. Although it may not be possible to achieve biomass values in arable land that are currently associated with pasture, any increases on cropped land are likely to have benefits to both water quality and flow, and to the crops we are growing.

In the stream, caddis fly numbers adjacent to arable land were just 20% of those in a nearby pasture catchment, while mayfly numbers were 30% of those associated with pasture. These insects represent valuable indicators, not just of water quality, but of the health of the catchment as a whole. We are also monitoring wildlife species that are not associated with water, but have important functions such as predators of crop pests, pollinators, and species of cultural value, such as birds. Together, these provide a quantitative record of how our small lowland catchment 'works', especially in terms of the interactions between food production and wildlife.

*Mayflies are valuable indicators, not just of water quality, but of the health of the catchment as a whole. © Dave Kjaer*

# Keeping on target

Some protected species like polecats raise legal, conservation and humaneness concerns if caught as a non-target. © Mike Short/GWCT

We have researched and improved traps and trapping for more than 30 years. A central issue in this work has been the problem of catching the wrong ('non-target') animal while carrying out legal and justifiable predator and pest control.

Legislators have sought to limit non-target issues by restricting trapping practices, and by declaring certain species protected. The deliberate targeting of some species is clearly prohibited by various pieces of legislation; but their accidental capture as non-targets is addressed in opaque legal language which has not been clarified by case law.

Every interaction we have with wildlife involves uncertainty, which means there is a crucial distinction between risk and outcome. A trap creates a risk aimed at the target animal; but the outcome – whether, when, and even what the trap catches – remains uncertain. That makes trapping difficult, challenging, fascinating and even exciting. But likewise there is no cast-iron guarantee against an unintended outcome.

A Police Wildlife Officer investigating a protected non-target species caught in a trap sees only the outcome. Somehow the regulatory system – investigator, legislation, magistrate, judge and jury – must interpret the actions of the trap operator leading up to the event and determine whether he/she had created a deliberate or unreasonable risk for that protected species.

**KEY FINDINGS**

- Non-target captures in traps raise reasonable conservation and humaneness issues.
- In pest and predator control, the risk of non-target involvement cannot be totally eliminated.
- A balance must be struck between the benefits and risks of trapping.
- Legislation does not distinguish adequately between risk, outcome and intent.
- Regulators should share responsibility with practitioners to achieve wise management through constructive collaboration.

Jonathan Reynolds

## Why do non-targets matter?

Non-target captures are a public concern for two reasons. The first is conservation: in general it is assumed that captures in traps will further damage a species whose conservation status is already poor or deteriorating.

The second public concern raised by non-targets is humaneness. A trap designed to kill or to hold the target animal humanely may not be humane for a larger or smaller or differently-built non-target. The Pests Act 1954 decreed that only spring traps approved by Defra may be used, and humaneness testing is the main part of the approval process. But should Defra test trap humaneness for species no-one intends to catch?

Besides these concerns, non-targets cause additional issues for the trap operator. They block up traps that could otherwise catch the target species; increase the time taken to check traps; may damage the trap itself, or spoil the trap location for future use; and may require extra tools to be carried for safe handling and liberation, or for humane dispatch.

## Measuring selectivity

The statistic most commonly quoted to indicate selectivity is simply the relative numbers of each species caught. Unfortunately this gives a poor indication of the risk for each species because it does not take into account their relative population densities. For example, one might expect the target species to predominate in the catch, but that is not necessarily the case. If trapping continues after the target species has successfully been brought to a low density locally, non-targets may dominate the catch, even if the risk to non-targets is relatively low. If the target species is entirely absent, the trap may catch nothing but non-targets. Conversely, a species that was rare, but unusually susceptible to trapping, would scarcely figure in the relative catch.

So it is not a trivial task to estimate the risk posed by a trapping practice to a particular species. It is not something that can easily be calculated by a trap operator or by a magistrate: they need guidance about reasonable practice, based on sound evidence.

## What makes a trap selective?

Size difference is commonly used to exclude non-targets. For instance, animals larger than the target species cannot access the trap, or small animals cannot trigger the trap. Increasingly such features are being built into trap designs. Live traps for mink often have a restricted entrance to exclude otters. The Kania 2000 trap has a housing designed to be mounted vertically on a tree trunk, excluding mammals that can't climb. Our GWCT breakaway snare allows animals that differ in size or strength from the target species (fox) to self-release thanks to a carefully specified minimum loop size and a 'breakaway' weak link in the noose.

Unfortunately hardware solutions like these are never perfect because of the overlap in size between target and non-target species. When we researched entrance restrictions for tunnel traps, we showed that it was just possible to exclude the smallest adult polecat, while still allowing the largest stoats to enter; but a consequence was that large rats and grey squirrels would be excluded too, reducing the catch of those species by 36% and 84% respectively. For snares, perfect selectivity by

*Excluding protected non-target species from tunnel traps by size has little or no effect on stoat or weasel captures, but has a big impact on capture efficiency for other target pests like squirrels or rats. © Jonathan Reynolds/GWCT*

There is always a risk. This cage trap was set to catch a fox, baited with a road-kill pheasant. The badger had to pull down the pheasant to trigger the trap door. The trap was installed months prior to baiting, and care was taken to avoid human scent. © Mike Short/GWCT

hardware design is not even theoretically possible because there is appreciable overlap in size and strength between foxes, badgers and hares.

### Selectivity by strategy

So the inherent selectivity of the hardware is only the start. Further selectivity is provided by things the operator does. Fundamental decisions on where, when and how to use a trap have a big impact on non-target capture risks. When rats or grey squirrels are at appreciable densities, trapping is best done by an intensive campaign, concentrating the catch and enhancing selectivity by pre-baiting with cereal baits. Such a strategy can be highly target specific, and an efficient way to reduce pest numbers without the environmental and animal welfare hazards of poisons or fumigants.

Possibly the most focused trapping strategy to date is the one we devised for mink, in which traps are used only in response to mink tracks on rafts, ie. only when there is definitely a mink present to catch, and only in a location it is known to visit. Additionally, either the tunnel or the trap has a physical excluder to prevent access by otters; and to avoid attracting non-targets we use no bait. The non-target catch would unquestionably have been far greater had we run the same number of traps continuously. So it is sobering to note that during four years in which we kept the River Monnow catchment clear of mink, allowing the reintroduction of water voles, only 70% of captures were mink. Most of the non-targets were arguably pests themselves (eg. grey squirrel, brown rat), but not all were: occasional captures of rarer species like water rail (also likely to benefit from mink control) provide a good reason to use live-catch traps in this context rather than kill traps.

Mink rafts minimise the use of traps, while maximising capture efficiency. © Ben Rodgers/GWCT

A common way to add further selectivity is to use a bait or scent attractant. Cereal baits are not generally attractive to carnivorous mammals, whereas predator odours are repellent to rodents. But there are many generalist species and other exceptions: badgers eat both cereal and meat baits, mice are also attracted to meat bait, carnivore odours tend to interest most carnivore species, and we have even seen video clips of hares rolling on fox gland scents.

The use of decoy birds in corvid traps brings outstanding selectivity, whereas concerns have been voiced about the risk of raptor captures when corvid traps are baited with carrion. The magnitude of this risk has yet to be properly assessed, so at this stage we don't know how significant it is or how best to ameliorate it.

## Changing the law

The UK's existing wildlife legislation is patchy, inconsistent, difficult to interpret, and in some aspects baffling. The passage of the Wildlife & Natural Environment Act (2010) in Scotland did little to improve this situation. In England and Wales, legislation is currently under wholesale review by the Law Commission, offering an opportunity to create practical legislation that commands respect and compliance because it makes obvious sense.

With respect to trapping, a future revision must accept that non-target risks can never be zero if trapping is to retain any utility. An interim statement by the Law Commission (Oct 2013) proposed that liability for an offence should lie somewhere between 'intention' (where the risk is foreseeably very high, almost certain) and 'recklessness' (where any risk can be foreseen). They suggest that taking steps to mitigate a non-target risk would imply that the risk was not accepted by the trap operator, which would exonerate him in the event of catching a protected species. However, it would be difficult for the operator to demonstrate that he had lowered the risk by limiting his use of traps, by careful choice of site, or by choice of bait; or to argue that he/she had considered the risk and felt that it was not unreasonably high. In any case, where – in the vast middle ground between almost certain and barely perceptible – would the risk be considered reasonable?

The operator deserves clear guidance. We need to be able to define trapping practices that are safe and reasonable but also effective; and to make these unquestionably lawful, subject to regular review. Well-reasoned Codes of Practice can serve this purpose. Our experience of contributing expertise and evidence to such Codes is that sound evidence leads to helpful, clear and persuasive advice that is respected by all sides. Future law could lay down a framework in which such Codes have an official status. From a legal perspective, though, a downside of such guidance is that it is too complex to test liability. How much deviation from a Code of Practice is acceptable before the operator is deemed to have taken an undue risk? The alternative, however, is legislation that is too vague to define good practice.

Regulators need to understand that although legislation is necessary, it can be a largely unconstructive force that divides regulators (always scrutinising) from practitioners (always scrutinised). To overcome this, we need a flexible system in which practitioners can cheerfully and fearlessly collaborate, to ensure that a rational balance is struck – and maintained – between the benefits and risks of trapping. In that way we might achieve a shared sense of responsibility and wise management.

*Operators need clear guidance. Trapping practices need to be safe and reasonable, but also effective.* 
*© Louise Shervington/GWCT*

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**Short, MJ, Weldon, AW, Richardson, SM, Reynolds, JC** (2012) Selectivity and injury risk in an improved neck snare for live capture of foxes. *Wildlife Society Bulletin* 36(2): 208-219.

# River Frome salmon population

*The multiple PIT tag detection antenna system installed at the bottom of the hydro-turbine at Bindon Abbey will help us to determine how 'fish friendly' these turbines are. © Bill Beaumont/GWCT*

## KEY FINDINGS

- The 2013 grilse run in the River Frome was low as a result of the poor 2012 smolt run.
- Numbers of juvenile salmon on the River Frome in 2012 recovered from the 2011 low.
- The GWCT is leading the first assessment of the effect of a small head hydropower scheme on survival of salmon to adulthood.

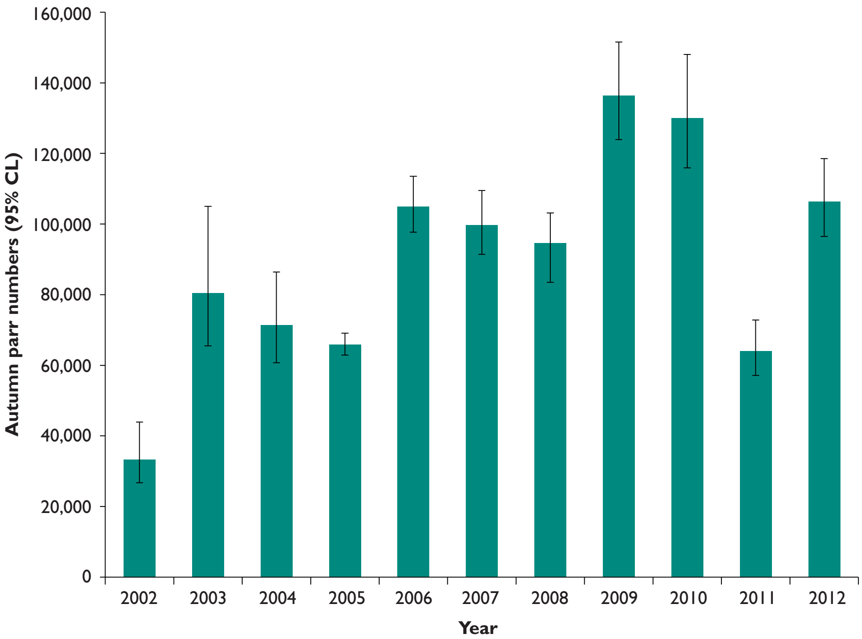
Anton Ibbotson

In comparison with the previous two years, the weather and consequently the flow patterns in the River Frome were much more favourable for salmon in 2013. There were no unusual events (droughts or significant floods) that affected the juvenile salmon population or our annual September tagging exercise, and we reached our 10,000 target in record time. This is the 12th year we have tagged salmon with Passive Integrated Transponder (PIT) tags in the River Frome, increasing the importance of this dataset to the international understanding of salmon populations.

The low production of juvenile salmon in 2011 (see Figure 1), which subsequently resulted in the low smolt output for 2012 (see Figure 2), has, as predicted, resulted in a low return of one-sea-winter adults (grilse) in 2013. However, total adult returns for 2013 also consisted of two-sea-winter adult salmon, which resulted from the strong output of smolts in 2010, and therefore the total adult returns remain around the average for the last decade (see Figure 3). Since female adult salmon lay around 1,200 eggs per kg of body weight they are sufficiently fecund that the salmon population should recover quickly from the temporary effects of the poor 2011 cohort. This neatly demonstrates two important life-history strategies of fish for Atlantic salmon. Firstly, not to 'put all your eggs in one basket' but spread them between different age classes, so that if one age class is badly affected the other age classes can step in to fill the gap; and secondly make sure there are plenty of eggs in the basket by laying large numbers of them. The temporary blip of 2011 was further highlighted by the high numbers of juveniles produced in 2012 (see Figure 1), when the estimated population size reached 106,000 and the estimated smolt output from these fish was one of the best the River Frome has produced in recent years (see Figure 2). Our conclusion from all this is that the 2011 cohort was a minor setback in a river where the salmon population is continuing to recover.

**Figure 1**

Estimated number of salmon parr in the River Frome each September 2002-2012



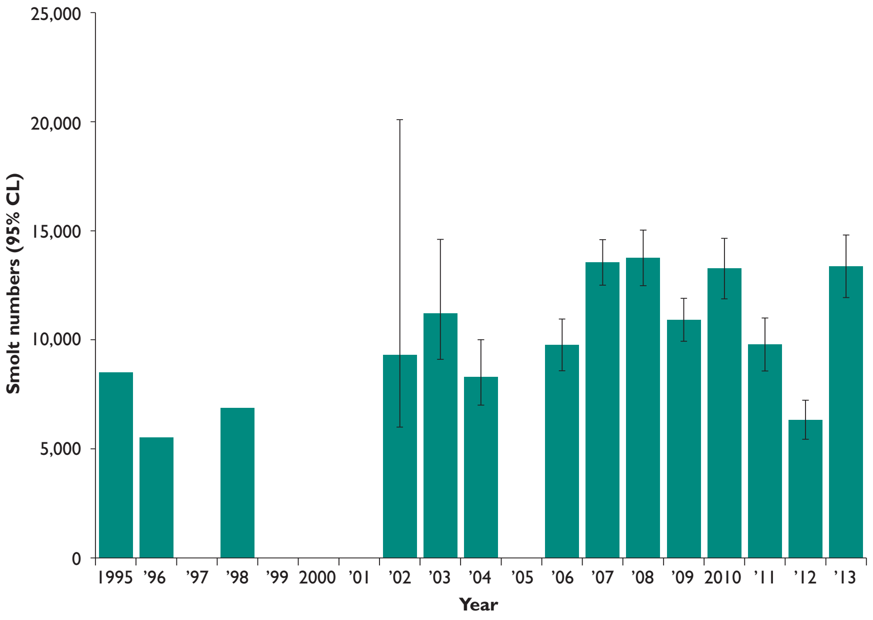



**Figure 2**

Estimated spring smolt population 1995-2013

A lot of staff resources in 2013 went into the design, manufacture and installation of the PIT tag readers at the Bindon Archimedes screw turbine hydro-electric site. In all, we had to set up instruments on the channel behind the turbine, two hatches on the main river channel and a smaller channel which acts as a fish pass. All the channels are different shapes, which required bespoke designs for each of the PIT tag readers. However, we now have operating readers in all channels and a number of autumn migrating parr were detected migrating downstream through the site in October and November. During 2014 we will be able to detect Atlantic salmon smolts migrating through the turbine and compare their subsequent survival with those smolts that migrate through the site without entering the turbine. As far as we are aware this will be the first time anyone has managed to assess the effects of a small head hydro-scheme on a naturally migrating Atlantic salmon population right through to the adult stage, incorporating the important effects of turbine passage on mortality as the smolts enter salt water. We also jointly ran a project with the Centre for Environment, Fisheries & Aquaculture Science, acoustically tagging salmon and sea trout smolts as well as eels, to determine the effects of the turbine on delays to migration and migration times and successful passage to and through the estuary. This will be repeated in 2014 and results should be published shortly afterwards.

## ACKNOWLEDGEMENTS

We would like to thank the Valentine Trust, the Alice Ellen Cooper-Dean Charitable Foundation, the Iliffe Family Charitable Trust, the Balmain Trust, the Frome Conservation Fund, Lulworth Estate, the Environment Agency and the Salmon & Trout Association.

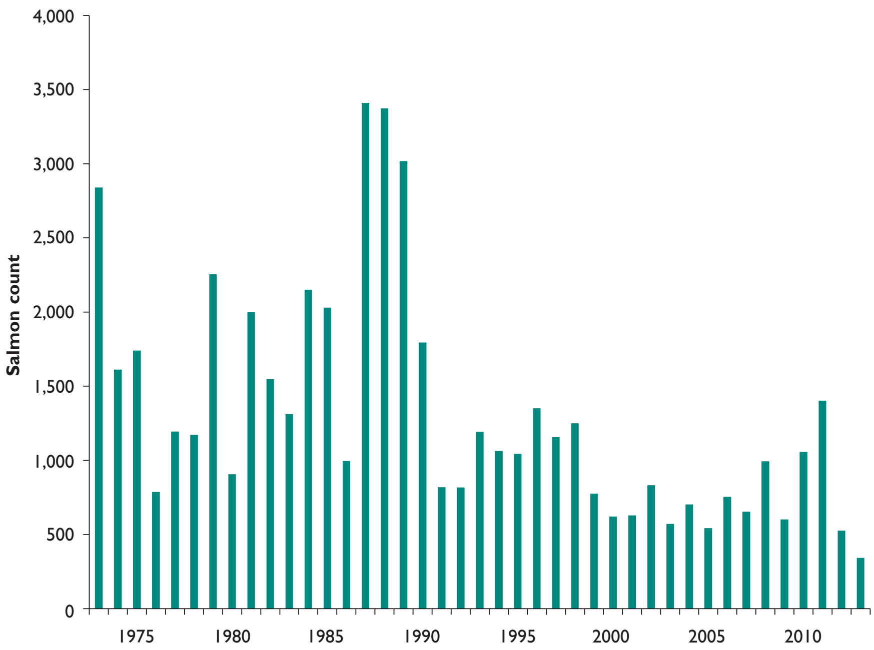



**Figure 3**

Numbers of returning adult salmon in the River Frome, 1973-2013

# Research projects

by the Game & Wildlife Conservation Trust
in 2013

## LOWLAND GAME RESEARCH IN 2013

| 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* |
| *Game marking scheme* | *Study of factors affecting return rates of pheasant release pens* | *Rufus Sage, Maureen Woodburn, Roger Draycott* | *Core funds, Solway Feeders, Roxan International* | *2008- on-going* |
| *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, Jack Buckingham, Chris Peel* | *Core funds, Private funds* | *2010-2014* |
| *Corvids and hedgerow birds* | *Does crow and magpie control increase productivity in hedgerow birds?* | *Rufus Sage, Sue Wilson, Tony Powell, Allan Goddard* | *Songbird Survival* | *2010-2015* |
| *Wild pheasant mortality (see page 18)* | *Investigating survival and productivity of wild pheasants* | *Roger Draycott, Lucy Ridding, Helen Duffield* | *Gayton Estate, Private landowners Sandringham Estate, Oakbank* | *2011-2013* |
| *Scottish Grey Partridge recovery project* | *Researching and demonstrating grey partridge management in Scotland* | *Dave Parish, Hugo Straker, Adam Smith, Gemma Davis, Katrina Candy* | *Whitburgh Farms, Mains of Loriston Trust* | *2011-2015* |
| *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, London* | *NERC/CASE* | *2011-2014* |
| *PhD: Ecology of small mammals on farmland* | *Habitat use, distribution and population genetics of small mammals on farmland in eastern Scotland* | *Amanda Wilson Supervisors: Dave Parish, Prof Hubbard University of St Andrews, Dr Begg Hutton Institute* | *BBSRC/CASE* | *2011-2014* |
| *PhD: Pheasant behaviour and the rearing system (see page 16)* | *Improving behavioural and physiological adaption of reared pheasants to the wild* | *Mark Whiteside Supervisors: Rufus Sage, Louise Dean Dr Joah Madden/Exeter University* | *Exeter University, Middleton Estate* | *2012-2015* |
| *PhD: Gapeworm and pheasants* | *Gapeworm on shooting estates, spatial and temporal factors affecting infections in pheasants* | *Owen Gethings Supervisors: Rufus Sage Professor Simon Leather (Harper Adams University)* | *BBSRC/CASE Studentship* | *2013-2017* |

## WETLAND RESEARCH IN 2013

| Project title | Description | Staff | Funding source | Date |
|---|---|---|---|---|
| *Woodcock monitoring* | *Examination of annual variation in breeding woodcock abundance* | *Andrew Hoodless, Chris Heward, Collaboration with BTO* | *Shooting Times Woodcock Club* | *2003- on-going* |
| *Avon Valley waders (see page 24)* | *Monitoring lapwing breeding success in relation to the Higher Level Stewardship scheme* | *Andrew Hoodless, Michael Hockey* | *Core funds, Natural England* | *2007-2013* |
| *Woodcock migration routes* | *Use of satellite tags and geolocators to examine woodcock migration strategies* | *Andrew Hoodless Collaboration with ONCFS* | *Shooting Times Woodcock Club, private donors, woodcock appeal* | *2010-2015* |
| *Woodcock winter survey* | *Randomised survey of abundance and modelling of habitat use* | *Andrew Hoodless, Chris Heward Michael Hockey* | *Core funds* | *2011-2013* |
| *Woodcock habitat use and behaviour in cold weather* | *Radio-tracking of woodcock in arable landscapes in winter* | *Andrew Hoodless, John Simper, Chris Heward, Michael Hockey, Freya Stacey* | *Core funds* | *2011-2014* |
| *Lapwings on fallow plots* | *Assessment of lapwing breeding success on AES fallow plots* | *Andrew Hoodless, John Simper, Matt White, Sarah Johnson, Sarah Knight, Richard Cann, collaboration with RSPB* | *Defra, The Manydown Trust* | *2012-2014* |
| *National breeding woodcock survey (see page 20)* | *Randomised survey to produce country population estimates and assess change since 2003* | *Andrew Hoodless, Chris Heward Collaboration with BTO* | *Shooting Times Woodcock Club, core funds* | *2013-2015* |
| *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* | *2010-2014* |
| *PhD: Factors influencing breeding woodcock abundance* | *Landscape-scale and fine-scale habitat relationships of breeding woodcock and investigation of drivers of decline* | *Chris Heward Supervisors: Andrew Hoodless, Prof Rob Fuller/BTO, Dr Andrew MacColl/ Nottingham University* | *Private funds, core funds* | *2013-2018* |

## PARTRIDGE AND BIOMETRICS RESEARCH IN 2013

| Project title | Description | Staff | Funding source | Date |
|---|---|---|---|---|
| *Partridge Count Scheme (see page 26)* | *Nationwide monitoring of grey and red-legged partridge abundance and breeding success* | *Neville Kingdon, Nicholas Aebischer, Julie Ewald, Ellie Brown, Holly Neary Dave Parish* | *Core funds, GCUSA* | *1933- on-going* |

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|---|---|---|---|---|
| *National Gamebag Census (see page 30)* | *Monitoring game and predator numbers with annual bag records* | *Nicholas Aebischer, Gillian Gooderham, Chris Wheatley, Ellie Brown, Holly Neary* | *Core funds* | *1961- on-going* |
| *Sussex Study* | *Long-term monitoring of partridges, weeds, invertebrates, pesticides and land use on the South Downs in Sussex* | *Julie Ewald, Nicholas Aebischer, Steve Moreby, Max Krioutchkov, Dick Potts (consultant)* | *Core funds* | *1968- on-going* |
| *Partridge over-winter losses* | *Identifying reasons for high over-winter losses of grey partridges in the UK* | *Francis Buner, Nicholas Aebischer Ellie Brown, Holly Neary* | *Core funds, GCUSA* | *2007-2013* |
| *Wildlife monitoring at Rotherfield Park (see page 28)* | *Monitoring of land use, game and songbirds for the Rotherfield Demonstration Project* | *Francis Buner, Malcolm Brockless, Julie Ewald, Peter Thompson* | *Core funds* | *2010-2014* |
| *Cereal invertebrates & climate change* | *Examine the effect of extreme weather events on cereal invertebrates* | *Julie Ewald, Chris Wheatley, Ellie Brown, Holly Neary* | *Natural England* | *2012-2013* |
| *Winter hopper feeding* | *Assessing hopper use by gamebirds and other wildlife through camera trapping* | *Carlos Sánchez, Francis Buner, Nicholas Aebischer, Max Krioutchkov* | *Fundación Caja Madrid* | *2012-2013* |
| *BDS Shooting Accuracy Project* | *Analysis of data from the BDS Shooting Accuracy and Deer Recovery Research Project* | *Nicholas Aebischer, Chris Wheatley* | *British Deer Society* | *2012-2014* |

## UPLANDS RESEARCH IN 2013

| Project title | Description | Staff | Funding source | Date |
|---|---|---|---|---|
| *Grouse Count Scheme (see page 34)* | *Annual grouse and parasitic worm counts in relation to moorland management indices and biodiversity* | *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* |
| *Capercaillie brood ecology* | *Surveys of capercaillie and their broods in Scottish forests in relation to habitat, predators and weather* | *David Baines, Graeme Neish David Howarth, Kathy Fletcher* | *SNH, Forest Enterprise Scotland* | *1991- ongoing* |
| *Timing of breeding in red grouse* | *Long-term assessment of changes in laying dates in relation to climate change* | *Kathy Fletcher, David Howarth, David Newborn* | *The Samuels Trust, Core funds* | *1995- on-going* |
| *Black grouse range expansion (see page 42)* | *Black grouse range restoration by translocating surplus wild males* | *Philip Warren, Frances Atterton* | *Biffa, SITA Trust Private funder* | *1996-2013* |
| *Tick impacts on grouse chicks (see page 44)* | *Tick control in a multi-host system and the effects on grouse chicks* | *Kathy Fletcher, David Howarth* | *Various Trusts* | *2000-2013* |
| *Strongylosis research* | *Development of strongylosis control techniques in red grouse* | *David Newborn, David Baines, Mike Richardson* | *Core funds* | *2006- on-going* |
| *Monitoring Langholm Moor Demonstration Project (see page 50)* | *Research data for moorland restoration to achieve economically-viable driven grouse shooting and sustainable numbers of hen harriers* | *David Baines, Sonja Ludwig, Tommy Pringle* | *Core funds, Buccleuch Estates SNH, RSPB, NE, Heather Trust* | *2008-2018* |
| *Conservation of grey partridges in the upland fringes (see page 40)* | *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* | *2009-2013* |
| *Tick research (see page 46)* | *Development of tick control techniques through trialling acaricide-impregnated neck collars* | *David Baines, David Newborn, Mike Richardson* | *Private donor* | *2011-2015* |
| *Estimating pine marten abundance in Scottish forests by DNA sampling* | *DNA analysis of marten hair obtained while visiting baited sticky sampling tubes* | *David Baines, Kathy Fletcher, David Howarth* | *Forest Enterprise Scotland Cairngorms National Park Authority* | *2012-2013* |
| *Factors affecting red grouse abundance* | *Effect of habitat composition, habitat quality and predator indices on grouse abundance and breeding success* | *David Baines, Sonja Ludwig* | *Natural England, Heather Trust* | *2012-2013* |
| *Black grouse in forested landscapes* | *Interpretation guidance from research projects on black grouse habitat use in forests* | *Patrick White* | *Forestry Commission Scotland* | *2012-2013* |
| *Alternative grouse diseases (see page 38)* | *Cryptosporidia in red grouse* | *David Baines, Mike Richardson* | *Core funds* | *2012-2015* |
| *Black grouse national survey* | *Co-ordination and analysis of data from lek counts in England and Scotland* | *Philip Warren, Frances Atterton* | *Core, SNH* | *2013- on-going* |
| *PhD: Impacts of buzzards on red grouse (see page 48)* | *Dietary studies of breeding buzzards and foraging patterns in relation to grouse survival* | *Richard Francksen Supervisors: David Baines, Mark Whittingham/University of Newcastle* | *Langholm Moor Demonstration Project University of Newcastle* | *2012-2015* |

## FARMLAND RESEARCH IN 2013

| Project title | Description | Staff | Funding source | Date |
|---|---|---|---|---|
| *Conservation Grade* | *To develop sustainable, multi-purpose, farmland* | *John Holland, Laura Kor, Amy Smith, Tom Birkett* | *Conservation Grade Ltd, Wixamtree Trust, John Oldacre Foundation* | *2010-2013* |
| *Sainfoin* | *To investigate the potential of sainfoin (Onobrychis viciifolia) as a resource for wildlife* | *Barbara Smith, Tom Birkett, Tom Elliot* | *Core funds* | *2011- on-going* |

## FARMLAND RESEARCH IN 2013 (continued)

| Project title | Description | Staff | Funding source | Date |
|---|---|---|---|---|
| *River Avon invertebrates* | *Long-term monitoring of River Avon aquatic invertebrates* | *Tom Birkett* | *Core funds* | *2011- on-going* |
| *New Forest heather management* | *A comparison of the effect of managed burning and vegetation cutting on biodiversity in the New Forest* | *Barbara Smith, Tom Birkett, Amy Smith, Laura Kor with Dan Carpenter (Natural History Museum)* | *New Forest National Park Authority, the Verderers and the National Trust* | *2012-2013* |
| *People and pollinators in India* | *To improve understanding of native Indian pollinators, their ecology and best practice management* | *Barbara Smith* | *Darwin Initiative* | *2012-2015* |
| *HGCA Encyclopedia* | *Pests and beneficials encyclopaedia for arable and field crops* | *John Holland, Barbara Smith, Steve Ellis (ADAS) and Rosemary Collier (University of Warwick)* | *HGCA* | *2013-2014* |
| *QuESSA (see page 52)* | *Quantification of Ecological Services for Sustainable Agriculture* | *John Holland, Barbara Smith, Tom Birkett, Steve Moreby, Laura Kor, Amy Smith, Liam Crowley, Tom Elliott* | *EU FP7* | *2013-2017* |
| *PhD: Farmland birds and agri-environment schemes* | *The breeding success of farmland birds and the impact of agri-environment scheme habitats* | *Niamh McHugh Supervisors: John Holland, Mick Crawley/ Imperial College, London* | *BBSRC/CASE studentship NE* | *2012-2015* |
| *PhD: Bumblebees and agri-environment schemes* | *How effective are agri-environment schemes in boosting bumblebee populations?* | *Tom Wood Supervisors: John Holland, Professor Dave Goulson (University of Sussex)* | *NERC/CASE studentship* | *2013-2016* |

## ALLERTON PROJECT RESEARCH IN 2013

| Project title | Description | Staff | Funding source | Date |
|---|---|---|---|---|
| *Monitoring wildlife at Loddington* | *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* |
| *Effect of game management at Loddington (see page 54)* | *Effect of ceasing predator control and winter feeding on nesting success and breeding numbers of songbirds. Use of feed hoppers. Commencement of shooting* | *Chris Stoate, Alastair Leake, John Szczur* | *Allerton Project funds* | *2001- on-going* |
| *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* |
| *School farm catchment (see page 60)* | *Practical demonstration of ecosystem services* | *Chris Stoate, John Szczur* | *Allerton Project, EA, Anglian Water, Agrii SoilQuest* | *2012- on-going* |
| *Pesticides in water* | *Assessing pesticide concentrations in water and the mitigation potential of constructed wetlands* | *Chris Stoate, John Szczur, Professor Colin Brown (York University), Chris Sinclair (Fera)* | *Chemicals Regulation Directorate* | *2012-2014* |
| *MICROCAT Microwave Assisted Catalytic Treatment of Agricultural Wastewater* | *Development of technology for the removal of pesticides and other pollutants from agricultural waste water* | *Chris Stoate, Loughborough and Leicester de Montfort universities and other partners* | *Technology Strategy Board* | *2012-2015* |
| *Water Friendly Farming* | *A landscape scale demonstration of resource protection integration with farming in the upper Welland* | *Chris Stoate, John Szczur, Jamie Partridge, Jeremy Briggs, Penny Williams, Adrianna Hawczak, Anita Casey (all Freshwater Habitats Trust), Professor Colin Brown (University of York)* | *EA, Syngenta, Chemicals Regulation Directorate, Anglian Water* | *2012-2015* |
| *Remote sensing data applications* | *An investigation into the potential uses of remote sensing and ground sourced spatial data for catchment management* | *Chris Stoate, Antony Williamson (EA), Crispin Hambidge (Geomatics)* | *EA* | *2013-2014* |
| *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 British Deer Society* | *2007-2013* |
| *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* |
| *MSc: Farming and soil health* | *The impacts of zero-tillage arable farming on soil health* | *Michael Summers, Masaki Shinzato Supervisor: Alastair Leake* | *Allerton Project/ Imperial College, London* | *2010- on-going* |
| *MSc: Phosphorus balance* | *An assessment of the phosphorus balance for the School Farm catchment* | *Lucy Hale Supervisor: Chris Stoate* | *Allerton Project/ Bangor University* | *2012-2012* |
| *MSc: Crop pest invertebrate predators* | *Production of beneficial crop pest predators by non-crop habitats* | *Grant Thompson Supervisor: Chris Stoate* | *Allerton Project/ Nottingham University* | *2013-2013* |

## PREDATION RESEARCH IN 2013

| Project title | Description | Staff | Funding source | Date |
|---|---|---|---|---|
| *Fox control methods (see page 62)* | *Experimental field comparison of fox capture devices* | *Jonathan Reynolds, Mike Short* | *Core funds* | *2002- on-going* |
| *Tunnel traps (see page 62)* | *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* | *2006-2014* |

## FISHERIES RESEARCH IN 2013

| 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* | *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- on-going* |
| *Salmon life-history strategies in freshwater (see page 66)* | *Understanding the population declines in salmon* | *Anton Ibbotson, Dylan Roberts, William Beaumont, Luke Scott, Rasmus Lauridsen* | *Core funds, EA, CEFAS, Valentine Trust, Alice Ellen Cooper Dean Charitable Trust, Mr A Daniell, Iliffe Trust, Balmain Trust, AST, S&TA, Winton Capital* | *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, Rasmus Lauridsen* | *CEFAS* | *2009- on-going* |
| *Water temperatures and salmonids* | *Micro habitat use by salmonids in relation to temperature* | *Anton Ibbotson, Dr Paul Kemp (Southampton University)* | *Southampton University, CEH, core funds* | *2009-2014* |
| *Avon demonstration test catchment project (DTC)* | *Demonstrating the impacts of catchment management to reduce diffuse agricultural run-off pollution on fish populations* | *Dylan Roberts, Luke Scott* | *Defra* | *2010-2014* |
| *Wessex biodiversity and ecosystem service sustainability* | *Wessex biodiversity and ecosystem service sustainability* | *Anton Ibbotson, Dr Iwan Jones (Queen Mary, University of London)* | *NERC* | *2012-2013* |
| *Macro-nutrient cycling-lateral exchange* | *Macro-nutrient cycling-lateral exchange* | *Anton Ibbotson, Dr Iwan Jones (Queen Mary, University of London)* | *NERC* | *2012-2013* |
| *Juvenile salmon and hydro* | *The effects of a hydropower installation on salmon smolts* | *Anton Ibbotson, William Beaumont, Graeme Storey (EA)* | *EA, core funds, S&TA, Lulworth Estate* | *2012-2015* |
| *MorFish* | *Alignment and analysis of long-term data sets on the Rivers Frome, Oir and Scorff. Technical development of PIT equipment on these rivers* | *Dylan Roberts, Anton Ibbotson, Dr Jean-Marc Roussel and Didier Azam (INRA), Paul Stephens, William Beaumont, Luke Scott, Rasmus Lauridsen* | *Core funds, INRA, EU Interreg Channel programme* | *2012-2015* |
| *DURESS* | *Ecosystems services in Welsh rivers* | *Dylan Roberts, Dr Isabelle Durance, Professor Steve Ormerod (Cardiff University)* | *NERC* | *2012-2015* |
| *Life history choice of juvenile salmon* | *Over wintering ecology and migration strategy of juvenile salmon* | *Rasmus Lauridsen, Anton Ibbotson, Dr Jean-Marc Roussel* | *Core funds, INRA, EU Interreg Channel Programme* | *2012-2015* |
| *Modelling fish population trends and uncertainties* | *An international collaboration to model historical fish populations using state-of-the-art Bayesian theory* | *Dr Stephen Gregory, Anton Ibbotson, Dr Jean-Marc Roussel, Bill Beaumont, Dr Etienne Rivot* | *Core funds, INRA, EU Interreg Channel Programme* | *2012-2015* |
| *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: 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: Anton Ibbotson, Dr Dylan Bright, Dr Jamie Stevens/Exeter University, WCRT* | *Exeter University, AST, S&TA, WCRT, Core Funds* | *2011-2014* |

*Key to abbreviations: ADAS = Agricultural Development & Advisory Service; AST = Atlantic Salmon Trust; BBSRC = Biotechnology and Biological Sciences Research Council; CASE = Co-operative Awards in Science & Engineering; CEFAS = Centre for Environment, Fisheries & Aquaculture Science; CEH = Centre for Ecology and Hydrology; Defra = Department for Environment, Food and Rural Affairs; EA = Environment Agency; ESRC = Economic & Social Research Council; EU = European Union; HGCA = Home Grown Cereals Authority; INRA = French National Institute for Agricultural Research; JNCC = Joint Nature Conservation Committee; NE = Natural England; NERC = Natural Environment Research Council; NFU = National Farmers' Union; RSPB = Royal Society for the Protection of Birds; S&TA = Salmon & Trout Association; SNH = Scottish Natural Heritage; WCRT = Westcountry Rivers Trust.*

# Scientific publications

by staff of the Game & Wildlife Conservation Trust in 2013


**Baines, D, Aebischer, NJ, MacLeod, A & Woods, J (2013)** Pine marten *Martes martes* and red fox *Vulpes vulpes* sign indices in Scottish forests: population change and reliability of field identification of scats. *Wildlife Biology*, 19: 490-495.

**Baines, D & Richardson, M (2013)** Hen harriers on a Scottish grouse moor: multiple factors predict breeding density and productivity. *Journal of Applied Ecology,* 50: 1397-1405.

**Boatman, N, Green, M, Marshall, J, Musters, K, Peach, W, Peel, S, Siriwardena, G & Smith, B (eds) (2013)** *Environmental Management on Farmland. Aspects of Applied Biology,* 118. Association of Applied Biologists, Warwick.

**Bright, JA, Anderson, GQA, McArthur, T, Sage, RB, Stockdale, J, Grice, PV & Bradbury, RB (2013)** Bird use of establishment-stage *Miscanthus* biomass crops during the breeding season in England. *Bird Study*, 60: 357-369.

**Cook, N, Hubbard, SF, Karley, AJ & Russell, JR (2013)** Genetic diversity and complementary sex determination (CSD) in *Dolerus aeneus* (Hymenoptera, Symphyta): implications for the conservation of an ecologically-important sawfly. *Conservation Genetics,* 14: 1125-1133.

**Davey, JS, Vaughan, IP, King, RA, Bell, JR, Bohan, DA, Bruford, MW, Holland, JM & Symondson, WOC (2013)** Intraguild predation in winter wheat: prey choice by a common epigeal carabid consuming spiders. *Journal of Applied Ecology*, 50: 271-279.

**Dicks, LV, Abrahams, A, Atkinson, J, Biesmeijer, J, Bourn, N, Brown, C, Brown, MJF, Carvell, C, Connolly, C, Cresswell, JE, Croft, P, Darvill, B, Zylva, P, Effingham, P, Fountain, M, Goggin, A, Harding, D, Harding, T, Hartfield, C, Heard, MS, Heathcote, R, Heaver, D, Holland, JM, Howe, M, Hughes, B, Huxley, T, Kunin, WE, Little, J, Mason, C, Memmott, J, Osborne, J, Pankhurst, T, Paxton, RJ, Pocock, MJO, Potts, SG, Power, EF, Raine, NE, Ranelagh, E, Roberts, S, Saunders, R, Smith, K, Smith, RM, Sutton, P, Tilley, LAN, Tinsley, A, Tonhasca, A, Vanbergen, AJ, Webster, S, Wilson, A & Sutherland, WJ (2013)** Identifying key knowledge needs for evidence-based conservation of wild insect pollinators: a collaborative cross-sectoral exercise. *Insect Conservation and Diversity*, 6: 435-446.

**Dicks, LV, Bardgett, RD, Bell, J, Benton, TG, Booth, A, Bouwman, J, Brown, C, Bruce, A, Burgess, PJ, Butler, SJ, Crute, I, Dixon, F, Drummond, C, Freckleton, RP, Gill, M, Graham, A, Hails, RS, Hallett, J, Hart, B, Hillier, JG, Holland, JM, Huxley, JN, Ingram, JSI, King, V, MacMillan, T, McGonigle, DF, McQuaid, C, Nevard, T, Norman, S, Norris, K, Pazderka, C, Poonaji, I, Quinn, CH, Ramsden, SJ, Sinclair, D, Siriwardena, GM, Vickery, JA, Whitmore, AP, Wolmer, W & Sutherland, WJ (2013)** What do we need to know to enhance the environmental sustainability of agricultural production? A prioritisation of knowledge needs for the UK food system. *Sustainability,* 5: 3095-3115.

**Díez, C, Sánchez-García, C, Pérez, JA, Bartolomé, DJ, González, V, Wheatley, CJ, Alonso, ME & Gaudioso, VR (2013)** Behavioural activity of wild rabbits *(Oryctolagus cuniculus)* under semi-natural rearing systems: establishing a seasonal pattern. *World Rabbit Science*, 21: 263-270.

**Firbank, L, Bradbury, RB, McCracken, DI & Stoate, C (2013)** Delivering multiple ecosystem services from enclosed farmland in the UK. *Agriculture, Ecosystems and Environment,* 166: 65-75.

**Fletcher, K, Hoodless, AN & Baines, D (2013)** Impacts of predator abundance on red grouse *Lagopus lagopus scotica* during a period of experimental predator control. *Wildlife Biology*, 19: 248-256.

**Fletcher, K, Howarth, D & Baines, D (2013)** The status of ptarmigan in Scotland: results of a survey questionnaire of land managers. *Scottish Birds,* 33: 291-297.

**Fletcher, K, Howarth, D, Kirby, A, Dunn, R & Smith, AA (2013)** Effect of climate change on breeding phenology, clutch size and chick survival of an upland bird. *Ibis,* 155: 456-463.

**Goodwin, CG, McHugh, N, Holland, JM & Leather, SR (2013)** The influence of Environmental Stewardship (ES) summer foraging habitat on the territory selection of yellowhammer, *Emberiza citrinella. Aspects of Applied Biology,* 118: 277-282.

**Holland, JM, Storkey, J, Lutman, PJW, Henderson, I & Orson, J (2013)** The Farm4Bio project: managing uncropped land for biodiversity. *Aspects of Applied Biology,* 118: 89-99.

**Hoodless, AN, Powell, A, Ferrand, Y, Gosler, A, Fox, J, Newton, J & Williams, O (2013)** Application of new technologies to the study of Eurasian woodcock migration. In: Ferrand, Y. (ed.) *Seventh European Woodcock and Snipe Workshop: 7-18.* Proceedings of International Symposium of (International Union for the Conservation of Nature) IUCN/Wetlands International Woodcock & Snipe Specialist Group May 2011, Saint-Petersburg, Russia. ONCFS (Office National de la Chasse et de la Faune Sauvage), France.

**Iannetta, PPM, Begg, G, James, EK, Smith, BM, Davies, C, Karley, A, Lopez Del Egido, L, Hawes, C, Young, M, Ramsay, G, Birch, ANE, Valentine, TA, Warburton-Brown, C, Goldring, A, Hughes, T, Sprent, J, Wolfe, M & Rees, RM (2013)** Sustainable intensification: a pivotal role for legume supported cropped systems. *Aspects of Applied Biology,* 121: 73-82.

**Ibbotson, AT, Riley, WD, Beaumont, WRC, Cook, AC, Ives, MJ, Pinder, AC & Scott, LJ (2013)** The source of autumn and spring downstream migrating juvenile Atlantic salmon in a small lowland river. *Ecology of Freshwater Fish*, 22: 73-81.

**Jarratt, S (2013)** *Linking the environmentally friendly farming careers of farmers to their effective delivery of wildlife habitats* *within the east of England.* Unpublished PhD thesis. University of Nottingham, Nottingham.

**Jarratt, S, Morris, C & Stoate, C (2013)** The role of Environmental Stewardship in the development of farmers' 'environmental learning careers'. *Aspects of Applied Biology,* 121: 149-156.

**McHugh, NM, Hughes, S, Leather, S, Stilman, R & Holland, JM (2013)** Yellowhammer breeding distribution in relation to field boundary habitat and summer foraging resources. *Aspects of Applied Biology,* 118: 297-302.

**Musgrove, A, Aebischer, NJ, Eaton, M, Hearn, R, Newson, S, Noble, D, Parsons, M, Risely, K & Stroud, D (2013)** Population estimates of birds in Great Britain and the United Kingdom. *British Birds,* 106: 64-100.

**Phang, SC (2013)** *Predicting salmonid population ecology from individual fish responses to environmental changes: bridging the gap between behaviour, conservation and fisheries management.* Unpublished PhD thesis. Bournemouth University, Bournemouth.

**Potts, GR (2013)** Some differences in the breeding ecology of *Alectoris* and *Perdix* partridges and implications for the conservation of *Alectoris*: a review. *Avocetta,* 37: 107-110.

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# Financial report
for 2013

**KEY POINTS**

- Overall funds increased by £486,725.
- The General Fund increased by £34,095.
- Income (excluding endowment receipts) was over £7 million for the first time.
- Expenditure on research again exceeded £3.5 million.

The summary report and financial statement for the year ended 31 December 2013, set out below and on pages 76 to 77, 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 GWCT Events Limited (formerly Game Conservancy Events Limited). They do not comprise the full statutory Trustees' report and accounts, which were approved by the Trustees on 15 April 2014 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 received a record amount of income into its non-endowment funds in 2013 and, combined with the gains on its investments, this allowed it both to spend around £4.3 million on its charitable objects and to continue to rebuild its reserves in accordance with its plan. Income increased by about 6%, reflecting both the continuing generosity of our supporters and our success in accessing public sector funding from both UK and EU sources. Once again expenditure was carefully controlled, resulting in a very small deficit on the unrestricted General Fund which was more than covered by investment gains.

The unrestricted investments and Underwood endowment produced total returns of 14.1%, which is considerably better than their manager's investment policy, which remains to exceed the return on cash. The ARET endowment achieved a total return of 17.9%, also well ahead of its blended benchmark of 12.6%.

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. At the end of 2013 the Trust's reserves (according to this definition) were around £1.3 million.

## Plans for future periods

A new five-year business plan was prepared in March 2012. The key aims are:

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 us a more relevant organisation to a broader range of stakeholders.

These continue to direct our work; our research and policy initiatives aim to deliver effective wildlife conservation alongside economic land use and in the light of the new challenges of food security and climate change. Our focus on practical conservation in a working countryside makes our work even more relevant as these challenges unfold.

I Coghill
Chairman of the Trustees

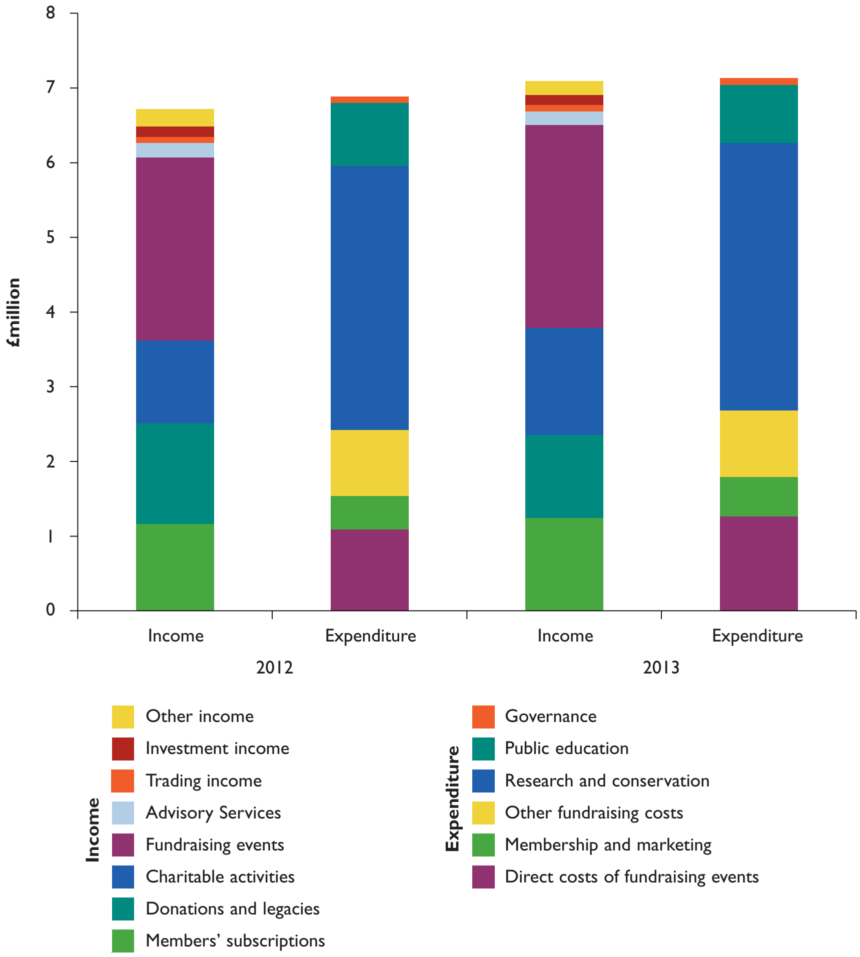


**Figure 1**

Total incoming and outgoing resources in 2013 (and 2012) 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 2013 which is set out on pages 76 and 77.

## 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 2013 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 2014

Consolidated

# Statement of financial activities

| | General Fund £ | Designated Funds £ | Restricted Funds £ | Endowed Funds £ | **Total 2013 £** | Total 2012 £ |
|---|---|---|---|---|---|---|
| INCOME AND EXPENDITURE | | | | | | |
| INCOMING RESOURCES | | | | | | |
| Incoming resources from generated funds | | | | | | |
| *Voluntary income* | | | | | | |
| Members' subscriptions | 1,238,671 | - | 10,009 | | **1,248,680** | 1,169,596 |
| Donations and legacies | 436,513 | - | 666,575 | - | **1,103,088** | 1,338,457 |
| | 1,675,184 | - | 676,584 | - | **2,351,768** | 2,508,053 |
| *Activities for generating funds* | | | | | | |
| Fundraising events | 2,715,545 | - | | - | **2,715,545** | 2,447,543 |
| Advisory Service | 183,199 | - | - | - | **183,199** | 196,746 |
| Trading income | 83,494 | - | - | - | **83,494** | 77,501 |
| Investment income | 11,302 | - | 107,276 | 14,353 | **132,931** | 140,658 |
| *Incoming resources from* | | | | | | |
| Charitable activities | 260,142 | - | 1,178,015 | - | **1,438,157** | 1,115,674 |
| Other incoming resources | 135,137 | - | 50,234 | - | **185,371** | 231,126 |
| TOTAL INCOMING RESOURCES | 5,064,003 | - | 2,012,109 | 14,353 | **7,090,465** | 6,717,301 |
| RESOURCES EXPENDED | | | | | | |
| *Costs of generating funds* | | | | | | |
| Direct costs of fundraising events | 1,266,385 | - | - | - | **1,266,385** | 1,093,172 |
| Membership and marketing | 530,203 | | - | - | **530,203** | 445,245 |
| Other fundraising costs | 887,105 | - | - | - | **887,105** | 879,415 |
| | 2,683,693 | - | - | - | **2,683,693** | 2,417,832 |
| *Activities in furtherance of the charity's objects* | | | | | | |
| Research and conservation - Lowlands | 804,164 | - | 682,834 | - | **1,486,998** | 1,469,108 |
| Research and conservation - Uplands | 480,211 | - | 164,331 | - | **644,542** | 754,151 |
| Research and conservation - Allerton Project | 130,129 | - | 841,809 | 4,150 | **976,088** | 914,276 |
| Research and conservation - Fisheries | 242,190 | - | 226,766 | - | **468,956** | 404,256 |
| | 1,656,694 | - | 1,915,740 | 4,150 | **3,576,584** | 3,541,791 |
| Public education | 668,575 | - | 65,688 | 50,000 | **784,263** | 840,859 |
| | 2,325,269 | - | 1,981,428 | 54,150 | **4,360,847** | 4,382,650 |
| Governance | 85,371 | - | - | 7,853 | **93,224** | 84,751 |
| TOTAL RESOURCES EXPENDED | 5,094,333 | - | 1,981,428 | 62,003 | **7,137,764** | 6,885,233 |
| NET INCOMING/(OUTGOING) RESOURCES BEFORE TRANSFERS | (30,330) | - | 30,681 | (47,650) | **(47,299)** | (167,932) |
| Transfers between funds | (24,000) | - | 24,000 | - | - | - |
| **NET INCOMING/(OUTGOING) RESOURCES** | (54,330) | - | 54,681 | (47,650) | **(47,299)** | (167,932) |
| **OTHER RECOGNISED GAINS AND LOSSES** | | | | | | |
| Realised gains/(losses) on investments | 8,056 | - | 394 | 34,623 | **43,073** | (7,366) |
| Unrealised gains/(losses) on investments | 80,369 | - | 3,933 | 406,649 | **490,951** | 224,234 |
| NET MOVEMENT IN FUNDS | 34,095 | - | 59,008 | 393,622 | **486,725** | 48,936 |
| BALANCES AT 1 JANUARY 2013 | 2,162,815 | 136,492 | 268,276 | 5,460,033 | **8,027,616** | 7,978,680 |
| **BALANCES AT 31 DECEMBER 2013** | £2,196,910 | £136,492 | £327,284 | £5,853,655 | **£8,514,341** | £8,027,616 |

Consolidated

# Balance sheet

as at 31 December 2013

| | | 2013 | | 2012 |
|---|---|---|---|---|
| | £ | £ | £ | £ |
| FIXED ASSETS | | | | |
| Tangible assets | | 3,264,672 | | 3,314,145 |
| Investments | | 4,337,851 | | 3,894,535 |
| | | 7,602,523 | | 7,208,680 |
| CURRENT ASSETS | | | | |
| Stock | 178,122 | | 163,521 | |
| Debtors | 878,667 | | 988,637 | |
| Cash at bank and in hand | 1,087,952 | | 721,844 | |
| | 2,144,741 | | 1,874,002 | |
| CREDITORS: | | | | |
| Amounts falling due within one year | 892,747 | | 681,749 | |
| NET CURRENT ASSETS | | 1,251,994 | | 1,192,253 |
| TOTAL ASSETS LESS CURRENT LIABILITIES | | 8,854,517 | | 8,400,933 |
| CREDITORS: | | | | |
| Amounts falling due after more than one year | | 340,176 | | 373,317 |
| **NET ASSETS** | | £8,514,341 | | £8,027,616 |
| *Representing:* | | | | |
| CAPITAL FUNDS | | | | |
| Endowment funds | | 5,853,655 | | 5,460,033 |
| INCOME FUNDS | | | | |
| Restricted funds | | 327,284 | | 268,276 |
| Unrestricted funds: | | | | |
| Designated funds | 136,492 | | 136,492 | |
| Revaluation reserve | 356,051 | | 289,512 | |
| General fund | 1,795,895 | | 1,827,560 | |
| Non-charitable trading fund | 44,964 | | 45,743 | |
| | | 2,333,402 | | 2,299,307 |
| **TOTAL FUNDS** | | £8,514,341 | | £8,027,616 |

Approved by the Trustees on 15 April 2014 and signed on their behalf

I COGHILL

*Chairman of the Trustees*

# Staff

of the Game & Wildlife Conservation Trust
in 2013

| | |
|---|---|
| CHIEF EXECUTIVE | Teresa Dent BSc, FRAgS |
| Personal Assistant | Lindsay Watson BSc, MSc |
| Head of Finance | James McDonald ACMA |
| Finance Assistant - Limited | Lin Dance |
| Accounts Assistant (p/t) | Suzanne Hall |
| Head of Administration & Personnel (p/t) | Ian Collins MCIPD, BA |
| 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) | Daniel O'Mahony |
| DIRECTOR OF RESEARCH | Nick Sotherton BSc, PhD |
| Personal Assistant (p/t) | Lynn Field |
| Head of Fisheries Research | Dylan Roberts BSc |
| Administrator - MorFish & Quessa | Paul Stephens BApp.Sc *(from January)* |
| Head of Salmon & Trout Research Centre | Anton Ibbotson BSc, PhD |
| Senior Fisheries Scientist | Bill Beaumont MIFM |
| Senior Fisheries Scientist | Stephen Gregory BSc, MPhil, PhD *(from January)* |
| Fisheries Scientist | Rasmus Lauridsen BSc, MSc, PhD |
| Research Assistant | Luke Scott |
| PhD Student *(University of Bournemouth)* - pike removal and weed cutting | Sui Phang BSc, MSc |
| PhD Student *(University of Exeter)* - salmon genetics | Charles Ikediashi BSc |
| MRes Student *(University of Cardiff)* - brown trout and bullheads | Janine Burnham BSc *(from October)* |
| 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 *(until November)* |
| Bird Surveyor | Sue Wilson BA *(April-July)* |
| Bird Surveyor | Tony Powell *(April-July)* |
| Bird Surveyor | Allan Goddard *(April-July)* |
| PhD Student *(Imperial College, London)* - birds and miscanthus | Henrietta Pringle BSc |
| PhD student *(University of Exeter)* - pheasant behaviour | Mark Whiteside MSc |
| MSc student *(Liverpool University)* - reared pheasants | Zara Gerrard BSc |
| MSc student *(University of East Anglia)* - wild pheasants | Helen Duffield BSc |
| MSc student *(University of East Anglia)* - wild pheasants | Lucy Ridding BSc |
| Placement Student *(University of Bath)* | Christopher Guggari-Peel *(until September)* |
| Placement Student *(University of Reading)* | Jack Buckingham *(from September)* |
| Head of Wetland Research | Andrew Hoodless BSc, PhD |
| Ecologist | John Simper BSc, MSc *(until November)* |
| Research Assistant | Chris Heward BSc *(until November)* |
| Research Assistant | Matt White BSc *(March-August)* |
| PhD Student *(University of Reading)* - game landscapes | Jessica Neumann BSc |
| PhD Student *(University of Nottingham)* - breeding ecology of woodcock | Chris Heward BSc *(from November)* |
| MSc Student *(Imperial College London)* - lapwings on fallow plots | Sarah Johnson MA |
| MSc Student *(University of Bournemouth)* - lapwings on fallow plots | Richard Cann BSc |
| MSc Student *(University of Southampton)* - lapwings on fallow plots | Sarah Knight BSc |
| Placement Student *(University of Southampton)* | Michael Hockey *(until August)* |
| Placement Student *(University of Cardiff)* | Freya Stacey *(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 St Andrews and John Hutton Institute)* - small mammal ecology on farmland | Amanda Wilson BSc |
| Head of Predation Control Studies | Jonathan Reynolds BSc, PhD |
| Senior Field Ecologist | Mike Short HND |
| Research Assistant | Tom Porteus BSc, MSc |
| 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 |
| PhD Student *(Imperial College London)* - stewardship and farmland birds | Niamh McHugh BSc, MSc |
| PhD Student *(University of Sussex)* - stewardship on wild bees | Tom Wood BSc, MSc |
| Placement Student *(University of Plymouth)* | Amy-Jane Smith *(until August)* |
| Placement Student *(Imperial College London)* | Laura Kor *(until September)* |
| Placement Student *(University of Bath)* | Liam Crowley *(from September)* |
| Placement Student *(University of Reading)* | Tom Elliott *(from September)* |
| Director of Upland Research | David Baines BSc, PhD |
| Office Manager, Uplands | 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 *(until March)* |
| Research Ecologist Langholm | Sonja Ludwig MSc, PhD |
| Research Assistant | Thomas Pringle BSc *(until March)* |

| | |
|---|---|
| PhD student *(University of Newcastle)* - buzzards and grouse | Richard Francksen BSc |
| Placement Student *(University of Durham)* | Melissa Dawson *(until July)* |
| Placement Student *(University of Leeds)* | Zoe Deal *(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 (p/t) | David Howarth |
| Research Assistant - Scottish Upland Research | Graeme Neish |
| Woodland Grouse Research Scientist | Patrick White BSc, PhD *(until August)* |
| Placement Student *(University of Plymouth)* | Robyn Owen *(until August)* |
| Placement Student *(Bangor University)* | Sion Thomas *(from August)* |
| DIRECTOR OF POLICY & THE ALLERTON PROJECT | Alastair Leake BSc (Hons), MBPR (Agric), PhD, FRAgS, MIAgM, CEnv |
| Secretary (p/t) | Natalie Augusztinyi *(until March)*; Katy Machin *(from April)* |
| Head of Research for the Allerton Project | Chris Stoate BA, PhD |
| Ecologist | John Szczur BSc |
| Game Manager | James Watchorn |
| Head of Education and Development | Jim Egan *(from January)* |
| PhD Student *(University of Nottingham)* - game as food | Graham Riminton BSc |
| PhD Student *(University of Nottingham)* - farmers' environmental learning | Susanne Jarratt BSc |
| MSc Student *(University of Nottingham)* - crop-pest predators | GrantThompson BSc |
| MSc Student *(University of Bangor)* - phosphorus balance | Lucy Hale BSc |
| Research Assistant | Jamie Partridge BSc |
| Research Assistant | Sofi Lloyd *(from November)* |
| Farm Manager | Philip Jarvis MSc |
| Farm Assistant | Michael Berg |
| Farm Assistant | Ben Jarvis |
| DEPUTY DIRECTOR OF RESEARCH | Nicholas Aebischer Lic ès Sc Math, PhD |
| Secretary, Librarian & National Gamebag Census Co-ordinator | Gillian Gooderham |
| Senior Conservation Scientist | Francis Buner Dipl Biol, PhD |
| SCCS Cambridge Intern *(WWF Pakistan)* | Muhammad Naeem Awan *(March-April)* |
| Erasmus Intern *(Afyon Kocatepe University, Turkey)* | Emine Hesna Kandir *(November)* |
| Post-Doctoral Researcher *(University of León)* | Carlos Sánchez García-Abad, PhD, BVSc |
| Head of Geographical Information Systems | Julie Ewald BS, MS, PhD |
| Partridge Count Scheme Co-ordinator | Neville Kingdon BSc |
| Biometrics/GIS Assistant | Chris Wheatley BSc |
| Placement Student *(University of Cardiff)* | Eleanor Brown *(until August)* |
| Placement Student *(University of Bath)* | Holly Narey *(until August)* |
| Placement Student *(University of Bath)* | Lucy Coals *(from September)* |
| Placement Student *(University of Bath)* | Charles Cunningham *(from September)* |
| Placement Student IT *(City University London)* | Maxim Kroutchkov *(until August)* |
| Placement Student IT *(University of Surrey)* | Christopher Price *(from August)* |
| DIRECTOR OF FUNDRAISING | Edward Hay |
| Personal Assistant/Sweepstake Co-ordinator (p/t) | Kathryn Solari *(until November)* |
| Shoot Sweepstake Fundraiser (p/t) | Kathryn Solari *(from November)* |
| National Events Co-ordinator (p/t) | Mel Dellow |
| London Events Manager | Lucinda Pearson |
| London Events Assistant | Tortie Hoare |
| Events Assistant | Phoebe Cumming *(from October)* |
| Northern Regional Fundraiser (p/t) | Sophie Dingwall |
| Southern Regional Fundraiser | Max Kendry |
| Eastern Regional Fundraiser | Lizzie Herring |
| Regional Organiser (p/t) | Gay Wilmot-Smith BSc |
| Regional Organiser (p/t) | Charlotte Meeson BSc |
| Regional Organiser (p/t) | David Thurgood |
| Regional Organiser (p/t) | Sarah Matson *(from January)* |
| 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 |
| Membership Assistant (p/t) | Angela Hodge |
| Administrator (p/t) | Suzanne Fairbairn *(until December)* |
| Head of Telesales | Joanne Hilton *(until May)* |
| National Recruitment Manager | Andy Harvey *(from March)* |
| Digital Fundraising & Marketing Officer | Rob Beeson *(from June)* |
| Direct Mail Fundraising & Marketing Officer | James Swyer *(from June)* |
| Website Editor | Oliver Dean *(from July)* |
| DIRECTOR SCOTLAND | Adam Smith BSc, MSc, DPhil |
| Scottish HQ Administrator (p/t) | Irene Johnston BA |
| Head of PR & Education - Scotland (p/t) | Katrina Candy HND |
| Policy Officer Scotland | Gemma Davis MA |
| Senior Scottish Advisor & Scottish Game Fair Chairman | Hugo Straker NDA[1] |
| DIRECTOR OF ADVISORY & EDUCATION | Ian Lindsay BSc[2] *(until December)* |
| Head of Advisory | Roger Draycott[4] HND, MSc, PhD *(from December)* |
| Co-ordinator Advisory Services (p/t) | Lynda Ferguson |
| Field Officer – Farmland Ecology | Peter Thompson DipCM, MRPPA (Agric) |
| Head of Education | Mike Swan BSc, PhD[3] |
| Regional Advisor - East (p/t) | Roger Draycott HND, MSc, PhD *(until November)* |
| Regional Advisor - North East (p/t) | Henrietta Appleton BA, MSc *(until December)* |
| Game Manager – Rotherfield | Malcolm Brockless |

*[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; [4] Roger Draycott is also Regional Advisor for the East.*

# External committees with GWCT representation

| | | |
|---|---|---|
| 1. | BASC Gamekeeping and Gameshooting | Mike Swan |
| 2. | BBC Scotland Rural Affairs Committee | Adam Smith/Katrina Candy |
| 3. | BCPC Science and Environment Group | Alastair Leake |
| 4. | Bird Expert Group of the England Biodiversity Strategy | Nicholas Aebischer |
| 5. | Cairngorms National Park Land Management Forum | Gemma Davis |
| 6. | CFE Hampshire Co-ordinator | Peter Thompson |
| 7. | CFE Steering Committee (Natural England-led) | Alastair Leake |
| 8. | CFE National Delivery Group | Peter Thompson |
| 9. | Capercaillie BAP Group | David Baines/Adam Smith |
| 10. | Capercaillie Research Group | David Baines |
| 11. | Cheviot Black Grouse Group | Philip Warren |
| 12. | Cold Weather Wildfowl Suspensions | Mike Swan/Adam Smith |
| 13. | National Gamekeepers' Organisation Committee | Ian Lindsay |
| 14. | Conservation Grade | Peter Thompson |
| 15. | Cornish Red Squirrel Project | Nick Sotherton |
| 16. | Council of the World Pheasant Association | Nick Sotherton |
| 17. | Deer Initiative | Mike Swan |
| 18. | Deer Management Qualifications | Mike Swan |
| 19. | Defra Upland Stakeholder Forum & Raptor and Burning sub-groups | Adam Smith/ Dave Newborn |
| 20. | Defra Hen Harrier Action Plan Group | Adam Smith/Teresa Dent |
| 21. | English Black Grouse BAP Group | Phil Warren/Fran Atterton/David Baines |
| 22. | Environmental Panel of the Advisory Committee on Pesticides | Nick Sotherton |
| 23. | Farmland Biodiversity 'Toolkit' Partnership | Peter Thompson |
| 24. | Fellow of the National Centre for Statistical Excellence | Nicholas Aebischer |
| 25. | Freshwater Fisheries CEO Meetings | Nick Sotherton |
| 26. | Futurescapes Project: North Wales Moorlands | David Baines |
| 27. | Gamekeepers' Welfare Trust | Mike Swan |
| 28. | Hampshire Ornithological Society | Peter Thompson |
| 29. | Hares Best Practice Group | Mike Swan |
| 30. | Heather Trust Board | Adam Smith |
| 31. | Honorary Scientific Advisory Panel of the AST | Nick Sotherton |
| 32. | Honorary Scientific Advisory Panel of the S&TA | Nick Sotherton |
| 33. | IUCN/SSC European Sustainable Use Specialist Group | Nicholas Aebischer/ Julie Ewald |
| 34. | IUCN/SSC Grouse Specialist Group | David Baines |
| 35. | Joint Hampshire Bird Group | Peter Thompson |
| 36. | Langholm Moor Demonstration Project Board & three sub-groups | Teresa Dent/Nick Sotherton/David Baines/Adam Smith |
| 37. | Lead Ammunition Group and the Primary Evidence and Risk Assessment Working Group | Alastair Leake |
| 38. | LEAF Policy and Communications Advisory Committee | Alastair Leake |
| 39. | Marlborough Downs NIA Board | Teresa Dent |
| 40. | Marlborough Downs NIA Species Delivery Group | Peter Thompson |
| 41. | MESME Steering Group | Alastair Leake |
| 42. | Moorland Gamekeepers' Association | Dave Newborn |
| 43. | NE National Arable Systems Option Review Group | Peter Thompson |

| | | |
|---|---|---|
| 44. | NE National CAP Species Workstream Review | Peter Thompson |
| 45. | NGO Committee | Mike Swan |
| 46. | Norfolk CFE Local Liaison Group | Roger Draycott |
| 47. | North Wessex Farmland Bird Advisor Steering Committee | Peter Thompson |
| 48. | Perthshire Black Grouse Group | Patrick White |
| 49. | Pesticides Forum Indicators Group of the Chemicals Regulation Directorate | Julie Ewald |
| 50. | Purdey Awards | Mike Swan |
| 51. | Rivers and Lochs Institute Advisory Group | Adam Smith |
| 52. | Scotland's Peatland Working Group | Gemma Davis |
| 53. | Scientific Advisory Committee of the Office National de la Chasse et de la Faune Sauvage | Nicholas Aebischer |
| 54. | Scotland's Moorland Forum & sub-groups | Adam Smith |
| 55. | Scotland's Rural College Council | Adam Smith |
| 56. | Scottish Black Grouse BAP Group | Phil Warren/Adam Smith |
| 57. | Scottish Game Industry Snare Training Group | Hugo Straker |
| 58. | Scottish Biodiversity Strategy Science Groups | Adam Smith |
| 59. | Scottish Parliament Rural Policy Working Group | Gemma Davis |
| 60. | Scottish Government Biodiversity Strategy Upland Ecosystem Group | Adam Smith |
| 61. | Scottish Government CAP Reform Stakeholder Group | Gemma Davis |
| 62. | Scottish Land & Estates Moorland Working Group | Adam Smith |
| 63. | Scottish Moorland Groups (four regional groups) | Adam Smith/Hugo Straker |
| 64. | Scottish PAW (Wildlife Crime) Executive & Raptor and Training sub-groups | Adam Smith |
| 65. | Scottish Upland Co-ordination Group | Adam Smith |
| 66. | SNH Deer Management Round Table | Gemma Davis |
| 67. | SNH Species Reintroduction Forum | Adam Smith |
| 68. | SNH Scientific Advisory Committee Expert Groups | Nicholas Aebischer |
| 69. | South Downs Farmland Bird Initiative | Julie Ewald |
| 70. | South West Farmland Bird Advisor Steering Committee | Peter Thompson |
| 71. | Strathspey Black Grouse Group | Kathy Fletcher |
| 72. | Squirrel Forum | Mike Swan |
| 73. | Suffolk FWAG Advisory Committee | Roger Draycott |
| 74. | Tayside Biodiversity Partnership Farmland Ecosystem Group | Dave Parish |
| 75. | The ACP Environmental Panel | Alastair Leake |
| 76. | The ACP/COT Bystanders Risk Assessment Working Group | Alastair Leake |
| 77. | The Agri-Environment Stakeholder Group | Alastair Leake |
| 78. | The Bracken Control Group | Alastair Leake |
| 79. | The CAAV Agriculture and Environment Group | Alastair Leake |
| 80. | The Green Food Project | Alastair Leake |
| 81. | The UK Pesticides Forum | Alastair Leake |
| 82. | The UK Soil Management Initiative Executive Committee | Alastair Leake |
| 83. | Upland Hydrology Group | David Newborn |
| 84. | UK Avian Population Estimates Panel *(JNCC-led)* | Nicholas Aebischer |
| 85. | UK Birds of Conservation Concern Panel *(RSPB-led)* | Nicholas Aebischer |
| 86. | Welsh Bird Conservation Forum | David Baines/Philip Warren |
| 87. | Wildlife Estates Scotland Expert Panel | Adam Smith |
| 88. | Winning Ways for Wildlife (Hampshire group) | Peter Thompson |

*Key to abbreviations: ACP = Advisory Committee on Pesticides; AST = Atlantic Salmon Trust; BAP = Biodiversity Action Plan; BASC = British Association for Shooting and Conservation; BCPC = British Crop Production Council; CAAV = Central Association of Agricultural Valuers; CAP = Common Agricultural Policy; CFE = Campaign for the Farmed Environment; COT = Committee on Toxicity; Defra = Department for Environment, Food and Rural Affairs; EA = Environment Agency; FWAG = Farming & Wildlife Advisory Groups; IUCN = International Union for Conservation of Nature, JNCC = Joint Nature Conservation Committee; LEAF = Linking Environment And Farming; MESME =Making Environmental Stewardship More Effective; NE = Natural England; NGO = National Gamekeepers' Organisation; NIA = Nature Improvement Areas; PAW = Partnership for Action Against Wildlife Crime; RSPB = Royal Society for the Protection of Birds; S&TA = Salmon & Trout Association; SSC = Species Survival Commission; SNH = Scottish Natural Heritage.*