Fields for the future

The Allerton Project - A winning blueprint for farming, wildlife and the environment

Chris Stoate, Alastair Leake, Phil Jarvis and John Szczur

www.gwct.org.uk/allerton

Game & Wildlife
CONSERVATION TRUST
The Allerton Project

Acknowledgements

Lord and Lady Allerton died within two years of each other and in April 1992 the Allerton Project was set up. The project stemmed from Lord and Lady Allerton's keen interest in shooting and its role in the wider countryside. The project set out to investigate the effects that different farming methods have on the environment and to evaluate and demonstrate farming practice designed to enhance wildlife and environmental quality.

This report is dedicated to the memory of Susan Treadwell, grand-daughter of Lord Allerton, Trustee of the Allerton Project and a Vice-President of the Game & Wildlife Conservation Trust, who showed an inspiring and generous dedication to the project and its staff, and to Philip Grimes, the Project founder chairman, whose vision made it possible.

The Allerton Project team. (L-R) – Katy Machin (Project PA), Phil Jarvis (Head of Farming), Jim Egan (Head of Development and Training), Michael Berg (Farm hand), Chris Stoate (Head of Research), James Watchorn (Gamekeeper), Alastair Leake (Head of Project), Ben Jarvis (Assistant Farm Hand) and John Szczur (Ecologist).

The Trust wishes to acknowledge with enormous gratitude the most generous gift made by Lord and Lady Allerton of the Loddington Estate and the endowment which accompanied this extraordinary bequest. We owe thanks to Philip Grimes, the Allerton Project's Founder Chairman whose vision made it possible, and to his successors, Sir Charles Morrison, Mike Barnes and James Keith; to our Trustees; Andrew Christie-Miller, Tom Cook, Joe Cowen, Hugh Oliver-Bellasis, Keith Preston and Susan Treadwell, whose expertise and sound judgement have guided the project wisely through the first two decades. We wish to thank our members, supporters and fundraisers all of whom have had a hand in making the Allerton Project the success story it is today.

We are grateful to the many funders of our research work, both from Government and industry, to our research partners in universities and other organisations across the country, to the PhD and MSc students who have contributed to our collective knowledge, and to the farmers on whose land we have worked and who have provided feedback on our ideas. In particular thanks to Nigel Boatman and Malcolm and Sarah Brockless who were involved with the project at the start.

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Visitors to the Allerton Project on Open Farm Sunday. (Front cover picture: yellowhammers © Laurie Campbell.)

Contents

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Foreword

Anyone who wants to see a bright and hopeful future for British agriculture should visit the Allerton Project. Where the Allerton farm at Loddington leads, farmers across the country need to follow. The steadily increasing pressure on land across the world makes the 20 plus years of science based achievements of the Project very welcome, but also of the highest importance to us all.

Demand for food - projected to 2050

Demand for food will rise with the increase in population across the world, yet available agricultural land will not. In just over 10 years' time, the population of sub-Saharan Africa alone is projected to grow by the equivalent of about 1,000 cities the size of Edinburgh. The global changes in climate and other factors will have variable effects upon agriculture, and consequently north-west Europe will have to rely less on the harvest from the rest of the world, while simultaneously the world will become more reliant on our production.

Even if we reduce our own demand – by moderating consumption and reducing waste, it is unlikely that this will accommodate a growth of 35% of world population by 2050. Growing more, without more land, will require an intensification of agricultural production.

Although we need to produce more, we know that high output modern agricultural practice has had some widespread and damaging environmental consequences. Agricultural production is, and has been, using natural capital at an unsustainable rate. Our environment provides us with very many goods and services that we rely upon: from the fertility of soils which underpins production, the provision of fresh water, natural pest control, the look of the landscape and the recreational value of the countryside, to the biodiversity of the plants, animals and birds that so many people deeply appreciate. It is increasingly acknowledged, by international and national Government and civil society, that intensification needs to be undertaken in a way that makes farming more sustainable.

> *"Long may the Allerton Project continue to show us that seemingly insurmountable challenges may actually be substantially more surmountable than most expect."*
>
> Tim Benton, UK Champion for Global Food Security & Professor of Population Ecology, University of Leeds

Sustainable intensification - how?

Therefore, the huge challenge we face is to move towards 'sustainable intensification'. How can we do this while reversing the unsustainable historical practices? Many apparently 'wildlife-friendly' farming methods which have lower yields, cannot alone be the solution, as they require more land to maintain the same level of production. Clever, innovative interventions in our farming systems are needed to show how growing production can go hand-in-hand with managing the benefits that our ecosystems provide, while reducing the conflicts between each. The Allerton Project continues to be an exemplary incubator for many of the innovations which demonstrate how to intensify sustainably.

Aligned productivity with ecology

Now, and in the future, farmers will need to manage the land by aligning production with ecological needs. There is considerable scope for innovation in our thinking. We need highly efficient production in the centres of fields while unfarmed areas such as field margins, should become increasingly efficient at providing ecosystem services. Achieving a landscape-wide network of unfarmed but highly managed land which is wildlife-friendly, and treating this as integral with productive land at both the field and catchment level, has been the major achievement of this Project. Likewise, by promoting community engagement and building trust, this Project has uniquely shown the way.

Long may the Allerton Project continue to show us that seemingly insurmountable challenges have options and answers.

Professor Tim Benton, UK Champion for Global Food Security & Professor of Population Ecology, University of Leeds

Overview

Since the start of the Allerton Project in 1992, agricultural policy objectives have changed from reducing food surpluses to combining the need for food security with environmental objectives. The project has played a key role in influencing this policy through its own farm business and research activities. Game management has been shown to have beneficial effects on other wildlife through habitat management, predator control and supplementary feeding in winter. At Allerton, the abundance of many bird species soared. Habitats have been developed and created in the non-cropped area to benefit a range of terrestrial wildlife, while measures to improve water quality and aquatic wildlife have been developed within and outside the cropped area.

Wherever possible, we identify management practices that have multiple benefits, such as woodland management for game, wildlife, carbon sequestration and wood fuel for our own buildings. Reduced tillage of soil improves soil moisture retention and soil structure for crops, and reduces crop establishment costs and carbon emissions, as well as improving water quality. Our research is conducted at a range of scales, and much of it is carried out in collaboration with other research organisations and through co-supervised PhD and MSc studentships.

The results of our research are used to influence agri-environmental policy at national level, and practice at the individual farm level through our demonstration work. Visitors to the project include policy makers, regulators, farmers, advisors, students and most recently, schools. We have a number of initiatives that involve the local community in improving our shared understanding of agricultural and environmental issues.

The Allerton Project is a combination of commercial farming, research, demonstration and community engagement. This provides an exceptional opportunity to contribute to current and future development of ways of integrating agricultural and environmental objectives that are scientifically sound and practically grounded.

We lead the way in maintaining intensive agricultural production, while boosting wildlife production on an impressive scale.

> *"Farmers sometimes ask me, rather colloquially: "Do you want me to produce food or birds?" The Allerton Project has shown us that there neither need be or should be a choice. For that alone it has earned its place in history."*
>
> Sir James Paice, former Minister of State for Agriculture and Food & Allerton Project Chairman, 2015-ongoing

History in the making

The farm at Loddington, Leicestershire is the former home of Lord and Lady Allerton who bought the estate in 1934. The Allertons were keen on fieldsports, although they had not managed their own farm for this purpose. The executors of their will set up the Allerton Research and Educational Trust in April 1992 to own and manage the farm. The Trust's objectives were:

- To advance **public education** in different **farming methods** and the effects thereof on the **environment and wildlife** (both flora and fauna).
- To conduct **research** into different **farming methods** and the effects thereof on the **environment and wildlife** (both flora and fauna) and to **disseminate** the useful results of such research.

The project set out to explore the potential of game management on farmland for meeting wider environmental objectives. These activities were managed by the Game & Wildlife Conservation Trust (then The Game Conservancy Trust) which had a long history of research into agricultural ecosystems. The project formally became the Game & Wildlife Conservations Trust's 'Allerton Project' in 2006.

A changing political scene

Key points

- Growing concerns about global food security.
- Intensification of agriculture at odds with wildlife conservation.
- Stewardship schemes to boost farmland wildlife have been adopted nationally.
- Increased focus on climate change, land use and water.

> *"The Allerton Project has shown that ordinary farms can make a profit while still doing extraordinary work for wildlife. Many farmers and landowners have visited it over the past 20 years and have left inspired to do more for wildlife on their own land."*
>
> Helen Woolley,
> Director General, CLA

During the life of the Allerton Project there have been growing concerns about climate change, global food security and the need to feed a growing human population from diminishing land, fuel and nutrient resources.

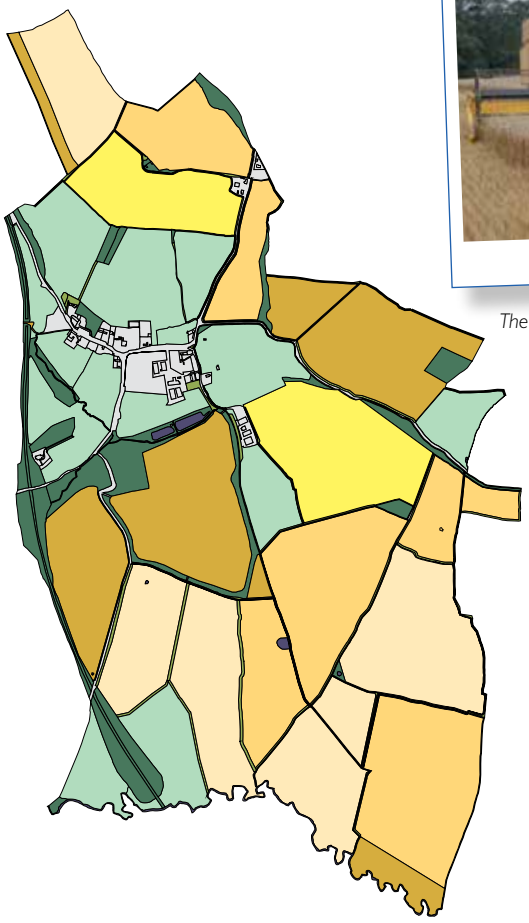
Calls for intensification of agriculture to satisfy increased food demands appear at odds with wildlife conservation, but the Global Ecosystems Assessment, published in 2005, casts new light on the role of biodiversity in meeting the needs of a rapidly increasing population. In 2011, the UK's own National Ecosystems Assessment and the Government's Natural Environment White Paper which it helped to inform, set out an agenda for integrating biodiversity conservation with productive farming.

Countryside Stewardship has played an important part in the conservation of farmland wildlife across the UK. The ground-breaking research carried out on the Allerton Project farm at Loddington has played a pivotal role in developing habitat options that not only deliver, but have been adopted by farmers across the country.

More recently, the EU Water Framework Directive has had an increasing influence on land use policy and management and has contributed to our focus on the relationship between productive land use and water quality and ecology.

Growing the farm business for crops and wildlife

Allerton Project cropping 1991/92



The farm has been managed as a commerical business and wheat and oats are grown to Conservation Grade standards.

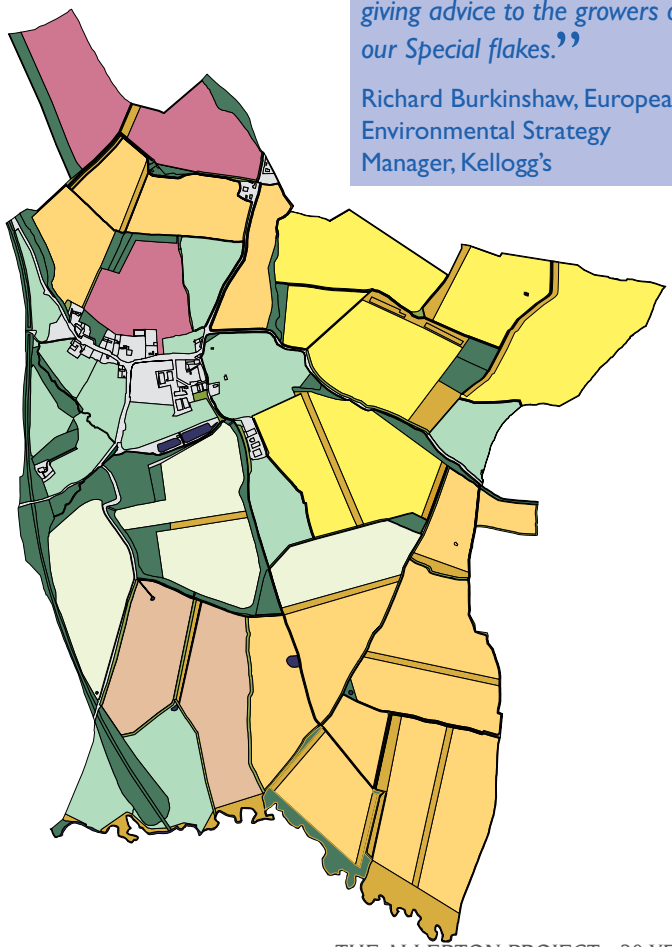
Figure 1
Allerton Project cropping 1991/92 and 2014/15

- Woodland
- Permanent pasture
- Winter wheat
- Winter barley
- Winter beans
- Winter oilseed rape
- Winter oats
- Red clover and lucerne
- Set-aside/Stewardship and CFE
- Hedgerow/verge

"Kellogg's is proud to be working with the Allerton project since the foundation of our UK Origins Project in 2013. We value the expertise, independence and integrity in demonstrating best practice and giving advice to the growers of our Special flakes."

Richard Burkinshaw, European Environmental Strategy Manager, Kellogg's

Allerton Project cropping 2014/15



Allerton Project: farming

In many respects the Allerton Project is a very ordinary farm which, as with most farms, seeks to maximise its profits. Originally 272 hectares (ha) at the outset of the project, additional land was purchased in the following three years, increasing the size to 318ha. The farm comprises 253ha of arable land, 29ha of pasture and 18ha of mature woodland. The set-aside area in 1992 was 27ha, rising to a maximum of 43ha in 1994 and disappearing in 2007.

The farm has been managed as a commercial business, primarily producing wheat, oats, oilseed rape and beans. We do not farm organically, but wheat and oats are grown to Conservation Grade standards with restrictions on pesticide use and every field has a substantial headland area that is managed for wildlife habitats.

Yields over the years and farming changes

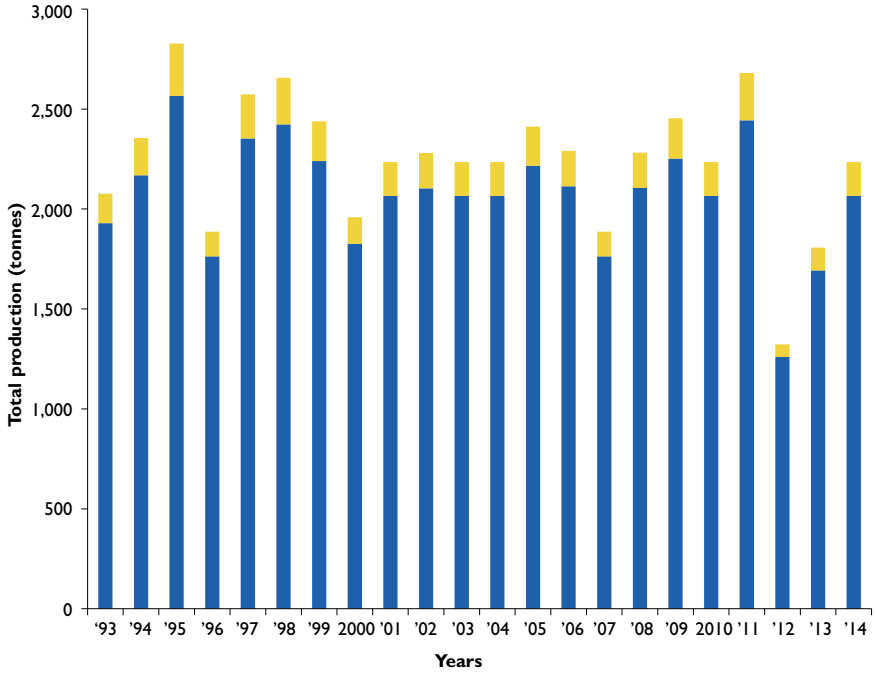
The area of land devoted to habitat management has ranged from 10-15% of the agricultural land area through most of the period, with 19% and 17% of land taken out of production in 1994 and 1995 respectively, mainly as a result of set-aside obligations. Crop production has varied annually with cropped land area and yield, but has remained

Figure 2

Total arable production and production foregone through land diverted to meet environmental objectives, using wheat as a proxy for all crops. Production varies with annual changes in the cropped area and yield

Production

Production foregone



> *"The challenge for the future is going to be for farmers to intensify their food production while improving our environmental performance. We need to give farmers the tools to be really smart about that – and the Allerton Project and the GWCT's research generally has given us many of those tools in the last 20 years."*
>
> Sir Peter Kendall, Chairman, Agriculture and Horticulture Development Board

constant within these annual changes (see Figure 1) and the farm's yields and profitability compare favourably with the regional average.

We initially dispersed crops across the farm to increase their availability to wildlife, but as the cost of this to the business became apparent, and as we developed alternative habitats for wildlife in the non-cropped area, we consolidated our cropping to improve economic performance and productivity, and modified our rotation to control blackgrass (see Figure 2).

Since 2000, the farm has been managed as a joint venture with the neighbouring Oxey Farm, benefiting both businesses by spreading fixed costs. Labour and machinery are pooled and deployed across the combined area. This has enabled us to invest in the necessary equipment to adopt a reduced tillage system, further reducing crop establishment costs and delivering environmental benefits. Contract work on other local farms also contributes to the farm's income. As tractor size increases and weather conditions have proved more challenging, we are experiencing higher levels of soil compaction and more erratic crop establishment. We are moving to increase the area of direct drilled crops which could help to alleviate this and conserve soil moisture to aid plant establishment. Creating a resilient rotation which takes an integrated approach to pest, disease and weed control, as well as improving soil structure and condition, and fostering biodiversity will be a strong focus for the project going forward.

The pasture land was grazed by our own flock of 280 mule ewes for the first 20 years, but since 2011 the grazing has been let to neighbouring Hill Top Farm which

We consolidated our cropping to improve economic performance and productivity and reduce our tillage system.

specialises in sheep to produce the famous 'Launde Lamb'. Therefore we now have late winter labour for hedge laying and woodland management within our agri-environment and Farm Woodland agreements, removing the need to hire contractors for this work. Through a land swap, it has also enabled us to introduce grass leys into the rotation to control blackgrass while cultivating pasture for our arable crops. We are also starting new research within the grassland area.

We need to demonstrate that our farming is commercially focused otherwise we cannot expect other farmers to consider our approach.

Farming profitably

We aim to farm profitably, so that we can demonstrate our practices to other commercial farmers. We cost out, in detail, our farming, research and demonstration activities and the farm's profitability has consistently matched or exceeded a benchmark of similar operations. The Basic Farm Payment has been critically important to us and without it, and in common with others, we would not have been profitable for many years of the project.

Our Countryside Stewardship agreement in 2003, and subsequently Entry Level and Higher Level Stewardship agreements, have provided a useful source of income to compensate for the land we have taken out of production for the benefit of game and wildlife, as well as paying for our routine Stewardship of hedgerows and field margins. However, minimising costs in the joint partnership through reduced overheads, maximising yields through good timeliness and agronomy, marketing our crops with Conservation Grade quality premiums and forward selling at times, have all been very important in achieving our main priorities of resilient and profitable farming.

> *"Consumers through their purchases can make a big difference. Conservation Grade has worked with the Allerton Project for 20 years to engineer biodiversity and wildlife into grocery supply chains."*
>
> Bill Jordan MBE,
> Chairman, Conservation Grade

Environmental Stewardship schemes have provided a useful source of income for our routine Stewardship of field margins and hedgerows.

Boosting biodiversity

Top crops for birds

Farmland birds have suffered severe declines. Correctly managing habitats for birds such as yellowhammers, song thrushes and reed buntings can increase their numbers. © Laurie Campbell and Peter Thompson

Key points

- Blackbird and song thrush nests are least successful near arable land.
- Linnets, reed buntings and tree sparrows favour break crops such as rape and beans.
- Yellowhammers benefit from crop diversity by foraging in different crops at different times.

Bird species differ in the extent to which crops they use as foraging habitats. Our analysis of blackbird and song thrush nesting success suggests that the area of pasture close to the nest has a positive influence, but our monitoring of birds in break crops shows that linnets and reed buntings are strongly associated with oilseed rape, and tree sparrows make considerable use of field beans as a crop to forage in. Hemp crops are used mainly by whitethroats, but also support large pre-migratory swallow roosts.

Crop diversity is beneficial to birds. Our research shows that when feeding their young, yellowhammers forage in oilseed rape early in the breeding season, then switch to barley, and later to wheat as the structure of the crops change. Yellowhammer pairs with several crops within their range will have a longer foraging season which may result in higher productivity.

Break crops such as oilseed rape can be valuable for wildlife.

Managing marginal land for wildlife

Although in 1992 the introduction of set-aside was designed to limit production in the face of food surpluses, we thought this provided a wonderful opportunity for us to explore its potential benefits to wildlife. By utilising these set-aside areas we have achieved outstanding results for wildlife by developing flourishing wild bird seed mixtures, grass margins and beetle banks.

We discovered that naturally regenerated rotational set-aside provided excellent nesting habitat for skylarks, but cutting vegetation and early use of herbicide destroyed their nests. Therefore we investigated and subsequently recommended the delayed use of herbicide to reduce damage to nests and prolong the nesting season.

However, it soon became clear that wider wildlife benefits of set-aside were limited unless the land was managed creatively for conservation. We concentrated on non-rotational set-aside, using some to create buffer strips against watercourses to protect them from run-off, and in the widest strip, creating a series of pools to capture sediment from field drains and create habitats for aquatic and terrestrial wildlife.

We use strips dispersed across the farm for more targeted management, some being located through field centres, effectively dividing fields in two, while others were placed along field margins.

Cropping costs and benefits of marginal areas of fields

Assessment of crop yields at varying distances from the crop edge has revealed that while inputs to field headlands may be the same as to the field centre, yields are 23% lower (see Figure 3). Through most of the project, our emphasis has therefore been on the development of field margin areas for wildlife. These set-aside areas provided a focus for our research into the development of habitats such as wild bird seed mixtures, grass margins and beetle banks.

Marginal land areas were used to create wildlife habitats providing excellent nesting habitat for skylarks.
© David Mason

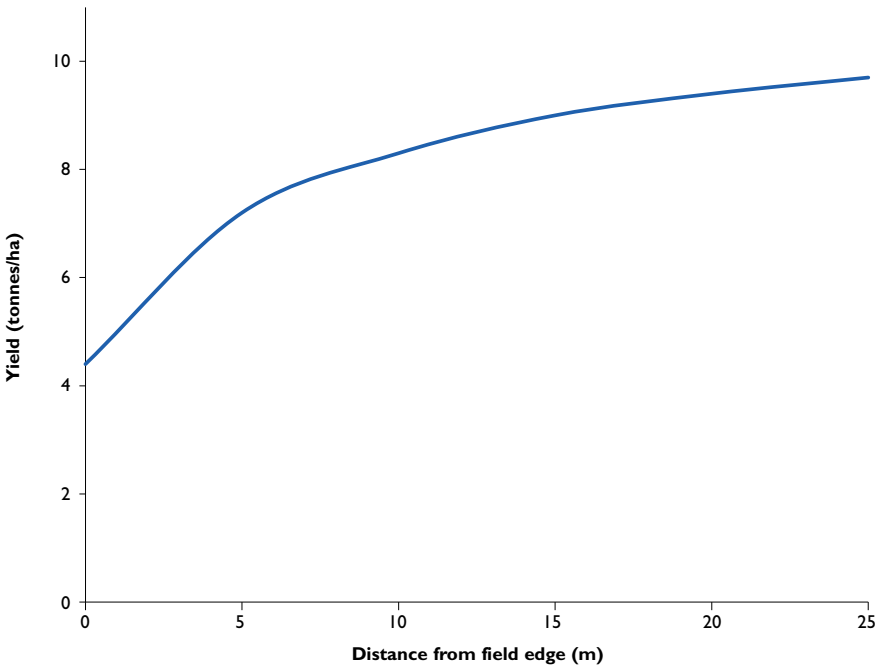


Figure 3

Wheat yield in relation to distance from field edge

Wild bird seed crops

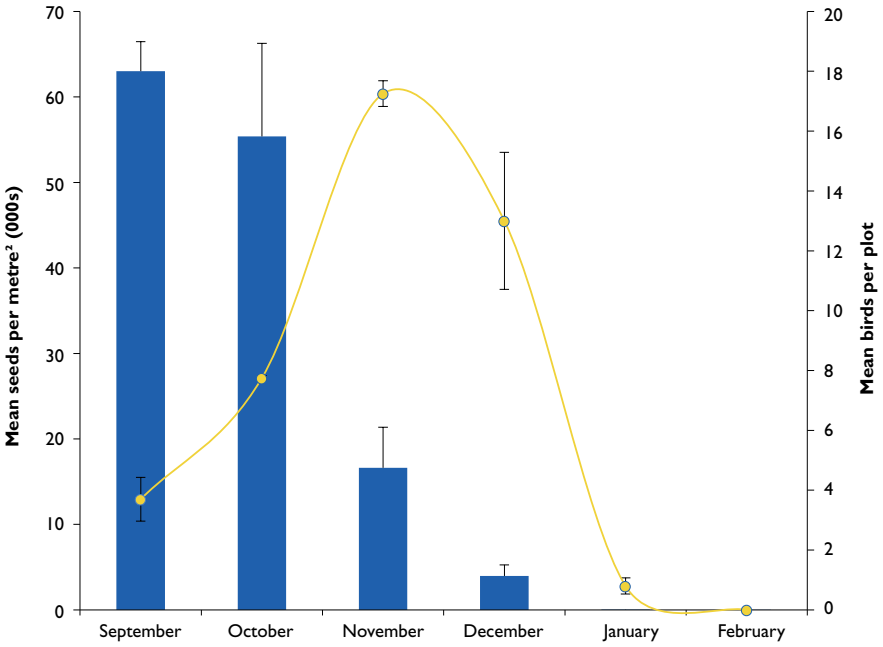
Kale, quinoa and a cereal such as triticale or millet provided the best sources of food for farmland birds such as yellowhammers. © Laurie Campbell

Feeding birds in the 'hungry gap'

Lack of food in winter has been identified as a contributor to the national declines in numbers of some farmland birds. The observation that many farmland birds make use of game crops in winter prompted us to research the potential of this habitat as a conservation measure and develop it further aimed at those species that had suffered declines. We looked at the use of a large range of seed-bearing crops by a range of farmland birds and produced recommendations for the composition of seed mixtures that might be appropriate Countryside Stewardship habitat options. Since then, wild bird seed mixtures have been included as an option in agri-environment schemes.

Figure 4

Yellowhammer numbers in plots of millet in relation to seed abundance



> *"The farm is living proof of what the GWCT's members have long asserted; that shooting interests conserve more wildlife than any other kind of management."*
>
> Matt Ridley, Scientist, Journalist and Author

Teasel seed supply was reduced by only 70% as only goldfinches were able to feed from this species. © Laurie Campbell

Our work showed that kale, quinoa and a cereal such as triticale or millet provided the best sources of food. These crops were advocated as an 'intimate mixture' by early Stewardship schemes, but our research showed that the crops were best grown as single species strips or blocks so that each could be managed according to their differing agronomic needs and seed production could be optimised to benefit birds. Early Stewardship scheme restrictions on fertiliser use also limited feeding potential for birds and our trials suggested an optimum rate of 60kg nitrogen per hectare (N/ha) (rather than the 30kg N/ha limit advocated within Stewardship).

Our research also showed that different crop species retained their seed for differing periods through the winter. By January, teasel seed supply was reduced by only 70% as only goldfinches were able to feed from this species, but for most crop species, seed had become completely exhausted.

For these crops, the seed supply declines as bird numbers increase during the first half of the winter, and then bird numbers drop in response to the continuing decline in the supply of food (see Figure 4). Our recommendation is that wild bird seed mixtures are implemented in combination with supplementary feeding in the second half of the winter. Influenced by our long-term data from the Allerton Project, this became an option within Stewardship schemes in 2013 and farmers can be paid to feed their birds in this 'hungry gap' period.

Grass margins

In 1992, fields were cultivated to the base of the hedge and unplanned spray drift and fertiliser had a considerable impact on self-established field boundary vegetation. We established two metre wide perennial grass margins around all the fields at the Allerton Project, based on our own research which demonstrated that this limits the occurrence of annual weeds such as cleavers and sterile brome by establishing permanent vegetation. We found that the presence of breeding whitethroats in hedges was strongly influenced by the width of the adjacent grass margin and 95% of whitethroat nests were in this habitat. Predation of yellowhammer nests was significantly higher for nests in hedges than for those in grass margins, providing evidence of an effect of predation pressure on habitat selection.

Set-aside, and subsequently Stewardship agreements, have enabled some of our grass margins to be widened to six metres. Some have been sited to reduce transport of sediment to adjacent watercourses, and some have been sown with wild flowers to make them better for insects and farmland birds. These wider grass margins help to reduce spray drift into hedges and provide access for tractors to cut hedges in late winter after the berries have been eaten by birds.

> *"The Allerton Project has shown that through good farming and conservation management it is possible to increase a wide range of game and wildlife within a viable conventional farming business."*
>
> Sir Charles Morrison, Allerton Project Chairman, 1994-2000

Encouraging insects

Beneficial predatory insects

Spiders and insect predators such as beetles that occur naturally in grass margins, help to control aphids and other crop pests. In the early years of the project, our research showed how herbicide drift into field margins could deplete spider numbers and change the spider community through destruction of vegetation used by web-builders. The dense mat of vegetation created by perennial grasses also provides an over-wintering habitat for beneficial predatory ground and rove beetles that feed on aphids in the crop. The undisturbed ground in hedges and woodland edges is also essential for the pupae of these beneficial beetles.

We have continued the pioneering research into the development of 'beetle banks', initially developed by the Trust in the 1980s. These low banks across the centres of fields are sown with coarse grasses such as cock's-foot to encourage beneficial insects out into field centres to control aphids. They have also proved to be a good habitat for harvest mice and other small mammals, as well as their predators such as barn owls and kestrels. The holes made by mice and voles are also used as nest sites by bumblebees, of which there are 10 species on the farm.

Beetle banks provide ideal habitat for mice and voles. The holes they make are then used as nest sites by bumblebees. © Laurie Campbell

Pollinating insects

Pollinating insects such as bumblebees and solitary bees are essential pollinators of some crops, top fruit and wild plants, but have declined on farmland in recent decades. We have investigated the role that wild pollinating insects play in the fruit-set of hedgerow shrubs. Perhaps surprisingly, bramble and dog rose do not require pollinators, but blackthorn is pollinated mainly by bumblebees, hawthorn by solitary bees and ivy by wasps. For blackthorn and hawthorn, naturally occurring numbers of bees limit the amount of hedgerow fruit produced. In fact, numbers of solitary bees in hedges in summer were correlated with the abundance of haws in autumn, and with the numbers of migratory thrushes that fed on them in winter.

Pollinating insects such as bumblebees are essential pollinators of some crops, fruit and wild plants.

This illustrates the inter-dependence of different wildlife species, even at different times of year. It also highlights the importance of naturally occurring pollinators to fruit-set which might equally well be fruit for human consumption as for wildlife.

We encourage naturally occurring pollinators to improve fruit production in hedges and in our new heritage apple orchard, by creating pollen and nectar mixtures of legumes and by providing nest sites.

Balancing soil, water and farming

Spring beans, which are now direct drilled, have shown substantial yield increases; (Inset) Reduced tillage favours earthworms.

Key points

- Reduced soil disturbance is associated with more earthworms, soil fungi and improved infiltration of rain.
- Tramlines running up and down the slope were responsible for 80% of the surface run-off, despite occupying 2-3% of the field surface area.
- Low ground pressure tyres improve infiltration and reduce run-off by 50%.
- Blackgrass populations are proving challenging to crop production; crop rotation, drilling dates, stale seedbeds and cultivation methods are being varied to assist control.

> *"The practical research undertaken on the Allerton Project farm is helping to develop soil management practices that ensure our soils are fit for purpose, resilient to degradation processes and future-proofed to support sustainable land use for future generations."*
>
> Jane Rickson, Professor of Soil Erosion and Conservation, Cranfield University

Reduced cultivations

Soil is a fundamental resource for agricultural production, but its management also has an enormous influence on water quality and aquatic wildlife, as well as the productivity of the land. Over the past decade, we have carried out a series of research and demonstration projects on soil management to improve soil productivity, water quality and aquatic wildife.

Over the same period, we have reduced tillage intensity, adopting a non-inversion cultivation policy where possible. We have found that reduced soil disturbance is associated with higher earthworm numbers and higher microbial biomass, mainly in the form of soil fungi. These help to improve soil structure and the capacity of the soil to absorb water during heavy rainfall. The implications of this are lower surface run-off, lower risk of flooding further down catchments, and lower concentrations of sediment and associated nutrients in water entering streams.

Although reduced cultivation can result in higher initial run-off, because there is less tilth compared with ploughed soil, sediment and nutrient concentrations in the water are lower than from ploughed land. Later, the improved soil ecology and structure associated with reduced tillage improves infiltration and reduces run-off. In some fields we can also improve this situation with a cross-field barrier in the form of a beetle bank and cultivation along in-field contours.

Wheat yields initially fell by around 5% in response to reduced tillage, whereas oilseed rape and spring beans have fared better. However, the cost of managing grass weeds has gone up and this has led to the increased use of stale seed beds, spring cropping and a move to direct seeding, which is helping to contain the problems and the cost.

Tramlines

Tramlines running up and down the slope were responsible for 80% of the surface run-off, despite occupying just 2-3% of the field surface area. We have explored various methods of improving the management of tramlines to increase infiltration and reduce run-off, including shallow sub-soiling with a tine, seeding down the tramline, re-profiling to create a convex cross-section, surface soil disruption using a rotary harrow and the use of low ground pressure tyres. On our clay soils, low ground pressure tyres show the greatest promise, reducing the amount of soil compaction that takes place and cutting down run-off by about a half. The rotary harrow is beneficial on lighter soils.

Land for oilseed rape is sown in a single operation.

(Foreground) Small ponds encourage settlement of sediment associated phosphorus. (Background) Research revealed that tramlines were responsible for 80% of run-off in our trials.

Farming and water

Surface run-off is clearly visible, but field drains flow more consistently.

Ponds benefit wildlife such as reed buntings and dragonflies.

Our main focus for aquatic research has been on sediment and phosphorus which is tightly adsorbed by sediment particles. Sediment has a physical impact on aquatic wildlife through siltation of stream beds, with consequent loss of the gravelly river beds that trout need in which to spawn. Sediment also reduces the water storage capacity of reservoirs and increases the risk of flooding by clogging up watercourses. Phosphorus causes 'algal blooms' such as toxic blue-green algae in reservoirs and blanket weed in ponds when present in high concentrations. These have a damaging effect on aquatic wildlife and also increase the cost of processing drinking water.

We have compared the sediment and phosphorus delivered to water from a mainly arable catchment at Loddington, with a pasture catchment in the headwaters of the Eye Brook at Tilton on the Hill. Phosphorus concentrations were more than four times higher in the arable catchment than in the pasture one during normal flow, and during most storm events. Only during exceptionally heavy prolonged rainfall did the pasture stream release as much phosphorus as the arable one. This reaffirms the need to improve the management of arable soils, but also highlights the implications of increased frequency of severe storm events that may be associated with climate change.

Surface run-off is clearly visible, but field drains flow more consistently and can deliver sediment and nutrients to water over a longer period through the winter. Buffer strips can be great for helping reduce field run-off but are ineffective at reducing the movement of sediment in field drain systems, so we have been investigating alternative means of capturing materials from field drains before they get into watercourses. Small field edge wetlands created by simply damming ditches were used more by birds in summer and autumn, and supported more aquatic insects than un-dammed sections. Exposed mud had a positive effect and hedge shading had a negative effect on insect numbers. About half of the dammed ditches were sufficiently silted up to need dredging after four years, so we were able to demonstrate that even small ponds could contribute towards keeping water clean.

Larger ponds supported more wildlife than very small ones and would also be more effective at trapping sediment and associated nutrients. We have investigated

> *"For the Freshwater Habitats Trust, the benefit of working with the team at the Allerton Project is the understanding they bring to our joint projects of real-world farming, scientific rigour in a practical setting, a willingness to think outside the box and a great approach to partnership."*
>
> Jeremy Biggs, Director, Freshwater Habitats Trust

Our research covers aquatic, as well as terrestrial wildlife.

Visitors from The Pesticides Forum looking at our larger ponds.

the potential of slightly larger, but still field corner scale, pond systems for reducing sediment transport from field drains and ditches to streams. Our pond systems did not trap as much sediment as those in sand and silt soils in north-west England because of our lower rainfall and because our clay soils deliver very fine particulate matter that does not readily settle out in small wetlands.

Rural septic tank discharge and farmland

Low human population density tends to come with a high density of septic tanks for the containment of domestic waste water. These are often poorly maintained and are ineffective on clay soils where soakaways do not function. By sampling upstream and downstream of two groups of houses at Loddington (see Figure 5), we have been able to demonstrate that rural residents are contributing phosphorus to streams via septic tanks. Phosphorus concentrations downstream of houses were up to 10 times higher than those upstream.

> “...rural residents, rather than just farms, are contributing phosphorus to streams via septic tanks”

Septic tanks have a major local effect on water quality during base flow conditions, which in turn, affects headwater streams. We have engaged with our local community, explaining the challenges and supporting changes eg. the use of low phosphate washing powders. High volumes of water that move down streams during winter storms, usually with the high concentrations of sediment and phosphorus, show that over the course of a year more than 90% of the phosphorus, and almost all the sediment leaving our study catchment was derived from farmland. The importance of domestic and agricultural sources of phosphorus varies with season and scale.

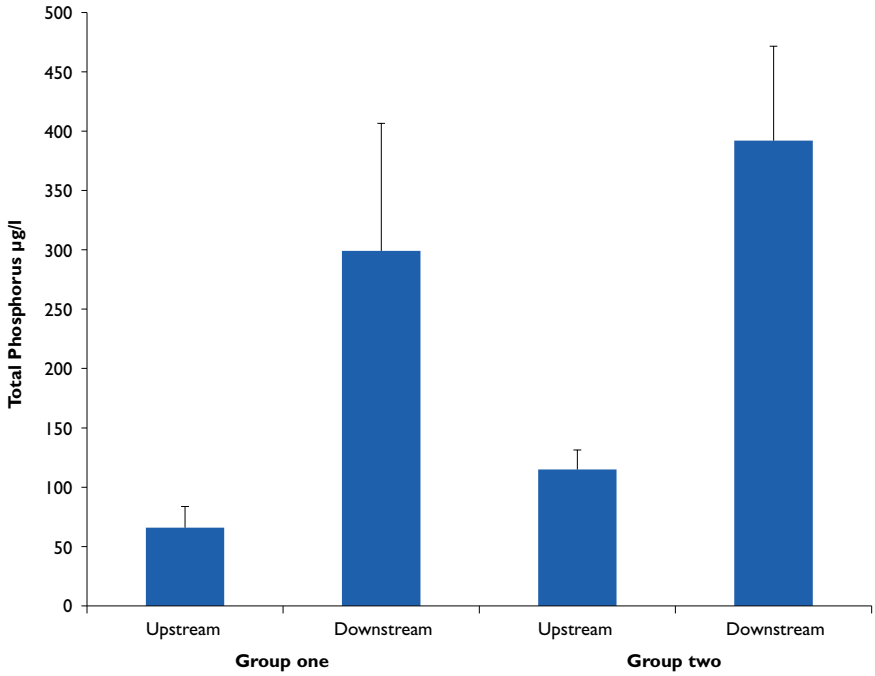


Figure 5

Total phosphorus concentration in stream water upstream and downstream of two groups of houses in Loddington village

> *“A farm that is managed with water quality in mind can have a tremendous and positive impact, not just on the water itself, but on wildlife, soil quality and even flood resilience for local communities.”*
>
> Sarah Mukherjee, Director of Environment, Water UK

Water Friendly Farming

The upper Eye Brook catchment at Halstead, part of the Water Friendly Farming project.

Water Friendly Farming is a landscape scale research and demonstration project which combines the active participation of the local farming community with scientific application and evaluation of activities to improve water quality, while maintaining farm productivity and income and meeting other environmental objectives. Our partner is the Freshwater Habitats Trust, and the primary driver for this work is the EU Water Framework Directive (WFD). The project aims to determine the extent to which WFD targets for water quality and wildlife can be met within the constraints of a real farming community. The project builds on many years of research and community engagement described on page 30.

The project is based on three local headwater catchments, each of nearly 1,000 hectares. They are broadly similar in terms of topography, soils and farming systems (mixed arable and livestock) and are comparable to many areas of lowland England. Since 2010, we have collected baseline data on water quality and ecology across all three catchments. We are interested to see what happens at two levels:

- The quality of water 'exported' from the base of each catchment to the rest of the river basin where it influences WFD targets;
- The quality and ecology of water within each of the three catchments, across numerous sampling sites including a range of water body types to improve understanding at the farm level.

Our monitoring is coupled with soil and nutrient management advice to farmers.

The main datasets are for nutrient concentrations, sediment and aquatic plants and invertebrates, with additional data for pesticides and fish. The plant communities across 237 sampling sites are consistent with those from other areas of lowland England. Localised assessments of birds and pollinators are also being carried out. Continuous feedback from participating farmers is an essential part of the process.

Measuring farming changes

Changes to reduce the effect of farming on water are being made across nearly 2,000 hectares of farmland in the Eye Brook and Stonton Brook catchments, whereas the Barkby Brook catchment remains unchanged and serves as a control to monitor background changes in water quality and ecology. We are applying management strategies that are scientifically sound while also being practically grounded. These consist mainly of various types of interceptor wetlands receiving water from surface run-off and field drains, with some farmyard measures, streamside fencing and installation of alternative livestock drinking sites. Additional data are being collected on soil structure and nutrients, and guidance on soil and nutrient management is being provided to farmers.

The baseline data have identified important domestic sources of phosphorus from small rural sewage treatment works in each of the three catchments, with peaks in phosphorus concentration in late summer. Sediment loads are highest in the second half of the winter, and enable us to estimate annual soil loss from arable land to be approximately 0.5 tonnes per hectare. The project is widely regarded as being nationally significant in terms of its implications for future land use policy.

Demonstrating benefits to agriculture

We have set up an instrumented 155ha catchment as a demonstration of ecosystem services, the various benefits we gain from the environment and the interactions between them. The catchment is a microcosm of lowland England, comprising ancient semi-natural SSSI woodland, other more recent woods and hedges, cropped land and pasture, of which the latter is used for lamb production and for horses. There are rural houses and roads, ditches, streams and ponds, and habitats created specifically for wildlife under our Environmental Stewardship agreement (see Figure 6).

As well as data on crop inputs and yields, soil nutrients and bird distribution, we have a valuable aquatic dataset for a three-year period from the Defra-funded 'PARIS' project. These include nutrient concentrations, aquatic invertebrates and diatoms (single celled algae with silica cell walls), and we are currently gathering additional data at the same base of catchment sampling site. Soil moisture sensors across the catchment reveal how soils become saturated, leading to run-off and erosion in winter, and become dehydrated during the period in which crops are ripening in summer.

The role of biodiversity

We have also mapped the breeding birds and surveyed earthworms, soil microbial biomass and organic matter in relation to the three major land uses – arable, pasture and woodland revealing that these are all lowest in arable land. Surveys of pollinators and carabid beetles reveal the importance of hedges, grass margins and wild bird seed mixtures to invertebrates that can contribute to crop production through pollination and control of crop pests. In the stream, invertebrate communities reflect sediment and nutrient loads and can be used to indicate the efficiency with which soils and nutrients are being managed in the catchment. In the stream, invertebrate communities reflect sediment and nutrient loads and can be used to indicate the efficiency with which soils and nutrients are being managed in the catchment.

Costs and benefits

We can use these results to explore how we maintain or increase food production, while simultaneously delivering all the other resources our society demands of the agricultural landscape. For example, land taken out of production for Stewardship habitats represents 7% of the arable area, equivalent to 21 tonnes of wheat, or the annual bread supply for 500 people, but this is off-set by quantified benefits to biodiversity, beneficial invertebrates and improved water quality and ecology.

We have surveyed earthworms and pollinators to explore how we manage demands on the agricultural landscape.

(Below) The pasture land is used for lamb production and horses.

Figure 6

School Farm Catchment 2012-2013

- Building/road
- Crop
- Garden
- Pasture
- Hedges
- Other vegetation
- Pond and stream
- Woodland
- Trees

Farming and climate change

Key points

- A 2011 survey revealed that 30% of local farmers had experienced some effect of climate change.
- Climate change is affecting birds and species such as grasshoppers.
- 60% of greenhouse gas emissions on our farm are associated with fertiliser; we are exploring options to use nutrients more efficiently.
- Carbon dioxide emissions are reduced by zero-till.
- Woodland and Stewardship habitats can off-set up to 68% of emissions from the farm business.

Climate change is affecting several species of birds and grasshoppers.

Use of wood fuel from our own woods, instead of fossil fuels, reduces our contribution to climate change.

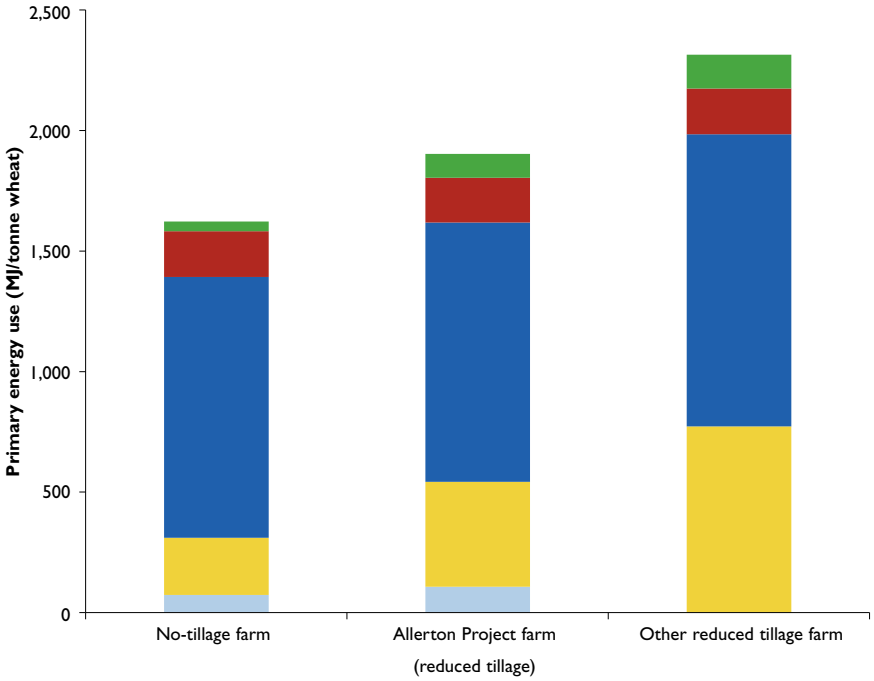
Farming influences climate change through emissions of greenhouse gases and a survey in 2011, before the exceptional conditions of 2012, revealed that 30% of local farmers had experienced some effect of climate change. Changing wildlife abundance and distribution for birds such as the little egret and nuthatch, and for some grasshopper and cricket species, also highlight the national and local impacts of global climate change.

We have compared the greenhouse gas balance for our farm with other local farms. Emissions from sheep are influenced by productivity of the flock, the growth rate of lambs, and linked to this, the ratio of grass to concentrates in the diet. For the arable side of the business, we explored emissions based on energy use. Our total emissions are intermediate between the two other local arable farms, as illustrated for wheat in Figure 7. About 60% of emissions are associated with fertiliser use. The fertiliser industry has been working on reducing emissions during the manufacture of nitrogen fertiliser and we can now adjust nitrogen fertiliser applications according to the need of the crop. We are also exploring options to be more efficient at the farm scale through the use of cover crops to capture soil nitrogen, and variable rate fertiliser applications, resulting in higher yields.

The main difference between the three arable farms is due to cultivations, with greenhouse gas emissions increasing with greater tillage intensity. This has influenced our decision to continue our reduction in tillage intensity across the farm. Non-crop areas such as woodland and Stewardship habitats also have an important role, off-setting up to 68% of greenhouse gas emissions from the farm business. The potential of woodland to perform this role is reduced by the harvesting of timber for wood fuel, but 17% of the off-setting potential in the Allerton Project's woods is associated with soil carbon sequestration which is unaffected by harvesting.

Figure 7

Energy use (reflecting greenhouse gas emissions) associated with wheat production for the Allerton Project farm and two other local farms



Farm woodland

New woodland has been planted and managed to create drives on shoot days as well as providing benefits for wildlife.

The farm's woods comprise a mix of plantations dating from the 1950s, naturally regenerated woodland along the old railway line and more mature woodland. They have been managed in rotation to improve the shrub and herb layers to provide winter cover and nesting sites for pheasants. In 1994 3.8ha of new woodland was planted with a further 3.4ha in 2011. New woods comprise mixed native broad-leaved and coniferous species and have often been sited to create drives on shoot days as well as providing new habitat for many species.

> *"It is encouraging to see how game management can make a significant contribution to an expansion of native woodland and its good management for a rich variety of wildlife. The Allerton Project has shown how conservation and modern farming can be woven together very effectively."*
>
> Sue Holden, former Chief Executive, Woodland Trust

Off-setting our carbon footprint

Timber from woodland thinning operations is chipped and used to fuel our wood-fired heating system in the Loddington House headquarters and our new visitors' centre. This helps to cover the cost of woodland management and eliminates the use of fossil fuels to heat the buildings. Hazel is coppiced to produce stakes and binders for hedge laying. Despite this harvesting, woodland also has the potential to partially off-set some greenhouse gas emissions from the farming operations (see page 20). To reduce damaging effects of tree felling on wildlife, some timber is stacked to provide habitat for insects associated with dead wood, including pollinating solitary bees.

Woodland management provides habitat for insects such as the speckled wood butterfly.

A survey of woods at and around Loddington has shown a clear relationship between the woodland structure resulting from their management for pheasants and the numbers of songbirds present in them. Most notably, the increased herb layer that develops when woods are thinned is linked with an increase in numbers of warblers.

Thinning woods allows an increased herb layer which has increased numbers of warblers such as the willow warbler. © Laurie Campbell

An abundance of songbirds and game

Dunnock and tree sparrows benefited from game management.
© Peter Thompson and Laurie Campbell

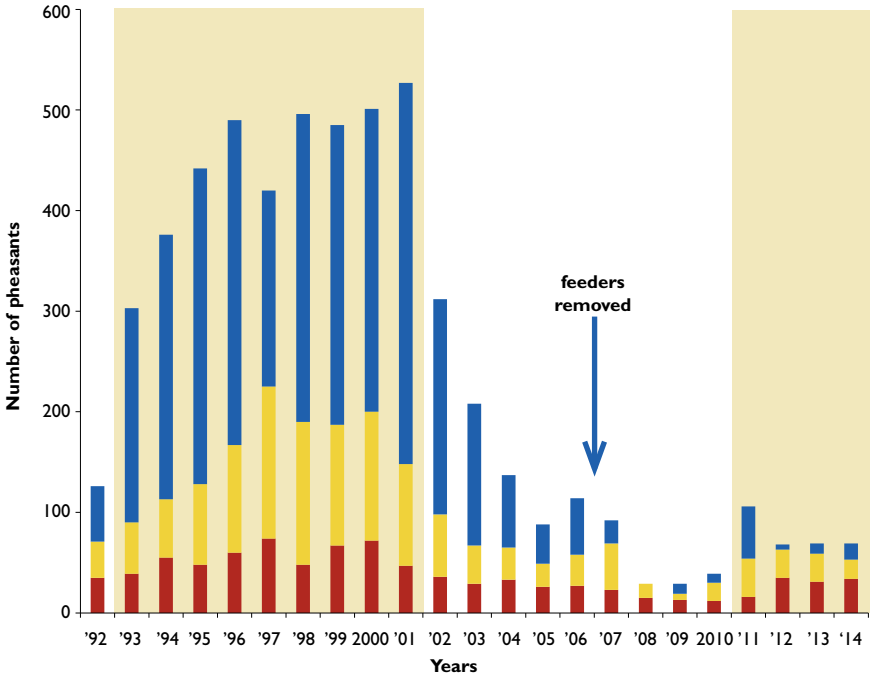
Key points

- Wild pheasants increased four-fold in response to full game management.
- Hare numbers dropped substantially once predator control was withdrawn.
- Songbird numbers doubled in response to game management, but showed a gradual decline once feeding and predator control were stopped.

Management of wild gamebirds was a core activity at the Allerton Project for the first 10 years, with 1992 providing a baseline year in which gamebirds were surveyed but no changes were made to their management. From 1993, woods were managed to improve the shrub layer, wheat was provided as feed from September to April, predators such as foxes, crows, magpies, rats and weasels were controlled to improve

Figure 8

Autumn wild pheasant numbers from 1992 to 2014



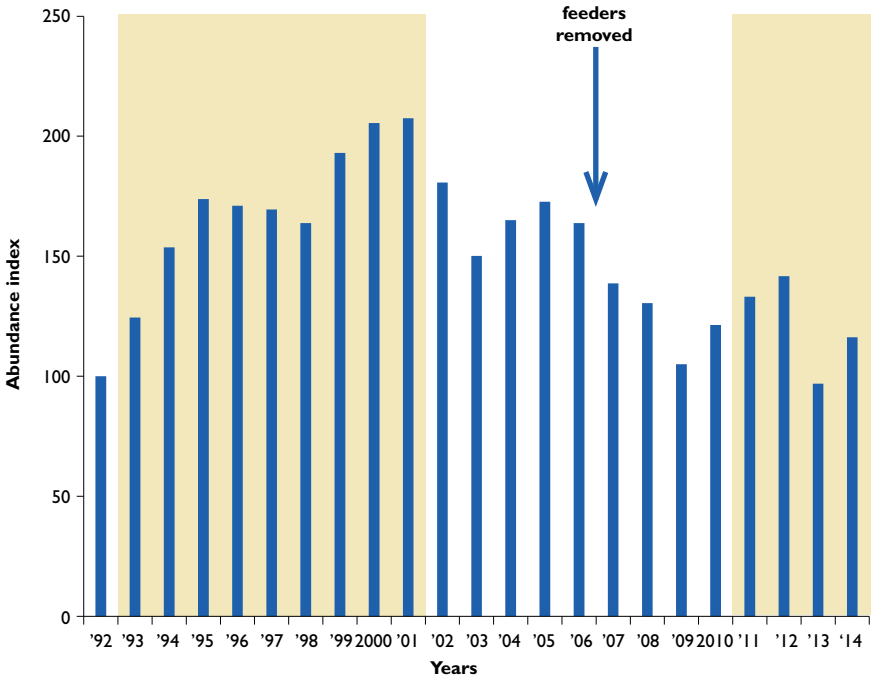


Figure 9

Songbird abundance relative to the start of the project

Keepered period

> *"The Allerton Project has been spectacular: everything from whitethroats to brown hares, from harvest mice to yellowhammers has boomed."*
>
> Matt Ridley, Scientist, Journalist and Author

nesting success, and several habitats were created on the farmland to meet the needs of wild gamebirds through the year. There was no releasing of reared birds. Five shoots were held each year (restricted to cocks only) including dog trial days. In this phase of the project, the emphasis was on management of wild pheasants, but the keeper's role also included activities that had benefits beyond those associated with the shoot, such as hedge planting, woodland management and rabbit and pigeon control.

In 2001, we stopped controlling predators to monitor the effects on game and non-game species, and in 2006, winter feeding was also stopped. Habitat management was kept as consistent as possible throughout this period. Figures 8, 9 and 10 show the changes in numbers of wild pheasants, hares and songbirds in response to the changes in management. Pheasants increased four-fold in response to the full game management system, but then declined from 2001 such that no further shoots could be held. For hares, we have data for another local site, revealing a very substantial increase on the Allerton Project farm but none at the other local site. Some hares were shot when numbers became so high that selective grazing of wildlife seed mixtures eliminated some of the key plants we were trying to grow to provide winter food for birds.

Songbird numbers doubled in the first phase of the project to 2001, including increases in some Biodiversity Action Plan species (see Table 1). They then declined so that by 2011 they were only 30% higher than the baseline, suggesting that in the early

Hare numbers dropped substantially when predator control was withdrawn.
© Laurie Campbell

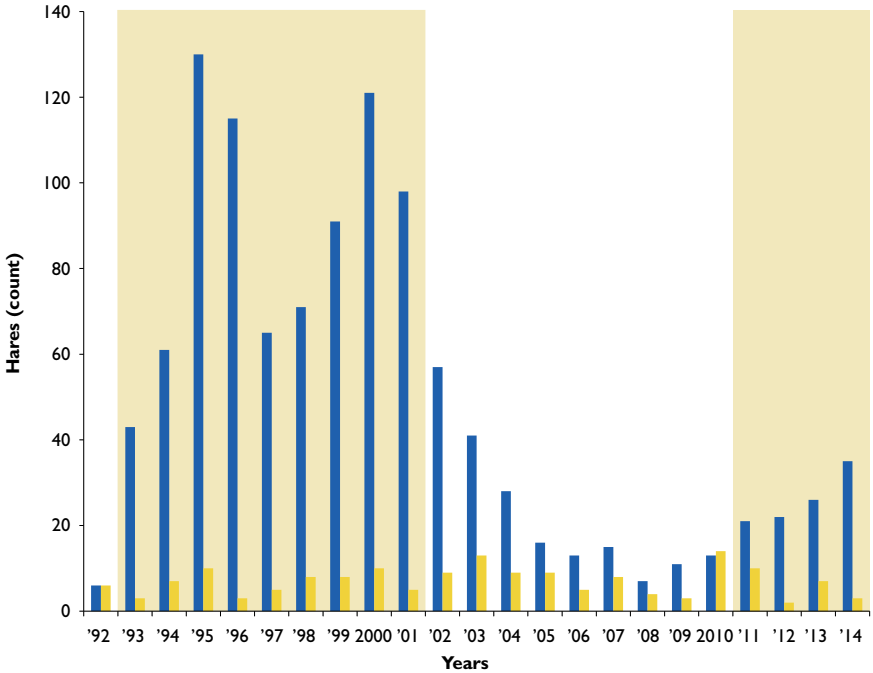


Figure 10

Winter hare numbers

Allerton Project farm (keepering only at Allerton)

Comparison site

Keepered period

Song thrush increased in numbers during the period of predator control and declined without predator control. © Laurie Campbell

phase of the project habitat management was responsible for this proportion of the increase. Where there is sufficient existing habitat, game management can therefore contribute to increasing songbird abundance without diverting land from food production (see Figure 11).

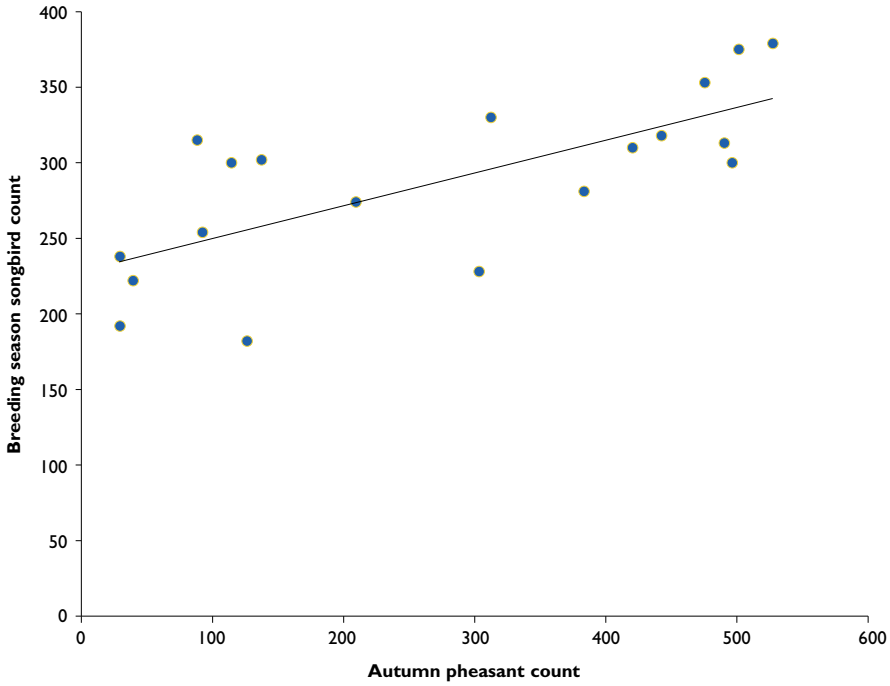
Measuring nesting success

For most of the project, we have located and monitored several hundred songbird nests each year, enabling us to compare nesting success during periods with and without predator control. For some years we have also gathered data from two other local sites where there is little or no predator control. Out of the six main study species, blackbird, dunnock, chaffinch and yellowhammer had significantly higher nesting success when predators were controlled than when they were not.

In the case of blackbirds for which data were analysed in more detail, this effect extended to numbers of breeding birds in subsequent years, with an increase in numbers during the period of predator control and a decline without predator control, relative to the regional trend. There was a similar effect for spotted flycatcher, a Biodiversity Action Plan species that has experienced considerable population decline nationally. In woodland, but not in village gardens, nesting success was highest when predators were controlled. Breeding numbers increased during the predator

Figure 11

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



Blackbird, spotted flycatcher, yellowhammer and chaffinch had higher nesting success during periods of predator control.

© Laurie Campbell

control phase and declined dramatically without predator control to the point that only one territory remained in 2011. In line with the results for nesting success, the changes in territory numbers took place mainly in woodland.

The effects of winter feeding

We have monitored numbers of songbirds present in winter since 2000, including years with and without winter feeding of gamebirds, and in some years we have filmed feed hoppers to record which species are using them. The filming has revealed that the time that the hoppers are occupied is roughly equally divided between gamebirds, small mammals and songbirds. The main songbird species present are blackbird, robin, dunnock, tree sparrow, chaffinch and yellowhammer, and the use of hoppers by these species increased between January and March as alternative sources of food diminished. The abundance of these species on the farm in this late winter period fluctuated from year to year in response to the availability of food and was correlated with breeding numbers in subsequent springs. In the absence of predator control, the number of breeding pairs of these species was 30% higher in years with winter feeding than in years without it.

Songbirds use of hoppers increased between January and March as alternative food sources diminished.

TABLE 1

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

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

** Based on nest counts.*

> *"It is so encouraging to see a farm where songbirds practically doubled in three years; this project is proof of what can be achieved and demonstrates the important contribution that game management can make to successful farmland conservation. The Allerton Project is a great example of how research can inform the ways in which agri-environment policies support wildlife and the natural environment."*
>
> Poul Christensen,
> Chair, Natural England, 2009-2013

Yellow wagtails, bullfinches, skylarks and linnets are among the bird species we have been monitoring since 1992.

© Laurie Campbell

© Laurie Campbell

The return of the shoot

(Top) In 2011 we employed a full-time gamekeeper to run the shoot.

Key points

- Our new shoot is of a size and type that is typical of other pheasant shoots.
- It is compatible with our objectives for the farm and wider environment.
- We aim to increase songbird numbers again and follow GWCT best practice guidelines.

Once we completed examining the effect of withdrawing predator control, and then subsequently withdrawing winter feed provision through hopper feeding, we employed a full-time gamekeeper in 2011. Our objectives for this current phase of the Allerton Project are to establish a shoot which is widely applicable to other small to medium-sized lowland farms, but most importantly, one which can cover its costs.

Following our overall ethos, the shoot is compatible with the farm business and integrates with our other objectives such as wildlife conservation, wood fuel harvesting and water resource protection. To justify employing a full-time gamekeeper we have taken on the shooting rights of 500 acres of land on our northern border and this has increased the number of drives and shooting days. This offers a different

Our shoot days focus on the quality of shooting, good company and a glorious setting.
© Andy Hook

habitat from the main estate, as most of the land is permanent pasture grazed by sheep, but includes one semi-natural wood which is classified as a Site of Special Scientific Interest.

In contrast with our earlier shoot, we are now releasing cock pheasants and providing the necessary pens and associated infrastructure necessary for a reared bird shoot. We provide grain for gamebirds through most of the year, mainly using feed hoppers supplemented with some hand feeding. We have grown maize strips for the first time to ensure that we have sufficient cover for birds on shoot days, but are positioning these alongside Stewardship wild bird seed mixtures. However, we have reduced our reliance on maize as the wild bird cover areas have become better established.

Shoot days

Shoot days have been sold as hundred bird days, with the emphasis very much on the quality of shooting, good company and a glorious setting, rather than on large numbers of birds. We have been running up to 14 days each season, with some of these sold at our county committee auctions to our members and supporters, while others are sold more locally to allow people living in the area to enjoy a day visiting the project. We constantly review our approach to the shoot and plan to reduce the number of days and the level of keepering to make the shoot more cost effective.

We are monitoring the vegetation in our release pens.

> *"The great thing about this estate is interest and variety. Here a successful livestock and arable farm with well managed habitat, perfectly demonstrates that commercial farming, best practice conservation and a top quality shoot really can exist together."*
>
> Chris Butterfield, Nottinghamshire GWCT county chairman, farmer and landowner

The shoot's team of beaters. The shoot is intended to be widely applicable to other shoots of a similar size.

Landscape scale conservation

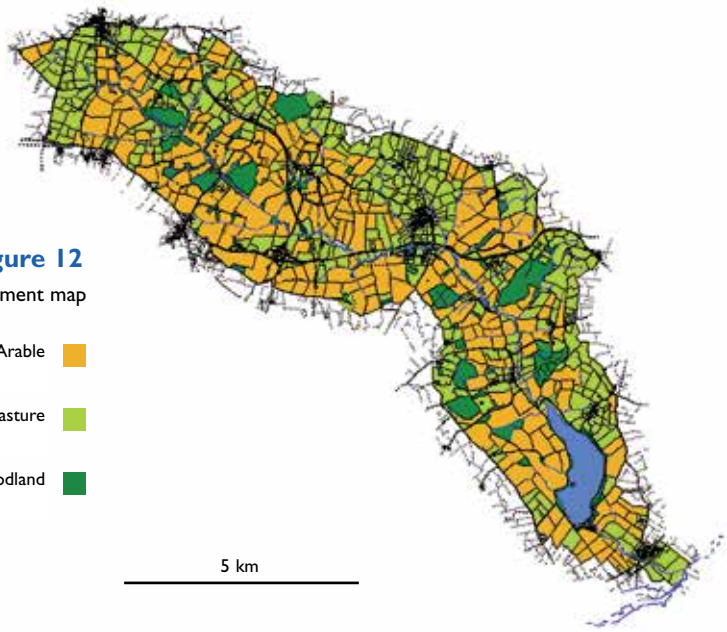


Figure 12
Eye Brook catchment map

Loddington sits in the central section of the Eye Brook catchment. (Inset) High sediment levels in rivers and streams reduce the spawning success of brown trout.

Key points

- High sediment levels in rivers and streams reduce the spawning success of brown trout.
- Targeted advice is helping to reduce the impact of sediment load from the agricultural catchment.
- Damage to woodland plants by muntjac is at the landscape scale, not associated with individual woods.
- When birds are nesting only 8% of territories have access to wild bird seed crops, showing that other sources of insect food are required.

> *"There is a growing consensus that integrated landscape scale conservation, such as in Nature Improvement Areas, is often the best way to achieve multiple environmental benefits. This project helped inspire that policy direction and helps to show how effective it can be."*
>
> Peter Unwin, Director General Policy Delivery Group, Defra

Our farm at Loddington is located in the central section of the Eye Brook catchment, a tributary of the River Welland (see Figure 12), and much of our research and demonstration work has been carried out at this catchment scale. We have surveyed fish throughout the length of the stream and found wild brown trout at all 10 survey points. However, numbers are not high and the proportion of young fish is generally low because of sedimentation of the stream bed spawning habitat. A survey of 13 tributaries recorded brown trout fry in only two of them.

Muntjac damage to bluebells is at the landscape scale, rather than associated with individual woods. © *Laurie Campbell*

We have assessed sediment loads carried during storm events in almost all of the stream's tributaries, identifying very low levels of sediment in two small streams flowing through mature woodland, and very high levels in two agricultural catchments. This has helped to target advice and mitigation work at the most affected sites to reduce the average sediment load delivered to the stream at the catchment scale.

Muntjac deer and songbirds

We have also surveyed terrestrial wildlife at the landscape scale in the Eye Brook catchment. Our study of damage to bluebells by muntjac deer identified higher levels of variation in damage within woods than between them. The problem of muntjac damage to bluebells and to much rarer woodland plants such as herb paris, is at the landscape scale, rather than associated with individual woods. Within woods, damage is linked with proximity to shrubby cover that develops as a result of conservation management of the woods such as thinning and coppicing. This creates a difficult conservation dilemma.

Our bird survey work across 34 farms in the catchment revealed 30% higher numbers of songbirds on farms with shoots than on those without (see Figure 13), supporting the findings of our work at the farm scale from those at the Allerton Project, where songbird numbers increased in response to game management. In the upper catchment wild bird seed mixtures are present on three farms. Assuming winter foraging ranges of up to one kilometre, this provides seed food for most of the winter bird community. As foraging ranges are much smaller when birds are nesting, only about 8% of territories have access to wild bird seed crops as a source of insect food, even for species such as skylark and tree sparrows with foraging ranges of up to 200 metres. At the landscape scale, other sources of food are required at this time of year.

> *"Everything must hinge, I submit, on the argument about wise stewardship of the land and of our wildlife, on making the point again and again that the followers of field sports are the people who provide the money to sustain a wide balance of nature."*
>
> Sir Max Hastings, Journalist, Author, Vice-President of the GWCT

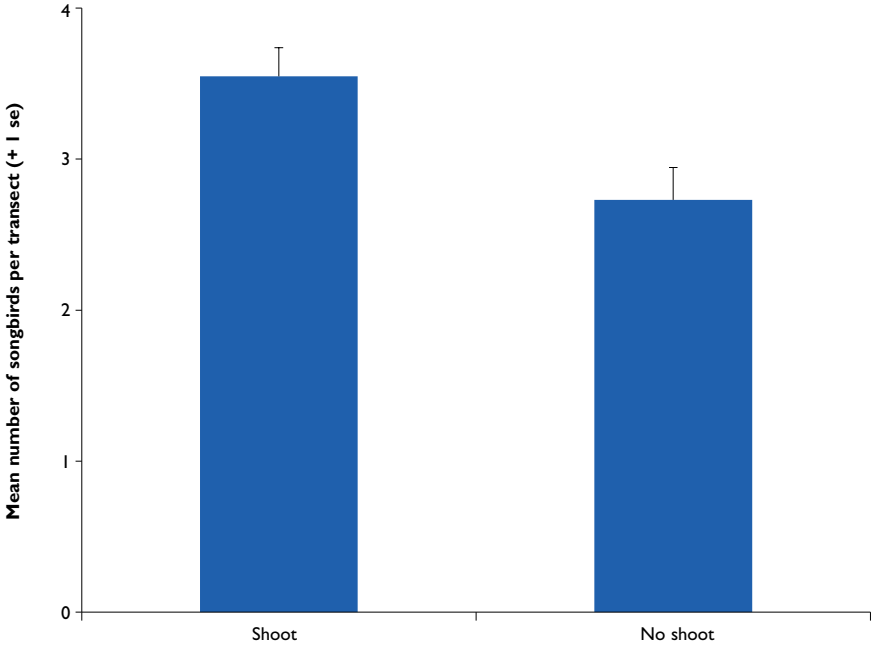


Figure 13

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

Community engagement

Local residents took on an active role and the WI helped us plant a community orchard. © Tim Scrivener.

Key points

- Community awareness is strengthened by combining local knowledge and scientific expertise.
- Land use history strengthens community 'ownership' of environmental issues.
- Plastics recycling brings farmers together; spinning wool brings villagers together.

As well as the influence of farming on the local environment, all residents in the community have an effect, as illustrated by the example of septic tank impacts on stream water quality (see page 17). The use of toilets, cars, household energy and other daily activities results in varying degrees of impact on the environment, wildlife and climate. Raising awareness of the issues associated with the management and use of natural resources is essential for sustainably living together.

> "...improved understanding of land use history increases local identity and ownership of environmental problems..."

We have been active in engaging with a wide spectrum of local residents. Most notably, a catchment community project aimed to raise awareness of these issues among residents, farmers and landowners alike, in the Eye Brook catchment. The project took an innovative approach by combining the scientific knowledge of the Allerton Project's research with the local knowledge of the community as a whole. A third element is historical knowledge, both from local people and others outside the area. This builds on the principle that an improved understanding of land use history increases local identity and ownership of environmental problems and opportunities. The project held several events each year, produced a teaching pack on historical use of natural resources and published a book *Exploring a Productive Landscape* which shared the lessons learned with a wider readership.

Within the East Midlands, our catchment management work sits within the context of the Welland Valley Partnership, set up under Defra's first set of pilot catchment initiatives, and led by the Welland Rivers Trust which the Allerton Project was instrumental in founding in 2010. We continue to play a major role in this

initiative, extending our experience from Loddington, the Eye Brook and the Water Friendly Farming project, to the river basin as a whole. We host workshops for Welland farmers, provide advice and help to co-ordinate a range of other activities across the river basin, including some pioneering initiatives to improve soil and water management. This provides valuable feedback from local farmers, as well as enabling us to share our research results directly with them.

The visitor centre is a focus for all the community including a local spinning school. (Below) Exploring a Productive Landscape *combines science with local knowledge that has enlightened us all.*

Involving the community

In 2012 a small community orchard was planted close to the village with the active involvement of the Women's Institute in selecting the apple varieties to be planted, and in their planting. The orchard comprises six local varieties and should be a focus for the community for many years to come. The shoot at Loddington also provides a focus for the local community, through the employment of beaters and pickers up, provision of meals and accommodation, and sale of shot game.

We have an agricultural plastics recycling enterprise, 'Allerton Recycling' with nearly a hundred local farm members paying an annual subscription to bring their pesticide containers, fertiliser bags and bale wrap to us for processing and subsequent sale for recycling. The recycled plastic is used for traffic bollards, horse jumps, seats, permeable car parking surfaces and other products, ensuring that what was until recently considered to be waste, is used productively and provides a focus for the local farming community.

A local 'spinning school' has been established at our visitor centre and this has coincided with the arrival on the farm of a small flock of Leicester Longwool sheep. Spinning the wool from the flock helps to preserve this rare breed, the botanically rich semi-natural pasture the sheep graze on, as well as providing items of locally, hand-produced garments and providing social engagement.

(Inset) Catchment residents learn about the Eyebrook Reservoir and its links with the upper catchment.

Our pesticide container recycling was a finalist at the 2014 MRW national recycling awards. Our recycling scheme takes agricultural waste and recycles it to produce horse jumps and traffic bollards.

Education and our eco-friendly building

School children are regular visitors to the farm.

Key points

- We run a range of educational activities for a wide audience from policy-makers and farmers to school children.
- Our science is used to shape policy.
- The community building provides focus for environmental messages.

Educational activities are central to the Allerton Project's objectives and we have concentrated on agricultural professionals such as farmers, agronomists and other advisors, with several hundred visiting each year. We run a 'Conservation Management' course for agronomists and other farm advisors as part of the BASIS scheme and provide training at other venues across the country. We also receive visits from university students, and more recently schools, as well as opening the farm to the public for the national Open Farm Sunday event. We produced a primary school teaching pack on historical use of natural resources as part of the Eye Brook Community Project. We also deliver lectures to university students and run courses at the project and at other venues throughout the country. We host the FWAG (Farming and Wildlife Advisory groups) Association which provides a mechanism to disseminate research results to trusted advisors nationwide.

Most recently we have been working with the breakfast cereal and healthy snack manufacturer Kellogg's, as part of its unique 'Origins' farmer group. The farmers work together and Kellogg's support expert advice to improve business and environmental performance. The Allerton Project supplies the group with expertise in biodiversity and 'greening' measures.

The eco-building has been a finalist in both the Climate and Energy Awards.

The heating system uses biomass chipped from thinnings from the farm woodland. The heat is fed through an under floor thermostatically zoned system.

The straw bales are rendered with lime mortar.

A permeable parking area is made from recycled silage wrap. The car park is sown with low-growing flowering herbage to attract insects and bees.

A rainwater harvesting system catches water from the roof and stores it in an underground tank to replace piped mains water.

Scientific papers and Government policy

Sharing our scientifically-based and practically-grounded research results with policy makers has also been important from the start and we continue to make a considerable contribution to the development of Countryside Stewardship schemes, and more recently, water-related policy. Our research is published as papers in scientific journals, with 200 being produced since the project started. This ensures that our work is shared with and recognised by the scientific community, but also gives our work the credibility needed to influence Government policy. Much of our research is carried out by PhD and MSc students, co-supervised by us, and this provides an excellent opportunity to both teach and learn from the students we host at the Allerton Project.

> *"The foundation for delivering a sustainable future is through inspiring public engagement. The Allerton Project team are outstanding at this, from acting as a hub for the local community on a day-to-day basis, through to their involvement with annual events such as Open Farm Sunday."*
>
> Caroline Drummond MBE, LEAF Chief Executive

Eco-friendly visitors' centre

Our award winning visitors' and training centre provides an inspiring opportunity to develop our educational activities further. The building was constructed in line with our environmental objectives for the farm, with straw bales from our fields and sheep's wool providing insulation, while the heating is run using chipped wood from thinnings from our own woodland. Rainwater harvesting for toilet flushing, and photo-voltaic panels for electricity generation add to the environmental credentials of the building, while the fencing and permeable car park surface are made from recycled agricultural plastics sown with low growing wildflowers. Barn owl and bat boxes are tucked into the roof space. The building won the Property and Construction Award as the most sustainable development of the year and we were a finalist in the National Climate Week and National Energy awards. The building seats 80 and enables us to meet the increasing demand from those who want to know more about our work, as well as being used by the local community.

The visitors' centre won the 'Sustainable Development of the Year award' and is regularly used for community events and launches, such as the FWAG Association below.

© Laurie Campbell/Thermafleece

The loft insulation is processed sheep's wool which uses eight times less energy to make than man-made fibres.

Solar photo cells provide the building with electricity as well as exporting to the grid.

The completed visitors' centre. The old visitors' centre is on the right and has been converted into offices for the staff.

The wall insulation is constructed of straw bales made from the farm's own wheat straw.

Looking ahead

"Over the last 20 years publicly funded applied agricultural research has been drastically curtailed. We should all be grateful that the Allerton Project, funded in the main by farmers and land-owners, especially the far-sighted Allerton family, is still undertaking such valuable work. It behoves us all, farmers and Government alike, to continue to support it for the next 20 years. The findings will continue to be of the greatest importance for establishing the evidence base for future land management practices."

Lord Selborne GBE FRS

After more than 20 years of activity, the Allerton Project spans a generation. This document records and explains some impressive achievements in that time. Even better, the project is in fine health, undertaking an unprecedented number of research studies across an ever-widening spectrum of subjects. The twentieth anniversary was marked with the opening of the new visitors' centre, reflecting the importance of our role in translating research results into national policy and practice on individual farms.

There is a growing number of partnerships with other key contributors working together for the development of agriculture, which secures and enhances the future for our natural resources and wildlife. Most notably, the Allerton Project is one of five sites nationally to be part of the Defra-funded Sustainable Intensification Platform, a network of research and demonstration farms seeking new ways of combining productive, profitable agriculture with wildlife conservation, resource use efficiency, climate change mitigation, water quality and flow improvement – in fact all the issues that the Allerton Project has explored to varying degrees over the past 20 years. The selection of the project and its wide range of landscape scale research for this national initiative is an affirmation of our success to date.

A farm for the future

It is also vital not to lose sight of the combination of interests and motivations which gave rise to the project in the first place and which remain its distinctive signature: a fairly ordinary farm, reasonably productive, with a modest but active game interest, in the middle of agricultural England. The Allerton Project is part of a landscape that is valuable for its traditional, productive beauty, part of a catchment which provides water for a wide swathe of towns and cities and forms part of a local community that is very much involved in the spirit of the project.

All around in the Leicestershire landscape there are the signs of great continuity of agricultural effort over the centuries, as well as the huge changes to which farming practice has had to adapt to survive and prosper. Game management is woven into this landscape. Local natural resources have provided opportunities and constraints and their current condition is partly the legacy of how they have been exploited and conserved in the past.

The Loddington landscape serves as a powerful metaphor – the inter-related quality of fields, woods and streams, settlements and soils illustrates the insight which the Allerton Project offers for the future. Everything has to work better, together, in the years ahead. There will be less room for manoeuvre, a greater need for integration, and all will depend on greater knowledge of how land can be managed for an increasing number of purposes. The high quality and range of research undertaken at Loddington will become ever more significant and ever more applicable across the country.

The research undertaken at the Allerton Project will become ever more significant and applicable across the whole country in years to come.

Landscape © Markus Jenny; Song thrush © Laurie Campbell

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