Review
of 2009

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

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Game & Wildlife CONSERVATION TRUST

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Review of 2009

Issue 41

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

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GAME & WILDLIFE CONSERVATION TRUST OBJECTS

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

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Council

as at 1 January 2010

Contents

© *Tom Hudson*

Chairman's report on 2009

by Mark Hudson

As I retire as Chairman in July 2010 this is my fourth and last comment in the *Review*.

It has been a great honour to serve as Chairman and a pleasure to meet members at our conferences, fundraising events and Game Fairs.

I shall take away three indelible impressions. The first is the breadth of research that the Trust carries out; on upland moor, lowland arable and pasture, the integration of farming and wildlife, and our work on trout and salmon. The second is the honesty of that research. Our scientists report what they find and avoid concluding anything beyond what science has shown. Thirdly, I have found that those employed by the Trust be they scientist, advisor, administrator or fundraiser, have a deep belief in the work of the Trust and many have made it their life's work. One of those is Dr Steve Tapper who has been with the Trust for almost 40 years as both research scientist and, more recently, Director of Policy. Steve will be retiring at the end of 2010 and we shall miss him.

As well as my duties as Chairman, I have worked alongside Steve Tapper explaining our policies to senior politicians and civil servants. This culminated last autumn in a meeting in central London for MPs, officials from Defra and Natural England and representatives from many environmental and wildlife organisations, to explain our views on the future of wildlife management. We stressed the importance of rewarding success in agri-environment schemes and simpler legislation to support the management of wildlife.

I want to close by thanking our members for all their support over many years and to ask you to continue that good work for the future. I also want to pay tribute to every staff member of the Trust and to commend to you the excellent director group, ably led by our Chief Executive, Teresa Dent.

Finally I acknowledge, with thanks, the work and advice of my fellow Trustees and wish my successor, Ian Coghill, well, in continuing to guide the Trust to greater success and influence.

© Morag Walker/GWCT

Chief Executive's report on 2009

by Teresa Dent

The end of the "noughties" sees the Trust helping to create a better conservation policy for our countryside, and using the "tools" of good game management, now proven to be beneficial, to do that. A gamekeeper will create suitable habitat, produce conditions that will allow game to breed successfully, and provide additional food in winter (or during the spring "hungry gap"), if needed. The aim is to improve productivity and survival so that the game species have a high population, thereby allowing a sustainable harvest (ie. shooting).

Recent research shows that these techniques are potentially as useful for the conservation of non-game species; the difference is that the population surplus will be used to create species recovery and dispersal, rather than an economic return. But the principles are the same.

This is an essential lesson that has come out of our Upland Predation Experiment at Otterburn. which looked at whether predator control (aimed at improving breeding success) was as beneficial to declining upland waders as it was to red grouse. It was, and the waders bred three times more successfully as a result. However, what really made us stop and think was the fact that the wader breeding success was so poor on the "control" plots where no predation control took place. It shows that for these wader species, simply providing good habitat is not enough; it helps explain why they are still declining away from grouse moors; and will surely make those responsible for conservation of declining species on a national scale think "we really do have something to learn from gamekeeping techniques".

We will be campaigning to get these game management "conservation" techniques taken up in national conservation policies for declining species. In October 2009, we hosted the launch of a discussion document *Restoring the balance,* which asked the question: "Why are our national conservation policies not working well enough?" This is covered in more detail in our policy report on page 7.

Ian McCall, our longstanding and much respected Director Scotland retired at the end of 2009. After 37 years, this was an event that took a bit of getting used to, so we were delighted when Ian said he would not abandon entirely either us or his clients and would remain as an advisory consultant for the foreseeable future.

Ian just about invented Scotland as far as the Trust is concerned. Having joined the staff at Fordingbridge as a trainee advisor fresh out of Wye College (London University) in 1972, he moved north as Director Scotland in 1985 at the time the Scottish Grouse Research Project was starting at Crubenmore under Dr Peter Hudson. Ian hit the ground running and, in his first year, organised both a Scottish Auction and Scottish Conference, now time-honoured and still very successful events. The first Game Conservancy Scottish Game Fair followed hot on their heels and that, as a testament to Ian's commitment and achievement, is now a three-day event with a record attendance of 36,106 in 2009. Alongside all this Ian continued to provide his numerous clients with expert and wise advice, as well as helping his wife, Kathleen, run their small family farm. It is perhaps no surprise therefore that a slightly early retirement for Ian began to feel attractive to both of them!

An immensely modest man, I know Ian would want me to thank all the members, volunteers and advisory clients in Scotland whose support over many years made it possible for him to do the enormously valuable job he did for the Trust.

Adam Smith, previously our Policy Officer in Scotland, has strengthened his role in Scotland by taking over Ian's responsibility as Scotland Director. There are a number of policy challenges looming in Scotland and Adam is very well placed to deal with those on behalf of the Trust and our members.

In April 2009, we opened a new "Salmon and Trout Research Centre" at East Stoke near Wareham in Dorset. We took on the salmon research team there and combined them with our existing brown trout research team. Research on salmon has been taking place at East Stoke uninterrupted since 1968, but the government-funded Centre of Ecology and Hydrology (CEH) had decided, as part of a national reorganisation, to pull its team out of East Stoke. This would have meant the research coming to a halt and the team approached us to see if we could help. Trustees decided that we should take it on as too much would be lost otherwise; research and data that will be of great benefit to salmon conservation and to our members and supporters. A full report is given on page 66.

It has been a challenging financial year and we are immensely grateful to our members, supporters, volunteers and other donors, funders and sponsors whose generosity has made it possible to continue our valuable work. I would also like to thank our wonderful staff who have pulled out all the stops and have somehow done "more for less".

Researchers at work. © Peter Thompson/GWCT

Educating policy shapers in traditional and novel land management solutions is essential; Scotland's Moorland Forum visit the Langholm Demonstration Project in June 2009. © Adam Smith/GWCT

Our policies

by Stephen Tapper and Adam Smith

Our members have long appreciated that our science is applied science – very little of it is theoretical or academic. We aim to improve wildlife conservation in the countryside. Often our results can be directly applied by farmers and gamekeepers, and equally often it provides a basis for parts of conservation schemes run by Natural England or Scottish Natural Heritage. Today, wildlife management is regulated by many well-intentioned laws that, although they have wildlife protection at their heart, often restrict management to the point where the conservation of game is difficult. This jeopardises the other wildlife that flourishes on the same ground. There is no better example than the several species of breeding wader that thrive on grouse moors.

When we lobby government on these matters, we need to do so with scientific evidence, not anecdote. This was the case with our Upland Predation Experiment, recently published in the *Journal of Applied Ecology*. This aimed not to improve gamekeeping or the management of grouse, but to test the utility of predator control for conservation. This research therefore had an unashamedly public-interest policy objective.

In the lead up to the Westminster and Holyrood elections, we are consolidating our recommendations to policy makers around three main themes.

1. Agri-environment schemes should support success. At the moment farmers are largely paid for providing wildlife habitat. This may not be enough for some species because predator control and supplementary feeding may be required too. We suggest additional payments to land managers if they actually succeed in supporting wildlife.

2. Make wildlife management easier so that private investment in game conservation can realise more of its potential. Our current legislation is a restrictive tangle of statutes that extend back into the mid-19th century. We desperately need to replace them with something simpler and more enabling.

3. Wildlife needs to be managed to protect land-use and deliver public benefits or ecosystem services. For example, government and its agencies no longer give enough priority to organised pest control, and have instead rather over-emphasised popular biodiversity causes like species re-introductions.

We have been promoting these ideas to politicians and other conservation groups at events, briefings and with literature since the summer of 2009.

"High quality research, investigation and debate is the hallmark of a successful organisation and is indeed the hallmark of the Game & Wildlife Conservation Trust. This organisation and the way it operates points to a prosperous, rural Scotland." Michael Russell MSP. © Scottish Natural Heritage

© *Peter Thompson/GWCT*

Delivering UK agri-environment schemes

by Ian Lindsay

Over the past two decades, our research has been central to the development of the UK's agri-environment schemes. Arising from our research on grey partridges and other farmland birds, today, over 60% of England's Entry and Higher Level Stewardship arable options, including beetle banks, conservation headlands and wild bird food crops, are based directly on our work.

For farmers 2009 saw an important step through the launch of the Campaign for the Farmed Environment (CfE), a voluntary initiative led by the CLA and NFU, to increase significantly the uptake and improve the effectiveness of these schemes in England. This, in part, has been driven by the fact that, to date, despite increased adoption of these schemes, farmland birds have continued to decline, pointing to a need for improved delivery in a way that is capable of benefiting wildlife. In addition, this voluntary initiative seeks to avoid the need for further statutory cross-compliance measures imposed on the farming community.

The Trust is a national partner of the CfE and its advisory staff played a key role at both national and regional level in designing and launching the scheme. Peter Thompson and Alex Butler now act as regional campaign co-ordinators and 2010 will see an increase in our involvement in the direct delivery of agri-environment schemes to farmers in England. In addition to CfE, 2009 saw the launch by Natural England of a complementary initiative aimed at providing funded advice to farmers to maximise the benefits of the Entry Level Stewardship Scheme to key declining farmland species. In partnership with ADAS, our advisory team will be providing advice to farmers under this scheme.

Long experience of game management principles, including our own demonstration projects at Royston and Loddington, strongly suggests that successful recovery of species such as the grey partridge and brown hare depend on careful targeting of key agri-environment prescriptions. Accordingly, a key part of this new initiative and one on which our advisors can lead, is to provide specific advice on the selection, siting and management of prescriptions capable of delivering measurable species recovery. This puts us at the heart of a national initiative, which builds on our existing game management advice, grey partridge groups and other training opportunities.

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Membership and marketing

by Andrew Gilruth

The loyal support of our members throughout the year has, once more, been invaluable to us on three key levels. Firstly, through providing valuable income to conduct vital research. Our work is crucial at not just a local level but increasingly at a national one. A recent parliamentary committee has highlighted that the nation's approach to conservation isn't working well enough and we need a new one.

Secondly, our members act as ambassadors for our practical solutions. This has ensured that game conservation principles continue to play an essential part in the conservation of our wildlife. One of the reasons for this is our focus on breeding success, in order to achieve greater abundance. Although this abundance concept is embedded in every member's mind, it is not universally understood. Our members came to listen and debated the role game conservation principles will play in the rebuilding of threatened species at talks and events from the GWCT Scottish Game Fair at Scone, to the GWCT Members' Conference in London.

Lastly, this uplift in participation from members has helped us to ensure that our voice is heard around the UK. Our message is quite clear: we need to end the nation's concentration on subjective, emotive issues and start focusing on objective researched solutions that achieve greater breeding success. Without this focus, local declines may become local extinctions. There is evidence and indeed supporting reports from members that this is happening now. Members continue to send us data, from annual gamebag records to partridge counts, which show that game management principles not only work but, more importantly, they are the basis of effective nature conservation in a working countryside.

We need you, but the nation needs both of us if game and wildlife are to thrive for future generations. Thank you.

Report by the Director of Research

by Nick Sotherton

Each year our *Review* is a shop window for the research department. It is a mixture of articles describing research projects that are nearing an end and yearly updates on some of the routine work that we do.

So, for example, we present the 2009 data for July/August red grouse count data from England and Scotland and information on population trends for black grouse and capercaillie. In this way, our *Review* becomes an archive of information on game species abundance (Partridge Count Scheme), gamebags (National Gamebag Census) and the predators of game. These data sets are unique and extremely valuable because they place the GWCT in a strong position to advise government, its advisors and the statutory bodies.

We completed three of our major projects in 2009, and these are reported in full in this *Review*. The first, our demonstration of grey partridge management on farmland near Royston, has been a great success (see page 28). It brings together the three essential elements of wild bird management, namely predator control, adequate winter (seed) and summer (insects) food and habitat creation (nesting cover, etc) to produce a population well in excess of our Biodiversity Action Plan target and one that produced a shootable surplus. On the River Monnow in Herefordshire (see page 62) a combination of habitat improvement and mink removal, made possible by the use of our mink rafts, enabled us to reintroduce water voles successfully onto the river system after an absence of over 15 years. While the river is mink-free, the water voles are doing well. However, with both the grey partridges at Royston and the water voles in Herefordshire, there is uncertainty regarding their future because, now that our funding has come to an end, our benign management ceases. With regard to the water voles, we are in discussion with other conservation organisations about carrying on with the work, but in the absence of funding, who knows what will happen?

Finally, after 14 years, the North Pennines Black Grouse Recovery Project ends in early 2010 and we report its important findings here (see page 40). The project met and exceeded the Biodiversity Action Plan targets for black grouse and met them early – quite an achievement for our upland team and the envy of those working on grey partridges. Over 70% of all black grouse leks are associated with grouse moors where gamekeepers actively manage the predators of red and black grouse.

We are continuing our commitment to predator research, both the quantifica-

Above: insect traps used in one of our farmland studies. © Sophia Gallia/Natterjack Publications tion of the impact of predators, and predator removal and the development of new methods of trapping. Watch out for reports on these issues in future *Reviews*.

In this *Review,* we begin to tell the story of lapwings on our doorstep here on the River Avon in Hampshire (see page 20). Using student power (why not, it's cheap!), following the fate of nests is proving to be fascinating. In the absence of predator control, we are observing very high levels of nest and chick loss, primarily to corvids. If government policy is to be evidence-based then data such as ours will be invaluable.

The highlight of 2009 was the acquisition of the salmon research team at East Stoke in Dorset, which would have otherwise have closed as part of the restructuring of the Centre of Ecology and Hydrology. Their first report is on page 66. In future *Reviews* we will report on the annual salmon run up the River Frome to continue our theme of the *Review* as an archive and to complement the 35 years of data on salmon in the river we now have access to.

Finally, the group published over 40 scientific papers in 2009, including the publication and defence of two PhD theses from research students working in collaboration with the Trust.

Much of our research involves radio-tracking.
© Peter Thompson/GWCT

Producing parent-reared grey partridge broods

The pens have two interconnecting parts. On the right is the rough area, and on the left, the sunny short-grass area where the feeder and drinker are located. © Chris Davis/GWCT

KEY FINDINGS

- Parent-reared broods can be produced either on the rearing field or at release locations.
- Released birds need good habitat and protection from predators if they are to thrive.
- Most arable farms could have at least one such covey of grey partridges to help restore wild stocks.

Chris Davis

Bringing back grey partridges to land where they have long been absent is a challenging business and must depend on re-stocking. If the land to be re-stocked already contains a few wild grey partridges then it is best to follow our published guidelines for fostering broods of hand-reared birds to mature wild pairs (see *Review of 2006*). However, on land where there are no wild birds we can't do this, so we need a system that involves the release of both parents and young.

To start with, it is essential that the land around the release sites has good habitat and there is some predator control in place to protect the, initially, rather naïve birds. Ideally, the brood pens should be located close to the point of final release. The corner of a field planted with brood-rearing cover is a good place.

Naturally-paired birds should be selected from the rearing field and placed in the breeding pens as early in the season as possible and certainly by the end of March. Both farm-reared and parent-reared adults have been used.

The pens measure 20' x 10' and are divided into two (10' x 10') inter-connecting sections. One section is managed as a rough grass nesting area which provides tussocky dead grass to nest in and some small mown 'rides' where chicks can run about. The remaining section of the pen is managed as a grass sunning area and should face south. This section should also include a gate for the keeper to get in and out of the pen. The grass in this area should be kept short and the birds can tolerate a little disturbance if they can hide in the rough grass section while the keeper is present. The sunning area is the place for the feeder, nipple drinkers and grit box. It should also contain some shelter and a dusting area, which may be a grass sod turned over to leave bare earth. Hygiene is paramount for all feeding and drinking equipment.

Surrounding the site with an electric fence will offer some protection from badgers and foxes. Make sure rats are controlled and, of course, remove any traps before the partridges are let out. Overhead wires can be strung to prevent birds of prey from sitting on the pens. Management consists mainly of a daily check, but bear in mind that when the hen goes broody she may be impossible to spot in the cover, although the cock is often seen 'on patrol'.

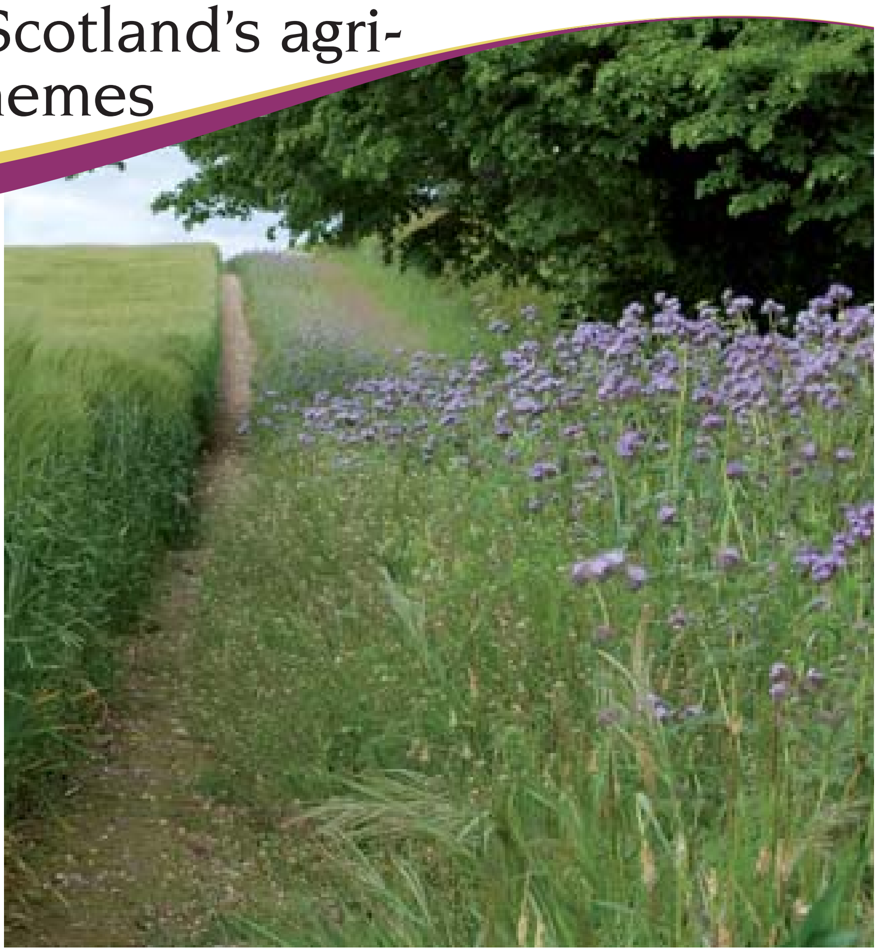
Feeders need to be topped up and, although water must be supplied, most birds will take their moisture from the dew and greenery in the pen. The daily round allows the keeper to estimate the approximate date of brooding; this is important as there should be suitable chick feed provided when the chicks first visit the feeder. In practice it is best to 'wean' the adults onto chick crumbs early so that when the hen leads the young to the feed it is chick crumbs that are available.

The brood may be moved for release, but it is better if the pen is at the release point so it merely requires the gate to be opened to allow the brood to wander off and, when they want to, return and take the supplementary feed.

We need to test this technique further, but it would be good if most arable farms could have at least one covey of grey partridges so that truly wild stocks can build up over time.

Penned partridges sunning themselves.
© Chris Davis/GWCT

Biodiversity in Scotland's agri-environment schemes



A margin, designed for brood-rearing alongside a barley crop. © Peter Thompson/GWCT

KEY FINDINGS

- Farms with agri-environment agreements were richer in biodiversity than non-scheme farms.
- However, there was no evidence that the schemes themselves contributed to this difference, rather that farms rich in biodiversity were targeted during the application procedure.
- We could find no differences in biodiversity between Organic Aid Scheme farms and conventionally-farmed non-scheme farms.

David Parish

We have investigated the effects on biodiversity of agri-environment schemes in Scotland. In collaboration with the Norwegian Computing Centre and the Royal Agricultural College Edinburgh, and led by the environmental consultants Scott Wilson, we looked at the Rural Stewardship Scheme (RSS, the main scheme active at the time), the Countryside Premium Scheme (CPS) and the Organic Aid Scheme (OAS).

We paired farms that were in schemes with farms that were not, taking care to have pairs distributed around Scotland. As the CPS had closed to applicants before the start of the project, we were able only to survey CPS farms once to give a 'snapshot' of their biodiversity (105 pairs of farms). For RSS we were able to survey farms before and after they entered the scheme (80 pairs). The repeat surveys were three years later. We surveyed the OAS farms using a combination of these approaches because there were too few new entrants to allow the same approach as for the RSS (15 pairs visited twice; 22 pairs visited once). On each pair of farms, we surveyed

Figure 1

Change in bird counts over three years on farms within RSS and OAS compared with paired non-scheme farms

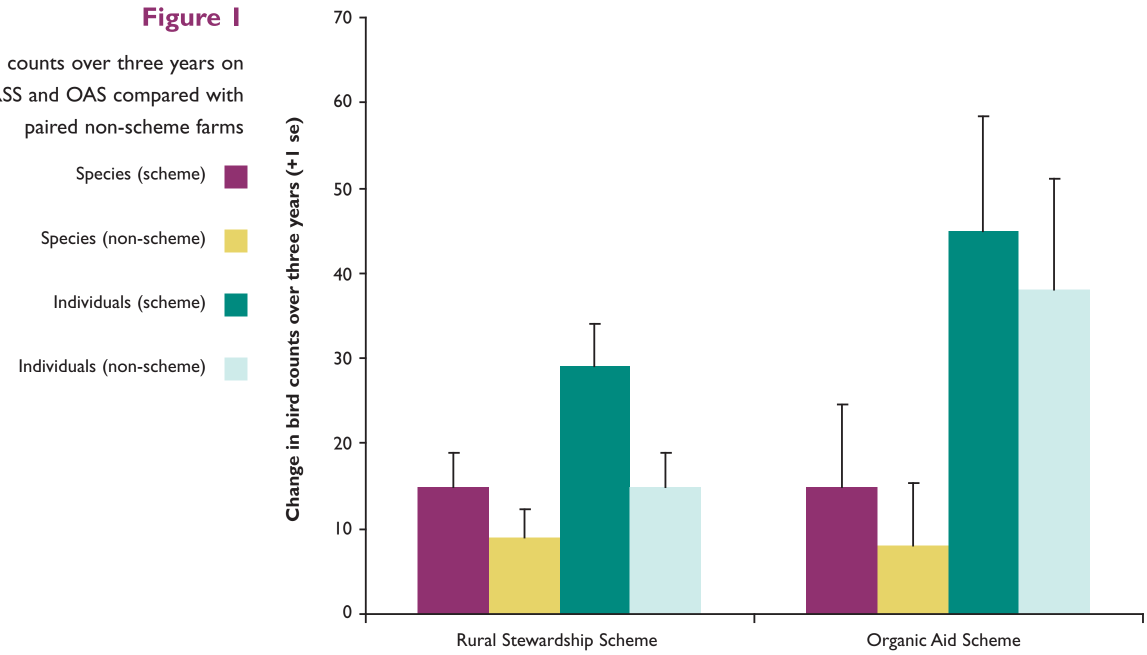


TABLE 1

Bird counts during the first count (baseline) for all species

Scheme	Number	Number of species (mean ± se) Scheme	Non-scheme	Number of individuals (mean ± se) Scheme	Non-scheme
Countryside Premium Scheme	105	23.2 ± 0.7	20.2 ± 0.7	140 ± 10	107.6 ± 6.5
Rural Stewardship Scheme	80	19.1 ± 0.7	17.3 ± 0.7	107.7 ± 8.3	85.9 ± 7.2
Organic Aid Scheme (once)	22	23.6 ± 1.8	20.8 ± 1.5	127.8 ± 14.8	116.7 ± 13.9
Organic Aid Scheme (twice)	15	19.9 ± 1.4	17.9 ± 1.7	82.7 ± 8.2	82.1 ± 10.5

vegetation, invertebrates and birds over the course of two visits, one in early spring and one in the summer. Some of the results for birds are presented here.

We found that farms entering the RSS were already richer in biodiversity than the non-scheme farms (see Table 1). For example, there were 33% more birds of 13% more species on the RSS farms. Over the course of three years, biodiversity increased on both the RSS (individual bird numbers by 29%; number of species by 15%) and non-scheme farms (15% and 9%) to a similar extent (see Figure 1). Furthermore, OAS farms showed increases in biodiversity over time, but again this was not different to the conventionally-farmed non-scheme farms (see Figure 1). In fact, we could find no differences in biodiversity between the OAS and non-scheme farms, although sample sizes were small here. CPS farms had on average 30% more birds of 15% more species than the non-scheme farms, but as this was from a 'snapshot' survey we cannot say whether CPS farms were richer in birds before they entered the scheme. Certainly for the RSS it seems that the procedure for selecting farms for entry into the scheme identified farms with more birds (and other wildlife) than average, but the scheme management plans did nothing to increase biodiversity further.

ACKNOWLEDGEMENTS

This work was funded by the Scottish Government Rural Payments and Inspections Directorate.

Prescriptions in Scotland's Rural Stewardship Scheme include cropped machair, which is a feature of Hebridean landscapes, such as this on North Uist. © Sophia Gallia/Natterjack Publications

Game management and hedgerows

Hedges are an integral part of the farmed landscape. © Roger Draycott/GWCT

KEY FINDINGS

- On average the total length of hedgerow per 100 hectares on farms with game shoots was 27% higher than on farms with no game shoot.
- Hedgerow height and width were similar on farms with and without game shoots.
- Hedge banks were 24% wider on farms with game shoots.

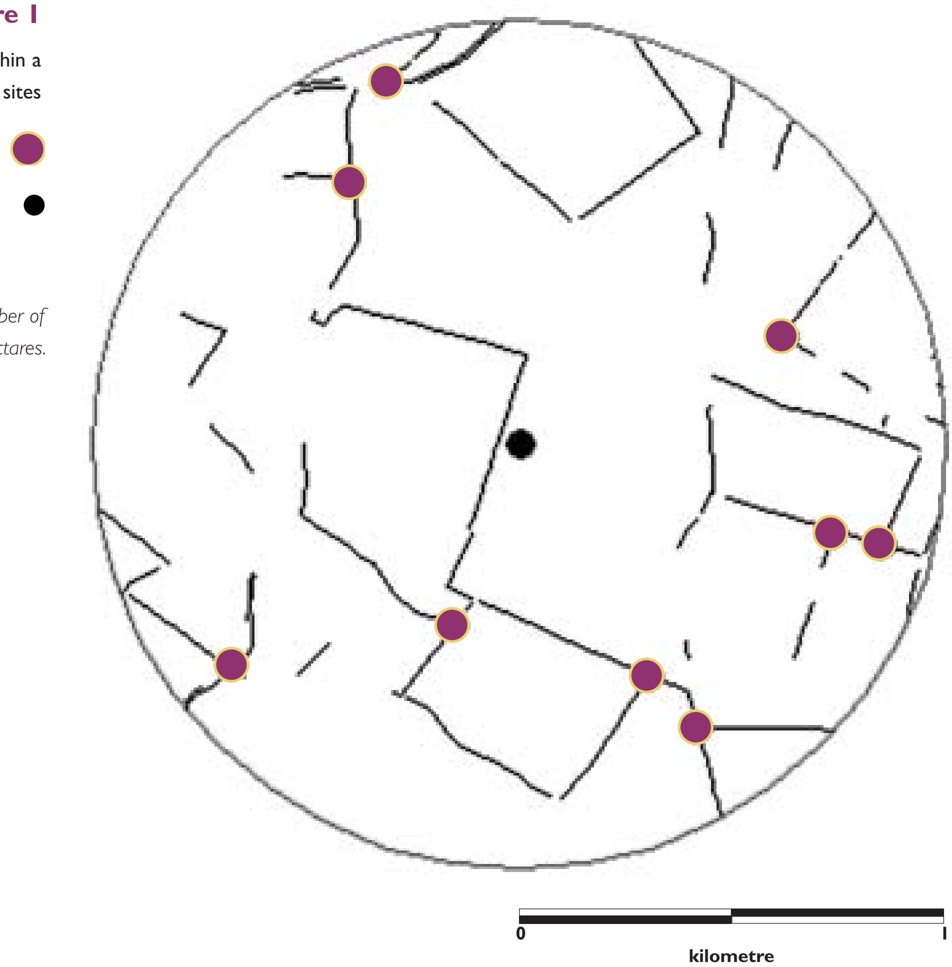
Roger Draycott
Andrew Hoodless
Matt Cooke

Hedges are an integral part of the farmed landscape and are important habitats for many birds and other wildlife. Game managers have long recognised the importance of hedges for gamebirds, both in the nesting season for wild birds and as dispersal routes from woodland release pens for reared pheasants in late summer. Previously (see *Review of 2006*, pages 68-69) we reported on the effects of pheasant releasing on the botanical diversity and structural characteristics of individual hedgerows. In this article we focus on the management of hedgerows and their extent and connectivity in the wider countryside. We wanted to know what effect game management had at the landscape level and whether shooting properties tend to have a greater density of hedges which will benefit other wildlife; this is important as farm and game management tends to be focused over a whole farm rather than in specific areas or on individual hedgerows.

To do this we analysed data from the same 150 sites we surveyed in 2006. This sample consisted of 90 sites in Hampshire and 60 in East Anglia. Of these, 97 were

Figure 1

Hedgerow network and connectivity within a one kilometre radius of study sites



Connectivity was measured as the number of hedgerow connections per 100 hectares.

TABLE 1

Comparing hedgerow characteristics on farms with and without game management

Factor	Farms with game management mean ± se (97 sites)	Farms without game management mean ± se (53 sites)	Significance of difference
Hedge height (cm)	300 ± 8	321 ± 11	NS
Hedge width (cm)	305 ± 9	320 ± 14	NS
Hedge bank width (cm)	144 ± 5	116 ± 5	**
Hedgerow trees (no/100m)	2.3 ± 0.3	2.1 ± 0.3	NS
Woody shrub species (per 100m)	4.6 ± 0.1	4.5 ± 0.2	NS
Hedge length (m/100ha)	2,032 ± 137	1,565 ± 125	***
Intersections (no/100ha)	1.6 ± 0.2	1.0 ± 0.2	NS
Time since last cut (years)	1.7 ± 0.1	1.8 ± 0.1	NS
Gappiness (%)	6.4 ± 1.1	10.4 ± 2.3	NS
Hedges with planted conservation margins on both sides of hedge (%)	23	11	*

** = P<0.05, ** = P<0.01, *** = P<0.001, NS = no significant difference.*

on pheasant shoots whereas the others were on farms where there had been no pheasant shooting for at least 25 years. Using a combination of Google Earth maps and digital mapping software, we were able to quantify the amount of hedgerow within a one-kilometre radius of the hedgerows surveyed in 2006. We were also able to measure the level of 'hedgerow connectivity' (the higher the degree of connectivity the better for wildlife) as the number of hedgerow intersections per 100 hectares (see Figure 1). We also re-analysed our existing data to compare structural and management characteristics of hedges on game and non-game farms.

We found that hedgerow characteristics were similar on farms with and without game shoots (see Table 1). However, on game shoots, hedgebanks were 24% wider and were twice as likely to be bordered by either a planted grass margin or game or wild bird cover (see Table 1). We found that on farms where game management was undertaken, there were on average 27% more metres of hedge per 100 hectares than on farms where there was no game management (see Table 1). There was no difference in the level of connectivity between game and non-game managed farms.

Many hedgerows were lost between 1945 and the 1980s; we believe these results show that the hedgerow network has been retained to a greater extent on game farms than on non-game farms and that hedgebanks are deliberately left wider on game shoots to provide nesting cover for gamebirds. Hedgebanks provide habitat for a wide range of wildlife including insects, songbirds and small mammals so it is likely that they benefit from the management of the hedgerow network on game shoots too.

Hedgerow networks seem to have been retained better on shoots than on farms without a game interest. © Sophia Gallia/Natterjack Publications

Origins of wintering woodcock: initial findings

Only 17% of woodcock wintering in Britain also breed here. © Andrew Hoodless/GWCT

KEY FINDINGS

- Stable-isotope analysis can tell us the relative proportions of British- and foreign-bred woodcock that winter in different parts of Britain and Ireland.
- Our analysis suggests a mixed population at wintering sites, with 83% of birds originating outside the British Isles.
- The proportion of Scandinavian birds in Scotland, Wales and Ireland appears to be higher than in southern England.

Andrew Hoodless
Adele Powell

Our woodcock research aims at better conservation of the species. At a European scale we need to understand the status of different breeding populations, their migratory routes, breeding success and winter survival. The main emphasis of our current work is woodcock migration. New technology makes gathering this information much more feasible.

We have analysed stable isotopes on almost 1,000 wing feathers to find out the hatching and moulting locations of woodcock wintering in Britain and Ireland. The technique relies upon the fact that isotopes in a bird's food are locked into the keratin of its feathers until the next moult – typically a year later for the flight feathers. We aim to determine the proportions of British- and foreign-bred woodcock in mid-winter and to find out where the foreign migrants come from. Hydrogen isotope values in woodcock feathers show good correspondence with known geographical isotope patterns in rainwater across Europe.

Our preliminary results suggest that approximately 17% of woodcock shot in Britain and Ireland are British breeders, 51% are from Russia and the Baltic states and 32% are from Scandinavia and Finland. Variation in the isotope values at each winter site suggests mixed populations from many different breeding areas. However, the proportions of woodcock from these three broad breeding areas differed across five wintering regions of Britain and Ireland. Woodcock from Russia and Belarus must travel to Britain across a broad front, because each of the five wintering regions in the UK had a similar proportion of birds with isotope values typical of this region. However, Scandinavian birds appear more restricted to the north and west, with higher proportions occurring in south-east Scotland, Wales and the west of Ireland than in Norfolk and Cornwall. This is in agreement with ring recoveries, which show birds from Norway and Sweden passing through Scotland on route to Ireland.

In 2010 we will focus on collecting more samples from known breeding areas and investigate the potential of trace elements as additional markers, refining the interpretation of the isotope values, all of which should lead to greater accuracy in determining woodcock origins. We also plan to use miniature geolocators on woodcock wintering in Britain and France, in collaboration with French scientists. These will give

A woodcock wearing a geolocator, used to track its migratory movements. © Andrew Hoodless/GWCT

ACKNOWLEDGEMENTS

We are grateful to the Countryside Alliance Foundation, Shooting Times Woodcock Club, Natural Environment Research Council and contributors to the Woodcock Migration Appeal for funding.

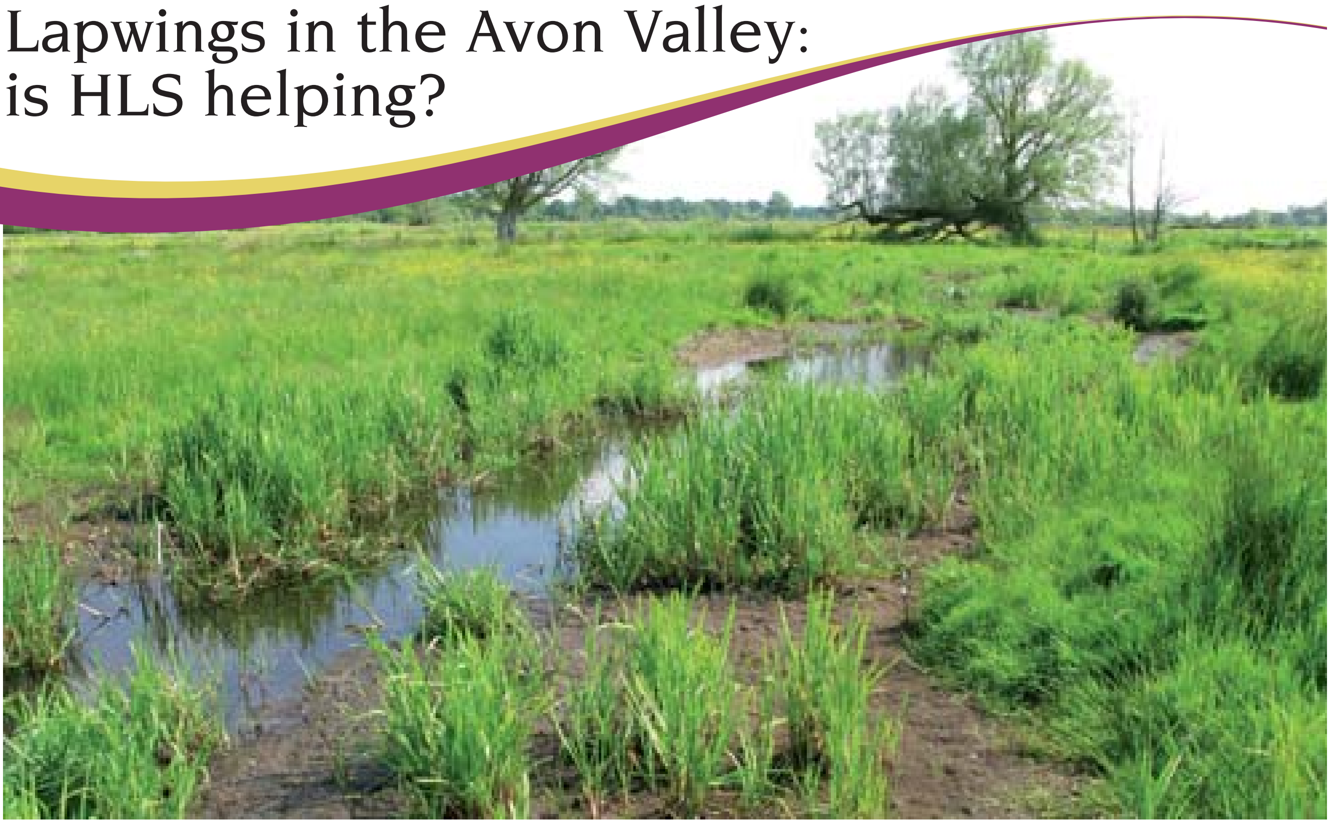
We would also like to thank everyone who has contributed feathers for stable-isotope analysis and those counting woodcock each spring.

us information on the timing and routes of individual birds travelling to and from their breeding grounds.

We remain unsure about the status of breeding woodcock in Britain. Despite the fact that our 2003 breeding woodcock survey recorded far higher numbers than previously estimated (see *Review of 2007*), it gives us no information on whether breeding numbers have declined. Since 2003 we have counted roding woodcock annually at about 40 sites and the trend in numbers in these woods has been stable. However, these sites are not a random sample and many have higher than average woodcock densities. Hence, we plan to repeat the national survey in 2013.

Analysis of woodcock wing feathers enables us to find out where woodcock were born. © Andrew Hoodless/GWCT

Lapwings in the Avon Valley: is HLS helping?



© Andrew Hoodless/GWCT

KEY FINDINGS

- Lapwing breeding success in the Avon Valley is low and below that needed to maintain a stable population.
- Habitat improvements through HLS may not be sufficient to reverse the decline.
- Predation of nests and broods may need to be addressed in some circumstances.

Andrew Hoodless

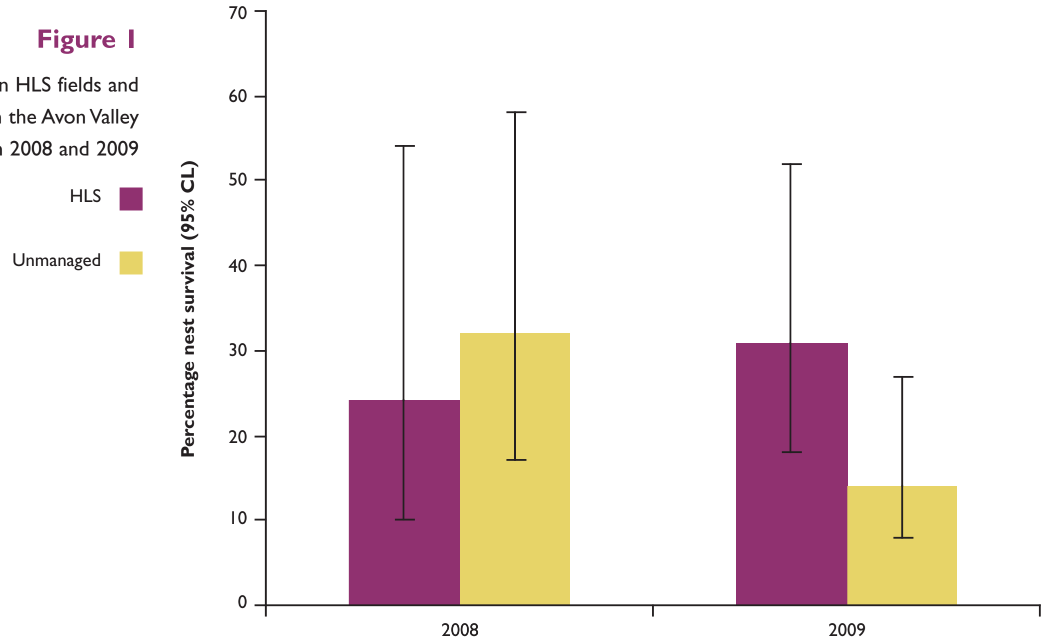
Numbers of lapwings breeding in the Avon Valley declined by 64% between 1982 and 2002. Defra's Higher Level Agri-Environment Scheme (HLS) aims to increase water levels, maintain appropriate sward heights and combat scrub encroachment to improve habitat in the valley. However, there has been no assessment of whether these measures are increasing breeding success and succeeding in stabilising or increasing lapwing numbers. Recent studies in the Netherlands, on RSPB reserves and by us at Otterburn have shown that high predator densities can lead to poor breeding success. However, predation rates vary between sites and years, and predation may be just one of several factors that need to be addressed to achieve lapwing population recovery.

We have worked in the Avon Valley since the mid-1990s and, in 2007, we began assessing lapwing productivity. Our aim has been to see whether lapwings breed more successfully on fields where the sward and water levels are managed under HLS compared with unmanaged fields, and to determine how this affects the lapwing numbers in the valley. We also want to investigate the relationships between lapwing nest and brood survival, predator densities and habitat quality.

We counted breeding pairs in April and May using standardised surveys, and made repeated visits to determine the proportion of pairs hatching chicks and fledging a

Figure 1

Nest survival rates on HLS fields and unmanaged fields in the Avon Valley in 2008 and 2009



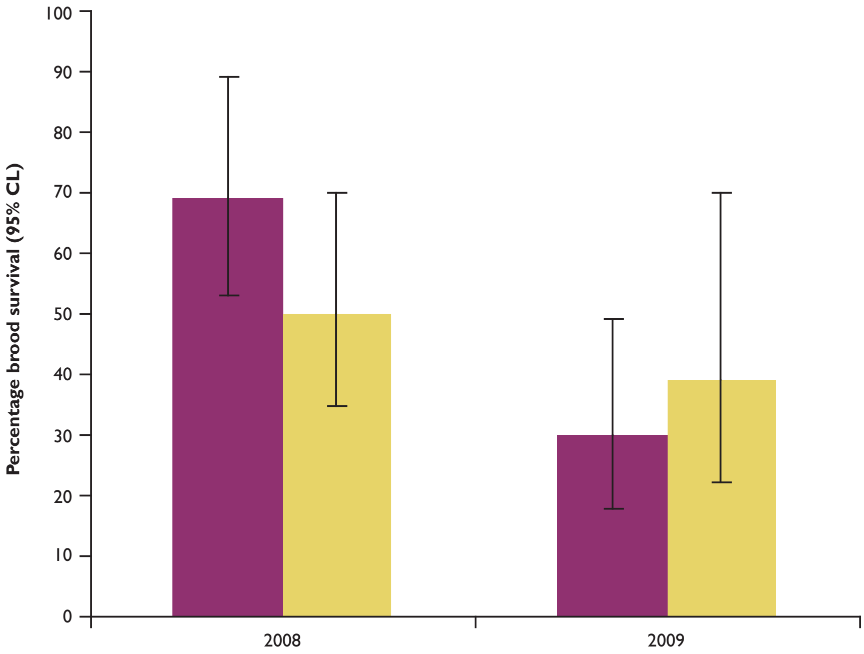


Figure 2

Brood survival rates on HLS fields and unmanaged fields in the Avon Valley in 2008 and 2009

HLS

Unmanaged

brood. In 2008 and 2009 we monitored samples of nests and broods to estimate survival rates. We recorded the abundance and activity of potential avian predators over lapwing nesting fields during timed counts.

Typical lapwing breeding densities each year were 10.9-18.5 pairs per 100 hectares. On average, densities were higher on fields managed under HLS than on unmanaged fields (26.1 ± 6.8 versus 11.5 ± 1.6 pairs per 100 hectares). During 2007-2009, the overall proportion of lapwing pairs that hatched a clutch of eggs varied between 38% and 50%. The proportion of pairs that raised at least one chick to fledging was 15-19%. Average productivity was low in all three years, at 0.36, 0.52 and 0.27 fledged young per pair. Current productivity is below that required for a stable lapwing population, which has been estimated at 0.83 young per pair. Brood survival was lower in 2009, with less rainfall in May and June than in 2008. Differences in nest (see Figure 1) and brood survival (see Figure 2) rates between fields managed under HLS and unmanaged fields varied between years. Overall, the probability of a nesting attempt producing at least one fledged chick was very low on both managed and unmanaged fields.

Our data suggest that a lapwing nest is more likely to hatch in a field containing other lapwings, but is less likely to hatch in a field with high numbers of black-headed gulls. Features such as field size, sward height and livestock density had little influence on nest survival. Brood survival was higher in fields with shorter swards and low sighting rates of buzzards and grey herons. In 2010, we will look at the circumstances in which predation is important. We hope to find ways of reversing the downward trend in lapwing numbers in the valley.

A predated lapwing egg. © Andrew Hoodless/GWCT

Three recently-hatched lapwing chicks, still in the nest. © Andrew Hoodless/GWCT

ACKNOWLEDGEMENTS

This study was funded by Natural England in 2009. We are grateful to all the landowners and farmers who provided access for this work.

Imprinted pheasant chicks and insects

Successfully imprinted chicks follow their mother.
© Rufus Sage/GWCT

During their first few weeks, pheasant chicks need a high proportion of insects in their diet for growth and feather development. The use of pesticides has reduced insect availability for many farmland birds. In this study we used human-imprinted pheasant chicks to investigate what insects pheasant chicks find in different arable habitats. The advantage of using the chicks themselves as a sampling method is that it takes into account chick behaviour and food preferences.

During 2007, 2008 and 2009 we ran trials with imprinted chicks on one of Europe's premier wild pheasant shoots, the arable Seefeld Estate in Austria. The reliably dry warm summers and wild game habitat management on the estate suited the aims of these trials. Immediately upon hatching in incubators, pheasant chicks were imprinted onto their human 'mother'. This involved eight to 10 hours a day brooding the chicks and calling softly to them to persuade them to adopt their surrogate mother. Of these pheasant chicks, 86% were successfully imprinted.

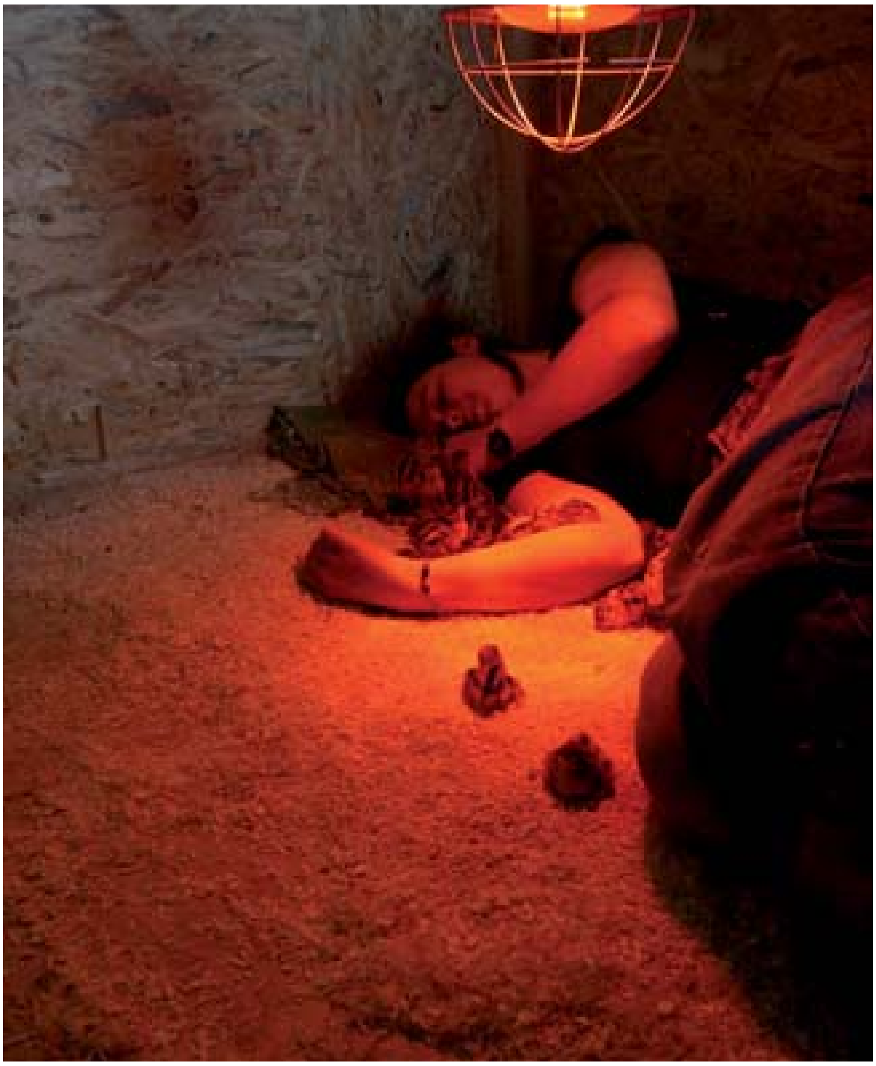
Field trials started at five days old; I chose four chicks to make up a 'brood' which I slowly led along a 10-metre transect within a single habitat. At the end of the 30-

KEY FINDINGS

- I successfully imprinted myself as the 'mother' of broods of pheasant chicks by brooding newly-hatched chicks.
- It was then possible to run these chicks in crops, watch them feeding and then collecting them to study their diet.
- The pheasant chicks ate ants, beetles and insect larvae in both arable crops and set-aside, but these were much more abundant and nutritional in the set-aside.

Gwen Hitchcock

Foraging practice for a pheasant chick.
© Gwen Hitchcock/GWCT



Imprinting pheasant chicks is tiring work!
© Stefan Knittel/GWCT

minute trial, I called the chicks back to me, collected them up and placed them in a pen so that I could collect the chick droppings the following day. I analysed the droppings to identify what insects they had eaten.

Over three-quarters of the diet comprised Hymenoptera (in particular ants and sawfly larvae), beetles and insect larvae (all types); whereas bugs and spiders made up less than a fifth. Chicks foraging in set-aside, a mixture of grassy natural regeneration and sown foraging cover, had access to abundant insects and ate a high proportion of ants (see Figure 1). Chicks foraging in arable crop fields, however, consumed more bugs, especially aphids, which are known to be of low nutritional value. Set-aside also provided good cover from predators.

Our findings support the notion that set-aside areas are considerably more valuable than arable crop areas for pheasant brood-rearing even where the climate may benefit insect populations in crops. These set-aside areas provide better foraging habitats and provide important shelter from both predators and farming activities.

Pheasant chicks have an innate foraging behaviour.
© Gwen Hitchcock/GWCT

ACKNOWLEDGEMENTS

With thanks to BBSRC, Imperial College London and especially Seefeld Estate in Austria for hosting the study.

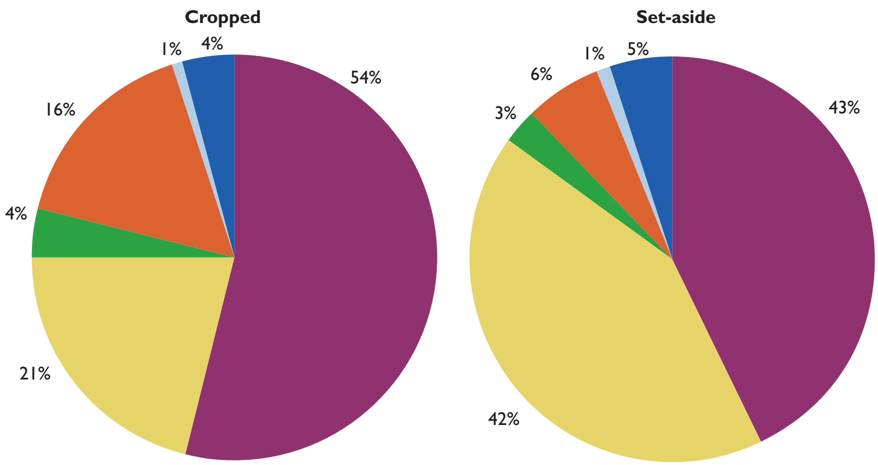


Figure 1

Diets of chicks feeding in arable crop fields and set-aside areas

- Coleoptera (beetles)
- Hymenoptera (ants/sawflies)
- Larvae (eg. ants, sawflies)
- Hemiptera (bugs)
- Araneae (spiders)
- Other

Partridge Count Scheme

Wild grey partridges using a cover crop.
© Peter Thompson/GWCT

Our Partridge Count Scheme has been leading the way in research-led conservation for many years. By contributing to the scheme, land managers are responsible for habitat provision and are involved in monitoring its effect, getting to see first hand the results of their work. We put these results in context by providing an individual analysis of each count. This allows participants to adapt their management and conserve partridges better. In 2009 we examined the effect of agri-environment schemes on grey partridges from 2005 to 2008 and the results can be seen on page 26. Here we present the results from the spring and autumn counts of 2009.

Despite the snowy weather in February 2009, counting began with an above-average dry sunny March (the exception being a wetter northern Scotland). We had a reduced number of counts returned, down to 825 from 877 in 2008 (a decline of 6%, see Table 1). However, the density of grey partridge spring pairs was slightly up in 2009 from 3.7 to 3.8 pairs per 100 hectares. This was encouraging as, after the bad summer of 2008, we had expected numbers to fall. Scotland was the unfortunate exception, with spring densities 20% less than in 2008. If we examine the long-term trends in the indices of grey partridge pair density, accounting for site effects and for whether a site has been involved in the scheme prior to 1999, long-term members have shown a 2% increase in pairs between 2008 and 2009, whereas the more recent members recorded an overall decline of -7% (see Figure 1).

Summer 2009 proved much better for chick survival than the preceding three years and this gave higher young-to-old ratios (see Table 1). Across all regions of England and Scotland, on average there were more than two young birds to every old one. The better production resulted in higher autumn densities in most regions. However, Northern England densities recorded the only decline, but only of -2.1%. This should reassure many that following poor years grey partridges can quickly show improve-

KEY FINDINGS

- The number of contributors to our count scheme was down by 6% on 2008.
- Density of grey partridges counted in the scheme was up marginally, except in Scotland.
- Long-term members of the scheme have recorded a 2% increase in grey partridge pairs since 2008, but recent recruits have recorded a 7% drop.

Neville Kingdon
Julie Ewald

TABLE 1

Grey partridge counts

a. Densities of grey partridges pairs in spring 2008-2009, from contributors to our Partridge Count Scheme

	Number of sites		*Spring pair density (pairs per km² (100ha))*		
Region	*2008*	**2009**	*2008*	**2009**	**Change (%)**
South	*145*	137	*1.6*	1.5	-6.3%
Eastern	*226*	205	*5.0*	5.6	12.0%
Midlands	*160*	158	*3.1*	3.1	0.0%
Wales	*3*	3	0.9	0.9	0.0%
Northern	*200*	191	*4.6*	4.9	6.5%
Scotland	*145*	131	*3.4*	2.7	-20.6%
Overall	*879*	**825**	*3.7*	**3.8**	**2.7%**

b. Densities and young-to-old ratios for grey partridges in autumn 2008-2009, from contributors to our Partridge Count Scheme

	Number of sites		*Young-to-old ratio*		*Autumn density (birds per km² (100ha))*		
Region	*2008*	**2009**	*2008*	**2009**	*2008*	**2009**	**Change (%)**
South	*117*	139	*1.5*	2.4	*6.5*	8.4	29.2%
Eastern	*173*	218	*2.0*	2.8	*23.6*	24.5	3.8%
Midlands	*132*	161	*1.4*	2.4	*13.2*	14.7	11.4%
Wales	*1*	1	-	0.3	*0*	6.6	6.6%
Northern	*156*	193	*1.9*	2.6	*29.1*	28.5	-2.1%
Scotland	*95*	98	*1.6*	2.6	*9.5*	16.2	70.5%
Overall	*673*	**810**	*1.7*	**2.6**	*17.9*	**19.7**	**10.1%**

The number of sites includes all those who 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.

ment when conditions allow established management and habitats to take effect.

We are always looking for more people to get involved in counting, regardless of how many grey partridges they have. If you wish to join, please contact the Partridge Count Scheme Co-ordinator (01425 651066) or visit www.gwct.org.uk/partridge.

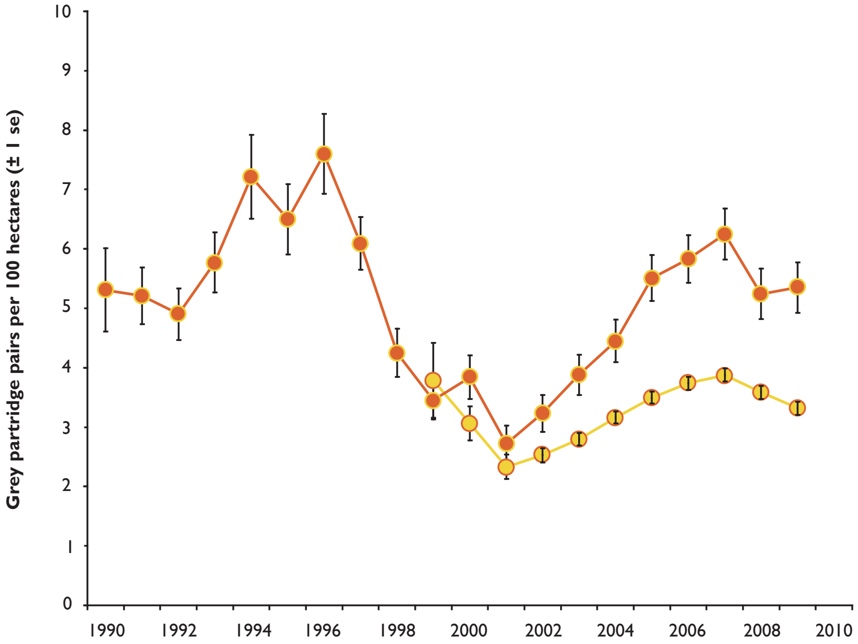


Figure 1

Trends in annual grey partridge pair density, controlling for variation between sites

Long term contributors

Recent contributors

Partridges and stewardship

An unharvested cereal conservation headland.
© Peter Thompson/GWCT

KEY FINDINGS

- Beetle banks, conservation headlands and wild bird cover were associated with consistently higher densities, breeding success and winter survival of grey partridges.
- Grass and scrub management was consistently the opposite.

Julie Ewald
Suzanne Richardson

Stewardship schemes have become a key part of conservation policy on farmland. Here we examine how grey partridge numbers on 1,031 sites within the Partridge Count Scheme (PCS) relate to membership in these schemes. We looked for an effect on breeding density (spring pair density), grey partridge production (young-to-old ratio and mean brood size) and over-winter survival. The results allowed us to determine which scheme options were giving landowners the best results for grey partridges and which they should be adopting when renewing agreements as well as which ones to avoid.

We classified options into 10 groups, based on the habitats that they provide at different stages in the life of grey partridges (see Table 1). We related changes in density, breeding success and winter survival to the area of these options at each site. Essentially, we looked for 'winner/loser' options using multiple regression, at each stage of the grey partridge life cycle (see Table 2). 'Winners' were those options where higher proportions on PCS sites were associated with higher densities, breeding success and winter survival whereas 'losers' were associated with lower values.

Three groups of options came out as winners – beetle banks, conservation headlands and wild bird cover. The option that was consistently a loser was grass and scrub management. Five other options were less clear-cut, showing positive relationships with either spring pair density and over-winter change but negative ones with

TABLE 1

Groups of stewardship options likely to be of major benefit to grey partridges

Group	Number of PCS sites with each group (% of 917 sites)	Examples
Arable flora management	14 (1.5%)	Cultivated plot or margin for arable flora
Beetle banks	167 (18.2%)	Beetle banks
Conservation headlands	157 (17.1%)	Conservation headlands: normal, fertiliser-free or unharvested
Crop management	19 (2.1%)	Supplement for small fields; reduced herbicide cereal crop
Field corner management	336 (36.6%)	Take field corners out of management: arable land
Grass strips	736 (80.3%)	Buffer strips on cultivated land, intensive grassland or arable land
Grassland & scrub management	95 (10.4%)	Enclosed rough grazing: parcels under 15 ha; maintenance/restoration of successional areas and scrub; maintenance/restoration of rough grazing for birds
Spring cropping	285 (31.1%)	Undersown spring cereals
Wild bird cover	516 (56.3%)	Wild bird seed mixture; six metre uncropped cultivated margins on arable land
Winter cropping	182 (19.8%)	Over-wintered stubbles; cereals for whole crop silage followed by over-wintered stubbles; brassica fodder crops followed by over-wintered stubbles

We grouped the stewardship options. We considered only options that were likely to benefit grey partridges, based on our research and the experiences of our advisors. The list of examples is not exhaustive, but is a summary of the options in each group.

TABLE 2

Stewardship options that resulted in better or worse grey partridge outcomes

	Grey partridge production			
	Change in spring pair density	**Young-to-old ratio**	**Mean brood size**	**Over-winter survival**
Winners	Conservation headlands	Beetle banks	Field corner management	Conservation headlands
	Crop management	Spring cropping management	Wild bird cover	Beetle banks
	Grass strips	Wild bird cover		Field corner management
	Winter cropping management			Grass strips
				Wild bird cover
				Winter cropping management
Losers	Field corner management	Grass strips	Crop management	Grass & scrub management
	Grass & scrub management	Grass & scrub management	Grass strips	Spring cropping management
	Spring cropping management	Winter cropping management	Grass & scrub management	

Orange*: options consistently associated with higher values;* Blue *- those consistently associated with lower values, based on multiple regression analysis of the proportion of each on PCS sites. The other options were winners at some life-cycle stages and losers at others. Their use requires careful consideration to provide the best outcomes for grey partridges.*

young-to-old ratio and mean brood size, or *vice versa*. The secret with these options is to manage them with others that offset their negative effect. For instance, spring cropping provides good brood-rearing cover, but no cover at all in February-March which can aggravate grey partridge losses to raptors. Conversely, winter cropping provides good cover in early spring, but is poor for brood-rearing. It would be best to use the two options in tandem to complement each other or perhaps use wild bird cover as brood-rearing cover near areas managed with winter cropping. Both young-to-old ratio and brood size were negatively related to the presence of grass strip options. Nesting cover is better provided by beetle banks, which are in mid-field and disconnected from field margins.

Although some of our Partridge Count Scheme members are using stewardship options to their full advantage for grey partridges, there are many who are not. To give grey partridges the priority they deserve, when agreements are up for renewal, why not make grey partridges the main concern? Based on this (and other) work we recommend including wild bird cover (both brood-rearing and winter cover varieties), conservation headlands and beetle banks in new agreements. This will help fulfil the targets of the Campaign for the Farmed Environment and conserve grey partridges.

ACKNOWLEDGEMENTS

This work was funded by Natural England.

A beetle bank adjacent to second year brood-rearing cover crop containing kale and teasel. © Peter Thompson/GWCT

Grey Partridge Recovery Project: final update

Our demonstration project at Royston has enabled us to show many others what is possible.
© Peter Thompson/GWCT

The Grey Partridge Recovery Project began in 2002 and 2009 was its last full year. The project aimed to demonstrate that the targets set for the grey partridge under the UK government's Biodiversity Action Plan were achievable. The demonstration area is in northern Hertfordshire, south-west of Royston, on 1,000 hectares (2,500 acres) of mainly arable farmland on rolling chalk hills. It is surrounded by a reference area of similar size. On the demonstration area we employed a gamekeeper to control predation, targeting especially foxes, stoats, rats, crows and magpies, and to provide supplementary food. This supplementary food was wheat supplied in hoppers, at a density of one or two hoppers per pair of grey partridges on the demonstration area. There are also red-legged partridge and pheasant shoots on the reference

Figure 1

Distribution of grey partridge coveys at Royston in autumn 2009, showing barren pairs, single males and brood sizes

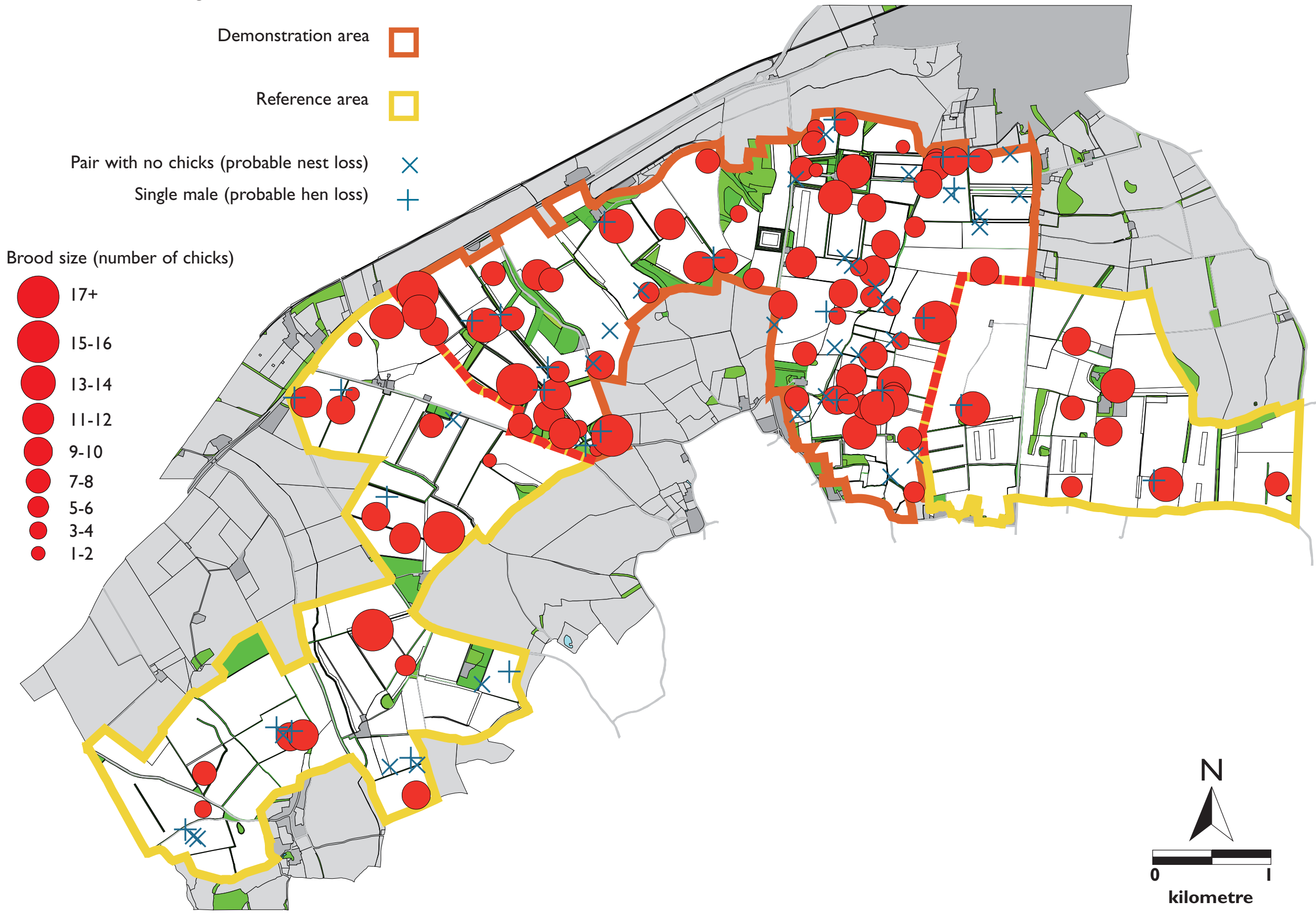


TABLE 1

Grey partridge counts on the recovery project at Royston, 2001-2009

a. Spring pairs per 100 hectares

Area	2002	2003	2004	2005	2006	2007	2008	2009	Predicted
Demonstration	2.9	**5.1**	**8.0**	**11.2**	**13.0**	**18.4**	**15.8**	**11.8**	**18.6**
Reference	1.3	2.1	1.4	2.1	2.8	4.2	4.7	4.0	3.7

b. Autumn birds per 100 hectares

Area	2001	2002	2003	2004	2005	2006	2007	2008	2009
Demonstration	7.6	**28.8**	**39.2**	**53.4**	**60.8**	**87.8**	**83.8**	**70.0**	**79.5**
Reference	8.1	6.4	18.3	11.8	18.6	25.9	17.9	15.0	22.7

Bold *denotes years/area managed for grey partridges.*

area, involving the release of these birds. On the demonstration area, farmers have been encouraged to use set-aside and agri-environment schemes to offset the costs of habitat creation. Changes to agri-environment schemes and the loss of set-aside over the course of the project have made it difficult for the farmers to provide all the nesting cover, brood-rearing and over-winter cover that we wanted.

We count grey partridges in spring and autumn (see Table 1). Since 2002, spring densities rose from 2.9 to 18.4 pairs per 100 hectares (250 acres) in 2007. The improvement in autumn densities has been even more impressive, with over an eleven-fold increase from 7.6 birds per 100 hectares to nearly 88 birds per 100 hectares by autumn 2006. By spring 2009 numbers had dropped following two poor summers. However, May and June 2009 were warm with little rainfall, signalling good conditions for grey partridge chick food. In autumn 2009 on the demonstration area, we counted 786 grey partridges with a young-to-old ratio of three chicks per old bird. This was a considerable improvement over the preceding years. The young-to-old ratio on the reference area was similar, reflecting the good summer conditions for grey partridge chicks, but the autumn density remained much lower than on the demonstration area, at 22.7 birds per 100 hectare (see Table 1).

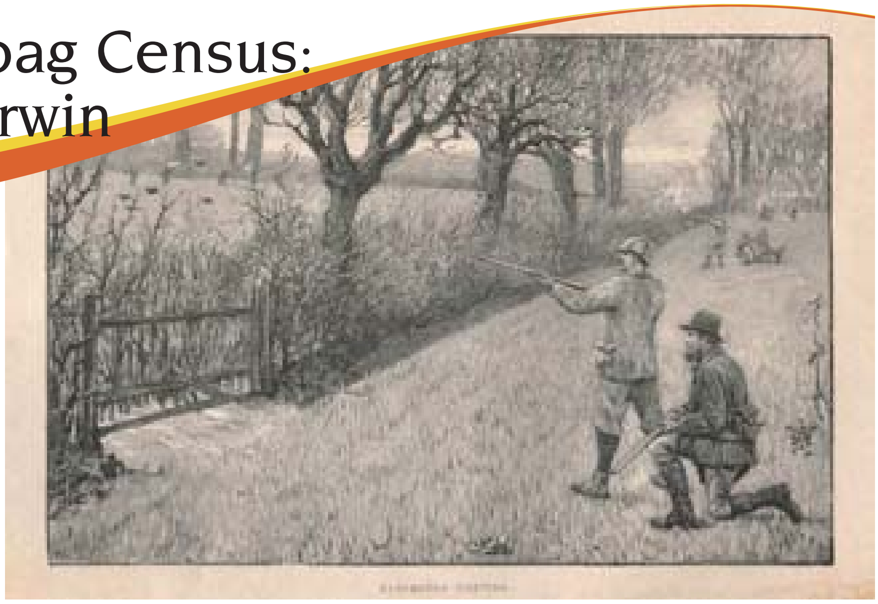
GIS student, Chris Wheatley, and Malcolm Brockless cleaning snow off partridge feeders on the demonstration site.
© Carlos Sánchez García/GWCT

KEY FINDINGS

- The demonstration showed that increases in partridge numbers can be achieved.
- Even though the spring density was down in 2009, conditions were good over summer, with three chicks produced for every adult bird.

Julie Ewald
Nicholas Aebischer
Malcolm Brockless

National Gamebag Census: data back to Darwin



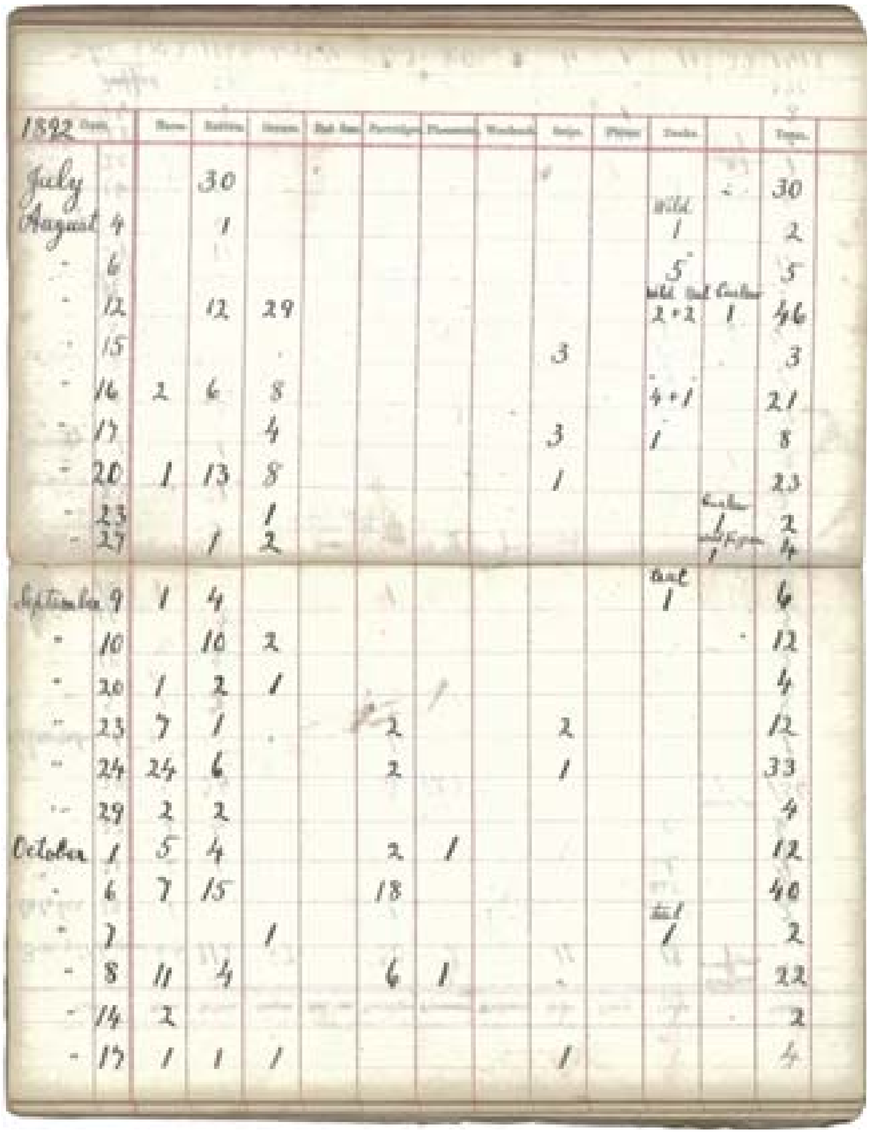
Partridge driving.

KEY FINDINGS

- The earliest records in the National Gamebag Census extend back to 1793.
- For grey partridge, red grouse and woodcock, we can produce continuous annual bag indices from the present day back to 1926, 1852 and 1832 respectively.
- The trends provide a long-term historical perspective that is unmatched by any other UK bird or mammal monitoring scheme.

Nicholas Aebischer
Peter Davey

The year 2009 was the bicentennial of the birth of Charles Darwin (1809-1882), who revolutionised biological thinking with *The Origin of Species* published in 1859. At that time, shooting was a popular country sport, and Darwin was clearly aware of the importance of game management when he wrote: "There seem to be little doubt that the stock of partridges, grouse, and hares on any large estate depends chiefly on the destruction of vermin". Game and predator bags are part and parcel of game management, so it seems appropriate to consider the historical perspective and to place our National Gamebag Census (NGC) in the context of other long-term datasets held by others.

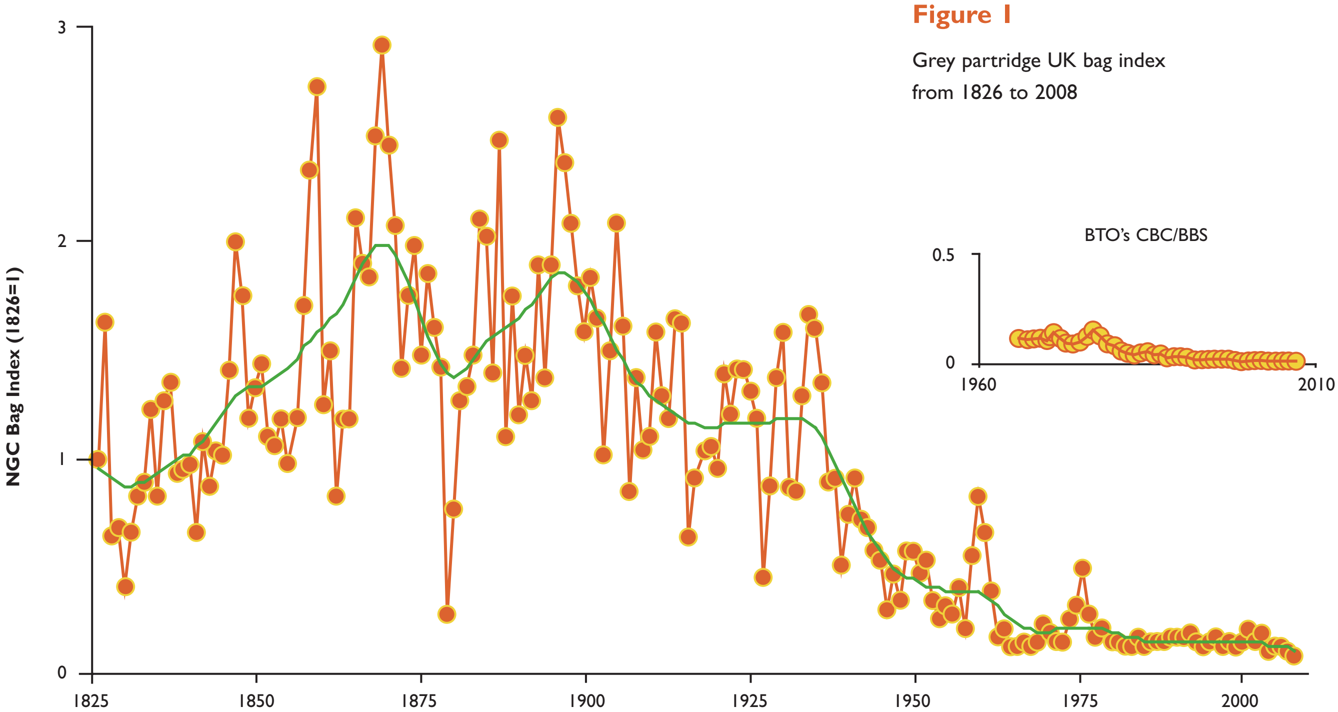


1892 Date		Hares	Rabbits	Grouse	Blk Game	Partridges	Pheasants	Woodcock	Snipe	Plover	Ducks		Total
July			30										30
August	4		1								Wild 1		2
"	6										5		5
"	12		12	29							Wild Teal 2+2	Curlew 1	46
"	15								3				3
"	16	2	6	8							4+1		21
"	17			4					3		1		8
"	20	1	13	8					1				23
"	23			1								Curlew 1	2
"	27		1	2								1	4
September	9	1	4								Teal 1		6
"	10		10	2									12
"	20	1	2	1									4
"	23	7	1			2			2				12
"	24	24	6			2			1				33
"	29	2	2										4
October	1	5	4			2	1						12
"	6	7	15			18							40
"	7			1							Teal 1		2
"	8	11	4			6	1						22
"	14	2											2
"	17	1	1	1					1				4

An estate game book open on 1892.

Figure 1

Grey partridge UK bag index from 1826 to 2008



The index is relative to 1826 (set to 1) and the green line shows the long-term trend. Inset, for comparison, is the equivalent BTO index (same scale) for grey partridges, which starts in 1966.

The NGC is a central repository of UK bag records, comprising information on the number killed of 24 huntable bird species, 11 'pest' bird species and 19 mammal species. We collect bag records by mailing questionnaires to some 900 contributors at the end of each season, and we also add historical data from game books. Participation in the scheme is voluntary, and we are most grateful to the owners and keepers who send in their returns each year and those who provide us with historical information.

Many of the species covered are monitored by other UK schemes, but no other annual scheme matches the historical depth of the NGC, whose earliest records extend back to 1793. For instance, the British Trust for Ornithology's Common Birds Census, from which grew the government's breeding bird monitoring scheme, began in 1962. The equivalent scheme for mammals, under the Tracking Mammals Partnership, begins its time-series in 1995. The NGC has good coverage for almost all its species back to 1961, and for many back to 1900. We were curious to know how far back it was possible to go while still producing reliable trends, so we examined bag data for the grey partridge, red grouse and woodcock. For each species, we based analysis on sites with two or more annual returns, and we included all years with five or more sites. The analysis summarises year-to-year change within shoots relative to the start year.

Grey partridge (Figure 1)

Grey partridge bags form the longest series in the NGC. We were able to produce trends in annual bag density that started in 1826, when Darwin was only 17 years

Walking up partridges in turnips.

old. There are large annual fluctuations, most probably linked to weather. Indeed, the collapse of bags in 1869 corresponds to the coldest year on record since 1740. Despite large swings from year to year, the underlying pattern (green line) charts the rise in popularity of this gamebird during the first half of the 19th century and its heyday during the second half of that century up to the First World War. The high average bags reflect the high densities arising from the extensive mixed agriculture that developed especially after the repeal of the Corn Laws in 1846, the ruthless elimination of predators by private gamekeepers and improvements in shotgun design. Partridge bags remained high until the Second World War, but declined thereafter, especially after the introduction of herbicides and the increase in agricultural mechanisation in the 1950s and 1960s. The BTO index (inset) starts in 1966, and catches the tail end of the decline.

Red grouse (Figure 2)

The earliest year for which we were able to produce a bag index was 1852, just seven years before the publication of *The Origin of Species*. The index captures the rise in popularity of grouse shooting during the second half of the 19th century, which was helped considerably by the development of rail links between London and Scotland in the 1840s. By the end of the 19th century, heather burning was part of moorland management for grouse, as was intensive predator control. Walked-up shooting was replaced by driven shooting, which increased the bag, and has become the tradition of grouse shooting ever since. The bag remained high until the Second World War, when shooting largely ceased. After the war, shooting resumed and many stocks were rebuilt, only to decline from the mid-1970s, particularly outside England. This coincided with increasing pressure on red grouse and its habitat from predators and afforestation. The BTO index (inset) begins in 1994, too late to detect any long-term trend.

Woodcock (Figure 3)

The start year for woodcock was 1831, only five years later than that for grey partridge. Unlike the previous two gamebirds, the woodcock is migratory and the bag comprises mainly wintering birds from Scandinavia and Russia. Weather affects the movements of woodcock and hence the bags, with lower bags reported in milder winters. Thus, for instance, the low bags around 1850 correspond to a period of relatively mild winters. Shooting largely ceased during the Second World War, and bag sizes recovered slowly until the mid-1970s. Thereafter they increased rapidly, to levels that exceeded those 100 years earlier. Part of the increase may be due to more pheasant shooting days produced by pheasant releasing and hence a higher shooting pressure, but the source populations are stable. The high bags may also reflect a rise in UK wintering numbers in response to extensive woodland plantings or maybe climate change. There is no BTO index for this species, and the bag data are the best source of information on the status of the UK wintering population.

NATIONAL GAMEBAG CENSUS

Do you have old game books from a shoot or an estate? If so, the records would make a valuable contribution to the NGC's historical coverage, and we would be delighted if you would allow us to include then in our database. The older the better! To offer your records, please contact Gillian Gooderham, the National Gamebag Census Co-ordinator, by telephone (01425 651019) or email (ggooderham@gwct.org.uk).

Figure 2

Red grouse UK bag index from 1852 to 2008

The index is relative to 1852 (set to 1) and the green line shows the long-term trend. In this margin, for comparison is the equivalent BTO index (same scale) for red grouse, which starts in 1994.

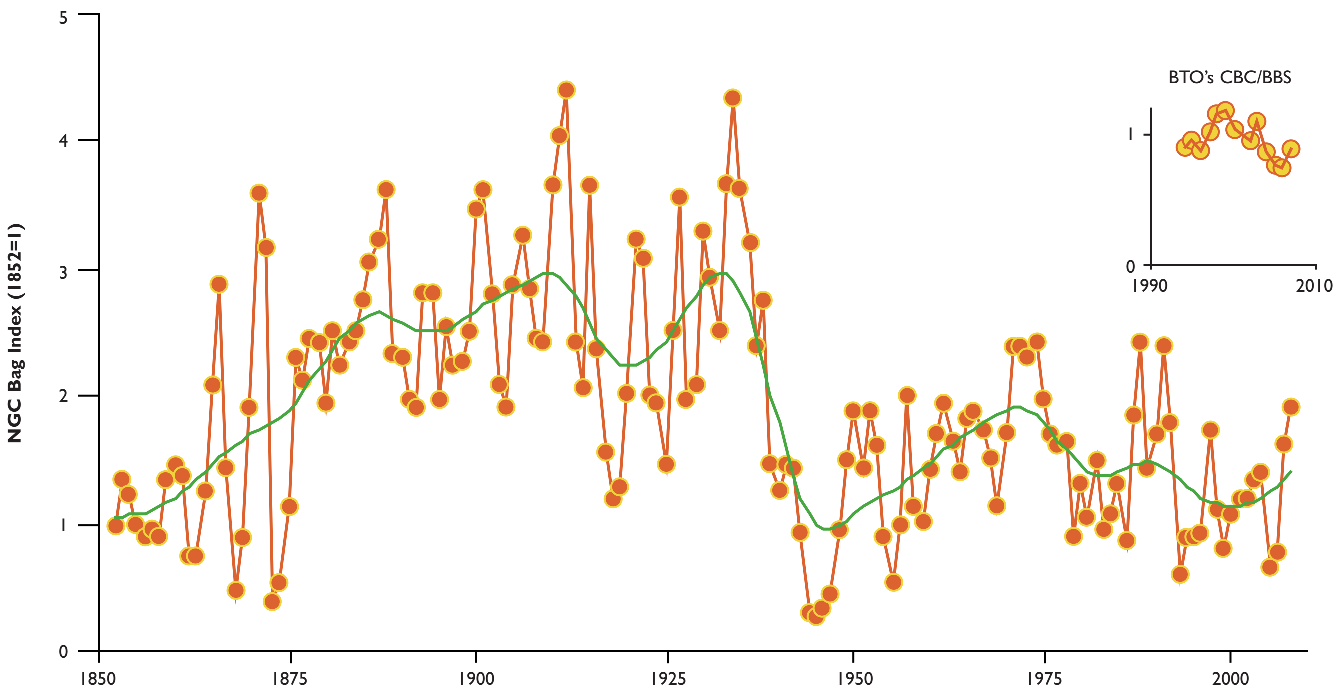
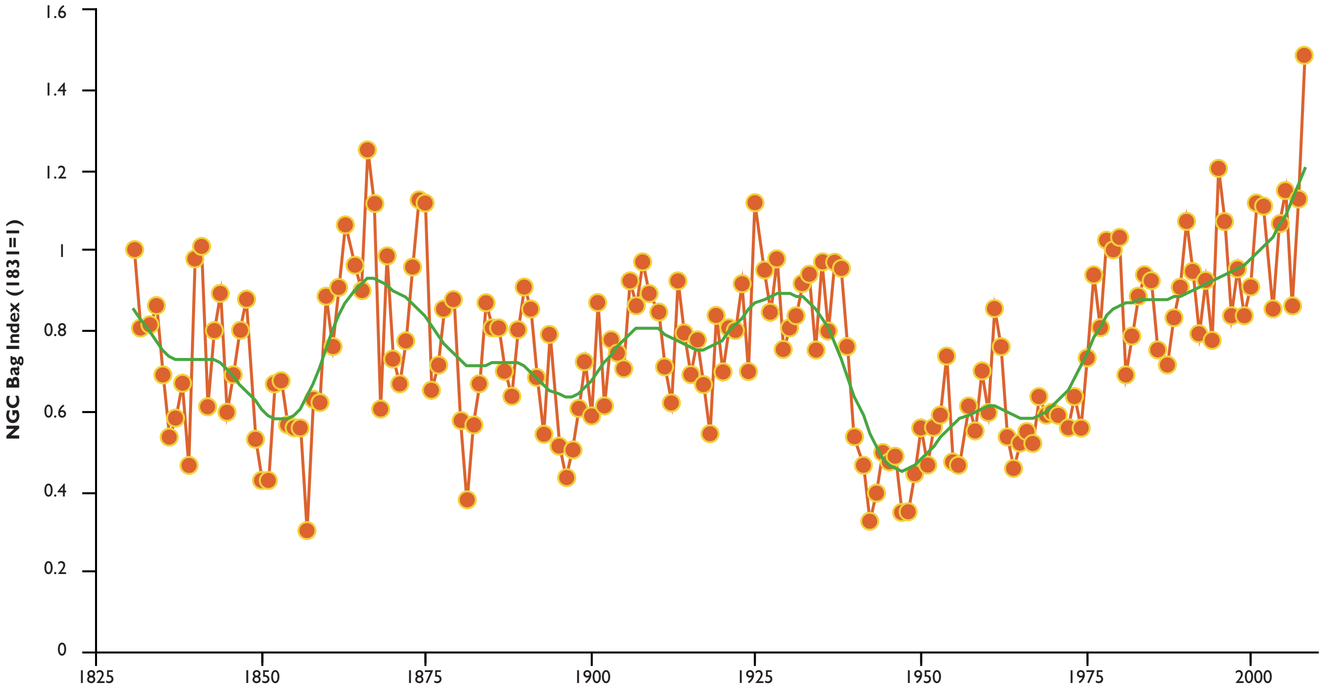


Figure 3

Woodcock UK bag index from 1831 to 2008

The index is relative to 1831 (set to 1) and the green line shows the long-term trend. There is no equivalent BTO index.



The woodcock can be a challenging quarry.

Uplands monitoring in 2009

It was noticeable in 2009 that red grouse did much better on moors using medicated grit.
© Laurie Campbell

KEY FINDINGS

- In northern England medicated grit reduced the severity of the crash in red grouse following the population peak in 2008.
- English moors that did not use medicated grit crashed in 2009, as predicted in our *Review of 2008*.
- Blackcock at spring leks dropped by 27% in 2009 in the North Pennines, but brood counts were above average in northern England.
- Capercaillie bred well in 2009, with productivity highest since 2006.

David Baines
Dave Newborn
David Howarth

Red grouse in Northern England

We count red grouse in March and April each year and after breeding in July and August. We do these counts using pointing dogs on heather-dominated moorland blocks, generally 100 hectares in size; the same block of moorland is counted each time. There are 25 blocks from the Peak District to Northumberland, the Trough of Bowland, and the North York Moors. The majority of these blocks have been counted annually for more than 25 years.

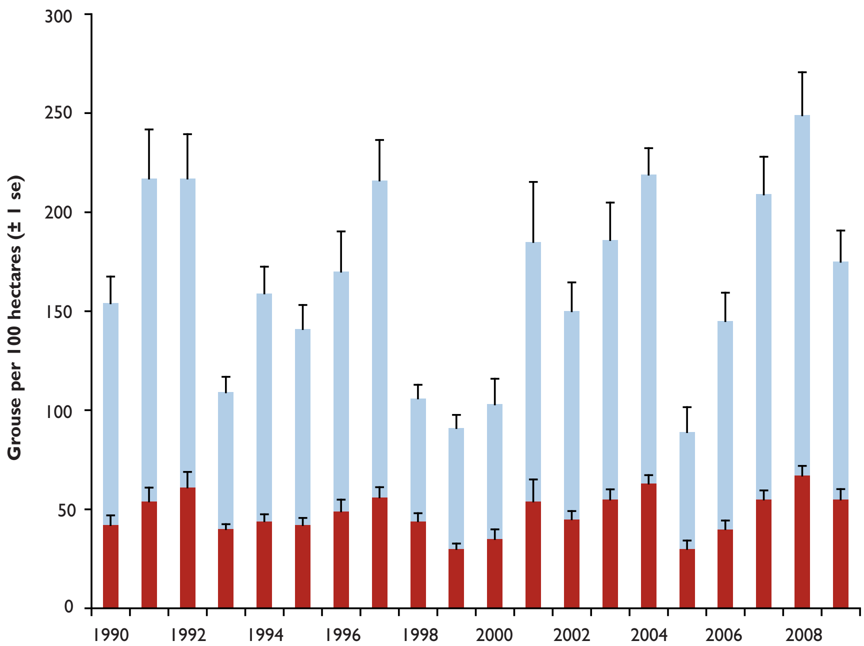
After a record-breaking grouse year for most moors in 2008, 2009 was a year which showed a big difference between moors that used medicated grit and those that didn't. In our *Review of 2008* we predicted that moors not using medicated grit would suffer a parasite crash in the spring of 2009. This proved to be the case, with densities from July counts on moors using medicated grit (mean 304 grouse per 100 ha) almost double those on moors not using medicated grit (mean 160 grouse per 100 ha, see article page 44).

Spring densities in 2009 averaged 71 birds per 100 hectares, a decline of 18% on the equivalent densities in 2008. However, where medicated grit was not used, adult grouse continued to die after the counts had been completed.

There are steep population crashes that follow the peaks in 1992 and 1997 (see Figure 1). The reduction following the peak in 2008 is noticeably less severe. We think that this is due to the widespread use of medicated grit.

Figure 1

Average density of young and adult red grouse in July from 25* sites across northern England, 1990-2009



** 1990-2000 = 18 sites*
2001 = 8 sites;
2002-2003 = 18 sites;
2004-2009 = 25 sites

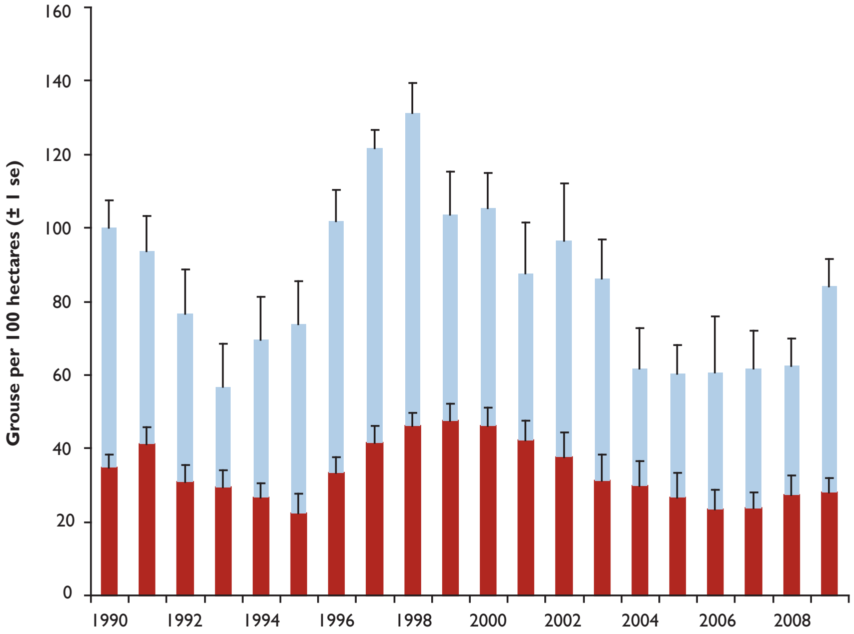


Figure 2

Average density of young and adult red grouse in July/August from 24 sites across Highland Scotland, 1990-2009

Young grouse

Adult grouse

Red grouse in Scotland

In Scotland in 2009 we counted our usual 25 long-term sites. Despite a cold snowy winter, spring arrived by mid-March and we were able to count with little delay.

In spring, densities averaged 30 grouse per 100 hectares compared with 26 in spring 2008. Grouse bred well and the first red grouse hatch was the earliest that we have recorded in 20 years, on 10 May.

In 2009 we had 2.0 young per adult compared with 1.3 per adult in 2008. This was helped by favourable weather in May and June, but the widespread use of medicated grit and good shepherding to reduce ticks may also have played a part. We had 83 grouse per 100 hectares in July 2009 compared with 59 in 2008 – a 40% increase (see Figure 2).

In Scotland, red grouse productivity was helped in May and June. © Peter Thompson/GWCT

There were fewer black grouse at spring leks in 2009. © Laurie Campbell

Black grouse

Blackcock at spring leks dropped by 27% in 2009 in the North Pennines and was worst in North Northumberland. This decline is due to poor breeding in 2007 and 2008 and prolonged snow cover in winter 2008/09. Extrapolating from these counts, we estimate that numbers in northern England have dropped back to 734 males, which is below the 1998 level of 773 males.

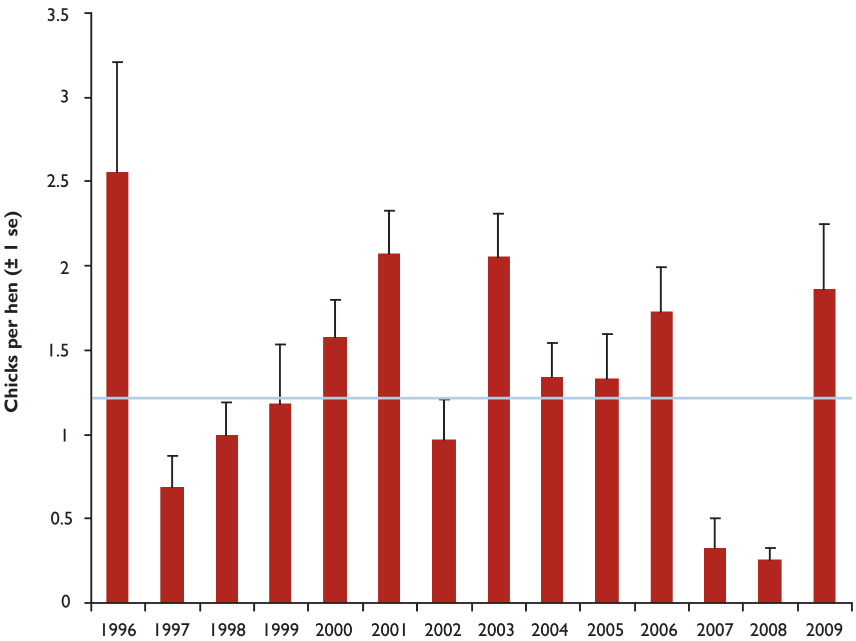
The extent of the North Pennines range remains stable and has expanded on the southern fringe in the Yorkshire Dales, but it continues to fragment in North Northumberland.

Brood counts in 2009 were above average for northern England. On our study sites, we found a total of 29 greyhens; 17 had broods, with a total of 54 chicks, giving an average of 1.9 chicks per hen (see Figure 3). All other things being equal, this should lead to increases in the numbers of males attending leks in spring 2010.

Figure 3

Black grouse breeding success in northern England between 1996 and 2009

The horizontal line at 1.2 indicates the estimated level of productivity required to maintain a stable population.



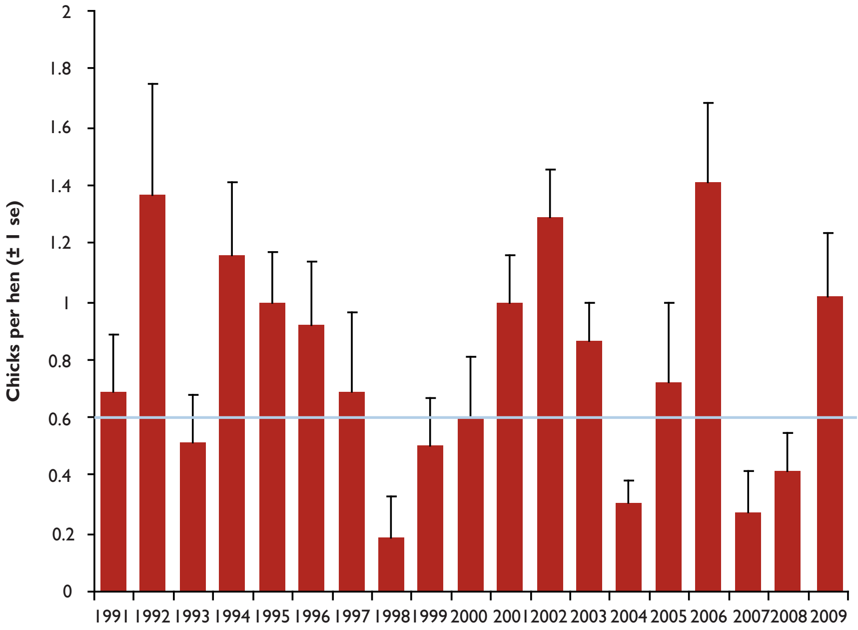


Figure 4

Capercaillie breeding success between 1991 and 2009* sampled from 14-20 forests per year in the Scottish Highlands

The blue line at 0.6 indicates the estimated level of productivity required to maintain a stable population.

** Apart from 2003 to 2009, capercaillie breeding success was derived from a different subset of forest areas each year.*

Capercaillie

Capercaillie bred well in 2009, with production at its highest since 2006. 46% of hens had a brood and breeding success was double that of 2008 with an average of 1.0 chicks per hen, well above the 0.6 needed to maintain numbers (see Figure 4). However, 75% of all broods were within the species' core range in Strathspey. On the periphery of its range, there is still a risk of population fragmentation and local extinction.

Capercaillie production in 2009 was at its highest since 2006 and was double that of 2008. © Laurie Cambpell

Langholm Moor Demonstration Project: year two

The Langholm Moor Demonstration Project team. From L-R: Andrew Johnstone (senior beatkeeper), Paula Keane (researcher), Damian Bubb (research ecologist), Simon Lester (headkeeper), Paul Bell (beatkeeper) and Aly McCluskie (researcher).
© Paul Quagliana/Shooting Times

The Langholm Moor Demonstration Project was launched in September 2007 and work started in early 2008. The 10-year project aims to reconcile grouse moor and raptor interests with the core objective of re-establishing Langholm Moor as a driven grouse shoot while maintaining a viable population of hen harriers.

The project is based on Langholm Moor, partly because it was the principal site for the Joint Raptor Study between 1992 and 1997. During that project hen harrier numbers increased, peaking at 20 breeding females in 1997 (see Figure 1). Red grouse showed a corresponding decline in numbers and, as a result of the reduction in grouse, the estate laid off or re-deployed keepers and management of the moor largely stopped.

Since early 2008, the project has employed a team of five keepers to manage the moor. In addition to predator control, heather burning and the provision of medicated grit to control strongyle worms, all harriers that nest on the moor are provided with diversionary food. In a previous study at Langholm, the provision of diversionary food for harriers was shown to reduce the number of grouse chicks brought to the harrier nests by 67% to 86%.

The numbers of harriers nesting at Langholm in the first two years of the project have been low, continuing the trend of recent years (see Figure 1). In 2008 two pairs nested raising a total of nine young and, in 2009, a single pair nested with five young fledging. Although the numbers of harriers nesting have been low, the breeding success has been higher than during the years when the moor was not managed.

All nests were provided with day-old cockerel chicks and rats, and the female harriers from all the nests took substantial quantities of this diversionary food. In 2008 harriers from the two nests combined took in excess of 60 rats and 1,000 day-old chicks whereas in 2009 the harriers took over 200 rats and 800 day-old chicks.

We watched all harrier nests to identify prey delivered to harrier chicks. We observed a total of 158 items at the three nests combined; of these most were passerines (57%) or diversionary food (32%). We have recorded no grouse or grouse chicks being brought to the harrier nests.

Red grouse numbers at Langholm have increased from the low densities recorded prior to 2008. Red grouse abundance (derived from distance sampling) showed a near doubling of density in 2009 compared with 2008. Spring densities had increased from 21.1 (95% CL 17.6, 25.4) birds per 100 hectares to 38.6 (28.4, 52.6) birds per 100 hectares; summer numbers in July/early August went from 45.7 (37.5, 55.8) birds per 100 hectares in 2008 to 99.5 (80.4, 123.1) birds per 100 hectares in 2009 (see Figure 2). Breeding success has also improved; the average young per hen was 4.6 in 2009 compared with 3.1 in 2008, and 1.9 in 2007.

KEY FINDINGS

- A single pair of harriers successfully nested with five young fledged. The nest was provided with diversionary food.
- Red grouse numbers showed a substantial increase compared with 2008 and breeding success was better than in previous years.

Damian Bubb

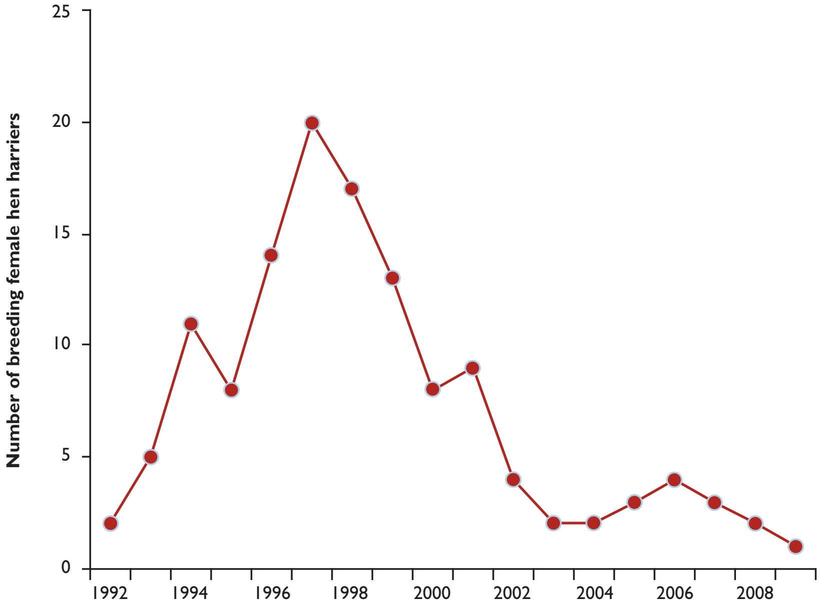


Figure 1

Number of breeding female hen harriers at Langholm from 1992 to 2009

ACKNOWLEDGEMENTS

The Langholm Moor Demonstration Project is a partnership between The Game & Wildlife Conservation Trust, Scottish Natural Heritage, Buccleuch Estates, RSPB and Natural England.

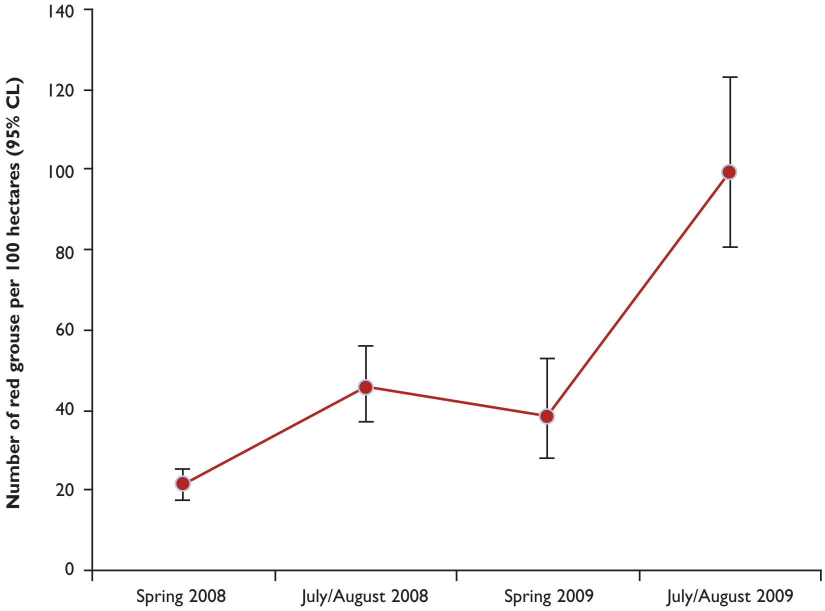


Figure 2

Density of red grouse at Langholm derived from distance sampling transects

Heather burning on Langholm's Roan Fell.
© Simon Lester

North Pennines black grouse: 14-year era ends

Phil Warren talking about sward management at Shaw Farm. © Phil Warren/GWCT

The black grouse is one of the most rapidly declining birds in the UK. Once widespread across Britain, there has been a serious decline in numbers over recent decades, with the population now restricted to the Scottish uplands, northern England and North Wales. Consequently, it is a species of high conservation concern, 'red-listed' and a 'priority species' for the UK Biodiversity Action Plan.

In England, black grouse were declining at 10% per year in the early 1990s, with the remaining 800 cocks confined to the Pennine hills. To help stem the decline, in 1996 in partnership with Natural England, the Ministry of Defence, RSPB and National Wind Power (later joined by Northumbrian Water in 2001 and the North Pennines Area of Outstanding Natural Beauty Partnership in 2006), we established the North Pennines Black Grouse Recovery Project. Following the recognition of black grouse as a priority species in 1999, this project adopted the following targets for England to:

- Stem or reverse the decline in numbers to 800 males by 2005.
- In the long term (20 years), increase the range to its 1988-91 extent.
- Prevent further fragmentation of the range.
- Promote re-colonisation of formerly occupied areas by 2005.

KEY FINDINGS

- We have encouraged the widespread uptake of appropriate management for black grouse throughout northern England.
- We have stemmed the decline, with numbers recovering from 773 males in 1998 to an estimated 1,200 in 2007.
- Black grouse remain threatened and their long-term future depends on improving breeding success and expanding their range.

Phil Warren

Scrubby broad-leaved woodland established to provide winter food and escape cover for black grouse. © Phil Warren/GWCT

To achieve these, we have provided free black grouse advice to landowners, farmers and conservation organisations; monitored black grouse numbers; and plugged gaps in our knowledge through a research programme. We have shown that by restoring moorland fringe habitats by reducing sheep grazing, black grouse breed better, leading to a 5% per year increase in displaying males. We have provided free advice through visits (30 per year), open days, training events and talks to interest groups; written newsletters and articles in the popular press. During the course of the project, we have drawn up management plans covering an area of 3,350 square kilometres. This coincided with considerable uptake of agri-environment schemes throughout the black grouse range; in 2009 90% of suitable habitats are now managed through agri-environment schemes compared with less than 20% that were in 1996.

We identified other factors limiting population recovery, such as nest predation by stoats, a lack of tree cover in the winter as an emergency food source and cover, fatal collisions with stock fences, and effects of accidental shooting. We have tailored our management advice accordingly, by producing, promoting and circulating written guidelines on woodland planting, fence marking and measures to prevent accidental shooting.

Numbers of black grouse increased from 773 cocks in 1998 to an estimated 1,200 in 2007. Blackcock range has increased from 38 to 42 10-kilometre grid squares. To promote the recolonisation of former range, we moved blackcock from their core area to the southern fringe of their range to establish new leks. Although hampered by poor weather in 2007 and 2008, we have found released cocks lekking and attracting hens, which breed successfully.

When the project finishes in March 2010, black grouse in northern England will still remain threatened if they continue to breed poorly. The species' long-term future depends on improving breeding success and expanding its range.

ACKNOWLEDGEMENTS

We would like to thank all grouse moors owners, gamekeepers and farmers whose support, access to land and uptake of prescriptions have helped to make this project a success.

Released blackcocks have set up leks and have attracted hens. © Laurie Campbell

Black grouse love cattle

A black grouse brood. © Lindsay Waddell

In northern England, black grouse nest and rear their chicks in rough grassland on the margins of grouse moors. Despite predator control by gamekeepers, black grouse often breed poorly and this limits population recovery. We already know that a third of clutches can be taken by stoats, but chick mortality is also high, particularly in a wet June. Mortality to weather is highest during the first three weeks of a chick's life while foraging for invertebrates. Sawfly larvae make up more than two thirds of their diet. Reducing sheep grazing does improve breeding success, but this is mainly due to better cover and more food plants rather than increased sawfly abundance. If we can improve sawfly abundance, we would also improve black grouse breeding success.

In Upper Teesdale, pastures are grazed by both sheep and cattle. We have been able to assess annual black grouse breeding success across some 40 enclosed fields either grazed by sheep, cattle or both on nine farms since 1998. Annual counts of grazing animals showed that grazing regimes are consistent between years. In June 2009, to coincide with the peak black grouse hatch, we collected vegetation and invertebrate data from 11 fields grazed by cattle (cattle only or cattle and sheep) in the summer and from similar adjacent fields grazed by sheep only. Vegetation species and height data were collected from 100 equally spaced points along a transect across the field, with invertebrate data collected at 10 equally-spaced intervals using a sweep net (25 sweeps at each point). Fields grazed by cattle had 50% more jointed rush than those grazed by sheep only. Fields grazed by cattle had twice as many sawfly larvae and caterpillars as those fields grazed by sheep only (see Table 1). Spiders, harvestmen, plant bugs and flies were also more abundant in fields with cattle. For the period 1998-2009, black grouse hens were three times more abundant and bred three times better in the fields grazed by cattle than in fields grazed by sheep alone.

Cattle-grazed fields had higher invertebrate numbers and better black grouse productivity. However, the mechanism for these associations is unclear. Reducing sheep grazing does enhance habitat for black grouse, but with time, their value as breeding habitat declines. In future we want to investigate whether introducing cattle to these swards can increase invertebrate abundance and black grouse breeding success.

KEY FINDINGS

- Sawfly larvae, which make up more than two thirds of black grouse chick diet, were found to be twice as abundant in fields grazed by cattle than those by sheep only.
- Overall invertebrate abundance was higher in fields grazed by cattle than those by sheep only.
- Black grouse hens were three times more abundant and bred three times better in the fields grazed by cattle.

Phil Warren

TABLE 1

Number of invertebrates caught by sweep netting (250 sweeps per field), vegetation composition, grey hen density and breeding productivity in fields grazed with cattle and those by sheep only

Invertebrate group	Cattle (n=11) (mean ± 1se)	Sheep (n=11) (mean ± 1se)
Beetles	2.5 (0.5)	1.9 (0.3)
Plant bugs	**102.1 (11.0)**	**89.3 (10.5)**
Flies	**86.4 (7.9)**	**56.5 (3.8)**
Spiders and harvestmen	**5.0 (0.4)**	**3.2 (0.8)**
Adult Hymenoptera (sawflies, wasps, bees, ants)	1.3 (0.3)	0.7 (0.3)
Caterpillars	**1.4 (0.3)**	**0.6 (0.3)**
Sawfly larvae	**6.3 (0.8)**	**3.6 (0.6)**
Moths	2.7 (0.4)	3.4 (0.8)
Total	**207.7 (17.4)**	**159.2 (12.4)**
Vegetation composition (% of total cover)		
Grasses and heath rush	**45.8 (4.1)**	**53.7 (2.7)**
Jointed rush	**8.7 (2.1)**	**4.7 (1.8)**
Soft rush	20.4 (3.0)	25.8 (3.6)
Herbs	12.4 (2.4)	5.9 (2.2)
Other (heather, bilberry, sedges, moss)	13.7 (1.5)	11.0 (2.1)
Black grouse		
Hen density (hens per 100 ha)	**12.0 (2.8)**	**4.1 (1.3)**
Breeding success (chicks per hen)	**1.5 (0.2)**	**0.5 (0.2)**

Bold type is used where differences are significant.

Evidence suggests that where cattle graze, black grouse hen density and breeding success are higher than where sheep graze. © Phil Warren/GWCT

Medicated grit and strongylosis

Above and right: grit boxes put out on the moor enable controlled access of grouse to medication. © *Dave Newborn/GWCT*

KEY FINDINGS

- Moors using medicated grit reared 40% more young per adult red grouse than on non-medicated moors.
- Post-breeding grouse densities were twice as high on medicated moors as on non-medicated ones.
- Moors using medicated grit had 84% fewer worms in adult grouse shot in autumn 2008 and 98% fewer in autumn 2009 than on non-medicated ones.

David Baines

Our long-term grouse monitoring provides an extensive approach to analysing grouse abundance. Here we use data from 2008 and 2009 to consider how grouse perform in relation to control of the parasitic worm *Trichostrongylus tenuis* using the most recent form of medicated grit. We counted grouse in spring and July, and assessed worm burdens from grouse (10 adults and 10 juveniles) shot on 25 moors in northern England. We split the moors into three regions: South Dales (including Peak District and Bowland Fells); North Dales; and North York Moors.

Breeding success (young per adult) did not differ between the three regions or between the two years. Breeding success was almost 40% higher (mean = 2.6) on moors where the estate used medicated grit compared with those which did not (mean = 1.9, see Table 1).

Post-breeding densities did not differ between years but differed between regions, being highest in the North Dales (mean = 270 grouse per 100 hectares), and lower in the South Dales (including Peak & Bowland) and the North York Moors (mean = 185). Having accounted for regional differences, there was a strong effect of medication, with densities from count areas on moors using medicated grit almost double those on moors that did not use medicated grit (304 versus 160 grouse per 100 hectares).

Worm burdens in shot grouse differed as to whether a moor was medicated. Medicated grit reduced worm burdens, irrespective of grouse age. The magnitude was greatest in 2009, with a 98% reduction in worm burdens of adult grouse, compared with a 84% reduction in 2008 (see Table 2).

TABLE 1

Red grouse breeding success (mean young per adult in July ± 1se) and post-breeding densities (mean birds per 100 hectares ± 1se) across three regions of northern England in 2008 and 2009 in relation to whether medicated grit was used

Treatment	South Dales/Peak (n = number of years)	North Dales (n = number of years)	North York Moors (n = number of years)
Medicated: young per adult	(10) 2.6 ± **0.2**	(8) 2.6 ± **0.3**	(2) 2.7 ± **0.5**
Non-medicated: young per adult	(10) 1.7 ± **0.2**	(18) 2.2 ± **0.2**	(8) 1.7 ± **0.3**
Medicated: post-breeding density	(10) 260 ± **27**	(8) 321 ± **42**	(2) 330
Non-medicated: post-breeding density	(10) 113 ± **24**	(18) 223 ± **35**	(8) 143 ± **38**

TABLE 2

Geometric mean worm burdens per red grouse on moors using medicated grit and those not using medicated grit in 2008 and 2009 in northern England

	Medicated moors		Non-medicated moors	
2008	**No sampled**	**Mean (95% CL)**	**No sampled**	**Mean (95% CL)**
Adults	19	319 (146-697)	17	1,965 (1,506-2,563)
Juveniles	26	71 (48-106)	17	255 (155-419)
2009				
Adults	13	56 (31-100)	7	2,855 (1,928-4,226)
Juveniles	13	20 (15-25)	7	178 (85-374)

The differences in breeding success, post-breeding grouse densities and worm burdens were all statistically significant and these differences were consistent across the three regions of northern England. The new form of medicated grit is starting to make a significant difference in the way intestinal worm parasites are being controlled.

Worm burdens were found to be far higher in dead grouse from moors not using medicated grit. *© Edward Gallia/Natterjack Publications*

Perennial brood-rearing habitat

KEY FINDINGS

- Perennial brood-rearing cover can provide floral resources for insects as well as cover and forage for grey partridges.
- Location is key. Selecting a site that is free of pernicious weeds will enhance chances of success.
- Increasing the proportion of grass in the seed mix does not help control the ingress of weed species into a field margin.
- Including a number of wildflowers in the seed mix will increase the abundance of insects that are eaten by grey partridge chicks.

Barbara Smith

Ideal grey partridge brood-rearing cover provides shelter for chicks, enough bare ground for ease of access and an accessible insect-rich habitat as a chick-food source. We are designing a brood cover that will benefit chicks early in summer and then provide pollen and nectar for invertebrates later. This is an excellent way of increasing the biodiversity value of sown field margins.

Conventional brood-rearing covers are annuals and need re-establishing each year. This is expensive and, if we can develop perennial brood-rearing crops, more farmers are likely to plant them, which will be of benefit to birds.

Our first approach was to compare three perennial seed mixes with different wildflower species (see Table 1). We sowed treatments that included a full grass rate (80:20 ratio of grass to wildfowers) or with the grass reduced by 50% or by 75%, in trials in two fields ('Orchard' and 'Judges') on a Hampshire farm with light chalky soils.

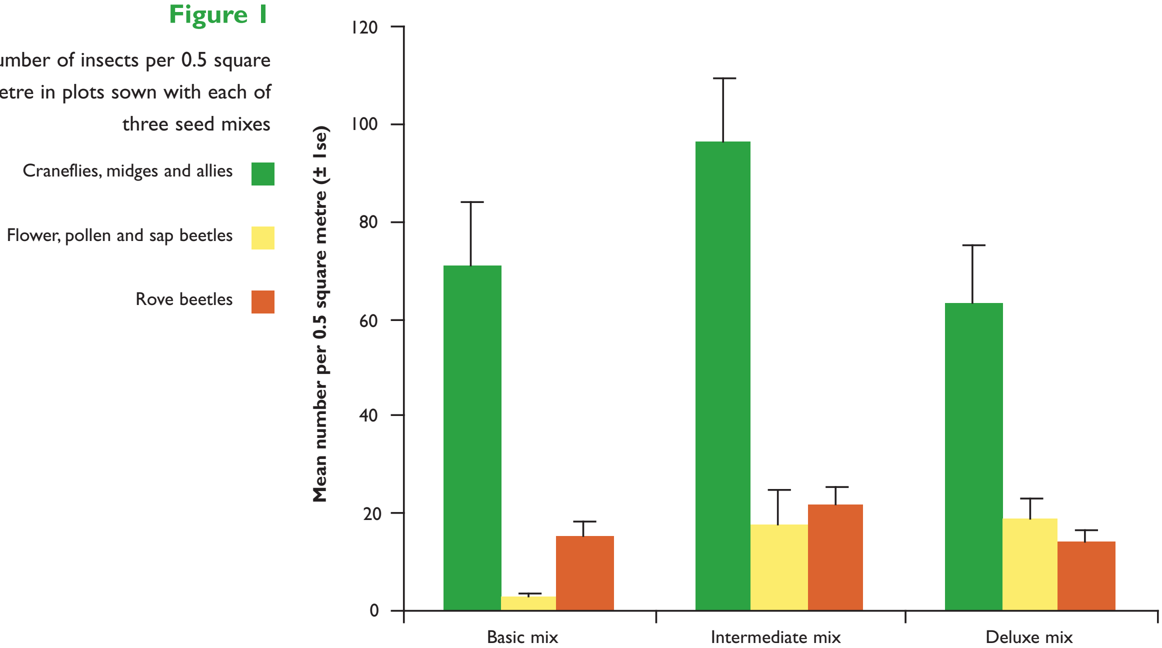
Location is key. By the second year, Judges field margin had become dominated by grass weeds and had 41% more cover than Orchard field. The grass weeds suppressed our sown flowers and grasses (42% cover), which fared much better in Orchard field (64% cover). Plant diversity was better too; there were with 30% more species recorded in Orchard field. These differences in vegetation were reflected in the insect community; the Chick Food Index (CFI) was higher in Orchard (1.6) than in Judges field (0.7), as was species richness and insect abundance. A pair of partridges raised 17 chicks in Orchard field.

The regular and diverse seed mixes produced a better sward than the basic mix. These seed mixes suppressed broad-leaved weeds, which were more numerous in plots sown with the basic mix. The proportion of grass in the seed mix had no effect on the proportion of grass weeds or broad-leaved weeds in the sward.

We looked at the effect of seed mixes on insects and spiders. We considered the CFI, insect diversity, total number of insects and the following groups: spiders; rove beetles; flower, pollen and sap beetles; bugs; caterpillars; parasitic wasps; crane flies,

Figure 1

Average number of insects per 0.5 square metre in plots sown with each of three seed mixes



midges and allies; other flies and woodlice. These groups are composed of species that are relatively similar and may be expected to respond to the vegetation in a similar way. The CFI, total number of insects and species diversity were not affected by seed mix. However, three groups of insects were (see Figure 1). From our analysis of faecal material, we know that these groups, rove beetles, pollen, sap and flower beetles and crane flies are all part of grey partridge diet. It is also likely that small midges are eaten but, as they are thoroughly digested, are not found in chick faeces. These beetles are dependent on flowering plants for food, and our results suggest that the intermediate mix is sufficiently complex. In 2010 we will be monitoring bumblebees to see which mix is the most attractive to them.

This study has been running for two years and we will continue it for another three. The margins are improving over time, the CFI has increased by 60% in Orchard field and 27% in Judges field since the margins were sown. There was no difference in the vegetation density between the two fields, showing that access for feeding chicks was the same. Management will be introduced in 2010 to ensure that the vegetation does not become impenetrable.

TABLE 1

Species composition of seed mixes sown as perennial brood-rearing habitat

BROADLEAF MIXES

Basic mix		**Percentage of weight**
Cichorium intybus	Chicory	50
Lotus corniculatus	Bird's-foot trefoil	50
	Price per hectare at 40kg per hectare	£137.50

Intermediate mix		**Percentage of weight**
Cichorium intybus	Chicory	25.6
Centaurea nigra	Greater knapweed	23.1
Leucanthemum vulgare	Oxeye daisy	7.7
Achillea millefolium	Yarrow	7.7
Lotus corniculatus	Bird's-foot trefoil	20.5
Prunella vulgaris	Selfheal	7.7
Rumex acetosella	Sheep's sorrel	7.7
	Price per hectare at 40kg per hectare	£146.55

Deluxe mix		**Percentage of weight**
Cichorium intybus	Chicory	10.0
Centaurea nigra	Greater knapweed	8.8
Leucanthemum vulgare	Oxeye daisy	7.0
Achillea millefolium	Yarrow	6.3
Lotus corniculatus	Bird's-foot trefoil	5.0
Prunella vulgaris	Selfheal	5.0
Rumex acetosella	Sheep's sorrel	5.0
Hypericum perforatum	St John's wort	2.8
Plantago lanceolata	Ribwort plantain	7.5
Geranium pratense	Meadow crane's-bill	7.5
Knautia arvensis	Field scabious	6.5
Ranunculus acris	Meadow buttercup	5.0
Echium vulgare	Viper's bugloss	5.0
Vicia cracca	Tufted vetch	7.5
Galium verum	Lady's bedstraw	5.0
Daucus carota	Wild carrot	6.3
	Price per hectare at 40kg per hectare	£147.29

GRASS MIX		**Percentage of weight**
Agrostis capillaris	Common bent	6.3
Cynosurus cristatus	Crested dog's-tail	46.9
Festuca ovina	Sheep's fescue	46.9
	Price per hectare at 40kg per hectare	£47.03

Judges field strip. © John Holland/GWCT

Grass margins and control of cereal aphids

Grass margin with exclusion traps in the distance.
© John Holland/GWCT

Agri-environment schemes are changing our landscapes and they may affect the balance of species and the biological control of crop pests. We investigated the impact of grass margins and flower-rich habitats on biological control of cereal aphids. Grass margins formed of tussocky grasses act as over-wintering sites for ground-active natural predators (beetles and spiders) which then invade crops in the spring, whereas pollen and nectar from flowers is used by flying predators. Both habitats support other insects eaten by the predators, which may help sustain predators when crop aphids are sparse.

To test the value of grass margins, we sampled insects in grass margins between two and six years old along with the adjacent hedge base. The grass margins

KEY FINDINGS

- Six-metre-wide grass margins double the number of over-wintering aphid predators, compared with hedge bottoms.
- Flying insects that eat aphids provide the best control of cereal aphids.
- Grass margins may help control cereal aphid numbers.

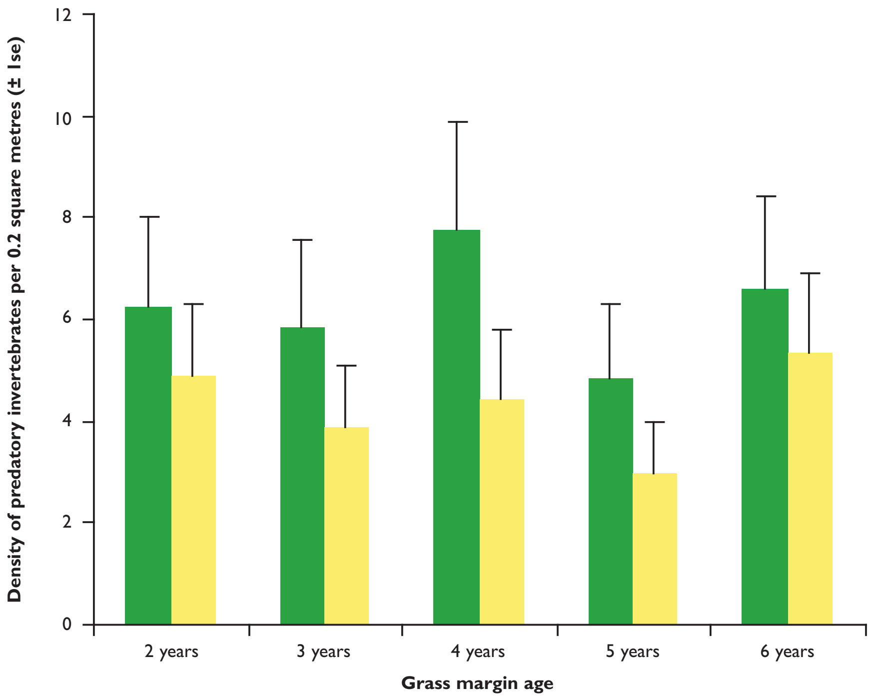
John Holland, Heather Oaten, Tom Birkett

Figure 1

Number of pest natural enemies over-wintering in the hedge base and adjacent grass margin of four hedges sampled

Hedge base

Adjacent grass margin



supported 30% fewer aphid predators than hedge bottoms, but since grass margins are often six metres wide they can double the numbers of these natural enemies (see Figure 1). Margin age did not affect the numbers of over-wintering aphid predators.

In 2006 and 2007 we tested the effectiveness of cereal aphid control. We selected farms (12 or 14) with varying proportions of grass margins across Hampshire and Dorset. In one wheat field per farm, we set up exclusion cages 80 metres from the nearest field boundary. The cages either excluded ground-active, flying or both types of predators or allowed all predators access to artificially-created cereal aphid colonies. By counting aphids at two-week intervals we were able to quantify the level of aphid control for the different groups of predators. We examined the relationship between land use within 100, 250, 500 or 750-metre radius of the exclusion cages and the level of aphid control provided by the predators.

Flying predators alone provided almost total aphid control, whereas ground predators were slower and less effective as previously found (see *Review of 2006*). Aphid control provided by the flying predators increased as the area of grass margins increased and this relationship held true when margins were within 250, 500 and 750 metres.

To investigate the effect of flower-rich areas, we sprayed sown flower strips with a Rubidium trace element that could be detected in insects and then mapped the distribution in relation to aphids in two adjacent fields. We did this with sticky traps placed in a grid pattern across the fields. Hoverflies that are known to consume nectar were abundant, but only 1.5% of those tested had fed in the flower-rich strip and there was little evidence that they were located near aphids. In contrast, another group of predatory flies (Empididae) showed a strong correlation with cereal aphid numbers. Overall, the study suggested that agri-environment schemes can benefit biological control.

ACKNOWLEDGEMENTS

Our thanks to all the farmers who participated in this study. Funding was provided through the Research Councils UK Rural Economy and Land Use programme (RELU).

Flower-rich field margins provide a greater range of resources for invertebrates. © Tom Birkett/GWCT

Loddington game in 2009

We plan to restart our shoot at Loddington in 2011. © Sophia Gallia/Natterjack Publications

KEY FINDINGS

- Numbers of wild pheasants and hares remained low after stopping predator control and winter feeding.
- Game shot on local shoots is traded both locally and further afield.
- Gamebird feed for shoots is sourced both locally and internationally.
- There is potential to build on the local and 'natural' appeal of game as food in developing plans for our new shoot.

Chris Stoate
John Szczur
Graham Riminton

Since stopping predator control in 2001, there has been a dramatic decline in both autumn and spring numbers of wild pheasants and hares (see Figures 1-3). Autumn pheasant numbers have been reduced more than spring numbers, which have been partially maintained by immigration from neighbouring farms.

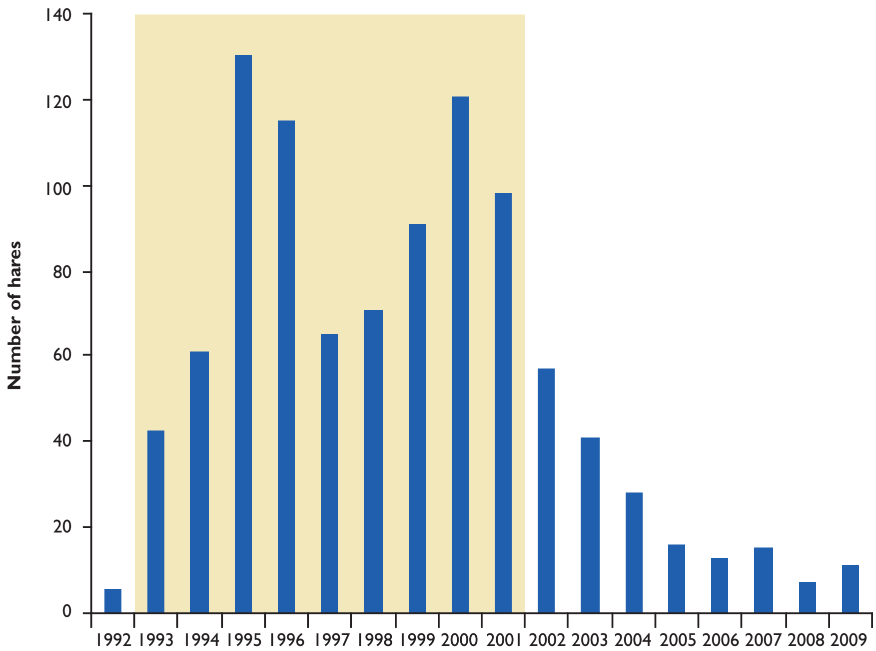
We plan to rebuild a shoot at Loddington in 2011. Important criteria for this are that the style of shoot we adopt will be similar to other places in the country and be able to cover its costs. It must also be compatible with our environmental objectives, especially those associated with wildlife such as the songbirds, which benefited from the first phase of the Allerton project. Another issue that we are considering is the value of shot game as food. This is being investigated as a PhD project, financially supported by the British Deer Society.

Pheasants are reared locally on a small-scale game farm that supplies a number of shoots in the area. The same business also buys shot game from local shoots, creating

Figure 1

Hare counts at Loddington 1992-2009

Keepered period



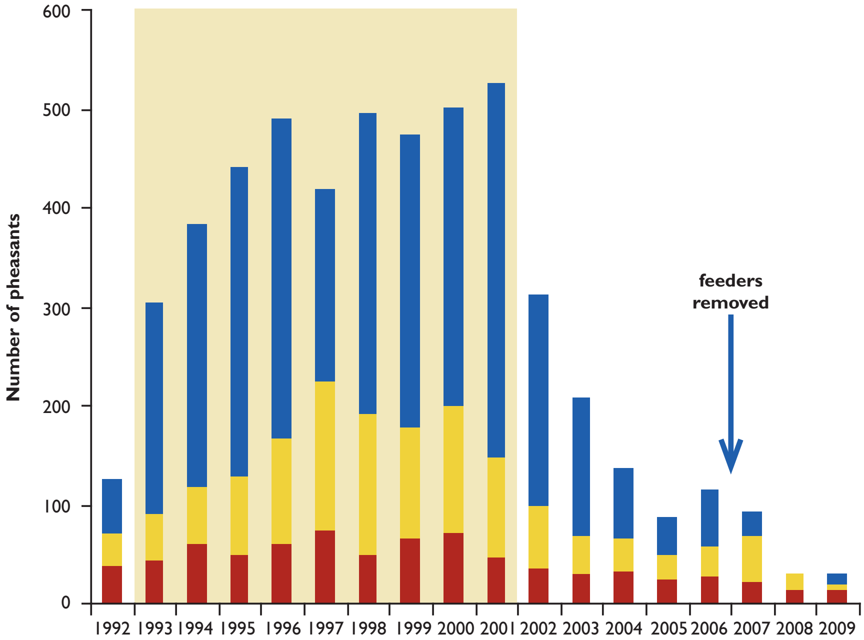


Figure 2

Total autumn pheasant numbers at Loddington 1992-2009

Young

Hens

Cocks

Keepered period

a local cycle from game farm to shoot and back to game dealer. Grain used on the shoots for winter feeding is sourced from the farms on which the shoots are held, and dead game is also often traded locally. Although the proportion of birds taken home 'in the feather' by guns, beaters and pickers-up is low, some are sold back to the shoots as oven-ready birds and others find their way into local shops, pubs and restaurants. This creates a short local food supply chain which is compatible with reduced food miles, and with market opportunities for locally-produced food.

However, the majority of shot pheasants go in the feather to wholesale butchers or Approved Game Handling Establishments and, from there, into prepared meals such as casserole mixes or game pies for retail (including supermarkets), pubs or restaurant chains. The largest proportion is exported and ends up in Holland (where raising birds for shooting is not permitted) or France. On the supply side, partridge chicks are sourced from France, and fish protein from South America and Iceland is incorporated into feed for chicks and poults. This creates a long international food supply chain, which reduces local marketing opportunities.

At Loddington we have demonstrated the value of game management to non-game species, and how management for shooting sits comfortably with other environmental objectives such as landscape and catchment management. Shooting can also play a role in the supply of locally produced food, contributing to the local economy and to social cohesion within the rural community. We will be seeking to optimise these benefits as we develop plans for the new shoot at Loddington drawing on the results of our recent and on-going research.

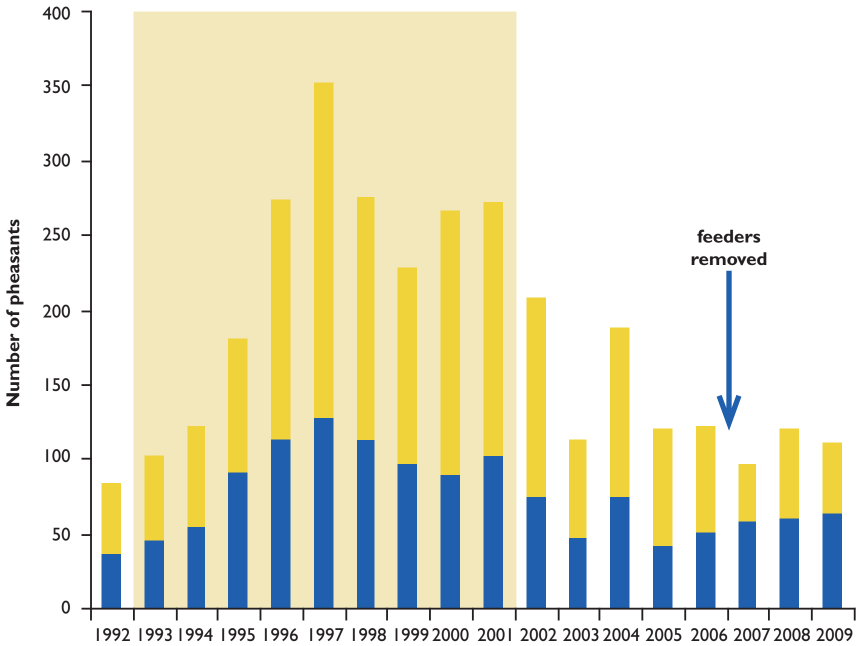


Figure 3

Total spring pheasant numbers at Loddington 1992-2009

Cocks

Hens

Keepered period

The farming year at Loddington

Winter wheat yields were better in 2009 than 2008. © Alex Butler/GWCT

KEY RESULTS

- The effect of unpredictable weather has been reduced with the purchase of a new combine.
- Winter wheat yields were up on 2008.
- The bean crop struggled and yields were low.
- Technological advances are enabling our farming practices to be as efficient and environmentally sound as possible.

Alastair Leake
Phil Jarvis

Every farming year always turns out differently. Although we continue to farm with the same fundamental rotation of wheat, oats, oilseed rape and beans, the varieties, machinery, agronomy and weather vary from season to season. It is usually the unpredictability of the weather that causes us the most difficulties, and that was certainly the case in 2008, although 2009 was kinder. The effect of unpredictable weather at harvest has been reduced by buying a new combine harvester.

TABLE 1

Arable gross margins (£/hectare) at Loddington 1994-2009

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008*	2009†
Winter wheat	773	1,007	981	551	668	723	572	603	518	836	536	591	837	772	778	765
Winter barley	596	877	802	625	478	534	403	315	328	-	-	-	-	-	-	-
Winter oilseed rape	520	808	868	593	469	468	523	329	611	614	477	381	362	596	1,075	674
Spring oilseed rape	433	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Winter beans	450	626	574	616	507	553	573	331	452	491§	415§	541§	409§	694§	663§	427§
Winter oats	-	-	-	-	-	-	-	-	462	759	545	516	692	634	643	651
Linseed	473	535	-	497	-	477	-	-	-	-	-	-	-	-	-	-
Set-aside	301	331	335	326	296	317	205	204	251	247	217	194	213	194	199	n/a

* revised figures § spring beans †estimated figures

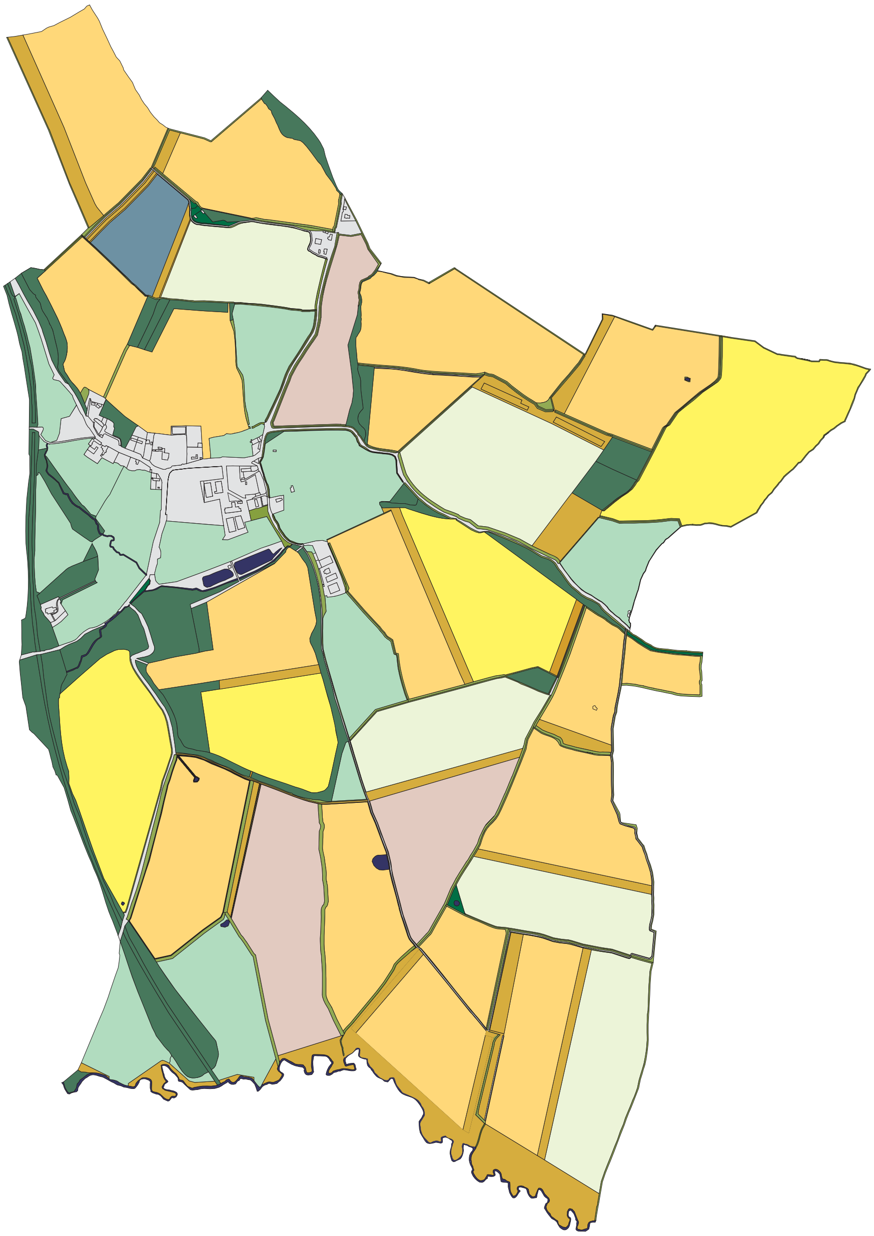


Figure 1

Loddington Estate cropping 2008/09

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

Modern combines are highly technical, increasingly powerful and reliable and are of course essential to an arable operation. Yet the high capital cost means that we need to be growing a sufficient acreage of combinable crops to justify having our own. We do this by working in partnership with our neighbour and pooling our

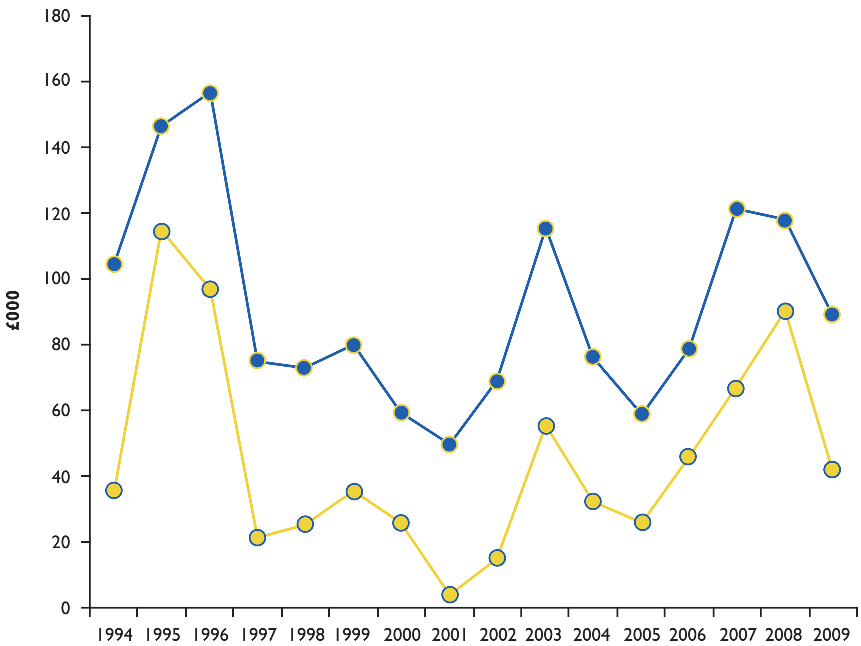


Figure 2

Gross profit and farm profit at Loddington 1994-2009

- Gross profit
- Farm profit

TABLE 2

Farm conservation costs at Loddington 2009 (£ total)

Set-aside (wild bird cover)[1]	
(i) Farm operations	570
(ii) Seed	679
(iii) Sprays and fertiliser	538
(iv) Extra set-aside	5,181
Total set-aside costs	**6,968**
Conservation headlands[2]	
(i) Extra cost of sprays	0
(ii) Farm operations	120
(iii) Estimated yield loss	1,070
Total conservation headland costs	**1,190**
Grain for pheasants	0
Grass strips	166
Stewardship (CSS & ELS)	9,214
Woodland	5,967
Total conservation costs	**23,505**
Stewardship income (CSS & ELS)	(14,522)
Total profit foregone	
- conservation	**8,983**
- research and education	**7,798**
	16,681

[1] Area of wild bird cover = 7.4 ha
[2] Area of conservation headlands = 4.4 ha

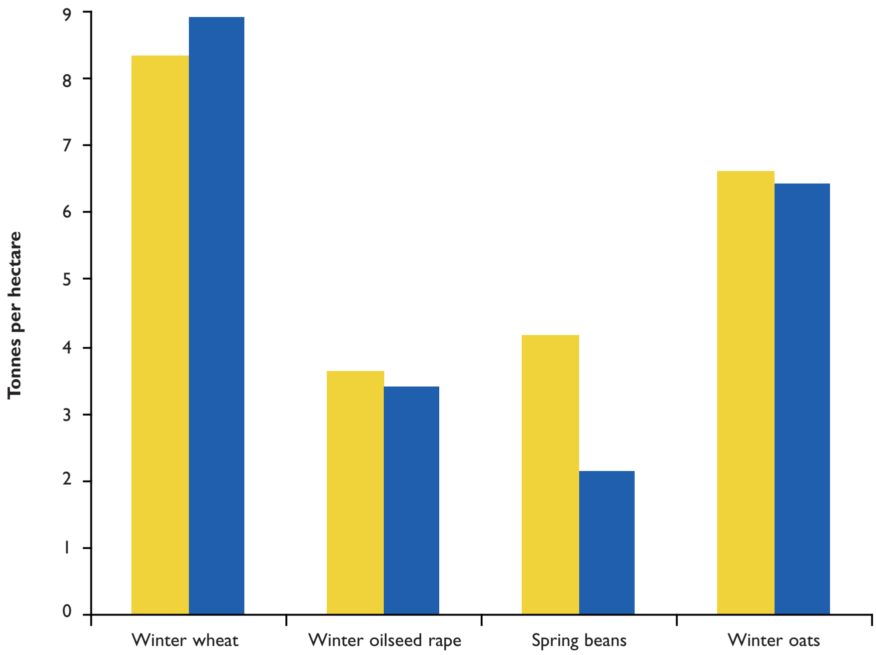
Further information on how these costs are calculated is available from the Game & Wildlife Conservation Trust

land area. The new combine has reliably given us more working days at the critical time. Furthermore, its power has allowed us to increase our operational speeds by more than 20%. These two factors, combined with the hard work of our farm staff – sometimes working up to 18 hours a day – have been responsible for bringing the harvest home.

In 2009 we also had a problem with our bean crop. Five years ago, we switched from winter to spring beans to help us control herbicide-resistant black-grass. However, spring beans on heavy land are less reliable than winter beans. For the first four years we were lucky and, in some cases, we got better yields than an average winter crop.

Figure 3

Crop yields at Loddington in 2008 and 2009



In the spring, we used a neighbour's seed drill, which gives good seed placement and seed-to-soil contact, getting good levels of germination across most of the area. However, a wet spell was followed by a dry one and the young bean plants struggled to grow away. This created a problem at harvesting as the first pods were low on the stem and difficult to cut. Modern combines have ground-levelling sensors, which protect the cutter bar from colliding with the ground in uneven conditions, but this means low pods are often missed. The crop was also attacked by a sudden but potent infestation of aphids at the late flowering/early podding stage and we had to apply an aphicide across the entire acreage. We are unsure which of these factors gave us the disappointingly low yield.

New farm equipment also brings technical advances. Using global positioning technology, our crop sprayer now tracks its own progress across the field. When the sprayer reaches a point where it has sprayed before, it automatically switches off to avoid double treatment.

Likewise, the combine harvester can measure the crop yield as it harvests and this information can be downloaded and examined. This shows us variability in crop performance across a single field and in future should help us tailor our inputs to crop potential. The yield maps are already showing the important effect of soil type. Although we cannot change the basic proportions of sand, clay and silt that make up our soil, we can influence the important soil organic matter. In partnership with Leicestershire City Council and waste company Biffa, we have begun adding organic matter derived from the anaerobic digestion of food and garden waste from the City of Leicester. Early indications from replicated treated plots of winter wheat at Loddington are that yields have improved.

We have also been looking at an alternative soil analysis technique. Known as the Albrecht Soil Survey method of nutrient management, we have divided four fields and treated them using two separate fertiliser calculations. We harvested equal strips from each field and measured yield. We recorded no significant difference in yield between the treatments, but the strips treated using the Albrecht method required 20% less nitrogen.

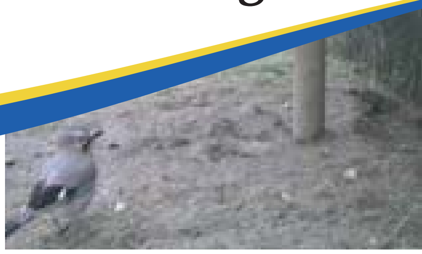
Opposite: Loddington's Simba solo double press with air seeder. © Alex Butler/GWCT

ACKNOWLEDGEMENTS

We would like to thank the Royal Agricultural Society of England and the Glenside Group for supporting this work.

Loddington's new combine has enabled us to speed up harvesting and it can measure crop yields as it goes. © Alex Butler/GWCT

Predation, winter feeding and songbirds



Unintended guests at the hoppers. From top left: jay; rooks and jackdaws; badger; muntjacs; rat; stockdove and squirrel.
© John Szczur/GWCT

KEY FINDINGS

- Now that we have stopped both predator control and winter hopper feeding on the farm, songbird breeding numbers have dropped to almost the level they were before we started using these measures in 1992, even though all the habitat measures designed to help farmland birds are still in place.
- Songbirds used feed hoppers, especially in late winter, and this is likely to have enhanced winter survival. Hoppers also attracted many nest predators.
- Winter numbers of seed-eating songbirds were higher when feed hoppers were present than when they were not.
- These results indicate that simply providing habitat may not be enough to improve the conservation status of some farmland birds.

Chris Stoate
John Szczur

We have been following songbird numbers at Loddington since 1992, the year before we began managing game on the farm. We have been particularly interested in the effects of predator control as a component of the game management system (see page 58). Another important practice is winter feeding.

Our gamekeeper started work in 1993 and began controlling gamebird predators and winter feeding game using grain hoppers. We stopped predator control in 2001, and stopped winter feeding in 2006 to see how this affected game and other species. Overall numbers of breeding birds have declined year on year since we stopped predator control (see Figure 1). Numbers are now almost back to what they were in 1992.

Winter feeding will not affect all songbirds as some do not winter in Britain and others do not feed on grain. We filmed 10 feed hoppers on a neighbouring farm from January to March 2009 to see what species were using them for winter food. This showed that blackbird, dunnock, robin, tree sparrow, chaffinch and yellowhammer were the main songbirds using feed hoppers in winter. Of these, tree sparrow and yellowhammer are Biodiversity Action Plan species.

Monthly transect counts carried out through the winters since 2000 show that providing food for gamebirds supports these songbirds through the whole winter too (see Figure 2). However, without winter feeding, songbird numbers were lower, especially in the second half of the winter. Higher numbers in November and December are probably due to the use of wild bird seed crops before these become depleted in January. Filming birds at hoppers showed that they increased their use of feeders more than four-fold between January and March – yellowhammers showed a ten-fold increase over this period. These results suggest that feeding beyond the end of the shooting season will benefit farmland songbirds at a time when alternative sources of food have been exhausted.

Nest predators such as rats, grey squirrels, jackdaws and magpies also used feeders and accounted for 19% of their use. Songbirds accounted for 38% of hopper use. The equivalent figure for gamebirds was 30%, with other species such as muntjac, rooks, pigeons and doves accounting for the rest. For some songbirds, the combination of predator control and winter feeding probably increases their numbers – just as it does for gamebirds.

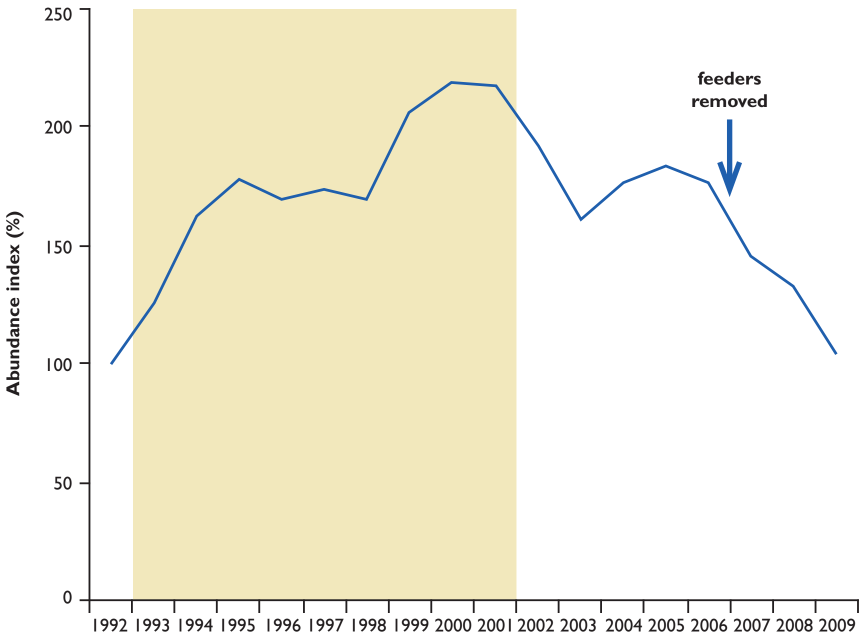


Figure 1

Abundance index of birds at Loddington, 1992-2009 (year 1 = 100%)

Keepered period

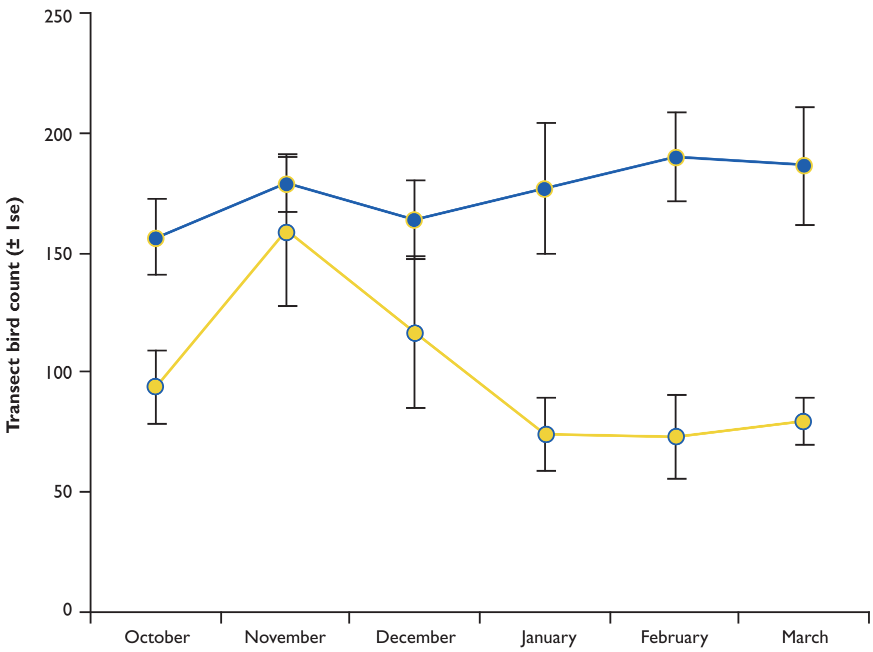


Figure 2

Monthly transect counts of birds at Loddington from 2000 to 2009

Feeding

No feeding

Some of the intended beneficiaries of the hoppers. From top left: pheasant, red-legged partridges; another pheasant (not so the squirrel!) and yellowhammers. © John Szczur/GWCT

ACKNOWLEDGEMENTS

We would like to thank the Manydown Trust for financially supporting this work.

Songbirds and predator control

Control of carrion crows (pictured) and magpies is usually done using Larsen traps in the spring.
© Sophia Gallia/Natterjack Publications

KEY FINDINGS

- Predator control had a positive effect on nest survival for at least three out of six study species.
- Even when accounting for re-nesting, yellowhammers may be able to fledge an average of 1.2 more chicks per season when predators are controlled.
- A population model predicted that this could potentially improve yellowhammer population growth rate by 23%.

Chris Stoate
Patrick White
John Szczur

A primary interest of our songbird research has been the effect of predator control, not only on nesting success, but on population growth. To estimate the effects on nesting success, we gathered data over an 11-year period from two comparison sites with minimum levels of predator control, while at Loddington we had a period with predator control, followed (since 2001) by a period without. We concentrated on six species because sufficient nests were found to enable statistical analyses: blackbird, song thrush, dunnock, whitethroat, chaffinch and yellowhammer.

Estimates of nest survival at Loddington alone were higher during the predator control period (Figure 1). However, these falls could simply reflect a trend in the surrounding countryside. When we performed a statistical comparison with data from the other sites to address this, we detected a significantly positive effect of predator control for blackbird, chaffinch and yellowhammer. For dunnock, the effect was less well supported, and there was no effect for song thrush or whitethroat. This result for whitethroat is consistent with our previous findings, but the song thrush result was surprising as we have previously thought that this species is susceptible to nest predation. For blackbird and chaffinch we detected a two-year delay after stopping predator control because corvid numbers were slow to re-establish after 2001.

It is known that low nest survival can be partially compensated for by an increase in the number of nesting attempts ('re-nesting compensation'), an effect that isn't picked up when simply comparing nest survival. Could re-nesting compensation significantly diminish any benefits of predator control? We tested this for yellowhammer,

Figure 1

Estimates of nest survival for six species of songbird during keepered and unkeepered periods at Loddington

Keepered period
Unkeepered period

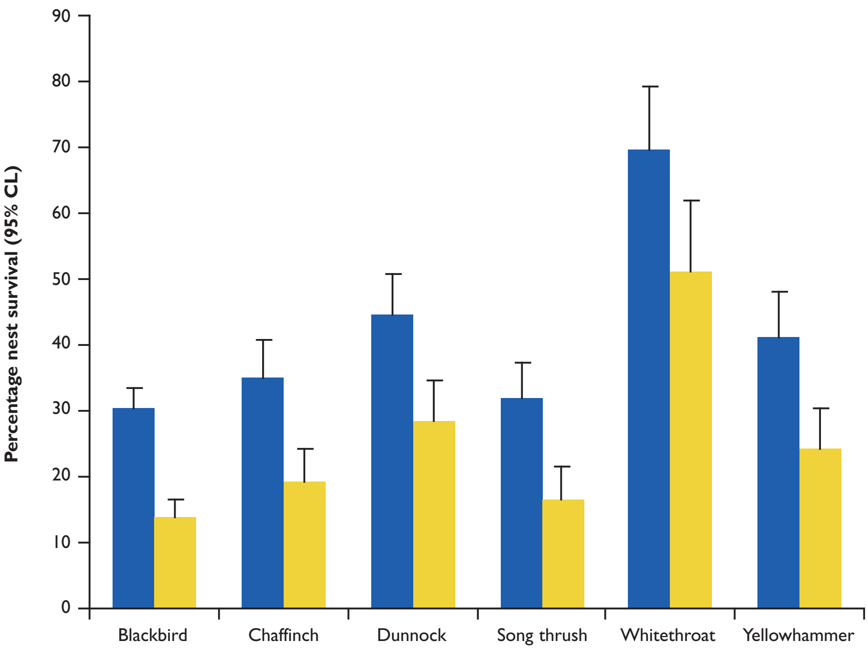


TABLE 1

Input data and results for simple models of yellowhammer population growth assuming poor first-year and adult survival

Input data	Value
Productivity without predator control (chicks)	1.96
Productivity with predator control (chicks)	3.19
Post fledging survival	0.51
First year survival	0.52
Adult survival	0.56
Age at first reproduction (years)	1
Results	**Value**
Population growth without predator control	0.65
Population growth with predator control	0.79

a declining species. By developing a model that simulated a yellowhammer breeding season, we produced estimates of average number of young fledged and numbers of nesting attempts made. With predator control, females were making an average of 0.8 fewer attempts per season, but there was still an estimated benefit of an average of 1.2 more chicks fledged per season with predator control.

Apart from productivity (the number of chicks fledged in a season), other influences on breeding numbers include post-fledging survival and survival of birds through the rest of the year. We used a combination of our own data and figures from published literature in simple population growth models to explore what the implications of the effect of predator control on yellowhammer nest survival might be on population growth. Input data and resultant population growth rate estimates are given in Table 1. We estimated that given poor first-year and adult survival, as is expected in a declining population, predator control could improve the population growth rate by 23%, from 0.65 to 0.79.

Controlling nest predators is expensive. At present it is usually practised as part of game management, with the benefits of predator control to songbirds being incidental.

Yellowhammers can fledge more chicks per season when predators are controlled, and population growth may be improved considerably as a result. © Peter Thompson/GWCT

Wild bird seed crops in the landscape

A wild bird seed mix containing maize and cereal adjacent to a beetle bank.
© Peter Thompson/GWCT

Since our research on wild bird seed crops a decade ago, this habitat has become a widely adopted option within Environmental Stewardship. The benefits to seed-eating birds, at least in the early part of the winter, are considerable. The same habitat can also provide a source of insect food for breeding birds as its management is less intensive than that of a conventional crop. However, we still do not know exactly what the benefits are or how these crops should best be distributed across a landscape to optimise those benefits.

We have data on songbird nesting success for 11 years and have explored the potential benefits of field-edge strips of wild bird seed crops to yellowhammers nesting in adjacent hedges.

After accounting for variation in predator control, weather and cropping, we found that yellowhammers nesting adjacent to such strips had increased clutch sizes and fledging success. Estimates of seasonal productivity suggested that these two effects could improve the number of chicks fledged by an average of 15% per pair. A simple population model suggested that at quantities present at Loddington (wild bird seed crops on 22% of boundaries), this could increase the annual population growth by 1% relative to a farm with no wild bird seed crops. Although this is only a small change, crops could also influence winter survival by providing seed food, especially if coupled with supplementary feeding in late winter. If combined on a managed shoot with predator control, the effect of which we predicted could improve population growth rate by 23% compared with no predator control, the benefits could be substantial.

From our previous work on yellowhammers, we know that they travel up to 270 metres from the nest to gather insect food for their young, whereas tree sparrows travel up to 220 metres and skylarks up to 200 metres. In winter, these same species can range 500 or 1,000 metres in search of seed food. These figures are useful in considering the distribution of wild bird seed crops across a farm, or as is more meaningful for bird conservation, across a landscape.

We mapped the distribution of existing wild bird seed crops in the upper Eye Brook catchment, including our farm at Loddington. We randomly allocated field boundary 'nest' sites across the landscape and assessed how many of them had access to wild bird seed crops within 200-metre and 300-metre ranges. We discounted blocks of maize planted purely as game cover as these provide little insect food in summer or seed food in winter. Three farms in the area had wild bird seed crops.

Eight percent of 'nests' were within 200 metres of wild bird seed mixtures and 18% were within 300 metres (see Figure 1). So, within our landscape, a substantial majority did not have access to this habitat, especially for species with 200-metre foraging ranges. Of course, foraging ranges are usually lower than these maximum values and many species do not travel this far for food. We also 'buffered' the wild bird

KEY FINDINGS

- Yellowhammer pairs nesting adjacent to wild bird seed crops produced 15% more chicks than pairs nesting further away.
- If such crops were present on a fifth of field boundaries, the annual population growth rate is predicted to be 1% higher than if none were present.
- Breeding season or winter foraging ranges provide a useful guide for planning the location of wild bird seed crops.

Chris Stoate
Patrick White
Frances Davis

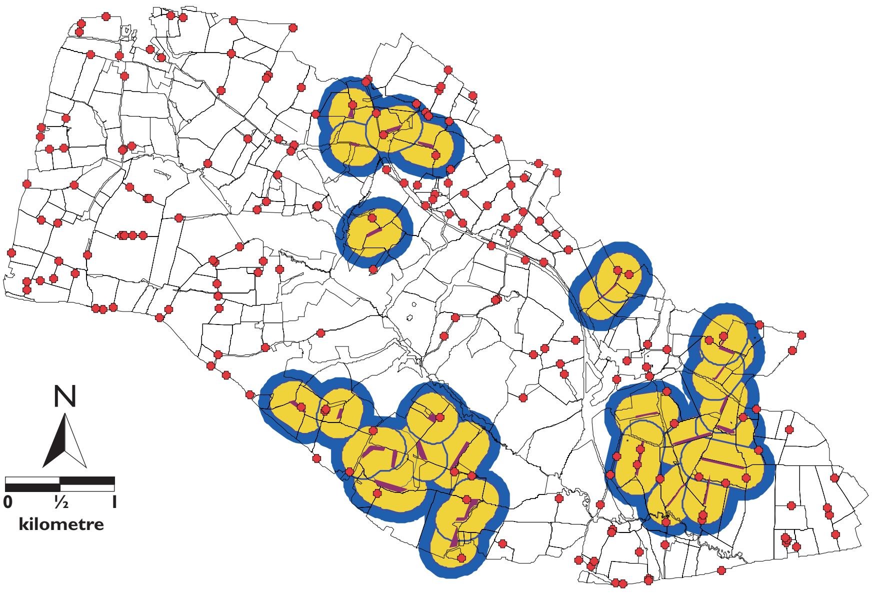


Figure 1

Randomly distributed 'nest sites' in the upper Eye Brook catchment, with breeding season foraging ranges for those within 200 metres of wild bird seed crops and for those within 300 metres

- Wild bird seed crop
- Area within 200 metres of a wild bird seed crop
- Area 200-300 metres from a wild bird seed crop
- Nest site

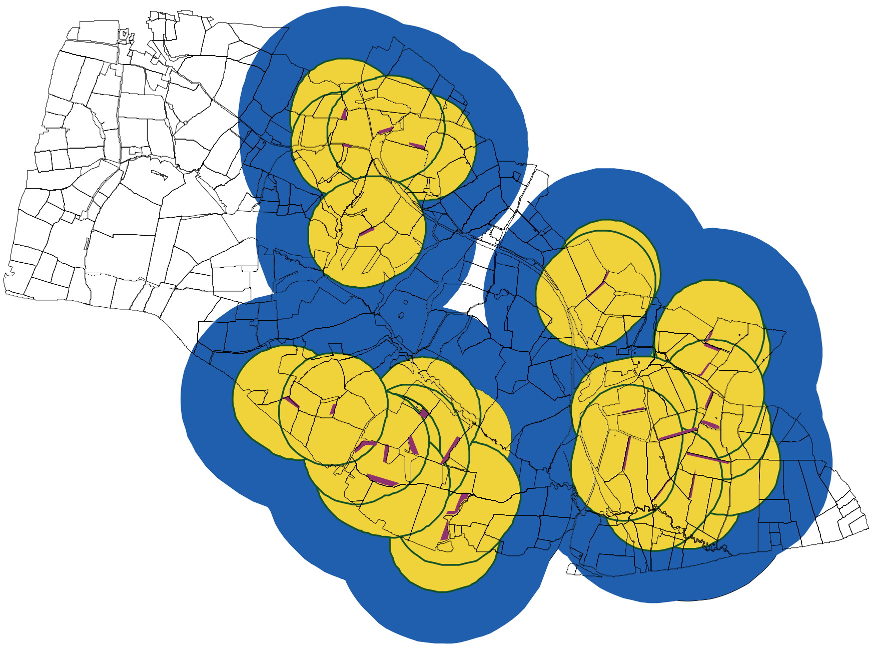


Figure 2

1,000 metre and 500 metre buffers around wild bird seed crops to represent the availability of this winter food source in the upper Eye Brook catchment

- 1,000 metre buffer
- 500 metre buffer
- Wild bird seed crop

seed crops to 1,000 metres to assess their availability to birds wintering in the upper Eye Brook. In this case, the three farms provide a food source for three quarters of the area (see Figure 2), at least for as long as the seed supply lasts. Using these summer and winter foraging ranges is a useful guide for planning the distribution of wild bird seed crops at a farm or landscape scale.

Tree sparrows will travel up to 220 metres from their nest to gather insect food for their young, and in winter will range up to 1,000 metres in search of seeds. © Peter Thompson/GWCT

Money down the mink sink: paying for Ratty

The River Monnow project took place on private land. More than 100 landowners granted us permission to access the river.
© Jonathan Reynolds/GWCT

In summer 2010, barring unexpected disasters, we expect to announce the success of our River Monnow demonstration project. The basic story will be that we have cleared American mink from a 400-square-kilometre pocket of Herefordshire, and successfully reintroduced water voles into it.

In 2006-7 we released captive-bred water voles at a density of about 35 per kilometre along the River Dore, chosen as the most favourable tributary of the Monnow. Newly reintroduced animal populations are very vulnerable to chance events. We know that both introduced and natural water vole colonies can go extinct within a few weeks of mink reaching them. So the continued presence of water voles throughout the Dore, three to four years after introduction, demonstrates that it is possible to reverse the biodiversity loss caused by American mink.

Although clearing mink from the River Dore in 2006 was relatively easy, we soon learned that in a couple of weeks it could refill through immigration. To provide some stability, we added a second field worker for 2008-10 and steadily extended the control area. This worked: as the mink control zone grew, invading mink were increasingly caught before they entered the River Dore. Mink detections fell, and the periods in which the Dore was demonstrably mink-free increased from zero in 2006 to 240 days in 2009. The cost for each mink-free day fell correspondingly, to finish at £306 per day in 2009. But that is a lot of money to spend on water voles, and it is unlikely to be available again, either here or elsewhere. So the obvious question is: how do we cut costs without losing the water voles?

Shortening the trapping season is an obvious option, but we think it carries too great a risk. After the initial clearance, the period from early May to mid-July was relatively mink-free, suggesting that a 10-week lay-off would be reasonable if workforce arrangements were this flexible. The risk would lie in failing to detect a pregnant female before trapping stopped. To put this into context, the food requirements of one female with five young during this period would be 77 water voles or their equivalent. Our founder stock was just 700 water voles. The progressive reduction of mink detections year by year suggests that any lay-off will have consequences later on. Even with intensive trapping, the short period that each mink is present before capture is serious: the 65 mink that entered the River Dore since we reintroduced water voles could have eaten about 400 water voles before capture.

Another option might be to withdraw effort from the innermost parts of the catchment and rely on trapping mink at entry points. But experience shows that we have not yet reached a scale where this is risk-free: mink entering over watersheds from neighbouring catchments can penetrate deep inside our control area within a few days.

Could we rely on volunteer labour to save the cost of two full-time employees? Although our fieldworkers lived centrally within the river catchment, vehicle mileage averaged 1,350 miles per month. Outsiders would incur greater mileage (and time) costs. Within the Monnow catchment, the human population is about 7,200 over-16s. There are very few professional gamekeepers or pest controllers. Monmouth itself, at

KEY FINDINGS

- Successful re-establishment of water voles in a Herefordshire river catchment hinged on continual, efficient removal of mink.
- At best, the cost per mink-free day was £306.
- Cost-cutting would introduce significant risk of mink invasion.
- Trap monitoring technology offers some hope.

Jonathan Reynolds

The equipment is simple, cheap and effective. More significant are costs of manpower and transport.
© Jonathan Reynolds/GWCT

No evidence of mink – what we like to see!
© Jonathan Reynolds/GWCT

the lower end of the catchment, has another 7,380 over-16s. In the UK as a whole, three people in every thousand do some voluntary conservation work, covering every aspect of the environment. We don't know how many hours each volunteer commits, but maybe voluntary effort could be found locally to supply the 50 hours per week needed for mink control. The larger the workforce, the less would be asked of each person – but the greater the problems with maintaining commitment, data collection (to monitor progress), and preserving good relationships with the 100+ landowners on whom the project depends for access to the river (over 40 visits to each raft each year). In addition, we need to find £8,700 per year for hardware and transport costs. So we are not optimistic about the volunteer model, at least for the Monnow.

Our last hope is technology. If, through an automated monitoring system, we could cut the manpower and mileage required, it might all become affordable. Trap monitors that send SMS-messages to your mobile phone are available, but as yet quite costly, and still to be tested for field reliability. Maybe, though, that is the shape of the future.

ACKNOWLEDGEMENTS

This project was supported by Defra's England Rural Development Programme, the John Ellerman Foundation, SITA Trust, and GWCT.

Our collaborator, Derek Gow, with one of his captive-bred water voles, prior to release.
© Jonathan Reynolds/GWCT

How habitat affects trout and salmon

A shaded site on a tributary of the River Teifi.
© Dylan Roberts/GWCT

KEY FINDINGS

- Trout and juvenile salmon numbers can be increased by excluding livestock from chalk rivers.
- Fencing livestock from upland rivers may not necessarily increase numbers of trout and juvenile salmon.
- Substrate coarseness, water depth and flow type are important in determining the carrying capacity of a stream for juvenile salmon and trout. Fencing upland rivers may have little effect on these factors.
- There are many other good reasons for fencing rivers including reducing run off and diffuse pollution.

Dylan Roberts

Since the early 1990s, we investigated the effect on numbers of brown trout and juvenile salmon of fencing out livestock from streams and tree cutting. The early work was based on the River Piddle, a chalk stream in Dorset. On this very productive stream, fish numbers responded positively once stock were fenced off and riparian vegetation allowed to recover.

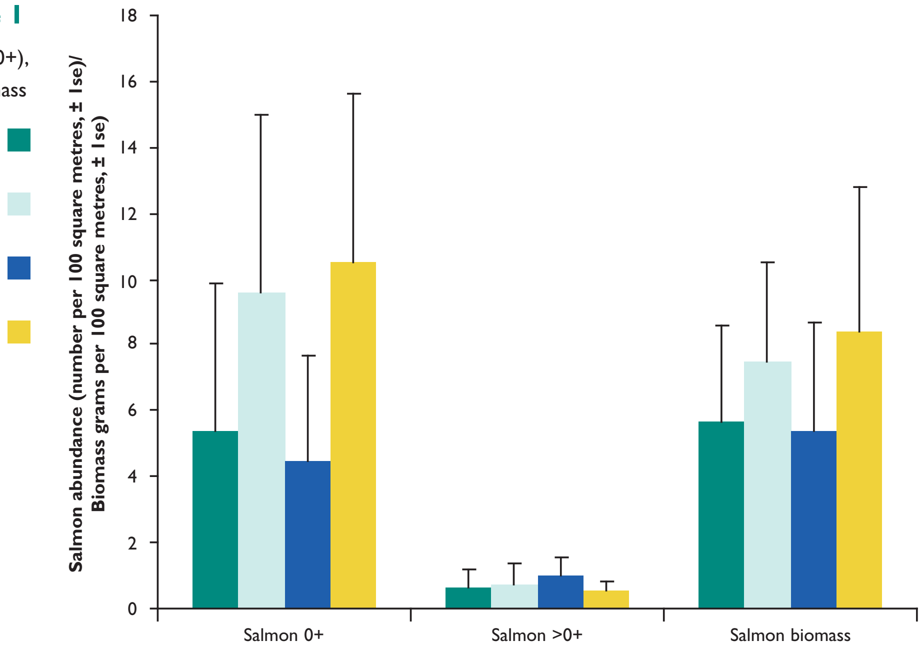
The next phase of this work in the late 1990s was in harsher climates and less productive streams of Herefordshire on the River Monnow, and mid-Wales on the Clywedog Brook. Results here showed little evidence of improvement in trout or juvenile salmon abundance following fencing out livestock or tree cutting to reduce shading. In 2006, we received funding from the Atlantic Salmon Trust for a three-year study to compare numbers and biomass of juvenile salmon and brown trout between fenced and unfenced, and shaded and unshaded reaches of tributaries of the Tywi and Teifi in West Wales.

We compared 33 reaches split into one of four categories: 1. fenced (stock excluded) and shaded, 2. fenced and not shaded, 3. unfenced and shaded and 4. unfenced and not shaded. We selected shaded reaches on the basis that more than 80% of the water was shaded, and unshaded reaches on the basis that less than 10% of the water was shaded. All reaches were grazed by sheep, dairy or beef cattle. Fenced reaches were made stock-proof with wire mesh on both sides of the stream. The length of reaches within each category averaged between 498 and 1,277 metres.

We divided the central 100 metres of each reach into two sites of approximately 50 metres and sampled them using electrofishing. We calculated fish densities for

Figure 1

Abundance of salmon fry (0+), parr (>0+) and biomass



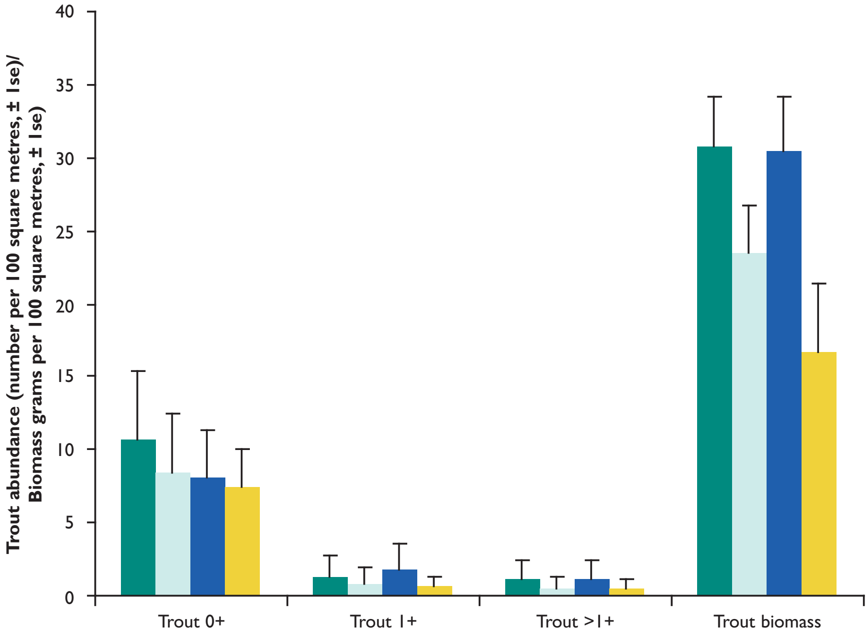


Figure 2

Abundance of brown trout fry (0+), parr (1+) and older trout (>1+) and biomass

- Fenced and shaded
- Fenced and unshaded
- Unfenced and shaded
- Unfenced and unshaded

salmon fry (0+) and parr (>0+) and trout fry (0+), parr (1+) and adults (>1+).

We found no statistically significant differences between numbers of juvenile salmon and brown trout recorded in the four categories (see Figures 1 and 2). Salmon fry (0+) seemed to be more abundant in unshaded sites, but the effect was not statistically significant.

We also collected data on water depth, substrate size and abundance of marginal vegetation at the sampling sites. When correlated with fish density, we found that densities of salmon >0+, trout 0+ and 1+ were significantly related to substrate, being highest in sites containing a predominantly cobble and boulder substrate (> 6cm diameter). In addition, densities of salmon 0+, trout 1+ and >1+ were significantly related to water depth, with salmon 0+ being more abundant at sites with a higher ratio of shallow water, and trout 1+ and >1+ more abundant where the ratio indicated deeper water. Trout biomass was also positively related to water flow and substrate.

Implications for management

Our work suggests that excluding livestock from the banks of chalk streams can increase the abundance of juvenile salmon and brown trout. This is caused by significant changes to the river width, depth, flow and amount of cover available following fencing. However, we have failed to replicate these results on upland rivers, because the physical habitat may not change as markedly within the river following stock exclusion on this naturally less productive river type. Hence care must be taken when targeting and planning the objectives of fencing projects on upland rivers.

ACKNOWLEDGEMENTS

We wish to thank the Atlantic Salmon Trust for sponsoring this work.

Electrofishing a grazed and un-shaded site on a tributary of the river Teifi. © Dylan Roberts/GWCT

East Stoke work in 2009

The salmon counter at East Stoke.
© Dylan Roberts/GWCT

In April 2009 we took over the running of the salmon research station on the banks of the River Frome and employed the three people who have been running the facility for a number of years, Dr Anton Ibbotson, Bill Beaumont and Luke Scott. The station is based at the Freshwater Biological Association site at East Stoke near Wareham in Dorset. This facility has been expanded to house our trout research and is now known as the Game and Wildlife Conservation Trust Salmon and Trout Research Centre. The centre and the River Frome catchment is of national and international importance in that it hosts a sophisticated system of fish monitoring using Passive Integrated Transmitter (PIT) tags to a detail unparalleled in the UK. The on-going work is aimed at monitoring the survival and migration of individual salmon both in the river and on their return from the sea and, by doing so, untangling some of the mysteries surrounding the factors that have caused such a dramatic decline in salmon numbers over the last 30 years

KEY FINDINGS

- PIT tagging revealed significant autumn migration of salmon parr into the lower Frome catchment.
- Numbers of grilse entering the Frome in 2009 was very poor.
- Survival of triploid trout eggs in the incubator boxes was poor.

Dylan Roberts

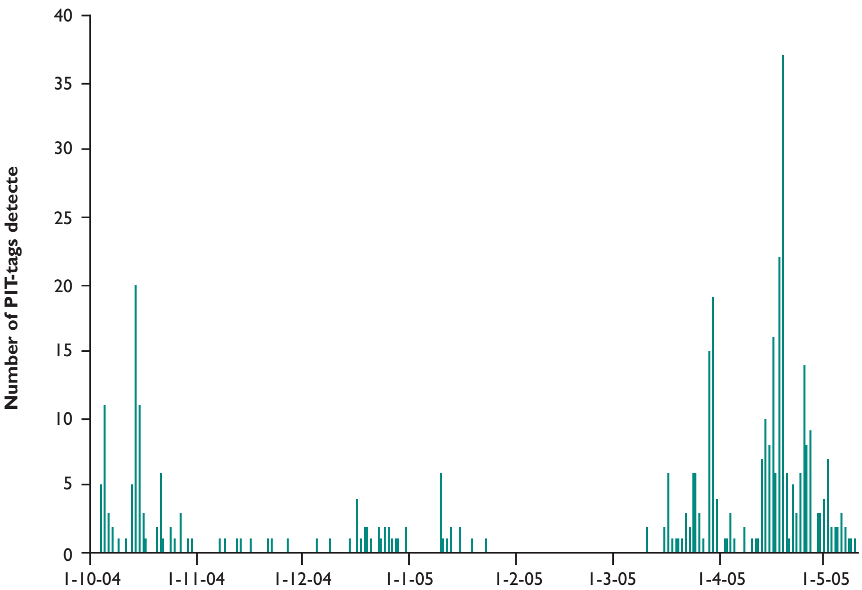
Salmon projects

The PIT-tagging programme has been undertaken since 2001 and, in total, some 60,000 salmon parr have been tagged. This includes 10,800 which were tagged in September 2009 by electrofishing several kilometres throughout the Frome catchment. We can now follow the survival of each fish, both in the river and when they return as adults from the sea.

Our PIT-tagging programme is showing that there is a significant downstream movement of salmon parr during the autumn to the lower end of the river (see Figure 1). Although this is not entirely unknown, we had not appreciated the scale of this migration. We have started to investigate whether it is changes or differences in

Figure 1

Autumn migration of parr and smolts from the River Frome



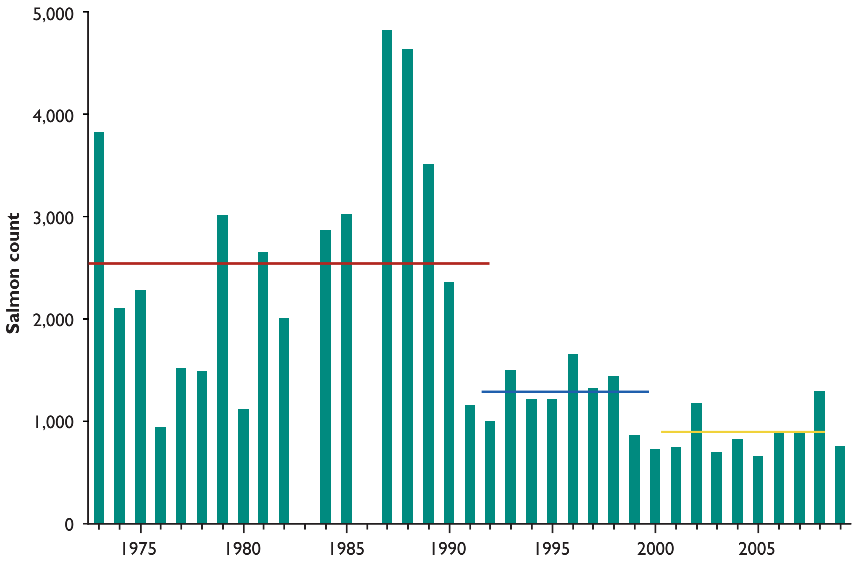


Figure 2

Gross salmon numbers 1973-2009

1973-1990 average = 2,620

1991-1998 average = 1,314

1999-2008 average = 876

habitat that cause this migration and whether these fish survive better or worse than those migrating in spring.

Numbers of multi-sea winter salmon entering the Frome in 2009 was encouraging. However, there was a marked decline in numbers of grilse. Overall, 2009 recorded the fifth lowest combined count of salmon and grilse (see Figure 2).

Trout projects

Our brown trout fry-stocking projects got underway in 2009 on the Rivers Piddle, Allen and Candover Brook (a tributary of the River Itchen). We aim to measure which fry-stocking technique produces the most catchable fish and if there are any effects on wild fish. Given the announcement by the Environment Agency that all trout stocked into rivers in England and Wales by 2015 must be triploid or native strain, we decided to focus our work on triploid trout and, through another study, native-strain fry (on the Candover Brook). We are therefore testing five stocking techniques:

- Triploid brown trout swim-up fry produced from eyed eggs in incubator boxes and stocked in April (photoperiod broodstock*).
- Triploid brown trout swim-up fry from a hatchery and stocked in April (photoperiod broodstock*).
- Triploid brown trout swim-up fry from a hatchery and stocked in January (normally-reared broodstock).
- Triploid brown trout fed fry from a hatchery and stocked in April (normally-reared broodstock).
- Native strain brown trout swim-up fry produced in incubator boxes and stocked in April.

We are also monitoring numbers and growth of wild trout in both the stocked and un-stocked control sites to assess effects on wild trout.

In early 2009 we put out four incubator boxes, two on the River Frome and two on the River Piddle, which we seeded with 18,000 eyed triploid brown trout eggs. In addition, we caught wild trout by electrofishing in December 2008 on the Candover Brook and the eggs of these fish were laid in incubator boxes on the brook and maintained by the Environment Agency. When the eggs hatched in spring 2009 and the young fish were ready to emerge from the boxes, we marked them with calcein so that we could differentiate them later from un-stocked fry. We also marked the other stocked fish from the hatchery with calcein and stocked these into separate randomly-selected study sites. In total, we used 24 stocked sites (six per stocking treatment) and six un-stocked control sites on the Piddle and Allen with sufficient buffer zones between sites to prevent mixing. We also stocked a further 13 100-metre sites on the Candover Brook with the native swim-up fry. We stocked fry at five per square metre, which is in line with current management practice.

In July and August we sampled all sites by electrofishing to assess numbers of stocked trout from each treatment and we also counted, measured and weighed wild trout to monitor any effects from the stocking treatment. Early data suggest that the survival of triploid eggs in the incubator boxes was poor and that the recapture rates of the stocked unfed fry was generally poor but the fed fry were recaptured in higher numbers. There is little evidence of impacts on wild fish from any stocking treatment so far. More detailed results will be available as the projects progress.

Dr Anton Ibbotson who runs the research at East Stoke. © Dylan Roberts/GWCT

** Photoperiod broodstock: normally, trout produce eggs in late autumn or early winter but by artificially increasing light levels during this period to increase day length (when it would be naturally decreasing) they can be manipulated to slow egg and sperm development until later in the winter. This technique is used on fish farms to produce new fish at different times of the year.*

ACKNOWLEDGEMENTS

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Research projects

by the Game & Wildlife Conservation Trust in 2009

WILDLIFE DISEASE AND EPIDEMIOLOGY RESEARCH IN 2009

Project title	Description	Staff	Funding source	Date
Gamebird health	*Disease prevention and control in game and wildlife*	*Chris Davis*	*Core funds*	*1998- on-going*
Rearing field (see page 12)	*Provision of the research facility for the grey partridge rearing programme*	*Chris Davis, Matt Ford*	*Core funds*	*2000- on-going*
PhD: Maternal immunity	*To investigate the extent of any immunity in pheasant chicks acquired from their mothers*	*Matthew Ellis Supervisors: Chris Davis, Dr Emma Cunningham/University of Edinburgh*	*BBSRC/CASE studentship*	*2006-2010*

LOWLAND GAME RESEARCH IN 2009

Project title	Description	Staff	Funding source	Date
Pheasant population studies	*Long-term monitoring of breeding pheasant populations on releasing and wild bird estates*	*Roger Draycott, Maureen Woodburn, Rufus Sage*	*Core funds*	*1996- on-going*
Monitoring of East Lothian LBAP	*Monitoring the effects of LBAP measures on bird populations in East Lothian*	*Dave Parish, Hugo Straker*	*Core funds*	*2003- on-going*
Grey squirrels and woodland birds	*Does grey squirrel control increase productivity in woodland birds?*	*Rufus Sage*	*European Squirrel Initiative*	*2007-2010*
Woodcock monitoring	*Examination of annual variation in breeding woodcock abundance*	*Andrew Hoodless*	*Shooting Times Woodcock Club*	*2003- on-going*
Testing the effects of unharvested crops on songbird populations	*Large-scale field experiment investigating the impact of winter feeding on songbird populations*	*Dave Parish, with RSPB Scotland*	*SGRPID*	*2004-2009*
Monitoring SGRPID's agri-environment schemes (see page 14)	*Comparing biodiversity on in- and out-scheme farms across Scotland*	*Dave Parish, various collaborators*	*SGRPID*	*2004-2009*
The management of grass-lands for wildlife and game	*Monitoring the impact of introduced game crops in grassland areas of south west Scotland*	*Dave Parish, collaboration with SAC*	*SAC, SGRPID*	*2008-2010*
Wild game cropping	*Productivity in wild game in East Anglia compared with cropping patterns*	*Roger Draycott*	*Felix Cobbold Trust, Chadacre Trust*	*2008-2010*
Released red-legged partridges	*Fate and dispersal in released red-legged partridges*	*Rufus Sage, Andrew Hoodless, Roger Draycott*	*Core funds*	*2008-2009*
Game marking scheme	*Study of factors affecting return rates of pheasant release pens*	*Rufus Sage, Maureen Woodburn, Andrew Hoodless, Roger Draycott*	*Core funds*	*2008- on-going*
Impacts of releasing	*Recovery of ground flora in pheasant release pens*	*Rufus Sage, Andrew Hoodless, Roger Draycott*	*Core funds*	*2007-2010*
Avon Valley waders (see page 20)	*Monitoring lapwing breeding success in relation to the Higher Level Scheme*	*Andrew Hoodless*	*Core funds, Natural England*	*2007-2010*
Birds in miscanthus	*Extensive surveys of summer bird use in miscanthus biomass crops*	*Rufus Sage*	*RSPB*	*2009*
Arable farming and birds	*Monitoring the response of birds to changes in farmland habitat and management*	*Roger Draycott*	*Sandringham Estate*	*2009- on-going*
PhD: Imprinting gamebird chicks (see page 22)	*Human imprinting gamebird chicks to release and recover as a tool for sampling chick-food invertebrates in crops*	*Gwendolen Hitchcock Supervisors: Rufus Sage, Dr Simon Leather/Imperial College, London*	*BBSRC/CASE studentship*	*2006-2010*
PhD: Trade-offs during pheasant growth and development	*Examination of the effects of carotenoid supplementation and parasite infection in early life on adult phenotype*	*Josephine Orledge Supervisors: Andrew Hoodless, Dr Nick Royle/University of Exeter*	*NERC/CASE studentship*	*2007-2010*
PhD: The management of grasslands for wildlife and game	*Autecological studies of granivorous birds in intensive agricultural grasslands of south west Scotland*	*Dawn Thomson Supervisors: Dave Parish, Dr Davy McCracken/SAC, Prof Neil Metcalfe/ University of Glasgow, Dr Jane MacKintosh/SNH*	*Core funds, SNH, SAC*	*2006-2012*
DPhil: Origins of over-winter woodcock (see page 18)	*The use of stable isotopes to study woodcock migration and winter movements*	*Adele Powell Supervisors: Andrew Hoodless, Dr Andrew Gosler/Edward Grey Institute/University of Oxford*	*The Countryside Alliance Foundation*	*2008-2011*

PARTRIDGE AND BIOMETRICS RESEARCH IN 2009

Project title	Description	Staff	Funding source	Date
Partridge count scheme (see page 24)	*Nationwide monitoring of grey and red-legged partridge abundance and breeding success*	*Neville Kingdon, Nicholas Aebischer, Julie Ewald, Dave Parish*	*Core funds*	*1933- on-going*
National Gamebag Census (see page 30)	*Monitoring game and predator numbers with annual bag records*	*Nicholas Aebischer, Gillian Gooderham, Peter Davey*	*Core funds*	*1961- on-going*
Sussex study	*Long-term monitoring of partridges, weeds, invertebrates, pesticides and land use on 62 square kilometres of the South Downs in Sussex*	*Julie Ewald, Nicholas Aebischer, Steve Moreby, 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*	*Core funds, Payne-Gallwey Charitable Trust*	*2007-2010*
Mammal population trends	*Analysis of mammalian bag and cull data from the National Gamebag Census under the Tracking Mammals Partnership*	*Nicholas Aebischer, Jonathan Reynolds Peter Davey*	*JNCC*	*2003-2010*
Transactional Environmental Support Systems (TESS)	*Designing an environmental support system across Europe*	*Julie Ewald*	*EU*	*2009-2010*
Agri-environment and grey partridges (see page 26)	*Examine grey partridge demographic responses to farm-scale use of English agri-environment schemes and options*	*Nicholas Aebischer, Julie Ewald, Suzanne Richardson*	*Natural England*	*2009*
Grey partridge recovery project (see page 28)	*Monitoring of land use, game and songbirds on the Royston demonstration project*	*Malcolm Brockless, Roger Draycott, Julie Ewald, Nicholas Aebischer*	*Core funds*	*2001-2009*
DPhil: Oxfordshire partridges	*To quantify the fate of released grey partridges in Oxfordshire*	*Elina Rantanen Supervisors: Francis Buner, Prof David McDonald & Dr Phil Riordan/ University of Oxford*	*Private individual donor, Core funds, Various charitable trusts*	*2006-2010*

UPLANDS RESEARCH IN 2009

Project title	Description	Staff	Funding source	Date
Strongylosis research (see page 44)	*Development of strongylosis control techniques*	*David Newborn, David Baines, Mike Richardson*	*Core funds*	*2006-2011*
Grouse monitoring (see page 34)	*Annual long-term counts and parasite monitoring*	*David Newborn, David Baines, Mike Richardson, Kathy Fletcher, David Howarth*	*Core funds, Gunnerside Estate*	*1980- on-going*
Black grouse research	*Ecology and management of black grouse*	*David Baines, Mike Richardson*	*Core funds*	*1989- on-going*
North Pennines Black Grouse Recovery Project (see pages 40 and 42)	*Black grouse restoration*	*Philip Warren, Frances Atterton*	*MoD, NE, RSPB, Northumbrian Water, North Pennines AONB, SITA Trust*	*1996-2011*
Otterburn Demonstration Moor	*Predator and habitat management for conservation benefits*	*David Baines, Craig Jones, Philip Chapman*	*Landmarc/Defence Estates*	*2008-2010*
Tick control	*Tick control in a multi-host system*	*Kathy Fletcher, David Howarth*	*Scottish Trustees, Various Trusts*	*2000-2010*
Woodland grouse - Scotland	*Ecology and management of capercaillie*	*David Baines, Allan Macleod*	*SNH, LIFE, Dulverton Trust*	*1991-2011*
Grouse ecology in the Angus Glens	*Roles of parasites, predators and habitat in determining grouse abundance in the Angus Glens*	*Kathy Fletcher, Laura Taylor*	*Core funds*	*2006-2012*
Monitoring Langholm Moor Demonstration Project (see page 38)	*Research data for oorland restoration to-achieve economically-viable driven grouse shooting and sustainable numbers of hen harriers*	*David Baines, Damian Bubb Paula Keane/RSPB, Aly McCluskie/RSPB*	*Core funds, Buccleuch Estates SNH, RSPB, NE*	*2008-2018*
Mountain hares	*Developing a reliable method for estimating mountain hare numbers*	*Scott Newey/MLURI Rob Raynor/SNH, David Baines*	*SNH, MLURI*	*2008-2010*
Spatial habitat use by black grouse in commercial plantation forests in Scotland	*Radio-tracking study of black grouse habitat use in and around plantations in Perthshire to derive forest-based management prescriptions*	*David Baines, Allan MacLeod*	*SNH, Cairngorms National Park Authority, Forest Enterprise Scotland*	*2009-2010*
Capercaillie and pine martens	*Assessment of changes in abundance indices of pine martens and other predator indices in Scottish forests used by breeding capercaillie*	*David Baines, Allan MacLeod*	*SNH, RSPB*	*2009-2010*
Conservation of grey partridges in the upland fringes	*Survey of the status, recent trends and habitat use by grey partridges in the upland fringes of northern England*	*Philip Warren*	*SITA Trust, Co Durham Environment Trust*	*2009-2011*
Scottish grouse moor economics	*Analysis of investment in moorland management*	*Adam Smith, Fraser of Allander Institute*	*Fraser of Allander Institute*	*2009-2010*

FARMLAND RESEARCH IN 2009

Project title	Description	Staff	Funding source	Date
Sawfly ecology	*Investigating the ecology of over-wintering sawflies*	*Steve Moreby, Tom Birkett*	*Core funds*	*2000-2010*
Re-bugging the system (see page 48)	*Investigating large-scale habitat manipulation for biocontrol*	*John Holland, Imperial College, Rothamsted Research, University of Kent Heather Oaten, Barbara Smith*	*RELU*	*2005-2009*
Farm4Bio	*Comparing different ways of managing uncropped land for farmland wildlife and to identify the proportion of land needed*	*John Holland & Rothamsted Research, BTO, The Arable Group, Tom Birkett, John Simper*	*Defra, HGCA, Bayer CropScience Ltd, BASF Ltd, Cotswolds Seeds, Dow AgroSciences Ltd, Du Pont, PGRO, Syngenta Ltd*	*2006-2011*
Perennial brood-rearing habitat (see page 46)	*Developing perennial brood-rearing habitat for grey partridges*	*Barbara Smith*	*Core funds*	*2007-2012*
Quarry restoration	*Measuring the success of quarry restoration using invertebrates as indicators*	*Barbara Smith, John Simper*	*Core funds*	*2006-2009*
PhD: Invertebrate aerial dispersal	*Examining the dispersal of beneficial invertebrates within arable farmland*	*Heather Oaten Supervisors: John Holland, Barbara Smith Dr S Leather/Imperial College, London*	*RELU*	*2005-2010*
PhD: Bumblebee nesting ecology	*Enhancing bumblebee nest site availability in arable landscapes*	*Gillian Lye Supervisors: John Holland, Prof Dave Goulson/University of Stirling, Dr Juliet Osborne/Rothamsted Research*	*NERC/CASE studentship*	*2005-2010*
PhD: The population genetics of sawflies	*The impact of population dynamics on genetics and the implications for habitat management*	*Nicola Cook Supervisors: Dave Parish, Dr Steve Hubbard/University of Dundee, Dr Joanne Russell & Dr Alison Karley/ Scottish Crop Research Institute*	*BBSRC/CASE studentship, Scottish Crop Research Institute*	*2007-2010*
PhD: Beetle ecology	*Molecular analysis of intra-guild predation and invertebrate community structure*	*Jeff Davey Supervisors: John Holland, Prof Bill Symondson/University of Cardiff*	*BBSRC/CASE studentship*	*2006-2010*

ALLERTON PROJECT RESEARCH IN 2009

Project title	Description	Staff	Funding source	Date
Effect of game management at Loddington (see page 56)	*Effect of ceasing predator control and winter feeding on nesting success and breeding numbers of songbirds. Use of feed hoppers.*	*Chris Stoate, Alastair Leake, John Szczur*	*Allerton Project funds Manydown Trust in 2009*	*2001- on-going*
Monitoring wildlife at Loddington (see page 50)	*Annual monitoring of game species, songbirds, invertebrates, plants and habitat*	*Chris Stoate, John Szczur, Alastair Leake, Steve Moreby, Sue Southway, Barbara Smith*	*Allerton Project funds*	*1992- on-going*
Wetting up farmland for biodiversity	*Assessment of bird conservation potential of small wet features on farmland*	*Chris Stoate, John Szczur*	*Defra*	*2004-2010*
Eye Brook community heritage project	*Community-based research into natural and cultural heritage of catchment as foundation for future management*	*Chris Stoate*	*Heritage Lottery Fund*	*2006-2010*
ClimateWater	*Climate change impacts on water as a resource and ecosystem*	*Chris Stoate*	*EU*	*2008-2011*
MOPS2: Mitigation options for phosphorus and sediment	*Development of constructed wetlands to reduce diffuse pollution*	*Chris Stoate, John Szczur*	*Defra*	*2009-2013*
Reducing risks associated with autumn wheeling of combinable crops	*Replicated field treatments looking at reducing compaction and increasing soil cover in tramline crop wheelings*	*Alastair Leake, Martyn Silgram (ADAS), John Quinton (University of Lancaster), Julian Hasler (HGCA/NFU)*	*ADAS, Chafer Machinery, Michelin, Simba*	*2009-2013*
Albrecht Soil Survey Technique (see page 52)	*Field-scale testing of the Albrecht Soil Survey Technique of nutrient management compared with conventional crop nutrition*	*Alastair Leake, Phil Jarvis*	*Royal Agricultural Society of England, the Glenside Group*	*2009-2012*
Slug control	*Field evaluation trials on new active ingredient for slug control*	*Alastair Leake, Phil Jarvis, Anthony Thevenot*	*Omex*	*2009*
Eye Brook game crops and woodland (see page 60)	*Influences of woodland structure and wild bird seed crop distribution on songbirds in the upper Eye Brook catchment*	*Chris Stoate, Frances Davis*	*Allerton Project funds*	*2009*
PhD: Songbird productivity and farmland habitats (see page 58)	*Influences on songbird nesting success in relation to habitat, predator abundance*	*Patrick White Supervisors: Chris Stoate, Dr Ken Norris/University of Reading*	*BBSRC/CASE studentship*	*2005-2009*

PhD: Game as food	Rural networks and processes associated with the use of game as food	Graham Riminton Supervisors: Chris Stoate, Dr Carol Morris & Dr Charles Watkins/University of Nottingham	ESRC/CASE studentship Supported by the BDS	2007-2010
PhD: Environmental learning careers of farmers and delivery of environmental goods through agri-environment schemes	An investigation into how farmers learn about effective environmental management through their active participation in agri-environment schemes	Susanne Jarratt Supervisors: Chris Stoate, Dr Carol Morris/ University of Nottingham	ESRC/NERC studentship	2009-2013

PREDATION RESEARCH IN 2009

Project title	Description	Staff	Funding source	Date
Fox control methods	Experimental field comparison of fox capture devices	Jonathan Reynolds, Mike Short	Core funds	2002- on-going
River Monnow project (see page 62)	Extension of mink control to the entire upper Monnow catchment, Herefordshire	Jonathan Reynolds, Ben Rodgers, Owain Rodgers	SITA Trust, John Ellerman Foundation, Core funds	2007-2010
Tunnel traps	Experimental field comparison of tunnel traps and methods of use	Jonathan Reynolds, Mike Short	Core funds	2008- on-going
PhD: Pest control strategy	Use of Bayesian modelling to improve control strategy for vertebrate pests	Tom Porteus Supervisors: Jonathan Reynolds, Prof Murdoch McAllister/University of British Columbia, Vancouver	Core funds, University of British Columbia	2006-2010

FISHERIES RESEARCH IN 2009

Project title	Description	Staff	Funding source	Date
Fisheries research	Develop wild trout fishery management methods including completion of write up/reports of all historic fishery activity	Dylan Roberts, Dominic Stubbing	Core funds	1997- on-going
Monnow habitat improvement project	Large-scale conservation project and scientific monitoring of 30 kilometres of river habitat on the River Monnow in Herefordshire	Dylan Roberts	Defra, Rural Enterprise Scheme, Monnow Improvement Partnership	2003- on-going
Salmon habitat (see page 64)	Pilot study to investigate bankside habitat management	Dylan Roberts, Dean Sandford	Atlantic Salmon Trust	2006-2009
Releasing trout fry	Survival of domesticated triploid farmed trout fry stocked from incubator boxes in chalk streams and their impacts on wild trout	Dylan Roberts, Dominic Stubbing	Core funds	2008-2013
Survival of native trout fry	Survival of native trout fry stocked from incubator boxes on the Candover Brook	Dylan Roberts, Dominic Stubbing	Vitacress Conservation Trust, , EA, Core funds	2008-2010
Salmon life history strategies in freshwater (see page 66)	Understanding the population declines in salmon	Anton Ibbotson, Dylan Roberts, William Beaumont, Luke Scott, Dominic Stubbing	Core funds, EA, CEFAS, Valentine Trust, Alice Ellen Cooper Dean Charitable Trust, AST, S&TA, Garfield Weston Foundation	2009- on-going
Salmon smolt rotary screw trap assessment	Calculating the effects of rotary screw traps on salmon smolts	Anton Ibbotson, Dylan Roberts, William Beaumont, Luke Scott, Dominic Stubbing	CEFAS	2009- on-going
PhD: Pike and weed management in lowland rivers	Impact of pike removal and weed management on brown trout	Sui Phang Supervisors: Dylan Roberts, Anton Ibbotson, Dr R Gozlan & Dr R Britten/University of Bournemouth	Core funds, University of Bournemouth	2009-2013
PhD: Water temperatures and salmonids	Micro habitat use by salmonids in relation to temperature	Frances Mallion Supervisors: Dylan Roberts, Anton Ibbotson, Dr P Kemp/University of Southampton	University of Southampton, Core funds, EA, CEH	2009-2013

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

Scientific publications

by staff of the Game & Wildlife Conservation Trust in 2009

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Note: the publications listed as 2007 and 2008 did not appear in print before the Review of 2008 went to press. For a complete record of the scientific publications by staff of the Game & Wildlife Conservation Trust, we therefore include them here.

Financial report
for 2009

KEY POINTS

- In response to the economic downturn, the Trust made savings of £400,000 compared with 2008.
- Income recovered in the year and exceeded the previous year by 2%.
- There was an increase in the value of total funds of 6%.

The summary report and financial statement for the year ended 31 December 2009, 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 Game Conservancy Events Limited. They do not comprise the full statutory Trustees' report and accounts, which were approved by the Trustees on 21 April 2010 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 was aiming for a small surplus or break-even in 2009, but trustees feel that the very small deficit (only half of one percent of income) was a reasonable result given the financial climate. Significant savings were achieved on expenditure compared with the previous year, but none of the savings prejudiced existing programmes or scientific projects. We continued to invest in expanding our policy work in both England and Scotland, as well as our education programmes. Expenditure on charitable activities as a percentage of total expenditure increased slightly, and governance costs reduced by 20%.

Investments performed well in the year with realised and unrealised gains of 8% of the value of the investments as at the start of the year.

The trustees have reassessed the Trust's financial expectations for 2010 in the light of continuing economic pressure and have implemented further cost savings to protect the Trust against inevitable uncertainty in fundraising in the current climate, but continue to be satisfied that the Trust's overall financial position is sound.

Plans for future periods

The key aims of the five-year business plan prepared in March 2008 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 it 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.

M H Hudson
Chairman of the Trustees

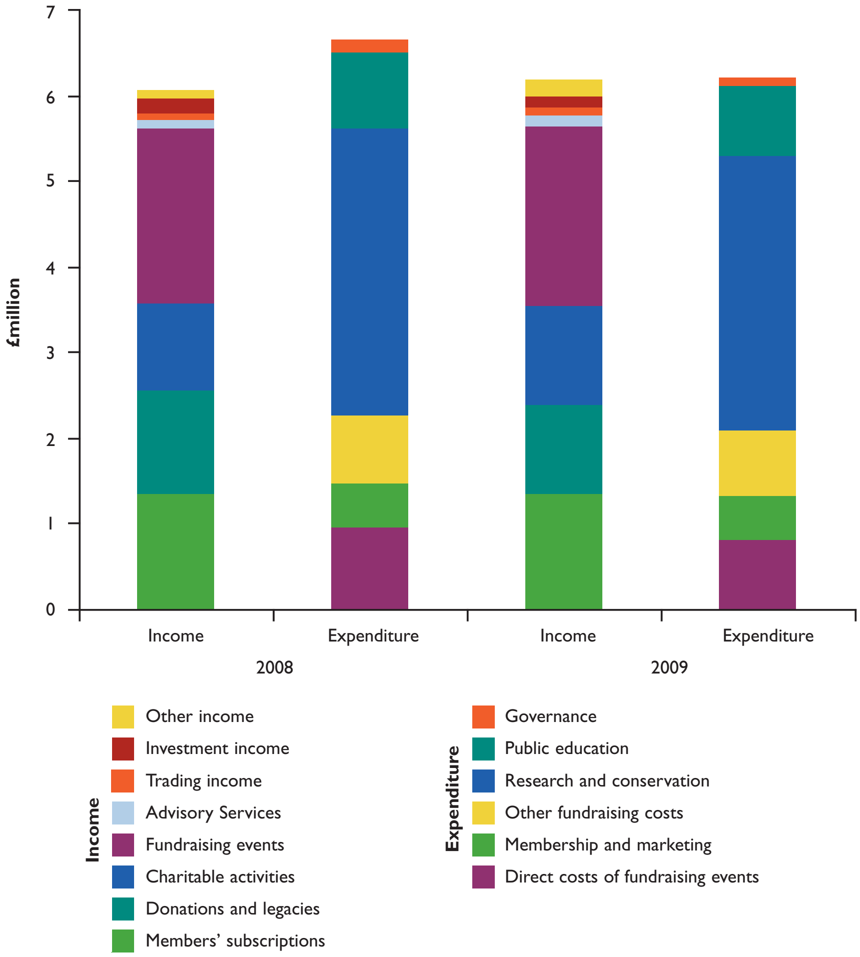

Figure 1

Incoming and outgoing resources in 2009 (and 2008) 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 2009 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 2008 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 2010

Consolidated

Statement of financial activities

	General Fund £	Designated Funds £	Restricted Funds £	Endowed Funds £	**Total 2009 £**	Total 2008 £
INCOME AND EXPENDITURE						
INCOMING RESOURCES						
Incoming resources from generated funds						
Voluntary income						
Members' subscriptions	1,343,396	-	5,773	-	**1,349,169**	1,355,363
Donations and legacies	492,391	-	543,568	-	**1,035,959**	1,205,033
	1,835,787	-	549,341	-	**2,385,128**	2,560,396
Activities for generating funds						
Fundraising events	2,087,719	-	17,378	-	**2,105,097**	2,030,949
Advisory Service	109,984	-	-	-	**109,984**	97,146
Trading income	107,115	-	-	-	**107,115**	94,485
Investment income	21,044	-	99,870	-	**120,914**	153,703
Incoming resources from						
Charitable activities	285,484	-	872,245	-	**1,157,729**	1,021,349
Other incoming resources	137,241	-	60,312	-	**197,553**	101,491
TOTAL INCOMING RESOURCES	4,584,374	-	1,599,146	-	**6,183,520**	6,059,519
RESOURCES EXPENDED						
Costs of generating funds						
Direct costs of fundraising events	812,567	-	-	-	**812,567**	955,660
Membership and marketing	514,892	-	-	-	**514,892**	516,064
Other fundraising costs	760,050	-	-	-	**760,050**	794,868
	2,087,509	-	-	-	**2,087,509**	2,266,592
Activities in furtherance of the charity's objects						
Research and conservation - Lowlands	1,226,360	-	405,809	-	**1,632,169**	1,743,042
Research and conservation - Uplands	314,773	-	354,124	-	**668,897**	853,784
Research and conservation - Allerton Project	101,548	-	546,042	-	**647,590**	625,114
Research and conservation - Fisheries	151,359	-	101,520	-	**252,879**	135,999
	1,794,040	-	1,407,495	-	**3,201,535**	3,357,939
Public education	658,569	-	157,737	-	**816,306**	885,633
	2,452,609	-	1,565,232	-	**4,017,841**	4,243,572
Governance	106,546	3,362	-	-	**109,908**	136,958
TOTAL RESOURCES EXPENDED	4,646,664	3,362	1,565,232	-	**6,215,258**	6,647,122
NET INCOMING/(OUTGOING) RESOURCES	(62,290)	(3,362)	33,914	-	**(31,738)**	(587,603)
OTHER RECOGNISED GAINS AND LOSSES						
Realised gains/(losses) on investments	28,962	-	-	10,024	**38,986**	72,947
Unrealised gains/(losses) on investments	59,977	-	-	154,172	**214,149**	(319,865)
NET MOVEMENT IN FUNDS	26,649	(3,362)	33,914	164,196	**221,397**	(834,521)
BALANCES AT 1 JANUARY 2009	2,317,136	193,886	507,449	4,079,019	**7,097,490**	7,932,011
BALANCES AT 31 DECEMBER 2009	£2,343,785	£190,524	£541,363	£4,243,215	**£7,318,887**	£7,097,490

Consolidated

Balance sheet

as at 31 December 2009

		2009		2008
	£	£	£	£
FIXED ASSETS				
Tangible assets		3,088,213		3,216,364
Investments		3,155,041		3,284,470
		6,243,254		6,500,834
CURRENT ASSETS				
Stock	150,778		196,773	
Debtors	1,188,221		922,588	
Cash at bank and in hand	531,691		370,205	
	1,870,690		1,489,566	
CREDITORS:				
Amounts falling due within one year	541,603		566,068	
NET CURRENT ASSETS		1,329,087		923,498
TOTAL ASSETS LESS CURRENT LIABILITIES		7,572,341		7,424,332
CREDITORS:				
Amounts falling due after more than one year		253,454		326,842
NET ASSETS		£7,318,887		£7,097,490
Representing:				
CAPITAL FUNDS				
Endowment funds		4,243,215		4,079,019
INCOME FUNDS				
Restricted funds		541,363		507,449
Unrestricted funds:				
Designated funds	190,524		193,886	
Revaluation reserve	392,591		446,695	
General fund	1,921,664		1,914,816	
Non-charitable trading fund	29,530		(44,375)	
		2,534,309		2,511,022
TOTAL FUNDS		£7,318,887		£7,097,490

Approved by the Trustees on 21 April 2010 and signed on their behalf

M H HUDSON
Chairman of the Trustees

Staff

of the Game & Wildlife Conservation Trust in 2009

CHIEF EXECUTIVE	Teresa Dent BSc, FRAgS
Personal Assistant (p/t)	Wendy Smith *(p/t from Sept)*; Liz Scott *(p/t from Sept)*
Head of Finance	James McDonald ACMA
Finance Assistant - Trust	Stephanie Slapper *(until Sept)*
Finance Assistant - Limited	Lin Dance
Accounts Clerk (p/t)	Sharon Duggan *(until May)*
Accounts Assistant (p/t)	Charlotte Ferguson *(from Sept)*; Suzanne Hall *(from October)*
Head of Administration & Personnel	Ian Collins MCIPD, BA
Administration & Personnel Assistant (p/t)	Jayne Cheney
Receptionist/Secretary	Joanne Hilton *(until Sept)*
Head Groundsman	Craig Morris
Headquarters Cleaner (p/t)	Rosemary Davis
Headquarters Janitor (p/t)	Chris Johnson
Head of Information Technology	James Long BSc
IT Assistant	Caroline Townend *(until November)*

DIRECTOR OF POLICY AND PUBLIC AFFAIRS	Stephen Tapper BSc, PhD
Head of Media	Morag Walker MIPR
Publications Officer	Louise Shervington
PR Assistant (p/t)	Jane Bushnell

DIRECTOR OF RESEARCH	Nick Sotherton BSc, PhD
Secretary (p/t)	Lynn Field
Head of Fisheries Research	Dylan Roberts BSc
Fisheries Biologist	Dominic Stubbing HND, MIFM, PhD
Fisheries Biologist	Dean Sandford BSc *(until May)*
Placement Student *(Sparsholt College)*	Paul Clancy *(July-Sept)*
Head of East Stoke Fisheries	Anton Ibbotson BSc, PhD *(from October)*
Senior Fisheries Scientist East Stoke	Bill Beaumont MIFM *(from April)*
Research Assistant East Stoke	Luke Scott *(from April)*
Placement Student East Stoke *(University of Durham)*	Jeffrey Mashburn *(Sept-Oct)*
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
Senior Scientist - Pheasants, Woodcock	Andrew Hoodless BSc, PhD
PhD Student *(Imperial College, London)* - pheasant chick foraging	Gwen Hitchcock BSc
PhD Student *(University of Exeter)* - pheasant growth and development	Josie Orledge BSc
DPhil Student *(University of Oxford)* - woodcock migration	Adele Powell BSc, MSc
MSc Student *(University of Reading)* - lapwings	Annalea Beard BSc
MSc Student *(University of Reading)* - lapwings	Vicky Buckle BSc
MSc Student *(University College, London)* - pheasant releasing & inverts	Naomi Collingham BSc
MSc Student *(University of Southampton)* - pheasant releasing & inverts	Samantha Bull BSc
MSc Student *(Imperial College, London)* - Miscanthus and bird research	Rosindra Davis MSc *(April-July)*
Placement Student - *(University of Plymouth)*	Claire Armstrong *(February-August)*
Placement Student - *(University of Bath)*	Matt Cooke *(until September)*
Placement Student - *(University of West of England)*	Sammy Leir Veater *(until February)*
Placement Student - *(University of Cardiff)*	Mark Hillsley *(from August)*
Placement Student - *(University of Bath)*	Amy Williams *(from September)*
Senior Scientist - Scottish Lowland Research	David Parish BSc, PhD
MSc Student *(University of Glasgow)* - yellowhammer ecology	Dawn Thomson BSc
MSc Student *(University of Dundee)* - population genetics of sawflies	Nicki Cook BSc
Head of Wildlife Disease & Epidemiology	Chris Davis BVM&S, MRCVS
Rearing Field Technician	Matt Ford
Rearing Field Assistant - *(University of Cumbria)*	Gavin Johnston *(April-August)*
Head of Predation Control Studies	Jonathan Reynolds BSc, PhD
Research Assistant	Mike Short HND
Research Assistant	Thomas Porteus BSc, MSc
Research Assistant	Suzanne Richardson BSc, MSc
Research Assistant	Ben Rodgers BSc
Research Assistant	Owain Rodgers
Research Assistant	Cameron Walker *(July-August)*
Research Assistant	James McDonald *(July-August)*
Head of Entomology Farmland Ecology	John Holland BSc, MSc, PhD
Post-Doctoral Senior Scientist - Entomologist	Barbara Smith BSc, PhD
Senior Entomologist	Steve Moreby BSc, MPhil
Entomologist	Sue Southway BA
Ecologist	Tom Birkett BSc, PgC
Ecologist	John Simper BSc, MSc
PhD Student *(Imperial College, London)* - insect dispersal	Heather Oaten BSc, MSc *(until September)*
PhD Student *(University of Stirling)* - bumblebees	Gillian Lye BSc
PhD Student *(University of Cardiff)* - predatory insects	Jeff Davey BSc
Placement Student *(University of Bath)*	Sam Cruikshank *(from September)*
Placement Student - *(University of West of England)*	Sammy Leir Veater *(March-August)*
Director of Upland Research	David Baines BSc, PhD
Office Manager, The Gillett	Julia Hopkins
Black Grouse Recovery Officer	Phil Warren BSc, PhD
Project Assistant - Black Grouse	Frances Atterton BSc, MSc *(from March)*
Researcher - Mountain Hares	Unai Castillo *(September-December)*
Research Assistant	Michael Richardson BSc

Research Assistant	Darrin Woods BSc *(March-October)*
Research Ecologist Langholm	Damian Bubb BSc, PhD
Head Gamekeeper - Otterburn	Craig Jones
Beatkeeper - Otterburn	Phil Chapman
Placement Student *(University of East Anglia)*	Richard Francksen *(until July)*
Placement Student *(University of York)*	Joanna Greetham *(until July)*
Placement Student *(University of Durham)*	Laura Kirk *(from August)*
Placement Student *(Harper Adams University College)*	Huw Lloyd *(from August)*
Senior Scientist - North of England Grouse Research	David Newborn HND
Senior Scientist - Scottish Upland Research	Kathy Fletcher BSc, MSc, PhD
Research Assistant - Scottish Upland Research	David Howarth
Research Assistant - Scottish Upland Research	Allan MacLeod BSc
Project Scientist - Angus Glens	Laura Taylor BSc
Placement Student *(University of Plymouth)*	Robert Dunn *(until August)*
Placement Student *(University of Durham)*	John Woods *(until August)*
Placement Student *(Harper Adams University College)*	Melanie Brown *(from August)*
Placement Student *(University of York)*	Hannah Gooch *(from August)*
Head of the Allerton Project	Alastair Leake BSc (Hons), MBPR (Agric), PhD, ARAgS, MIAgM, CEnv
Secretary (p/t)	Natalie Augusztinyi
Head of Research for the Allerton Project	Chris Stoate BA, PhD
Ecologist	John Szczur BSc
PhD Student *(University of Nottingham)* - game as food	Graham Riminton BSc
PhD Student *(University of Stirling)* - birds and bees	Jenny Jacobs BSc *(until September)*
PhD Student *(University of Reading)* - songbirds and farmland	Patrick White BSc PhD *(until September)*
PhD Student *(Univ of Nottingham)* - farmers' environmental learning	Susanne Jarratt BSc *(from September)*
MSc Student *(University of Lancaster)* - game crops	Frances Davis BSc *(from May)*
Placement Student *(Harper Adams University College)*	Ben Hazell *(until July)*
Placement Student *(Unit of Tours)*	Anthony Thevenot Francois Rabelais *(June-August)*
Placement Student *(Harper Adams University College)*	Claire Anderson *(from August)*
Farm Manager	Philip Jarvis HND
Farm Assistant	Michael Berg

DEPUTY DIRECTOR OF RESEARCH	Nicholas Aebischer Lic ès Sc Math, PhD
Secretary & Librarian	Gillian Gooderham
Assistant Biometrician	Peter Davey BSc
Grey Partridge Ecologist	Francis Buner Dipl Biol, PhD
Visiting PhD Student *(University of León)* - partridge ecology	Carlos Sánchez García-Abad BVSc *(from November)*
Placement Student *(King Mongkut's University of Technology, Bangkok)*	Niti Sukumal *(March-April)*
Head of Geographical Information Systems	Julie Ewald BS, MS, PhD
Partridge Count Scheme Co-ordinator	Neville Kingdon BSc
Research Assistant - GIS	Vikki Kinrade BSc, MSc *(until December)*
Placement Student *(John Moores, Liverpool)*	Laura Brown *(until September)*
Placement Student *(University of Plymouth)*	Hayley New *(until September)*
Placement Student *(University of Cardiff)*	Penny Holgate *(from September)*
Placement Student *(University of York)*	Christopher Wheatley *(from September)*

DIRECTOR OF FUNDRAISING	Edward Hay
Personal Assistant	Charlotte Harmer BA
National Events Co-ordinator	Sophie Sutcliffe BA
London Events Assistant	Florence Mercer
Northern Regional Fundraiser (p/t)	Sophie Dingwall
Southern Regional Fundraiser	Max Kendry
Eastern Regional Fundraiser	Lizzie Herring
Fundraiser - Scotland	Andrew Dingwall-Fordyce

DIRECTOR OF MEMBERSHIP & MARKETING	Andrew Gilruth BSc
Head of Membership Records	Corinne Duggins Lic ès Lettres *(until September)*
Supporter Relations Administrator - Donations (p/t)	Beverley Mansbridge *(until September)*
Supporter Relations Administrator - New members (p/t)	Suzanne Fairbairn *(until September)*
Supporter Relations Administrator - Renewals	Angela Hodge *(until September)*
Supporter Relations Administrator - BDS	Annie Nadin *(until May)*
Corporate Sponsorship Manager	Liz Scott *(until September)*
Head of Database	Corinne Duggins Lic ès Lettres *(from September)*
Database Assistant (p/t)	Beverley Mansbridge *(from September)*
Membership Manager	Alexandra Bonczoszek BA *(from September)*
Membership Assistant	Angela Hodge *(from September)*
Administrator (p/t)	Suzanne Fairbairn *(from September)*
Head of Telesales	Joanne Hilton *(from September)*
Corporate Partnership Manager	Philip Coley BSc *(from August)*

DIRECTOR SCOTLAND	Ian McCall BSc[1]
Secretary - Scottish HQ (p/t)	Irene Johnston
PR & Education - Scotland (p/t)	Katrina Candy HND
Head of Scottish Policy	Adam Smith BSc, MSc, DPhil
Scottish Game Fair Director (p/t)	Garry Barnett
Scottish Game Fair Secretary (p/t)	Corrina Gow
Shows Assistant (p/t)	Alex Towns

DIRECTOR OF ADVISORY & EDUCATION	Ian Lindsay BSc[3]
Co-ordinator Advisory Services (p/t)	Lynda Ferguson
Advisor/Development Officer	Alex Butler
Field Officer – Farmland Ecology	Peter Thompson DipCM, MRPPA (Agric)
Head of Education	Mike Swan BSc, PhD[4]
Regional Advisor - Central & Southern Scotland & Northern England	Hugo Straker NDA[2]
Regional Advisor - Eastern & Northern England (p/t)	Martin Tickler MRAC
Regional Advisor - North East	Henrietta Appleton BA, MSc
Game Manager - Royston	Malcolm Brockless

[1] Ian McCall is also Regional Advisor for Tayside, Fife, Northern Scotland & Ireland; [2] Hugo Straker is also Development Officer for Central and Southern Scotland; [3] Ian Lindsay is also Regional Advisor - Wales, Midlands; [4] Mike Swan is also Regional Advisor for the South of England.

Notes