LIFE Project Number

LIFE13_BIO/UK/000315

FINAL REPORT

Covering the project activities from 01/06/2014 to 31/01/2019

Reporting Date

30/04/2020

LIFE+ PROJECT NAME or Acronym

LIFE Waders for Real

Data Project

Project location	Avon Valley, UK
Project start date:	01/06/2014
Project end date:	31/12/2018 **Extension date:** (31/12/2019)
Total budget	€ 1,254,638
EC contribution:	€ 627,319
(%) of eligible costs	50%

Data Beneficiary

Name Beneficiary	The Game & Wildlife Conservation Trust
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List of abbreviations and terms

Avian predators – corvids, raptors, gulls and herons, all avian species that could possibly predate lapwing eggs or chicks.

Camera traps – motion activated cameras, these are positioned in the field to remotely collect data on mammal abundance.

CEO – Chief Executive Officer

Defra – UK government Department for Environment, Food and Rural Affairs

EA – Environment Agency

EC – European Commission

Ink-tracking tunnels – a small plastic tunnel fitted with an ink pad to pick up the tracks of any small mammal using it.

GPS – Global Positioning System

GWCT – Game & Wildlife Conservation Trust

IUGB – International Union of Game Biologists

IWSG – International Wader Study Group

Mink raft – a floating raft that is placed into the river or ditch, with a clay pad in the centre to pick up the tracks of any mammal using the raft. Developed by the GWCT this is the most effective way of detecting American mink.

Mammalian predators – red fox, European badger, American mink, and any other mammal species that may predate lapwing eggs or chicks.

NE – Natural England

RSPB – Royal Society for the Protection of Birds

SPA – European designated Special Protection Area

Temperature loggers – a small device (1 cm diameter) placed in the bottom of a lapwing nest, which records the temperature every 15 minutes.

Avon Valley Sites

All sites in the Avon Valley run along the river Avon, sites neighbour each-other on their northern and southern boundaries. Most sites are owned and managed independently, however some do share ownership, with different tenant farmers.

Hotspot sites – a site of optimum habitat with reduced predation pressure, where the birds are able to fledge sufficient chicks to increase recruitment to the population and where higher breeding densities enable the birds to better fend off predators. All our habitat work is focused on these sites.

Hucklesbrook, Ibsley, Kingston, Watton's Ford, Avon Tyrell North (Standlynch and Ogber added 2018).

Non-hotspot site – sites within the Avon Valley that have not received management plans, habitat restoration and intensive monitoring.

Standlynch, Shallows Farm, Folds Farm, Burgate Manor Farm, Ellingham, Westover Farm
Moortown Farm, Week Farm, Avon Tyrell South, Ogber, Cowards Marsh, Winkton, Knapp Mill.

Detailed site maps Annex 7.2 Avon Valley sites and hotspots.

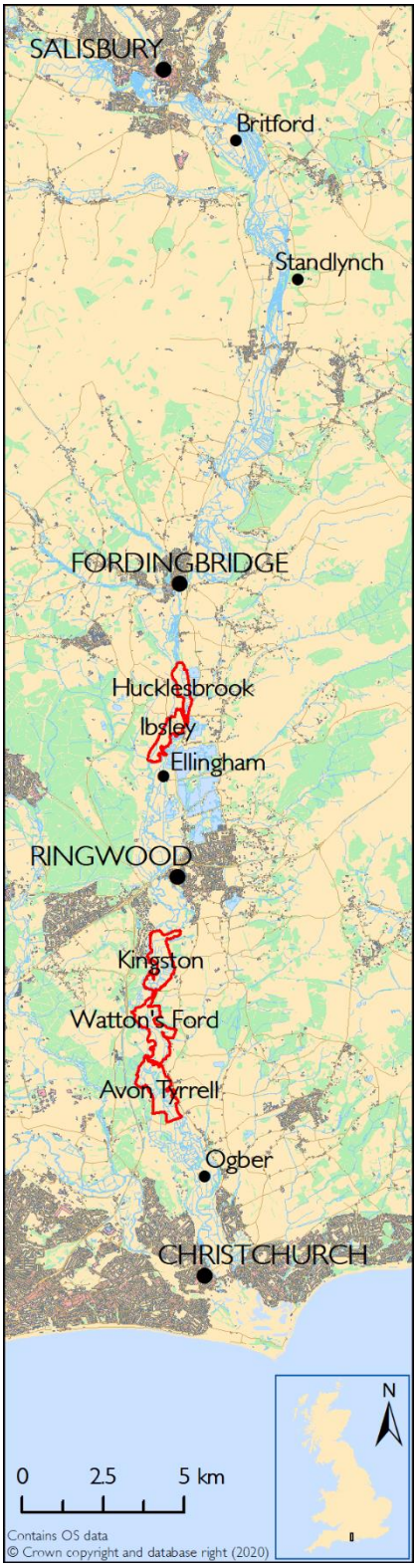


Figure 1 Map of the Avon Valley

2 Executive Summary

Project objectives

The aim of the LIFE+ Waders for Real project was to start to reverse the long-term decline of breeding waders in the Avon Valley, UK through engaging stakeholders and implementing effective habitat and predator exclusion measures. The Avon Valley is a river floodplain of high biodiversity interest, part of which is designated as a SPA. Numbers of breeding waders in the Avon Valley, in common with other lowland river valleys and wet grasslands, have declined dramatically since the 1980s, with declines of 66% in lapwing *Vanellus vanellus* pairs, 81% in redshank *Tringa totanus* pairs and 97% in numbers of displaying snipe *Gallinago gallinago* between 1990 and 2010. Lasting solutions to issues of habitat quality and predation are urgently required.

Monitoring of lapwing breeding success in the Avon Valley by the Game & Wildlife Conservation Trust (GWCT) during 2007-2014, showed that the number of chicks fledged was too low to maintain a stable breeding population. To halt the decline of lapwing and redshank urgent intervention was required to improve breeding success, which should lead to increases in breeding density.

The project objectives were to employ a combination of habitat restoration and targeted, seasonal predator exclusion to:

- Increase lapwing numbers in the Avon Valley, through the novel approach of creating strategic 'hotspots' of optimum habitat with reduced predation pressure (Actions C1, C3, D1).
- Increase numbers of lapwing chicks fledged at 'hotspots' to the point where breeding densities became sufficient to enable lapwings to better fend off potential predators on their own (Actions C1, C3, D1)
- Halt the decline of redshank in the Avon Valley by increasing productivity (Actions C1, C3, D1).
- Create conditions to encourage snipe to return to breed (Action C1, D2).
- Using a new approach called Planning for Real, deliver sustainable conservation actions (Actions D5, E1, E2).
- Demonstrate how far habitat manipulation can be used to push the balance in favour of waders rather than predators, and assess predator behaviour in manipulated landscapes (Action C1, C2, D1, D2).
- Demonstrate the most appropriate techniques for the efficient exclusion of predators and quantify any benefit or problems associated with predation control (Actions C2, C3, D1).
- Quantify the costs of different techniques for increasing wader breeding success and the timescale over which this translates into higher wader numbers (Action D1).
- Monitor the effects of restoration for waders on other key elements of floodplain biodiversity, particularly the flora, invertebrates and wintering wildfowl (Action D4).

Key deliverables and outputs

As well as starting to reverse the decline of breeding waders in the Avon Valley, we wanted to better understand which factors most influenced the waders and which measures were most

effective. Key deliverables and outputs included the production of six hotspot management plans within the Avon Valley (Action A2), protocols for wader, habitat and predator monitoring (Action A4), and reports on the monitoring of waders and changes in breeding success and pair numbers (Action D1), the effect of habitat actions on hotspots (Action D2), GPS tracking of foxes to understand their use of wet meadows (Action C2), and the implementation and efficacy of predator exclusion techniques (Action C3). We were also interested in the effects of managing for breeding waders on other key wet grassland taxa and produced a report on summarising monitoring of flora, soil invertebrates, aquatic invertebrates, dragonflies and damselflies, grassland passerines, and wintering wildfowl (Action D5). An evaluation of the socio-economic impact of the project was an important output (Action D5).

During the project, we aimed to raise the profile of issues concerning wader conservation and to disseminate project results to local, national and international audiences. Dissemination outputs included two leaflets, one setting out the project objectives and the other summarising project results and lessons. Four noticeboards highlighting the importance of the landscape for breeding waders and describing the project were erected at points near public footpaths. Project staff gave talks to local interest groups and manned stalls at open farm days and county shows. We produced a technical publication on predator management and a guidance note on electric fencing for wetland site managers and farmers. Two scientific papers on the response of breeding waders, one on fox behaviour on wet meadows and one on monitoring small mustelids were produced to ensure that project results reach researchers and policy makers. Throughout the project, progress and successes were reported, and contacts built, through a dedicated website, blog, Twitter feed and Facebook page.

A one-year prolongation in 2019 ensured that the project delivered more than originally planned, with the opportunity to fully realise tangible progress towards the overall objective of reversing the decline of breeding waders in the Avon Valley.

Project management

The project was managed by a research team leader and an experienced fundraiser and administrator at GWCT, both of whom had previous experience of managing large conservation projects. Financial oversight was provided by a small executive committee at GWCT, with practical advice and monitoring of progress towards targets provided by a steering committee comprising individuals from statutory authorities and NGOs. The Project Officer role was crucial for engagement and building trust with stakeholders, and for overseeing day-to-day monitoring activities. The GPS tracking of foxes *Vulpes vulpes* was only possible thanks to the expertise of experienced mammal ecologists. The time required for effective dissemination activities was underestimated at the project outset and the addition of a dedicated role in 2018 made an appreciable difference to audience reach in the last two years of the project.

Preparatory actions

The first eight months of the project were spent in discussion with statutory authorities and farmers, clarifying necessary permissions for habitat works and identifying possible hotspot sites. Agri-environment scheme agreements were scrutinised to understand habitat work

already taking place and identify potential for new works that we believed would make a significant difference. Our final decision on hotspot locations took into consideration landowner and farmer receptiveness to new ideas and willingness to modify their existing management. Four hotspots were agreed by 2015: Hucklesbrook-Ibsley, Kingston, Wattons Ford, and Avon Tyrell North. Two additional hotspots, Standlynch Farm and Ogber, were identified with the project extension in 2018.

Monitoring protocols for the breeding waders, fields conditions and potential egg and chick predators were devised in February-March 2015, prior to the first project field season. The Senior Officer and Predation Manager posts were filled internally by GWCT staff, enabling us to commence these tasks as soon as the project agreement was signed. The Project Officer was recruited in March 2015.

Conservation actions

Implementation of new habitat works (Action C1) and predator exclusion measures (Action C3) were crucial to the success of the project, as predation of lapwing eggs and a scarcity of suitable brood foraging areas were identified as issues when the project was conceived. By removing old fences (over 1,000 m) to enlarge fields, felling trees (15), clearing willow scrub (6,200 m), digging scrapes (33) and ditches (1,700 m), and renewing overgrown ditches (6,750 m) we created more suitable patches of breeding habitat for the waders at hotspot sites. Habitat works were largely complete at all four of the original hotspot sites by spring 2017 and were entirely completed by March 2019, with some works at two adjacent sites at Avon Tyrell South and Sopley Island included. We improved a total of 229 ha of habitat across all sites, exceeding our project target of 120 ha. The addition of new wet features has more than doubled the number of brood-rearing patches available to the birds before the start of the project.

Several studies of predation on wader clutches have identified foxes as the main predator and so we deployed temporary electric fences to exclude foxes (and badgers) from nesting areas during April-May. Deployment of fences was slower than anticipated during the first two years of the project and the technique was perfected as the project progressed to incorporate alternate plastic and metal supports to increase fence rigidity and strimming of vegetation beneath the fence in May. By the later years of the project 7-8 fences were deployed annually and despite known breaches by foxes, fences had an overall beneficial effect on lapwing breeding success.

The monitoring of fox activity with GPS collars at two sites in the valley (Action C2) constituted a novel approach to understanding how to reduce predation, with relevance not just to the Avon Valley, but many other wet grassland sites. The combination of trail camera images and data from 34 tracked foxes indicated high densities of foxes in the Avon Valley in spring, with up to 18 individuals estimated to use an area of 1 km² during April-June and about ten of these breeding in the 1 km² patch. Small mammals, particularly water voles *Arvicola amphibius* at one site, comprised the largest component of fox diet, but foxes regularly followed linear features, including ditch edges where they were likely to encounter wader broods.

Monitoring actions

Monitoring the outcomes of the conservation actions was an important aspect of our project. The key monitoring was of wader breeding success and numbers (Action D1), the restoration of ecosystem services (Action D4) and the socio-economic impact of the project (Action D5). Annual monitoring of the waders was undertaken by the Project Officer and experienced assistants to establish a pair count of lapwings and redshank and estimate the number of fledged lapwing broods and young on the four hotspots and ten comparison non-hotspot sites. We offered an MSc student project each year which focused in more detail on lapwing brood survival. Analysis of these data in the final project year enabled us to confirm the effect of the habitat and predator measures.

By contracting an ecological consultant, we were able to collect detailed information on meadow flora, aquatic invertebrates, and dragonflies and damselflies at the hotspot sites. These taxa comprised groups which we expected to be affected by the ditch and scrape management instigated during the project. Grassland passerines and wintering wildfowl were counted by project staff and an MSc project on soil invertebrates was hosted in two years.

The purpose of the socio-economic monitoring was to better understand farmer and landowner attitudes to wader management and to track the change in their knowledge and willingness to implement measures during the project.

Dissemination actions

Our project website (www.gwct.org.uk/wadersforreal/) has seen steady growth in the number of page in total we had 8,863 visits to our website over the duration of the project. 25 project blogs have been posted and many new contacts with practitioners and researchers have been made through the project Twitter feed during 2015-2019, the total number of followers on twitter reached 721 while the total number of tweets was 950. Our overall number of impressions was 534,100 and grew each year. From 2018, updates have been posted on a project Facebook page. During the project, 7 press releases to national, regional and local broadcast and print media were produced. These were picked up by a range of publications from newspapers to specialist-interest magazines (14 different new outlooks). Four scientific papers have been prepared for submission to journals to ensure that project results reach researchers and policy makers.

Over the duration of the project, community engagement has been carried out through face to face discussions at many events with the general public, seminars for educational organisations, conference networking, questionnaires and direct interviews, as well as arranging regular focused meetings for the Avon Valley farmers and land managers. This process was developed using the Planning for Real process to involved local parties and stakeholders in the planning, evaluation and development process to increase awareness and create an action plan for the sustainable delivery of the project's conservation actions.

Over 40 networking events were organised or attended over the course of the project, with interaction with over 50 organisations and/or projects. Events ranged from two-day networking workshops with specific organisations and projects, to smaller discussion meetings and attendance at our end-of-project, regional and international conferences. Networking events were often accompanied by seminars by the project team. The opportunities provided by the LIFE programme to undertake networking activities have been

valuable to the development of the project team and partner organisations. Important and valuable outcomes of the LIFE Waders for Real project are the strong relationships built with staff at many other conservation organisations, universities and projects. The GWCT team now has a much larger network of contacts than prior to the project, with whom they can openly discuss ideas, solve problems and collaborate.

Project evaluation and long-term benefits

The project has been very successful, with targets for habitat creation exceeded and a greater number of wader pairs achieved than expected: lapwing 105 pairs (target 80-90 pairs), redshank 35 pairs (target 30 pairs). Snipe have started to reappear in the valley in summer for the first time in about ten years. During the four years of active management within the project, the five-year running mean of lapwing productivity for the valley increased from 0.50 to 0.66 chick/pair. Prior to project inception, the five-year mean productivity for 2011-2013 was 0.41-0.43 chick/pair. A figure of 0.70 chick/pair is considered the level of productivity required for a stable breeding lapwing population and, except in 2017 which was a very dry year, values above this were regularly achieved on the hotspots. We were able to demonstrate a statistically significant difference in lapwing productivity between hotspots and comparison farms.

Owing to the time taken to fully engage with stakeholders and agree management plans during the first year of the project, combined with annual variability in wader breeding success in relation to winter rainfall, the project extension to a fifth year was extremely useful in enabling us to demonstrate the value of the measures implemented during the project. The success of the project is important in a regional context because breeding waders are also declining at other nearby areas within the landscape, such as the New Forest, a national park adjoining the Avon Valley.

Continued maintenance of habitat and predator management measures will be required to sustain the wader increase in the Avon Valley. The recent formation of an Avon Valley farmer cluster A greater rate of increase should be possible if the effects of low winter rainfall can be mitigated and this will be a priority. Creation of more in-field wet features should help, but improved water control measures are also needed to ensure that ditches and scrapes remain wet at the peak of chick hatching every year. We plan to create a further 12 scrapes and c.1000 m of ditches in the next five years. Given the rate of wader response to date, we aim to reach a population of 140 lapwing pairs and 60 pairs of redshank in the valley by 2025.

The project has demonstrated that with relatively minor changes to agri-environment schemes, the options for breeding waders could be more effective and hence represent better value for money. Support through agri-environment schemes is already in place in the UK for most of the habitat management measures required by farmers to create and maintain suitable nesting and chick-rearing areas. The current level of funding for measures such as creating scrapes and shallow ditches, and removal of trees and willow scrub is adequate, but funding for electric fencing is very low and does not provide an adequate incentive for farmers to undertake it. This has been reported to Defra and we are advocating better support for a complete wader package that includes predator management in the new Environmental Land Management (ELM) agri-environment scheme.

Our experience during the project, and feedback from stakeholders, suggested that high quality advice from a trusted advisor was essential for project buy-in from farmers and for successful implementation of measures. With increasing cuts to the budgets of statutory authorities such as Natural England, numbers of experienced staff have dropped and the ability of advisers to provide tailored advice for individual farmers within agri-environment schemes has reduced. We have advocated for support for advice within ELMs at meetings with Defra and Natural England.

Financial report

Overall expenditure exceeded budget by 6%. Wader monitoring was one of the costliest actions but was important to understand the effect of conservation work and disseminate results to policy makers. Our external assistance and consumables costs were over budget, but the external assistance guaranteed expert help with the more specialised aspects of project monitoring. Higher staff costs in 2018 and 2019 enabled significantly increased dissemination outputs. Cost savings were made by using students to help with running trail cameras and other survey work. Money was saved on electric fencing by using some equipment from a previous project.

3 Introduction

LIFE Waders for Real

The aim of the LIFE+ Waders for Real project was to start to reverse the long-term decline of breeding waders in the Avon Valley, UK through engaging stakeholders and implementing effective habitat and predator exclusion measures. The Avon Valley is a river floodplain of high biodiversity interest, part of which is designated as a SPA. Numbers of breeding waders in the Avon Valley, in common with other lowland river valleys and wet grasslands, have declined dramatically since the 1980s, with declines of 66% in lapwing *Vanellus vanellus* pairs, 81% in redshank *Tringa totanus* pairs and 97% in numbers of displaying snipe *Gallinago gallinago* between 1990 and 2010. Lasting solutions to issues of habitat quality and predation are urgently required.

Species recovery at local scales is no small task and it relies on many stakeholders working together to keep the ‘cogs’ of a conservation project like Waders for Real moving in the right direction. Success can only be achieved by un-locking enthusiasm, through building trusted relationships between land managers and advisors. Advice needs to be tailored, realistic and trusted to allow land managers and farmers on the ground to take ownership of their environmental goals alongside their day to day working practices.

The objectives are, through a unique combination of habitat restoration and innovative targeted, seasonal exclusion of predators to:
1. Increase lapwing numbers in the Avon Valley, through the novel approach of creating strategic ‘hotspots’ of optimum habitat with reduced predation pressure.
2. Increase numbers of lapwing chicks fledged at ‘hotspots’ to the point where breeding densities become sufficient to enable lapwings to better fend off potential predators on their own.
3. Halt the decline of redshank in the Avon Valley by increasing productivity.
4. Create conditions to encourage snipe to return to breed.

5. Using a new approach called Planning for Real to deliver lasting conservation action.
6. Demonstrate how far habitat manipulation can be used to push the balance in favour of waders rather than predators. We will assess predator behaviour in manipulated landscapes.
7. Demonstrate the most appropriate techniques for the efficient exclusion or reduction of predators and quantify any benefit or problems associated with predation control.
8. Quantify the costs of different techniques for increasing wader breeding success and the timescale over which this translates into higher wader numbers.
9. Monitor the effects of restoration for waders on other key elements of floodplain biodiversity, particularly the flora, invertebrates and wintering wildfowl.

The Avon Valley

The Avon Valley spans from Salisbury to Christchurch, following the river Avon, see Figure 1 (more detailed site maps Annex 7.2 Avon Valley sites and hotspots). The decline seen in breeding waders has caused them to constrict their range south of Fordingbridge, hence our focal sites have been from Fordingbridge to Christchurch. Hotspot sites (outlined in red in the map, right) were designated if they followed the criteria of an existing population of breeding waders, some existing habitat features for waders and with land managers and farmers enthusiastic to be involved in the project.
The focal habitat type is farmed water-meadows, with the focal species Northern lapwing *Vanellus vanellus*, redshank *Tringa tetanus* and snipe *Gallinago gallinago*. All work undertaken through the project was aimed at improving and better understanding the breeding success of these species, with the primary species being lapwing. With all measures we implemented it was crucial it was not to the detriment of any other species of farming practices.

Improved Habitat

New and restored in-field wet features create optimum wader foraging habitat. These habitats provide a rich source of invertebrates on which wader chicks feed, and soft soil to facilitate probing. These mini wetlands also host dragonflies, damselflies, molluscs, important wetland plants, as well as overwintering waders and waterfowl. In addition, our farmers have modified grazing and cutting regimes to increase diversity and maintain shorter swards.

Reduced Predator Pressure

Waders select open landscapes, avoiding places where predators perch and hide. With help from our project partners, we have removed over 1km of old fences and willow scrub along with an additional 18 dead trees (which can otherwise provide perches for avian predators). We deployed temporary electric fencing, protecting 125,885m^2 of wader breeding habitat. Fences were deployed in areas where nest predation was identified and typically surround a wet feature where chicks are likely to feed. Intensive camera trapping allowed us to monitor presence of mammalian predators on hotspot sites.

Tracking Mammalian Predators

The Avon Valley supports a large suite of predators that may impact on wading birds. Foxes figure prominently in most detailed studies of predation on ground-nesting birds, especially lapwing breeding in wet grassland habitats. We have fitted GPS-tracking collars to foxes and obtained tens of thousands of locations to analyse habitat use, and collected hundreds of fox scats for dietary analysis. We also used a network of mink rafts on water channels, and ink-tracking tunnels on river meadows, to map the distribution of small mammalian predators on our hotspot sites.

Socio-economic value

Our socio-economic report uses the Theory of Change model to understand how our four key stakeholder groups have benefited from the Waders for Real project: farmers/landowners/gamekeepers, students, the wider community and the GWCT. Using SORI principals, target outcomes were identified for each stakeholder and data was gathered to support assessment at the end of the project. All outcomes were achieved, though quantitative data collection as proposed was not always possible.

Expected longer term results

The Waders for Real LIFE project has brought together a group of farmers and land managers who are working together at the landscape scale with the common goal of protecting breeding waders. This will continue for at least for the next three years in the form of a Farmer cluster, we were successful in receiving additional funding through a Facilitation Fund from Natural England to allow our project officer to continue the advisory and facilitator role within the Avon Valley. This funding was reliant on farmer participation and at the close of the project, 14 different farms signed up to be involved with many more interested to join.

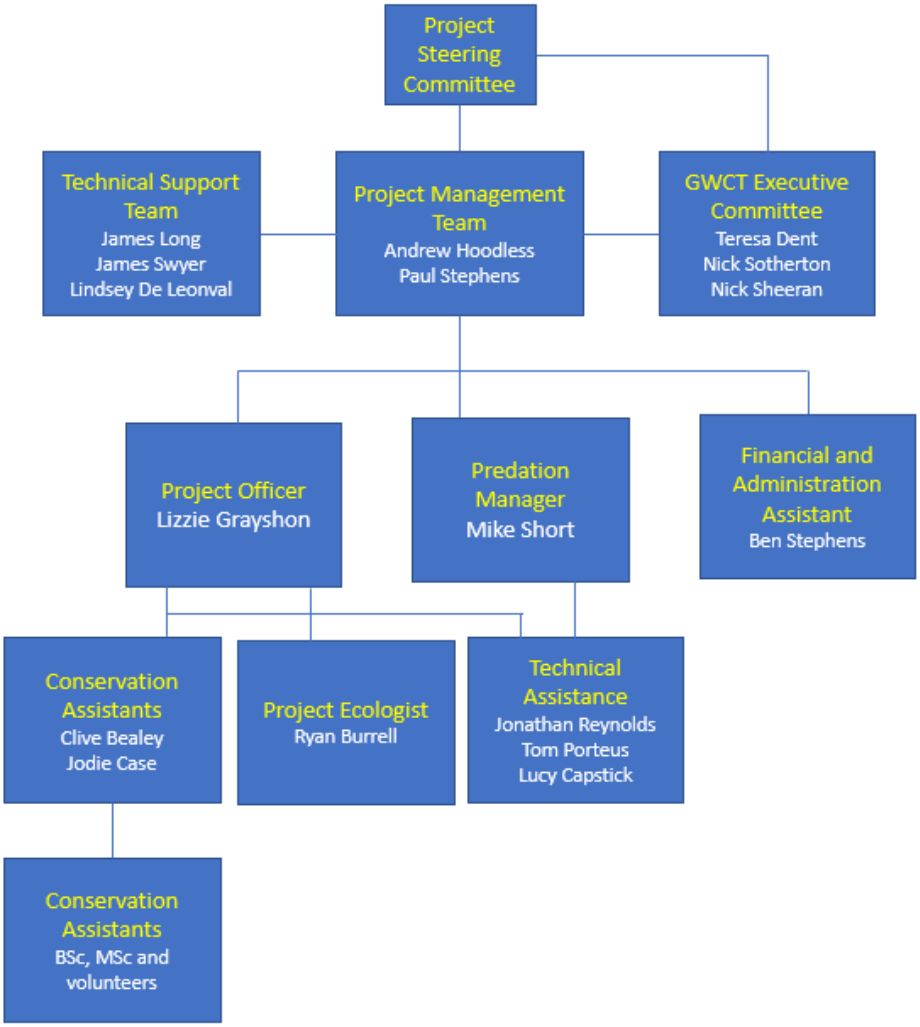
In the final year of the project in 2019 we reached 105 pairs of breeding lapwing and 35 pairs of breeding redshank (is this across the Avon Valley or in the hotspots?). This is an increase in lapwing from 61 pairs in 2015 and from 19 redshank. We documented two pairs of lapwing North of Fordingbridge, one of which successfully fledged chicks. With the continuation in farmer cooperation we could begin to see more expansion further north. We have improved 229 ha. of habitat across all sites, creating water-meadows better suited to lapwing and redshank nesting/brood rearing largely through increasing the amount of accessible wet features. We hope that through project continuation we can maintain this area and if more farmers get involved, we could increase this area further.

100% of farmer/landowner/keepers surveyed in our end of project questionnaire agreed that they plan to continue inputting some of the conservation measures for waders beyond the project. Looking forward we aim to restore Avon Valley wader numbers to 140 pairs of lapwing and 60 pairs of redshank by 2025. We plan to deliver this by facilitating the creation of at least 12 additional scrapes and c.1,000 m of ditches in the Avon Valley over the next five years and ensuring that electric fences are deployed in key locations to protect wader nests and chicks each spring.

We believe this is achievable as stakeholders now understand what is required for adequate wader productivity. The recent creation of an Avon Valley farmer cluster, with the LIFE Waders for Real Project Officer acting as facilitator for at least the next three years, means that the group should be able to capitalise on the project achievements to date.

4 Administrative part

The project was managed by Andrew Hoodless, an experienced research team leader, and Paul Stephens, an experienced public sector fundraiser and administrator. They were ultimately responsible for project delivery, but were assisted in making decisions on project actions by a steering committee comprised of seven representatives from statutory authorities (Natural England, Environment Agency), NGOs (Hampshire & Isle of Wight Wildlife Trust, Wessex Chalk Streams Trust), landowners and Planning for Real, and financial oversight was provided by a small executive committee at GWCT. The key roles for delivering the project's conservation and dissemination actions were those of Lizzie Grayshon (Project Officer) and Mike Short (Predation Manager). Lizzie was responsible for overseeing habitat works and predator exclusion, wader and habitat monitoring, and public engagement. Mike was responsible for conducting predator monitoring. The ability of these two people to communicate effectively with stakeholders about project aims and proposed actions was crucial to the project's success. In 2018, we employed Ryan Burrell and Jodie Case as additional conservation assistants, as agreed in the reworking of our budget for the project extension. Ryan has helped to greatly improve the communications and profile of the project.



The management team met one or twice a year to discuss progress and report on progress to Nick Sotherton (Executive Committee) on a regular basis. There was weekly communication

between team members who were all based at the same site close to the project location. Andrew Hoodless drew up annual internal budgets for the project and received monthly reports on expenditure, allowing accurate tracking against budget. A restructure of the GWCT finance department in August 2016, with new direction from Nick Sheeran and additional staff aided the smooth running of operations.

We held two formal steering group meetings, in January 2015 and January 2017. We circulated papers and invited comment in spring 2018, along with several one-to-one meetings with members of the committee. It proved more difficult than anticipated to get all of the steering group members to meet regularly, but we kept them updated on project progress and sought opinions on project actions via email correspondence. We kept in regular contact with steering committee members as part of our ongoing communications strategy, e.g. one-to-one meetings with the farmer representatives and phone and email communications with statutory authority representatives. More regular dialogue was undertaken in 2019 as the project drew to a close and we considered the After-LIFE plan. We also set up a smaller working group of farmers to outline priority species and areas for future conservation work.

We agreed an extension to the LIFE project by one full year to 31 December 2019 in early 2018, along with a budget modification. As part of our revised project deliverables, we hosted a very successful final project conference on 6-7 November 2019, with a range of invited speakers to engage practitioners and generate discussion on practical methods of wader conservation. We submitted four reports to the EC: an inception report in February 2015, a mid-term report in August 2016, a progress report in February 2018 and a progress report in January 2019.

The management system worked well, particularly after a change to the structure of the GWCT finance team in 2016. We had expected to meet more regularly face-to-face with the project steering group, but good email communication ensured that we were able to obtain valuable advice and agree priorities.

5 Technical part (maximum 50 pages)

5.1. Technical progress, per task

A1 Recruitment and appointment of key staff members

We recruited an effective team to undertake and manage this project, but with some changes to the structure envisaged in the original project proposal.

Project Manager. This post has been filled by Paul Stephens since June 2014, as reported in the Inception Report.

Senior Officer. Dr Andrew Hoodless (Head of Wetland Research at GWCT) took on the role of Senior Officer in June 2014. He covered some of the Conservation Advisor work during winter 2014/15, owing to a delay in appointing this person.

Predation Manager. Mike Short (Senior Predation Scientist at GWCT) has fulfilled this role since June 2014, as recorded in the Inception Report.

Our chosen candidate for the Conservation Advisor role, Rhys Morgan of Hampshire & IOW Wildlife Trust, was not available to work on this project in 2014. An agreement was reached with HIWWT to second Rhys for two days per week during April-October 2015 to liaise with farmers and statutory authorities. However, HIWWT encountered local political difficulty with farmers at this time regarding badger vaccination and, following discussion, it was decided that it would be better for the project to create the Project Officer role and employ someone on the GWCT payroll.

Project Officer (combined Conservation Advisor and Conservation Assistant role). Lizzie Grayshon has been employed from 9 March 2015 to finalize the habitat plans and ensure their implementation, to run the field team and oversee day-to-day running of the project to completion. Dr Kaat Brulez worked on the production of maps and monitoring protocols in January February 2015 until Lizzie was appointed and continued to provide occasional support, particularly with database management until December 2017.

Conservation Assistants. Dr Clive Bealey, an experienced local ecologist who has previously worked with Natural England and some of the farmers in the Avon Valley, has been employed by GWCT on a seasonal contract to conduct wader surveys, habitat monitoring and ecosystem monitoring during spring-summer 2015-2019. Many MSc and undergraduate students undertook placements for up to a year to work on the project as Conservation Assistants and Conservation Technicians.

Dr Tom Porteus has helped the Predation Manager with managing the data from fox GPS collars and Dr Jonathan Reynolds has dealt with Home Office licensing for fox tagging and helped write the fox outputs.

Dr Carlos Sanchez worked on the project as a Conservation Technician until 2017 and was replaced by Dr Lucy Capstick. Both contributed small amounts of time relative to other staff but provided valuable technical expertise.

During April-May 2018, we recruited Ryan Burrell as a full-time project assistant and Jodie Case as a seasonal field assistant to help deliver actions C1, C3, D1, E1, E2 and D1, D3, D4 respectively, as agreed in the project extension.

The Financial Assistant role was not envisaged at the outset, but Ben Stephens has provided valuable support to the Project Manager and Senior Officer.

A.2 Meeting with statutory authorities and initial stakeholder meetings

It was clear from the outset of the project that both Natural England (NE) and the Environment Agency (EA) were supportive of the LIFE Waders for Real project and believed that it broadly complemented their ambitions for the improvement of ecological condition of the Avon Valley. We had in-depth discussions with local staff from both organisations 3-4 times a year during 2015 and 2016, while habitat works were being considered and implemented, to check whether surveys were required, and which methods and timing were appropriate.
The project provided scope for synergies and added value for some taxa (meadow flora preferring wetter conditions, aquatic invertebrates, other ground-nesting birds, bats, some fish), but also potential conflict with some fish and bats. Meetings were held with Environment Agency to discuss issues of tree removal near the River Avon and the possibility of fish stranding in new ditches and scrapes following winter flooding. Assessing the balance of benefits was discussed, along with the possible need for statutory authorities to conduct site visits prior to works on a case-by-case basis. A meeting with the Avon Roach Project was valuable in identifying areas for working towards common goals. For the sites proposed as hotspots the capital works elements of their HLS agreements were all complete, so there was no issue with additional habitat works.

This action was undertaken according to the planned schedule and continued dialogue with Natural England at a local level throughout the project proved very useful.

Deliverable A.2 Report from Statutory Authorities meeting

Deliverable A.2 Completion of report from stakeholder meetings

A.3 Scrutiny of agri-environment scheme management plans and identification of hotspot sites fields and farms

At the beginning of the project, four hotspot sites were identified (Table 1), these sites required an existing lapwing population of 5-10 pairs and some existing habitat features for breeding waders. Most importantly these sites had land managers and farmers who were interesting in improving wader numbers and breeding success. Site management plans were produced for each site through discussions with statutory agencies and stakeholders (see Deliverable A.2 Report from Statutory Authorities meeting, Deliverable A.2 Completion of report from stakeholder meetings) along with meetings with individual farmer. Management plans were aimed at increasing breeding wader success through reduced nest predation, creation of in-field wet features for broods and creating larger nesting 'colonies' of lapwing. Plans incorporated increased habitat for redshank and snipe. Existing HLS agreements were reviewed to avoid double funding.

Table 1l Avon Valley hotspot sites and area covered

Site	Area ha
Avon Tyrell North (original)	132
Huclesbrook/Ibsley (original)	121
Kingston (original)	109
Watton's Ford (original)	115
Ogber (added 2018)	63
Standlynch (added 2018)	64
Total	**477**

Each hotspot site received regular meetings and management advice, support for derogations to allow beneficial farming practices to continue. Temporary electric fences and nest protection cages were prioritised on hotspot sites. Detailed lapwing monitoring on hotspot sites allowed for accurate feedback on results of work, this was critical for investment and motivation for continued work by land managers and farmers.

During the second half of 2017, we explored possible options for a further two hotspot sites which were included under the amendment to the LIFE project for the project extension (Table 1). Management plans were drawn up for Ogber (50º45'N, 01º46'W), where lapwing, redshank and snipe all bred 20 years ago and 6-8 pairs of lapwing still nest and 1-2 pairs of redshank. The project identified some habitat improvements which could be beneficial for waders such as restoring a central ditch and adding scrapes, this habitat creation could help with the main identified issue of chick predation. The other additional hotspot site is across parts of Alderbury, Witherington and Standlynch farms in the north end of the Avon Valley (51º01'N, 01º44'W). Lapwing and redshank have not nested here for several years, but the habitat is appropriate for redshank to nest here again. The scope for habitat improvements here were to restore the ditching system and remove a number of trees to encourage waders back to this area to breed, this will also largely benefit wintering waders and waterfowl. The farmer on this site was particularly keep to be involved in the project and hopes to encourage breeding waders back to these northern meadows.

Deliverable A.2 Production of 4 Site (hotspot) management plans

A.4 Write monitoring protocols for habitats, predators and waders

Monitoring protocols were produced at the beginning of the project, these then evolved and grew during the five years of the project as the project developed. Wader and habitat monitoring protocols remained broadly the same, with some development on field sheets to allow for more efficient data collection. Original protocols were developed to monitor wader (detailed productivity monitoring for lapwing), predators (avian and mammalian) and habitat. Additional protocols were developed to go along side the fox tagging (scat searched and high seat watches), invertebrate monitoring (terrestrial and aquatic).

The aim of the monitoring outlined is two-fold: to measure change at the four hotspot sites where the most intensive management for waders will take place and to compare habitat conditions and wader breeding success against four comparison non-hotspot sites. Breeding wader surveys were conducted on all sites to give a baseline of breeding wader numbers along with detailed monitoring of lapwing productivity. Predator monitoring and detailed vegetation monitoring were undertaken on key hotspot sites, as well as wader breeding success and vegetation monitoring undertaken at comparison non-hotspot sites.

Deliverable A4 Production of protocols for Habitat, predator and wader monitoring

C.1 Implementation of new habitat works

In our original proposal we aimed to double the current area of in-field wet features (carriers/footdrains and scrapes) over at least 120 ha, to provide more attractive nesting areas for lapwings and redshank and better access to brood rearing areas. It was proposed that the area of habitat suitable for nesting redshank should be increased by 20 ha. in the Avon Valley in order to halt the decline in the number of breeding pairs.

We also aimed to create at least four patches of optimal habitat for breeding snipe, totalling c.20 ha, situated close (within c. 500 m of the edge) to our 'hotspots' and record whether this is successful in encouraging birds back to breed. If successful, a prescription describing the management required would be documented for promotion at other sites across the country.

Finally, each hotspot site was required to have a comprehensive conservation plan drawn up and implemented, including approximately 1,000 m of new boundary ditching and 1,000 m of in-field carrier/wet feature restoration.

Habitat works commenced in August 2015. To facilitate this work, a mutually beneficial agreement with Sparsholt College was reached, whereby their students assisted with some of the habitat tasks in return for lectures from GWCT staff on wildlife management. Groups of 12-15 students assisted with scrub removal, learned new skills and, in particular, had the opportunity to use chainsaws in difficult conditions. This work would originally been subcontracted but that this was an opportunity to collaborate with the college. However, many benefits were made through this collaboration for both parties and the they became one of the main groups of stakeholders in the project.

Habitat works were largely complete at all four hotspot sites by spring 2017 and were entirely completed by March 2019 see

Table 2. Habitat works were also completed works on two extra non-hotspot sites Avon Tyrell South and Sopley Island. The new hotspot site, Standlynch Farm was identified in the project extension in 2018 to target wintering waders and wildfowl and allow for future breeding wader population expansion (Figure 1 Map of the Avon Valley, page 2).

Table 2 All habitat management conducted throughout the project.

Site	Fence Removed m	Scrub removed m	Scrape Added m²	Ditch added m	Ditch reprofiled m	Trees removed	Area of water meadows improved ha
Avon Tyrell North - Hotspot		4944	998	83	866		34
Avon Tyrell South (South of Avon Tyrell North)					110		8
Hucklesbrook - Hotspot			1955	1603	2463		53
Ibsley - Hotspot	1012		1090			5	30
Kingston - Hotspot		1294	4937			3	45
Sopley Island (South of Avon Tyrell North)			562		738		9
Watton's Ford - Hotspot			1377		349	5	38
Standlynch Farm			285		2226	2	12
Total Hotspot	1012	6238	10357	1686	3678	13	200
Hotspot average	253	1559.5	2589.25	421.5	919.5	3.25	50
Total	**1012**	**6238**	**11204**	**1686**	**6752**	**15**	**229**

Ogber hotspot (added 2018) - unfortunately, our proposed plans were unable to be completed due to landowner complications. We were unable to resolve these complications during the final year of the project and consequently unable to complete our proposed habitat work. We were able to use the funds to conduct further scrape creation on Kingston and Watton's Ford in autumn 2019 instead.

We have improved 229 ha. of habitat across all sites, creating water-meadows better suited to lapwing and redshank nesting/brood rearing largely through increasing the amount of accessible wet features (this is the combined area of fields that have received new or restored wet features). Habitat work on hotspot sites created 200 ha. of improved habitat for breeding waders through creating new, or restoring existing, wet features (ditches/scrapes). Wet features have at least doubled compared to what was originally available per field, this exceeds our original proposal of improving 120 ha. of habitat for breeding lapwing.

Our original proposal outlined that we would create approximately 1000 m of new boundary ditching and 1000 m of in-field carrier/wet feature restoration. All scrapes were created in the middle of fields, ditches were sometimes along field boundaries and sometimes infield, however all ditches created were appropriate for use from wader chicks, i.e. not deep carrier boundary ditches running alongside woodland or other unsuitable habitat. On average we created 39.5m of new or restored boundary ditch and 158.5 m² of boundary scrapes. Although this does not meet our target, we have exceeded in in field features, these arguably are more beneficial for our sites. We have created or restored an average of 1279 m² of in field ditching per hotspot sites, and 2430 m² of infield scrapes on average per hotspot site (see Table 2). We are confident that this has had achieved the same overall outcome, especially when considered in the context of the overall amount of habitat which has been made appropriate for breeding waders.

The improvement of 229 ha. of water meadow carried out through the Wader for Real project has benefited redshank alongside the lapwing. This is evidenced by the increase of redshank pairs over the 5 years of the project. Redshank chicks rely on wet features to facilitate feeding and a mosaic of vegetation to provide cover from predators. Both of these habitat features were improved through habitat works undertaken as part of the project. Through the project farmers have become more aware of the management needed to make these important water meadows suitable for waders. Consequently, grazing regimes have been improved to make some fields more appropriate for snipe on the Hucklesbrook and Kingston hotspots. In two later years of the project drumming snipe were observed, this demonstrates that some sites have become more suitable for breeding snipe.

Deliverable C1 Report on new habitat works completed (updated Feb 2020)

C.2 Predator tracking and monitoring

The Avon Valley supports a large suite of predators that may impact on wading birds, here we discuss our research on fox behaviour and movements. Other predators are discussed in D3. Foxes figure prominently in most detailed studies of predation on ground-nesting birds, especially lapwing breeding in wet grassland habitats. Given GWCT's expertise with foxes and their control, we chose to focus on this predator. We aimed to advance our understanding of fox ecology and management in river meadow habitats important for breeding wading birds, principally through GPS-tracking. Ancillary research involved using trail cameras and high-seat counts to monitor fox activity on sites where foxes were tagged, and a variety of dietary studies.

Fox tracking

Between 2015 and 2019, we used neck snares to catch and GPS-tag 21 adult foxes occupying river meadows at Britford (just south of Salisbury) where waders no longer breed; and 16 adult foxes on the Somerley Estate, home to our Hucklesbrook and Ibsley hotspot sites. We programmed tags initially to record a GPS-location every 10 minutes to provide adequate detail on habitat use and hunting behaviour. In some cases, we changed this to record once per hour to conserve battery life. When falling battery voltage indicated that little battery life remained, a remote drop-off mechanism could be triggered remotely, allowing the collar to be recovered. 35/37 foxes were tracked from February-July, to cover the wader nesting period, and tagging generated a total of 152,428 useable GPS locations. Data analysis will provide new information about fox densities, habitat use, activity patterns and hunting behaviour in areas where waders once bred and still do. In 2018 and 2019 foxes were tagged on river meadows where temporary electric fences were used to protect nesting birds, providing a unique opportunity to explore the effectiveness of fences at preventing incursion by foxes.

The work undertaken on this action greatly exceeded that originally envisaged in our project proposal (10 foxes tagged). This was partly because we were unsure about how much effort would be required to catch the foxes when preparing the proposal, but partly because when successful we wanted to capitalise on the interesting results, especially because feedback from other projects suggested that the information produced would help the wider wader management community with decisions on fox management strategy.

Fox detectability

We gathered data on the detectability of tagged foxes by using: (a) point-counts from high-seats around sunset, and with thermal-imaging equipment at night, (b) with trail cameras and (c) by searching for their scats (faeces).

- Between 2016-2019, at Britford (non-hotspot)and Somerley (Hucklesbrook and Ibsley hotspot sites), we conducted a total of 200 high-seat counts, from 30 different high-seat locations, around sunset and with thermal imagers at night.
- Trail cameras were set at 30 different locations at Britford and 69 different locations at Somerley, which resulted in 153,427 images (not all of foxes). Camera records from 2019 are still being processed and analysing the huge volume of GPS data gathered during the project and marrying it with camera and high-seat data to calculate fox detectability, is an enormous and currently incomplete task and not a LIFE deliverable.
- Fox scats were collected both opportunistically, and by walking fixed transect routes at set intervals. Between 2017-2019, we collected 549 fox scats at

Britford and Somerley (163 at Britford; 386 at Somerley). We took 88 faecal-swabs from a sample of scats collected at Britford for DNA-analysis to reveal individual identities and gender to further inform density estimates. These swabs, along with a sample of scats and fur collected from tagged foxes, were sent to Umeå University in Sweden to be analysed by a team of geneticists experienced in fox DNA work. Samples from Somerley are in frozen storage and will be swabbed for genotyping and analysed by either macroscopic or molecular methods if funds become available. (Insufficient resource was available to do this through the LIFE project.)

Fox diet

Fox diet was studied throughout the Avon Valley to understand the importance of various food resources to foxes utilising wet meadow habitats. Every approach to reconstructing fox diet has its drawbacks. We used three methods, each giving a different insight: (a) fox scats – identification of undigested prey remains in the faeces, (b) stomach contents – identification of undigested food in the stomach of dead foxes, and (c) trail cameras – these were used primarily to monitor fox activity, but also show foxes carrying food items.

Between 2017 and 2019, we collected circa. 800 fox scats during the wader nesting season (including the 549 described above). In 2017, scats were collected throughout the Avon Valley, but in 2018 and 2019 scat collection effort was focussed only on Hucklesbrook/Ibsley hotspot sits where foxes were tagged. It is difficult to study diet by scat analysis where lethal control is in progress, because scats are harder to find due to the reduced fox density. This was the case at the most important areas for breeding waders in the Avon Valley, at the Kingston and Watton's Ford hotspot sites. Here, instead of scats, we analysed the stomach contents of 64 foxes killed on or close to these breeding grounds by the Estate keeper, immediately prior to and during the wader nesting period in 2017-19.

Between 2016-2017, 100 trail camera images of foxes at Britford showed them to be carrying food items, predominantly trout scavenged from a fish farm on the site. Between 2018-2019, trail cameras were set at Somerley; images from 2019 are still being processed, but several cameras were set looking at cubbing earths tended by tagged foxes and reveal multiple images of prey items being delivered to cubs.

Summary

Our lapwing monitoring indicated that more than 60% of nests that were predated at the start of the project were taken at night, indicating that the fox was one of the most important predators and justifying the effort expended on action C2. This effort was further justified by the fact that the rate of nocturnal nest predation declined during the project as more electric fences were deployed to protect nests from mammalian predation. Full details relating to work undertaken for this LIFE deliverable, C2: Report on the implementation and efficacy of predator monitoring and tracking are reported in "**Exploring the lives of Red Foxes in the Avon Valley: a nationally important site for lowland breeding waders**."
This report does not include details on:

- Spatial analyses of tagged foxes around electric fences, and the impact of fox culling on Bisterne Estate. See LIFE deliverable **E1: Technical publication on the direct and indirect predator control techniques for wader population stabilisation and increase, including implementation and efficacy of indirect measures.**

- Investigations into the diet of foxes throughout the Avon Valley. See LIFE deliverable **E1: Leaflet for wetland site managers summarising the Avon Valley results on fox density and diet.**
- In-depth analysis of fox movement behaviour and activity from GPS-tracking.

Deliverable E1 Scientific paper – fox habitat

In this paper, we use estimates of home ranges obtained from GPS tagging of foxes during the wader nesting season to understand differences in habitat composition between fox territories, and use of different habitats within territories. We use the GPS data to characterise fox movements in relation to linear habitat features. We also examine the location of cubbing earths in an environment with a high-water table, given the expectation that slightly higher terrace areas will be important for earth location and the availability of drier areas may influence territory size.

Deliverable E1 Scientific paper – fox movements

In this paper, we aimed to examine fox ecology during the wader nesting season at contrasting sites within a river valley; one site where waders still breed, and one site where waders no longer breed but habitat remains good. We used data from trail cameras and GPS telemetry to estimate daily activity patterns and distances moved by foxes. We then fitted home range models to fox GPS data to produce metrics about fox territory size and used these to understand within- and between territory movements, including interactions between tagged foxes.

C.3 Implementation of indirect predation reduction measures

The project aimed to trial a number of predator exclusion/deterrent measures at each of the hotspot sites where lapwing /waders are breeding which currently cannot be funded under HLS. The aim was to reduce predation pressure on breeding waders without the use of lethal control. During 2014-2019 we trialled electric fences on 6 different sites and nest cages on 3 sites.

Hotspot sites 477ha	**Non-hotspot sites 846 ha**
Direct non-lethal predator management	
Electric fences	Limited use of fences (two small fences used in one year)
Nest cages - attempted	Advice on best practice lethal predator control
Advice on best practice lethal predator control	
Camera traps used across sites to understand presence of mammalian predators.	
Indirect predator management	
Detailed management plans	General management advice
Habitat restoration – ditches and wet features	Some habitat restoration
Removal of fence lines and scrub	Support for derogations and beneficial farming practices to continue
Advice on sward management and grazing.	
Support for derogations and beneficial farming practices to continue	
On site meetings	

Nest cages

The aim was to deploy 20 excluder cages each year to project lapwing nests. Nest cages were deployed as early as possible in the incubation period in 2015 and 2016. We attempted with 10 different lapwing nests in 2015 and only one female accepted the cage and returned to the nest. Two more nests were attempted in 2016, these were not accepted by the female lapwing. If, after waiting 45 minutes, the cage was not accepted it was removed to avoid clutch desertion. The one protected nest in 2015 did hatch.

Once we started deploying cages it became apparent that lapwings were taking a long time to accept them and only one female out of ten accepted the cage and entered to incubate the clutch. We therefore had to remove the cages where they were not accepted to avoid clutch desertion. The one protected nest in 2015 did hatch. In spring 2016, we experimented with different designs of nest excluder (slightly wider bar widths, cages with mesh sides but made of finer gauge wire) in order to find a design that was more readily accepted, however this was still very time consuming and we were not confident with the acceptance rate. Deploying temporary nest cages is very time consuming, especially in areas where you can only access by foot, the nest needs to be visited regularly and the cages are heavy to carry to isolated locations. Regular visits to nests can be detrimental to nest survival so this needs to be a consideration to the use of cages.

We decided that due to the onerous nature of deploying the nest cages and the low rates of acceptance from nesting birds it was not a worthwhile management option in this circumstance.
This is not to say that they could not be successful for other project, we believe part of the problem for us was that our population is very undisturbed so the appearance of a new object near the nest is likely to be very off putting. Sites with easy vehicle access and a population that are more used to human disturbance could well have more success with this method.

Electric fences

Temporary electric fences were deployed from 2016 and in each year subsequently, there were reservations from land managers to begin with on the use of fences and this caused delays in their deployment. In spring 2018 we were able to put out seven temporary electric fences giving an overall perimeter of 3146m and protecting 8.17 ha of breeding wader habitat. However, extremely wet weather conditions in early April meant that most of the fenced areas were flooded during the first two weeks of April, causing birds to nest elsewhere. Fence locations were based on nesting in previous years and chick foraging sites and around new habitat features created (action C1). As these areas were naturally low lying, these were some of the first areas to flood in the extreme weather seen in early April 2018. This also increased our fence maintenance time to make sure they were effective in time for when the waters retreated. In 2019 we successfully deployed 8 temporary electric fences, protecting 11.46 ha of breeding wader habitat, we also monitored 14 lapwing nests inside fences.

We did not meet our targets for 2000m during the first three years, however we did exceed this target in the two later years of the project, therefore achieving a total of 8890m of electric fencing during the course of the project. We were also able to develop the style of fencing during this period.

Table 3 Total area fenced each year, split between hotspot sites and non-hotspot sites in hectares

Year	***Fenced area ha Hotspots***	***Fenced area ha, non-hotspot sites***	***Length of fence m***	***Nest monitored fenced***	***Nests monitored unfenced***
2015	0	0	0	0	56
2016	1.37 (1)	0	486	0	64
2017	3.05 (3)	0	1231	2	49
2018	6.75 (5)	1.42 (2)	3146	5 (2 on non-hotspot sites)	24
2019	11.46 (8)	0	4027	14	37

We were unable to trial damp nesting islands and permanent predator exclusion fences. The concept of damp nesting islands was difficult for farmers to accommodate owing to concerns about land lost to grazing or inability to take a hay cut in late summer. Permanent predator fences were considered in a few locations, but winter flooding often causes Avon Valley farmers issues with standard 1 m livestock fences owing to the build-up of debris on the fence. Given the relatively high cost of installing permanent exclusion fencing, and the expected high maintenance incurred by having to clear debris from winter flooding, we

decided that in most situations temporary electric fences were a better option. We are in discussions Kingston and Watton's Ford hotspot sites about the use of semi-permanent predator fencing. There may be scope for this in future agri-environment schemes for capital payments.

Deliverable C3 Guidance note for farmers on electric fencing to protect wader nests and chicks
Deliverable E1 Technical publication on the direct and indirect predator management techniques for wader population stabilisation and increase, including implementation and efficacy of indirect measures

D.1 Annual monitoring of wader numbers and breeding success

Monitoring of lapwing breeding success in the Avon Valley 2007-2014 prior to the project showed that productivity was too low to maintain a stable breeding population. To halt the decline of lapwing and redshank, we urgently needed to intervene to improve breeding success. Higher breeding success can, depending on overwinter survival, lead to an increase in adults returning to breed and consequently, to increases in breeding population density.

Therefore, from 2015 to 2019 habitat and predator management under actions C1 to C3 has been put in place to improve wader breeding success in the Avon Valley within hotspot areas. In order to document how this management affected breeding wader numbers and breeding success we have conducted detailed monitoring each year (2015-2019). Lapwing breeding success was monitored through pair surveys, nest and brood monitoring and other breeding waders were monitored through pair counts. Redshank and snipe pairs were counted every year.

Lapwing Pairs

Over the project we have begun to see a stabilisation in the number of lapwing breeding pairs across all sites in the Avon Valley at around 70-80 pairs (see Figure 2). Prior to the project the population had been in decline since the 1980s, a low of 41 pairs was counted in 2012. Pair numbers in 2019 reached 105, the highest pair count since 2010, we also had lapwing successfully breeding north of Fordingbridge, showing a possible expansion of territories.

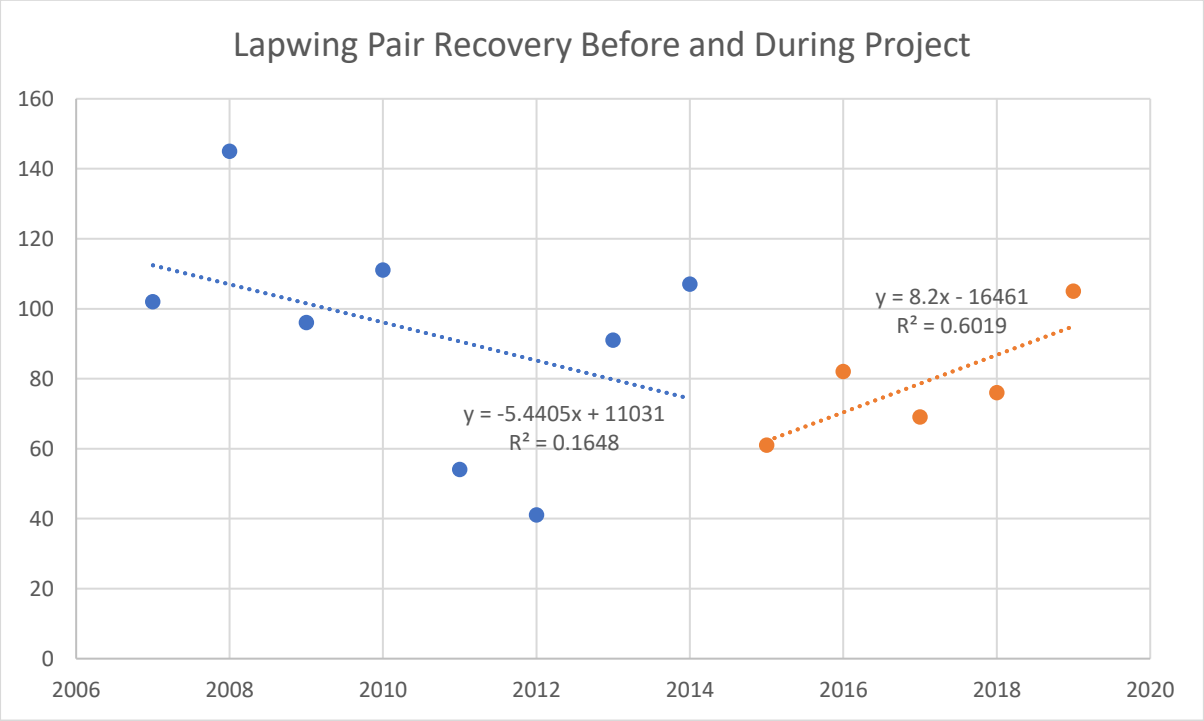


Figure 2 Count of Lapwing pairs in the Avon Valley in the years before and during the Waders 4 Real project

Over the five years of the project, the majority of lapwing pairs have been observed on the hotspot sites. Surprisingly the proportion of the total pairs observed on hotspot sites has remained relatively constant at around 65% (See Figure 3).

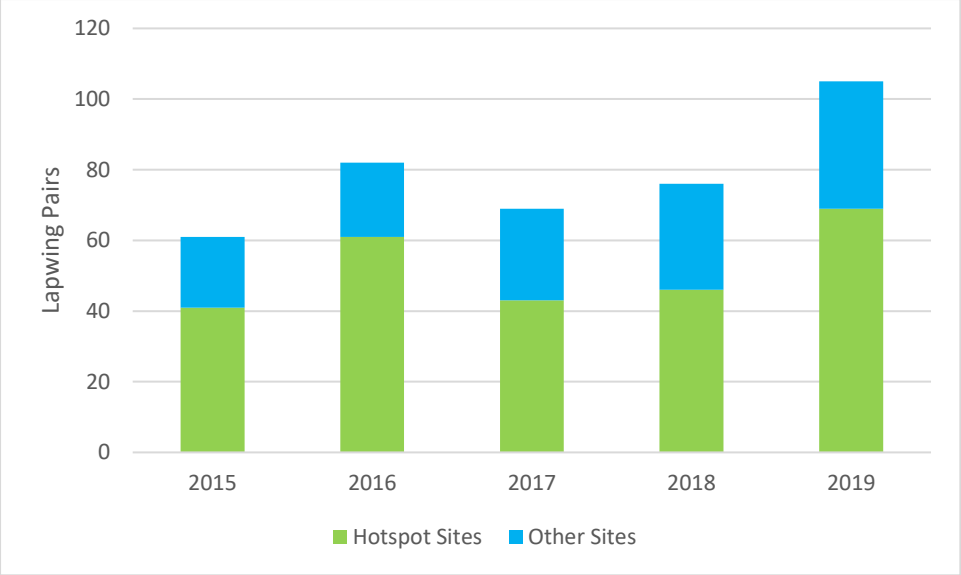


Figure 3 Lapwing pairs counted in hotspot and non-hotspot sites in the Avon Valley

Lapwing nesting success

Nesting success before the start of the project (2007-2011) averaged 44.9%, this increased by an average of 11% during the years of the project (2015-2019) (Table 4). Between 2015 and 2019 251 nests were monitored and nesting success averaged 55.3%. There was some variation in nesting success between years but in 2019 nesting success was at an all-time high of 76%.

Table 4 Lapwing hatching success across project monitoring

Year	Hatched	Unknown	Failed	Total
2015	31 (55 %)		25	56
2016	28 (43 %)		36	64
2017	20 (39 %)	5	26	51
2018	15 (52%)	4	10	29
2019	39 (76%)	1	11	51

Of nests which were known to have failed, predation was the main cause of nest failure (Table 5). It was not surprising that this was the most common cause of failure as other causes of nest loss, such as livestock trampling or insensitive farming practices, were minimised. Due to the low intensity of farming practices and conscientious grazing regimes we only recorded 8 nest failures due to farming practices or livestock throughout the project.

Table 5 Lapwing nest fates across project monitoring

Year	Predated	Abandoned	Flooded	Trampled	Unknown Failed
2015	18	3		3	1
2016	19	2	1	3	11
2017	16	1			9
2018	8	1	1		
2019	7	3			1

During the project it was possible to estimate the timing of nest predation using temperature loggers in the nest. This timing can be used to provide insight into nest predator identity; in

general, the majority of nocturnal predation is thought to be due to mammalian predators whereas diurnal predation could be due to a variety of different predators including birds. Over the course of the project we have seen a change in proportion of night and daytime predation events. In 2015 62.5% of known nest predation timings were at night, this was also 62.5% in 2016, 33.3% in 2017, 25.0% in 2018 and 27.3% in 2019. Although this is based on a relatively small sample size, of 52 nests over the 5 years, this still shows a possible shift in predator types in the Avon Valley. This could possibly be linked with to the increased use of temporary electric fences to exclude mammalian predators (Table 6) however, given the number of changes in management we are unable to distinguish the exact cause in increase in success. For more information see Deliverable C3 Guidance note for farmers on electric fencing to protect wader nests and chicks.

Table 6 Nest survival within temporary electric fences.

Nest Survival	***2019***	***2018***
Unfenced	67.5 %	50 %
	(n=25)	(n=12)
Fenced	100 %	60 %
	(n=14)	(n=3)

Lapwing chick survival

Radio tracking was used as a method to investigate lapwing chick survival. Lapwing chicks were tagged as close to hatching as possible, preferably on day one while still in the nest. 133 lapwing chicks were tagged during the project. We report here on chicks from 2015-2018 as analysis of 2019 chicks has not been possible yet.

The main cause of failure in chick survival is predation, however we were unable to determine the main causes of predation (Table 7).

Outcome	***Cause***	***Number of chicks***
Fledged		28
Failed	Assumed predated	22
	Known predated	20
	Trampled	1
	Drowned	1
	Unknown	9
Unknown		17

Table 7 The fate of ninety-eight chicks radio-tracked over four years (24 in 2015; 31 in 2016; 19 in 2017; 24 in 2018).

Lapwing productivity

We monitored wader productivity as chicks fledged per pair per year. Lapwing need to fledge an average of 0.7 chicks per pair each year in order to maintain a stable population. Out of the five years of the project we were successful in reaching this 0.7 threshold in three of the years. On average productivity was higher on hotspot sites compared to non-hot-spot sites, 2018 being the outlier, where one non-hotspot site had a particularly successful season (see Table 8).

Table 8 Lapwing productivity over the project

Year	***Productivity overall***	***Productivity – hotspot sites***	***Productivity – non-hotspot sites***
2015	0.49	0.49	0.50
2016	0.71	0.87	0.23
2017	0.34	0.38	0.28
2018	0.77	0.58	1.03
2019	0.96	1.17	0.58

There has been a large increase in productivity on hotspot sites during the course of the project. We have chosen to include 2015, the first year of the project as 'before project' i.e the baseline as there was no habitat work or predator reduction techniques used before the spring of 2015 (see Deliverable E1 Technical publication on the direct and indirect predator control techniques for wader population stabilisation and increase, including implementation and efficacy of indirect measures). An increase of 0.24 chicks fledged per pair was seen on hotspot sites during project years (Table 9). This increase took the average productivity during the project years (2016-2019) to about the 0.7 threshold needed to maintain a stable population. This is a great achievement over the 5 years of the project and highlights the work not only put in by the Waders for Real team, but the land managers and farmers who were responsible for altering management practices and increasing awareness of how to farm alongside breeding waders.

Table 9 Lapwing productivity change on hotspot sites vs non-hotspot sites across the project

	Productivity – hotspot sites	Increase in productivity	***Productivity – non-hotspot sites***	Increase in productivity
Before project (2007 - 2015)	*0.51*		0.47	
During project (2016 - 2019)	0.75	0.237	0.53	0.058

Due to a number of external factors, such as variation in weather and water-levels, wader productivity is notoriously variable from year to year, so it is important to look at this as a 5-year average. We are pleased to report a steady increase in 5-year average productivity since the beginning of the project. When the project began in 2015 the average productivity of the previous 5 years was 0.5, this has now increased to 0.66 in 2019 (Figure 4).

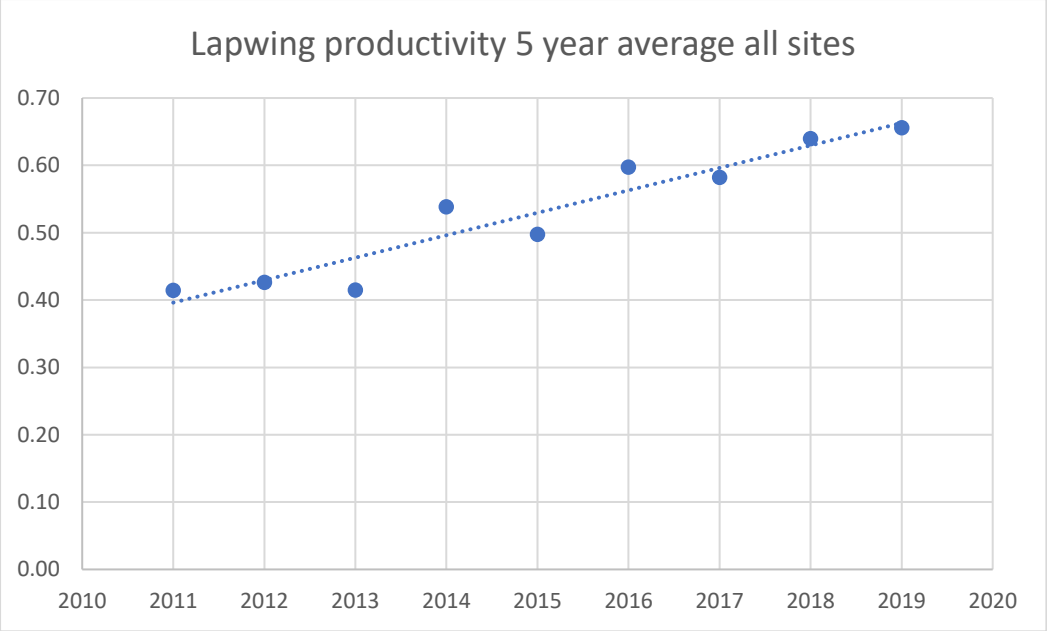


Figure 4 A rolling five-year average of Lapwing productivity in the Avon Valley

Redshank pairs

We have seen an encouraging increase in Redshank pair numbers over the course of the project and are happy to report 35 pairs were surveyed during the 2019 field season, a significant increase from 19 pairs at the beginning of the project in 2015 (Figure 5).

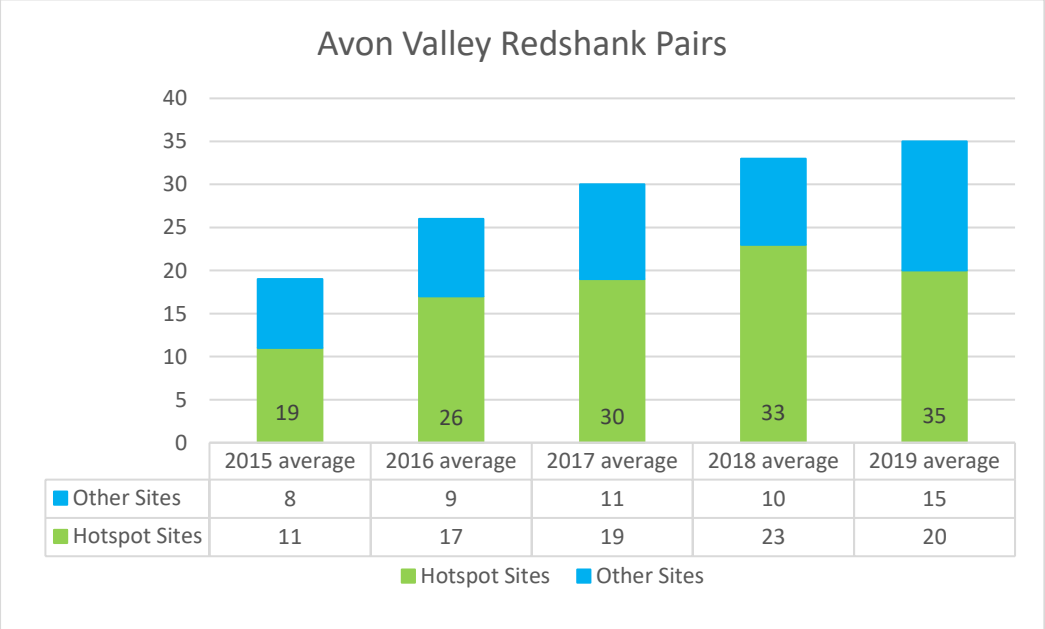


Figure 5 Redshank pairs counted in hotspot and non-hotspot sites in the Avon Valley

As with lapwing, the split of pairs occupying hotspot site compared to non-hotspot sites is very consistent over the 5 years despite the increase in pair numbers, on average 62% of redshank pairs are on hotspot sites.

Snipe

There have been possible signs of snipe returning to breed in the Avon Valley over the course of the project. Two drumming snipe (drumming is part of a courtship display) were heard on hotspot sites in 2018 and one chipping snipe (another display call) in 2019. We do not have direct evidence of breeding in the form of nests or chicks, but at low densities these are hard to find. These sightings of breeding behaviour show the potential for birds to move back to breed in the Avon Valley.

Lapwing tracking

Although the main demographic cause of lapwing decline is low productivity, little is known about the movements of lapwings during the winter and the importance of links between breeding and wintering sites. The objective of this tagging was to determine where lapwings go during the winter, connectivity between breeding and wintering sites, the timing of movements and, hopefully, the degree of fidelity to winter sites. Twenty lapwings were nest-trapped in May and June 2019 and each was fitted with a 4.3 g GPS-UHF tag attached with a leg-loop harness. Tags were programmed to collect four locations a day during March-August and two a day during September-February. They require a base station, placed within 300 m of the tag, to download data.

A base station was set up in the Avon Valley in mid-March 2020, but the UK has been in lockdown since 23 March owing to Covid-19, with GWCT staff working from home and unable to do fieldwork. We are in contact with Avon Valley farmers to move the base station, but have been unable to collect it and check for downloaded data. We have some evidence from data collected shortly after birds were tagged in 2019 that the tags were working as expected. A few additional tags were deployed by GWCT at a farm in Scotland in 2019 and it has been possible for someone there to download data from two birds. Both tags have worked as expected and provided interesting tracks of winter movements. We hope to find a way of getting out in the Avon Valley with the base station before lapwings start to disperse in mid-July. If this is not possible, the tags will remain attached to the birds and we will attempt to download data in spring 2021. The tags should collect data and continue to transmit for three years.

Lapwing chick colour ringing

Colour-ringing is a non-invasive and cost-effective way to monitor survival and movement in birds. Conventional ringing using metal ID rings can tell us a great deal, but the selection of open landscape and highly migratory behaviour of waders means individuals are often not recaptured limiting the utility of this type of mark. Colour-ringing offers a solution. As they can be read in the field, once rings are fitted, there is no need to re-capture the bird as each individual has a unique combination of colour marks unique to the LIFE Waders for Real project. Observers can then trace the bird back to the project providing us with data on the movements and survival of our birds. Resightings of birds during the breeding season tell us the breeding site preferences and recruitment of fledged young into our population, which can help us deduce what is driving site choice and whether it is consistent between years. Overwinter sightings can inform us about the wintering site selection and the pressures our lapwing may face whilst on their wintering grounds beyond the Avon Valley.

Due to the high levels of predation of Lapwing chicks, individuals were marked shortly before fledging at approximately 20 days, this provides increased confidence that colour-marked birds will make it to fledging. Over the course of the project, 144 chicks were colour-

marked at LIFE Waders for Real wet grassland and arable sites (Table 10). The number of chicks marked varied year to year though effort remained fairly constant throughout the duration of the project. The aim was to mark approximately 30 chicks each year, which was achieved in 3 of the 5 years. In 2015, the project officer had only just started explaining the low number chicks marked in that year. 2017 was a very dry and hot year leading to low chick survival and subsequently a lower number of chicks' colour marked.

Table 10 Lapwing chicks' colour ringed during the project

Year	*Lapwing chicks' colour ringed*
2015	15
2016	37
2017	13
2018	31
2019	48
Total	**144**

The majority of Lapwing colour-mark resightings were made by members of the LIFE Waders for Real team at project sites. Sightings covered both fledged chicks within their hatch year and returning breeding adults. In total 78 resightings were made over the course of the project. The vast majority of resightings showing fledged birds returning to breed in the Avon Valley wet grassland suggesting promising recruitment into the populations at project sites. However, this concerns a relatively small proportion of the overall chicks marked and so should be taken with caution. Colour-ringing has highlighted the interaction between Avon Valley wet grassland, neighbouring arable sites and the New Forest SPA. Eight individuals fledged from wet grassland sites are known breeders on adjacent arable farmland and at least one individual now breeds on the New Forest.

Figure 6 Nf//RN-G//Nm or in full "left above: black-flag, left below: red over black, right above: green, left below: black over metal". This individual was marked as a chick in May 2015 on the Ibsley hotspot and resighted 7.07km away breeding on arable farmland adjacent to the Kingston hotspot in 2018 and 2019.

Deliverable D1 Report on tracking of lapwings

Deliverable D1 Wader breeding monitoring report

D.2 Documentation of habitat actions and annual monitoring of habitat suitability

Through the LIFE Waders for Real project we have added new or restored existing wet features in 217 ha of fields across the Avon Valley. This has created wet grassland habitat better suited to lapwing and redshank nesting/brood rearing due to the increase in accessible wet features (ditches/scrapes). These techniques have had an effect on the vegetation structure and community within the water meadows.

By combining detailed monitoring of the breeding wader populations with ongoing assessments of the vegetation and field conditions we were able to document the effect of the habitat work detailed above in the Avon Valley.

We measured vegetation structure, community composition and soil penetrability using several different monitoring methods. This monitoring was used to demonstrate any effect of the changes in vegetation management, and wet feature management, implemented through the project *(See D4: Assessment of restoration of ecosystem functions).*

Repeated analysis of fixed quadrat locations in 2015 and 2019 indicated that over the course of the project sites did not see an increase in species which prefer wet habitat or species which prefer more or less acidic soils. However, there was evidence that the number of species that prefer high fertility soils decreased between 2015 and 2019, particularly on grazed (rather than hayed) fields (Figure 7). The elevated fertility of these fields was likely caused by historical mis-management (overstocking and artificial fertiliser input) therefore this decline in fertility could be evidence of the sensitive management of stocking densities implemented through the project.

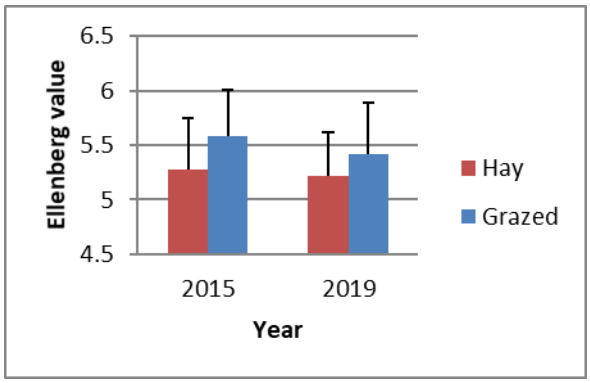


Figure 7 Fertility scores for hayed and grazed water meadows at the beginning and end of the project.

High fertility and vegetation species that prefer high fertility conditions are likely to produce a faster growing denser sward. The decline in these species is therefore likely to benefit breeding lapwing which prefer a shorter more open sward for nesting.

Quality assessments suggested that the quality score (based on positive indicator species) of sites in the Avon Valley increased slightly over the 10 year monitoring period, particularly on hayed fields (Figure 8). The greater increase in QS in hayed field could be because of the higher resilience of these communities to disturbance (their recovery is less likely to be perturbed by exceptional events like flooding (see Deliverable D4 Assessment of restoration of ecosystem functions).

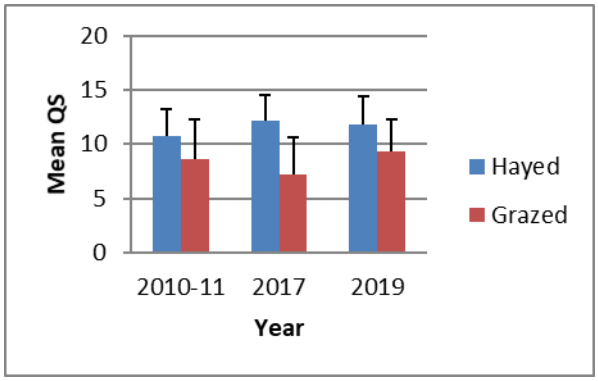


Figure 8 Quality scores (positive indicator species) for hayed and grazed water meadows before, during and at the end of the project.

More simple vegetation measures were undertaken each year to gain information on general vegetation structure and soil penetrability. These surveys showed that there were differences between years in both vegetation height and soil penetrability, however these differences were generally related to annual variation in external factors (such as overwinter rainfall) rather than indicative of management changes.

Changes in habitat and lapwing breeding success

As well as looking the results of our vegetation surveying, and other habitat monitoring, for evidence of the impact of our habitat works we can also directly relate our measures of vegetation and soil condition to our monitoring of lapwing breeding success.

Chicks survived better in fields with shorter vegetation heights. Shorter vegetation is likely to improve lapwing ability to perceive predators and facilitate chick foraging. The reduction in species which prefer fertile soil within the community could contribute to creating a short, less dense sward.

Although, we did not find evidence for a shift in vegetation community (more species which prefer wet conditions), or an overall increase in soil penetrability, that would indicate the benefit of wet feature creation, this is likely because of the scale of the wet features we created relative to the total field area. We did find evidence that lapwing chicks preferred to forage in conditions associated with wet features; chicks favoured sites where there was a greater proportion of bare ground and where the soil was more penetrable. This suggests that the mobile lapwing chicks could utilise the wet features created and restored as part of the W4R project.

Deliverable D2 Document outlining the effect of habitat actions at hotspots on habitat suitability for waders

Influences of lapwing chick survival in regard to habitat use and home range will be further explored in the upcoming Deliverable E1 Scientific paper on the importance of wet in-field features for increasing lapwing chick survival (in writing)

The changes in pair numbers and productivity before and during the project will be further explored in the upcoming Deliverable E1 Scientific paper on lapwing breeding success in the Avon Valley before and during the LIFE project and contributing factors (in writing).

D.3 Documentation and annual monitoring of predator abundance

Camera traps

Within the LIFE Waders for Real project, we desired to gain a broad understanding of the presence of mammalian predators across hotspot sites. Relating this information to wader breeding success alongside improving our understanding of predator activity in wader breeding areas will allow future comments and investigations on potential strategies to mitigate predator impacts. In addition, camera traps were used to improve the efficiency of legal predator control already conducted on hotspot sites, with sightings reported to site managers to direct efforts at improve wader breeding success.

Ten Ltl Acorn® camera traps (Ltl-6310MC or Ltl-5310; **Error! Reference source not found.**) were deployed at each hotspot site (Ibsey/Hucklebrook, Kingston, Watton's Ford and Avon Tyrell North) from the end of March to the end of June/early July between 2015 – 2019 to encompass the wader breeding season.

In total, over 1,763,991 photographs were recorded by camera traps during an expected 16,831 camera trap days over the 5 annual periods of camera trap monitoring. Of these, 37,819 photographs or 2.14% were of target species of terrestrial mammalian predators. The disparity between the two total photo counts stated comes from photos triggered by species not of interest such as cattle and deer, along with false triggers by vegetation. The number of photos taken of each target species varied between years, in some cases significantly (**Error! Reference source not found.**). Originally the target of the camera trapping work was terrestrial mammalian predators. Badger sightings remained consistent in number as the project progressed, with Red Fox and Stoat declining over the 5 year of LIFE Waders for Real.

Due to the large amount of data gathered through this survey method, and the resulting time needed for data management, analysis of the whole dataset has been limited at this time. Initial analysis during student projects found links between fox abundance-activity and wader breeding success. Further analysis of the camera trap data will investigate patterns in the records of terrestrial mammalian predators across sites and over time in relation to lapwing breeding success. In addition, analysis of activity patterns will aim to identify patterns the timing of detections alongside the impact of landscape features (bridges, fords, woodland, fence lines etc) allowing for potential improvements to predator management.

Camera traps were used on temporary electric fences, positioned on two of the four corner posts on each fence, facing inwards to detect fence breaches. This did not cover the whole area inside the fence; however, it would pick up most breaches.

Fences were designed to restrict access by mammalian predators, predominantly foxes, however we hoped badger and otter access would also be restricted. Use of camera traps across hotspot sites show presence of all three species on each site, however there were very few breaches detected by camera traps inside fences (Table 11).

Table 11 Fences breaches captured on camera traps.

Mammal	2018	2019
Fox	1	0

Badger	1	2
Otter	0	0
Hare	18	19
Cat	0	0
Dog	0	0
All deer species	39	43
Cattle	1	0
Unknown mammal	1	4

Deliverable D3 Monitoring of Mammalian Predators - Camera Trapping and Avian Predators

Avian predators

Birds have several behavioural responses to discourage predators from taking their eggs and chicks. Lapwing, as with many other avian species predominately conduct mobbing. A behaviour where adult breeding birds observe, approach and harass potential predators. The degree of mobbing behaviour by lapwing has been shown to vary by predator species and stage in the breeding cycle. This suggests lapwings may assess and adjust their behaviour to the changing risk a predator species poses. It was this behaviour that led us to focus on the anti-predator responses of adult breeding lapwing as part of our monitoring to gauge the perceived predation risk by different avian predator species.

Within the LIFE Waders for Real project, timed watches over fields containing breeding lapwing were conducted to obtain information on the abundance-activity of avian predators and where possible information on the frequency of direct predation by different avian predator species. Watches were conducted between early April to June in 2015 and 2016. In 2015, two different protocols were conducted, as the protocol was developed during the breeding season. In 2016, only protocol 2 was conducted. Protocol 2 was developed as a more appropriate way of looking at effects of avian predators, therefore protocol 1 was no longer used.

In 2015, we conducted 40 avian predator watches: 22 watches following Protocol 1 and 28 watches following Protocol 2 (25 for one hour, 2 for one hour 30 minutes and 1 for 17 minutes). In 2016, we conducted 13 watches following the revised protocol (12 for 1 hour 30 minutes, 1 for 30 minutes). In total 68 hours and 37 minutes of avian predator watches were conducted. From these 168 predator chases by lapwing protecting either eggs or chicks were recorded, with no direct predation events observed. Gulls and Corvid species showed the greatest abundance-activity over lapwing fields when all surveys are pooled. Note, abundance-activity does not denote likelihood of predation.

To provide a comparative assessment of avian predator abundance-activity to the camera trapping for mammalian species, we also recorded all avian predators observed during regularly bird surveys. However, surveys were conducted across all core Avon Valley sites, rather than purely on hotspots as with the camera trap monitoring.

In total, 20 species of potential avian predator were recorded on surveys. Although no predation events were observed 168 predator chases were recorded of lapwing protecting eggs or chicks. Gulls and corvids were the most abundant over lapwing fields.

- Barn owl
- Black-headed gull
- Buzzard
- Crow
- Grey heron
- Herring gull
- Hobby
- Jackdaw
- Jay
- Kestrel
- Lesser black-backed gull
- Magpie
- Marsh harrier
- Mediterranean gull
- Peregrine
- Raven
- Red kite
- Rook
- Sparrowhawk
- Great black-backed gull

When all sites are pooled, jackdaw and black-headed gull were the most observed species, both by the frequency of observations and total number of individuals observed. Crow was the most observed predator previously established to have a significant impact on breeding waders. Crows are known to predate both lapwing eggs and chicks are subsequently pose a threat throughout the breeding season.

Deliverable D3 Monitoring of Mammalian Predators - Camera Trapping and Avian Predators

Ink tunnels

Ink tunnels have been used by biologists in the UK and NZ to indicate population abundance of small mustelids by recording footprints. The concept of a tunnel as a landscape feature attractive to these species derives from kill-trapping practice in the UK. No other satisfactory methods have been developed to monitor small mustelids. We deployed ink tunnels systematically across 4 'hotspot' sites in the Avon Valley where wading birds attempted to breed with the aim of mapping occurrence of weasel, stoat, polecat and mink.
The work was carried out in 2015 and 2016 on four of the sites designated as breeding wader 'hotspots'.

Small mustelid predators were shown to be present on all four hotspot sites (stoat, weasel, polecat and mink). Comparison of detection rates with other ink-tunnel studies suggests that their densities were relatively low. However, we found that ink tunnels had a low probability of detecting any of the 4 small mustelid species where these were shown to be present. Numerous records of voles and shrews at almost every tunnel location demonstrated that the ink card itself was fit for purpose. Tunnel density was also more than sufficient. Adding egg, meat or scent lure to ink tunnels failed to increase the probability of detecting small mustelids.

Although we do not know the reason, we conclude that ink tunnels are an unsatisfactory tool for reliable mapping of small mammalian predator activity in this river meadow habitat. Trail cameras were unexpectedly better for stoats and mink (and presumably therefore polecats), but did not detect weasels, which are typically active out of sight in long grass or in vole tunnels. Approximately 1,000 person-hours of work were used in deploying and operating ink tunnels in 2015 and 2016. In view of the unsatisfactory results and the additional cost of supervising students, we abandoned this method for 2017-19.

While it is possible that trail cameras could be used for stoats (only) in a way that makes them more satisfactory than ink tunnels, the manpower cost of sorting stoat images from among all images captured makes this an inefficient and costly approach.

Deliverable D3 small mustelid report

Mink rafts

As a separate exercise, we also ran mink rafts on water courses in the same areas to determine the distribution of mink activity. 21 rafts were used in 2016. This was increased to 48 in 2017 to ensure that small ditches and drainage channels were adequately addressed. The results showed low, but clustered encounter rates, with very few mink detections except around Sopley Island (Avon Tyrell South). The method was very labour intensive and the mink rafts were not used after 2017 because we concluded that, relative to foxes, mink were likely to be a less important predator of waders and effort was better expended understanding fox movements.

Deliverable D3 small mustelid report

D.4 Assessment of restoration of ecosystem functions

Throughout the Waders for Real project, surveys of other species characteristic of floodplain habitats have been carried out to assess any impacts from the project's actions. Without complex experimental design it is not possible to determine which of the project actions directly impacted wider wildlife, however, we have documented here what was measured and assessed and advise on management where possible, and discuss how the project's restoration work can affect wetland ecosystem function.

Terrestrial Invertebrates

Masters research placements were created for the 2018 and 2019 field seasons. In each year, field work was conducted between May and June with 180 core soil samples and 180 pitfall samples collected over 18 study sites, to gather data to examine the effects of field condition, vegetation quality and management on soil invertebrate communities and the food resource they represent for birds. Overall, this study has established that various environmental variables and conditions should be considered when planning conservation efforts in relation to waders to support the invertebrate community in the Avon valley. Particularly, vegetation height is important for most invertebrate orders as they prefer a denser, more structural sward. Additionally, this study also revealed that there are species-specific effects on invertebrates when it comes to environmental variables, highlighting the issues we face when considering species-specific conservation management techniques and how all species in a community are affected.

Aquatic Ditch Invertebrates

The method for this study was chosen to record aquatic invertebrate numbers at ditches and rivers on four main sites along with vegetation and other physical attributes (and water quality). Two surveys were carried out, in June 2017 and June 2018. 26 ditch and 6 river sections were selected for the study across four focal sites, with sampling carried out over a 3-minute period along a 20m representative section, using a standard method. A total of 32 transects were surveyed each year over the period 2017-18, although it was not always possible to carry out some individual surveys due either to excessive flooding or dry conditions resulting in no water being present in the ditch. At the time of reporting, only samples from 2017 have been fully identified and quantified.

A total of 126 species or representatives of unique taxonomic groups were recorded across the four sites; species richness was only influenced by vegetation score and species diversity seems to be only related to water chemistry, with increasing diversity associated with increasing nitrate levels, pH and conductivity. This seems to suggest that such water bodies contain higher quality water which is defined as being less polluted, high available oxygen content and elements of naturally occurring vegetation communities. However, water body physical properties, in this case, the increasing size of water body also contributes to aquatic invertebrate 'quality' which is considered to reflect better water quality. The traditional management of both water bodies and aquatic, emergent and bankside vegetation need to be maintained for this and many other species.

Ditch Invertebrates

Dragonfly and damselfly surveys were conducted along sections of the river and ditch systems on the four hotspot sites in spring/summer of 2016-19; A total of 32 transects were surveyed each year, although it was not always possible to carry out some individual surveys due either too excessive flooding or dry conditions resulting in no water being present in the

ditch. A total of 25 species were recorded across the four sites and of particular note were: the consistent high counts for the banded demoiselle *Calopteryx splendens*, the sudden decline (between 2018 and 2019) of the emerald damselfly *Lestes sponsa* and the consistent increase in both the small red damselfly *Ceriagrion tenellum* and the four-spotted chaser *Libellula quadrimaculata*. There also seemed to be a contrast in fortunes for the two common blue damselflies, the azure damselfly *Coenagrion puella* (steady decline) and the common blue damselfly *Enellagma cyathigerum* (steady increase).
Some of the changes in other species can be explained by ditch maintenance work (deepening and reprofiling) which is carried out on a regular 5-10 -year cycle and effectively rejuvenates the water body. This creates opportunities for some of the species associated with 'new' habitats and who are good colonisers, including the four-spotted chaser.

Population changes over the four- year monitoring period can partly be explained by the vagaries of the weather, particularly flooding and drought events, but ditch and riverbank management programmes will also have had a major influence. Clearly, the Odonata fauna of the Avon Valley is of significant importance and forms part of the aquatic invertebrate assemblage for which both the river and wider water meadow system are designated as SSSI and SAC. Continued research and monitoring of this fauna and associated habitats should be considered a high priority.

Vegetation Communities

During the early stages of the project (2015/2016), in each year detailed vegetation data were gathered from 36 fields at 5 fixed locations (180 quadrats in total) to look at gradual vegetation change, recording all vascular plant species plus bryophytes and environmental variables. Samples were also collected in this manner during the 2019 field season. Additionally, on these fields and an extra number of sampled fields, a less intensive survey was carried out during the 2017 field season to look at the 'quality' of the vegetation. This uses the presence of positive indicator species (such as Marsh Marigold and Meadow Sweet), and negative indicators (such as docks and large sedges) to calculate a 'quality index' of the botanical importance. Penetrability of soil, community assemblage and structure were also assessed throughout the 2018/19 breeding season on all project sites. This was to understand the vegetation community characteristics and habitat conditions for various breeding waders occupying the valley.

Project start and end year data were compared and comparisons were also made between management and conservation 'status'. The most striking differences were between grazed and hayed fields - this can be explained by the management where more intensive cattle grazing throughout the spring to autumn period and a past history of applying fertilizer to some fields to 'improve' them has increased the soil fertility. Analysis showed a gradual increase in Quality Score over a 10 year period with hayed fields showing a consistently higher score compared to grazed ones. Hayed fields, although also more prone to seasonal inundation, are closer to the river and therefore tend to be those containing larger proportions of SSSI quality grassland. A reduction in fertility particularly on the grazed fields may be a continuation of a trend detected in the mid-2000s due to agri-environment prescriptions. This work will feed in to analysis of data on wader breeding location, success and habitat use and also with research in to the possible link between habitat 'quality' and vital invertebrate food sources, particularly at the chick stage.

Winter Wildfowl Counts

Wildfowl counts were carried out from 2015 to 2018 on each study site once a month over a three-month period of December to February. The standardised survey method for winter wildfowl surveys has allowed the surveys to be repeatable between 2015 and 2018. However, variation between site visits each month and each year may have led to total counts being over or underestimates due to counts based on max counts across the whole valley. This aside, it seems that rainfall and associated flooding largely influences the total numbers of winter wildfowl recorded. The wet, presumably mild winter of 2015/2016, which flooded the Avon Valley, attracted large numbers of ducks especially *Anas penelope, Anas crecca, Tadorna tadorna, Anas clypeata, Anas acuta* as well as waders such as *Limosa limosa* and *Vanellus vanellus*.

The subsequent periods of lower rainfall seemed to encourage lower numbers of grazing ducks and waders to winter in the valley. Furthermore, it is assumed temperatures in continental Europe also influence Avon Valley wildfowl totals. If temperatures remain mild, wintering duck species are believed to be short stopping and won't cross the North Sea from areas such as the Netherlands or Germany. Whereas if persistent cold weather occurs winter wildfowl may move to areas with milder climates, like the Avon Valley. The improved habitat management in the valley, throughout this period, has provided pools and more extensive areas for wildfowl to feed and roost. Species such as *Gallinago gallinago* seem to have increased with management with the wet 'in field' features such as scrapes and pools alongside ditches and different stages of maintenance has provided wildfowl, especially winter duck, safe roosting and feeding areas during the winter.

Breeding Birds

In each year from 2015 to 2019, bird surveys were undertaken at nineteen farms between March and July throughout the Avon Valley. These surveys were primarily undertaken to record Northern Lapwing *Vanellus vanellus* and Common Redshank *Tringa totanus* activity and pair numbers, providing high amounts of data for waders within the Avon Valley. These summer surveys, undertaken between March and July has allowed additional sightings of waterfowl and wetland songbird species, to provide an indication of breeding in the Avon Valley study area. Variable coverage and different types of survey effort between 2015 and 2019 has resulted in an issue when comparing data over the five years but general trends have been highlighted from the surveys. The presence of *Cuculus canorus* in the Avon Valley is positive, as a range of habitats in the water meadows alongside farming practices has provided this red listed species with a local stronghold. Similarly, confirmed breeding of amber listed species such as *Anser anser*, *Tadorna tadorna*, *Anas platyrhynchos*, *Anas clypeata* and *Emberiza schoeniclus* is important for the overall populations of these species, regionally and nationally.

Wetland Ecosystems and Restoration of Ecosystem Function

At the outset of the project the proposal agreed to look at the project impacts on other taxa. The EC advised that an ecosystem services assessment for the project would be beneficial; however, having investigated this route it was evident that a specialist would be required at budget expense which was not feasible in the latter stages of the project. Therefore, throughout the project data has annually been collected in relation to other taxa, providing data to investigate abundance before and after the habitat work carried out by the project. To summarise, ecosystem services generally, are broadly categorised as supporting services, regulating services, habitat services, provisioning services and cultural services; which can all be provided by wetland habitats, like the Avon Valley.

Restoring ecosystem function of wetlands can be created by connectivity of suitable habitat, promoting ecosystem services through spatial and temporal heterogeneity, which can be beneficial for all species. Shifting mosaics of habitat provide greater opportunity for colonisation, food availability and protection from predators; this approach can help to increase biodiversity across taxonomic groups and can stimulate regulating services of well-functioning ecosystems. A number of ecosystem processes can be regulated in wetland habitats including maintenance of air quality, regulation of climate, control of erosion, and protection from extreme climate/weather events. The Waders for Real approach aimed to restore ecosystem functions by improving habitat conditions for waders and to connect areas of suitable habitat at landscape scale to encourage breeding. This was done by removing predator perching areas such as dead trees and by opening landscapes by clearing areas of willow scrub and old fence lines. Wet features such as ditches were re-dug and existing in field features were maintained and new features created where suitable. This management is likely to have contributed to the provision of regulating ecosystem services, for example, the creation of wet features increases water storage in the landscape and affects flood regulation. The work carried out by the Waders for Real project also included bespoke management advice and community engagement, promoting cultural and provisioning services, with the aim of managing a balance between farm production and associated provisioning services, breeding wader conservation and wider ecosystem restoration.

Deliverable D4 Evaluation report on the impact of the project actions on the restoration of ecosystem functions

D.5 Assessment of socio-economic impact on the project

Utilising the Theory of Change approach (see Deliverable D5 – Midterm Evaluation report on socio-economic impact for an explanation) throughout the Waders for Real project has contributed to the project's overall objectives, by identifying useful activities and assessing outcomes, so that resulting changes are recognised and understood.

The Waders for Real project set out to start the recovery of breeding wader populations in the Avon Valley, undertake research on breeding wader and predator activity and to disseminate project findings to a wide audience.

The Theory of Change approach allowed the project to understand:

- If the activities carried out helped project objectives to be met
- If the activities carried out negatively affected project objectives
- Which activities could only be achieved through teamwork and collaboration
- How the project activities contributed to change in a variety of circumstances

Initially four main stakeholders were chosen; Farmers, Students, Wider Community and GWCT, these were the groups who were most likely to benefit from the project. we developed a theory of change for each group and then devised methods for quantifying this change. For details on this process and outcomes please see Deliverable D5 End of Project Evaluation report on Socio-economic impact of the project.

Farmers

A general change in attitude of both farmers and landowners was noticeable during the first two years of the project. During the first year of the project, seeking permission to access sites was often tricky and required large amounts of effort and communication. The project officer who was brought in at the beginning of the project was a new face for all farmers and landowners and a lot of work and time was put into gaining their trust and respect. The result of this was seen during the second year of the project where requesting access and permission for habitat work became a lot quicker and easier.

Our questionnaires showed that there was an average knowledge increase of 17.6% across all topics, the highest increase in knowledge was in understanding of lapwing numbers and breeding success with an increase of 28.3%. This shows that our reporting and feedback was successful in increasing this area of understanding. Understanding in redshank numbers and breeding success also saw an increase of 25.4%. Understanding of management for lapwing increased by 20.3%, this means the likelihood of continuation increased, as without understanding it would not be possible for farmers to continue conservation efforts alone. All farmers surveyed agreed or strongly agreed that they plan to continue inputting some of the conservation measures for waders beyond the project. This is extremely encouraging to hear.

Students

We saw an average increase in skill confidence of 0.8 on a scale of 1 – 5. The areas where most students are least confident is *Statistical Analysis* followed by *Public speaking* and *Fieldwork.*

The largest increase in confidence was seen within *Fieldwork*, this makes sense due to the large fieldwork component offered as part of a placement within the Waders for Real project. This process allows us to understand the students 'journey of change' and progress across these areas. This could also be useful for colleagues who arrange the placements as it will give an insight into where students feel they are gaining most from the placement.

Our theory of change outlined a number of outcomes, the main outcome achieved is the employability of students, 100% of potential employers agreed that recent graduates with a Waders for Real style placement are more likely to have the practical skills required for a job in conservation and/or research and are more likely to show an understanding of how theoretical ecological principles can be applied in a practical context. This was encouraged during the Waders for Real project where varying working hours, specialist surveys and the use of specialist equipment helped students obtain the skills necessary to contribute significantly to the end conservation goal. This highlights the value of completing a placement year for a new graduate and how it can provide essential skills required for future work. An ability to plan and manage time well is an important skill for a person to have and highlighted to students how a job in the ecology sector can sometimes be unpredictable and involve a range of tasks of varying duration and difficulty. 57% of potential employers agreed or strongly agreed that students who had completed a placement would be more adaptable.

The conclusion from potential employers strongly supported a preference for those students who had completed a Waders for Real style placement. A placement provides a good steppingstone into a career in conservation and research. It also imparts significant transferable skills should other disciplines or careers be sought.

Wider community

The project team used several methods to involve the community and stakeholders as well as incorporating Planning for Real pin board activities where the opportunity arose. To not only raise general awareness of the project's actions and deliver the outcomes proposed in our Theory of Change for the wider community but to also ensure farmers and land owners were enthused to carry out actions on the ground and to assist with community engagement activities, with the aim to increase the interaction between this stakeholder group and the local community. These trusted relationships enabled the project's actions to be shared more widely with the local community, by land managers and farmers actively conducting community engagement, whether that be providing workshop venues, invitations to country shows and speaking to students and other conservation organisations about the project and wider conservation issues.

At all events, a range of dissemination activities were delivered, and resources provided including posters, leaflets (Table 12).

Table 12 List of community events organised or attended where Planning for Real activities were delivered

Date	Place	Event Type	Engagements
20/11/2015	Blashford Lakes	Workshop	32
21/11/2015	Blashford Lakes	Workshop	32
05/06/2016	Bisterne Farm	Open Farm Sunday	150
11/06/2017	Bisterne Farm	Open Farm Sunday	140
01/07/2017	Fordingbridge Library	Workshop	41
01/09/2017	Blashford Lakes	Young person's bird race	52
26/05/2018	Blashford Lakes	Workshop	34
23/06/2018	Blashford Lakes	Workshop	39
24/07/2018	Lyndhurst	New Forest Show	<100,000 attended over 3 days
04/08/2018	Blenheim Palace	Countryside show	150,000 + attended over 4 days
05/08/2018	Werrington Park Near Launceston Cornwall	Cornwall and Devon Countryman's Fair	8500 attended the event
09/06/2019	Bisterne Estate	Open Farm Sunday	4000 attended the event
14/07/2019	Blashford Lakes	Workshop	31
01/08/2019	Lyndhurst	New Forest Show	<100,000 attended over 3 days

The map of the Avon Valley where participants could indicate with flags, their wildlife observations, areas of activity and how they used these areas, was very effective, with people readily engaging with this activity (Figure 9). In total 394 records were added to the map at community engagement events. Out of three sections: wildlife, activity and access, wildlife held by far the largest contribution. This was likely influenced by the activity being presented by a wildlife organisation for a conservation project. Buzzard (40), lapwing (37) then fox (29) were the top three most reported wildlife species, with sightings of Lapwing falling almost exclusively around hotspot sites. This suggests the wider community have an appreciation of the significance of these species and sites to the overall ecosystem and the Waders for Real project.

Figure 9 Pin board interactive flag system to gather information on use of the Avon Valley

Educational events were conducted by LIFE Waders for Real using a range of approaches: field visits including hands-on habitat management and interaction with project staff, seminars and interactive visits to educational establishments using project and Planning for Real materials (Table 13). In total, 429 students at various education stages interacted with the project during these events. Before events, the event leader attempted to get an idea of the experience level of students. This varied from having almost no knowledge of wetlands, waders and conservation to reasonable expertise. After each event, significant positive praise was given by organisers and attendees regarding the quality of the messages and approach. Although, we cannot quantitatively measure the impact of our education programme, due to the number of students interacted with and nature of responses we are hopeful that we significantly increased the knowledge and understanding of the project themes. This experience made clear there was great interest in the environmental and ecological themes within education, something we hope to develop within the GWCT going forward.

Table 13 Summary of education events, with age group and audience size

Organisation	***Age Group***	***Audience***
Sparsholt College	15-20	15
Sparsholt College	15-20	16
Sparsholt College	15-20	17
Sparsholt College	15-20	18
Sparsholt College	15-20	25
Sparsholt College	15-20	19
Sparsholt College	15-20	7
Sparsholt College	15-20	9
Sparsholt College	15-20	20
Six Penny Handley School	5-10	120
Uppingham School	15-20	30
University of Bath	15-20	52
Sparsholt College	15-20	11
Countryside Trust	5-10	20
Sparsholt College	15-20	15
Burgate School	10-15	15
Six Penny Handley Scouts	10-15	20
Total	**15-20**	**254**
	10-15	**35**
	5-10	**140**

In total, 600 project leaflets were distributed over the course of Waders for Real. The leaflets enabled us to reach out to our target audiences with key messages and improve the awareness of the contribution of the LIFE programme and EU to conservation and environmental works. Poster boards were placed at 4 key sites (Figure 10). Boards were distributed between sites with high public footfall and targeted visitor engagement.

Avon Valley Footpath, Ibsley/Hucklesbrook

Avon Valley Footpath, Kingston

Education Area, Watton's Ford Hotspot

New Queen Inn, Avon Tyrell

Figure 10 4 project boards erected at areas of high footfall overlooking each original hotspot site

In total we had 8,863 visits to our website over the duration of the project. The total number of followers on twitter reached 721 while the total number of tweets was 950. Our overall number of impressions was 534,100 and grew each year. Our total number of Facebook followers was 106 and our page received 98 likes. In total 25 blogs were posted, with a frequency of 1.75 blogs per month. Our average views per blog was 545, though the number of views varied significantly by the blog content (Table 14). Blog views also varied over time, with blogs in 2018/19 having an average of 670 views.

Table 14 Summary of total views of each key theme of LIFE Waders for Real blogs

Key Theme	*Total Views*
Conservation careers/Volunteering	778
Networking/Other Projects	2110
Predator monitoring	5417
Project Status	1589
Wader monitoring	3831
Wetland habitats and biodiversity	879

In total 8 press releases were written and circulated, 3 greater than our expected result. Leading to at least 25 articles in local, regional and national press, with a potential readership of 2,154,000 individuals. In addition, 9 articles were written in specialist publications released by the GWCT, with an additional reach of 22,000 individuals. We believe our efforts in the media will have raised the profile of the project significant and delivered the key outcomes highlighted in our theory of change for the wider community.

Over 40 networking events, with conservation projects/organisations and government conservation agencies were organised or attended over the course of Waders for Real, covering over 50 organisations and/or projects. Events ranged from 2-day networking workshops with specific organisations and projects, to smaller discussion meetings and attendance at our end of project, regional and international conferences. Often networking events were accompanied by seminars by the project team which generates discussion.

The Waders for Real approach have focused on long term outcomes by promoting our research within the wider scientific community, as well as aiming to inform and influence policy. The project has hosted and attended visits from other scientific organisations, such as RSPB, WWT, Fundación Artemisan and Lough Earn Waders Project, and hosted university and college seminars to inform young scientists of our project research. Members of the Waders for Real Team have also continually attended UK and international conferences to increase networking opportunity within the scientific community; these conferences have been held by the International Wader Study Group, British Trust for Ornithology and the International Union for Game Biologists.

The project's achievements have also become known within the political sector, through project team members and GWCT staff attending important political events; our end of project conference outcomes and full reporting will also be available to policy makers. The future Environmental Land Management Scheme (ELMs) is currently being designed through test and trials up and down the country, and therefore once policy has been designed, we will be able to understand if our project aims and activities have produced the desired outcome of informing and influencing future environmental policy.

One area of environmental policy which has been influenced from the project's very beginnings, is the Countryside Stewardship's Facilitation Fund. This source of funding provides payment for a facilitator to help a group of farm managers and other land managers to work together at a landscape scale and effect greater environmental improvement, than what could be achieved at single farm scale. The Waders for Real project was the first collective group of farmers and land managers to work 'unofficially' in this manner and which enthused and started work of the same approach to be trialled and tested elsewhere, to understand the feasibility and outcomes of such collaborative work. Since the Waders for Real project began in 2014, with farmers working collaboratively at landscape scale under an 'unofficial' Farmer Cluster concept, the number of official Farmer Clusters who have applied for Facilitation funding and been given 'official' Farm Cluster status, have now reached over 120 across England and Wales, with the numbers continuing to rise. This is a legacy which the Waders for Real project may see for many years to come and therefore an outcome which could have lasting and meaningful outcomes for the future of land management in the UK.

Deliverable D5 Mid Term Evaluation report on Socio-economic impact of the project

Deliverable D5 End of Project Evaluation report on Socio-economic impact of the project

F.2 Networking with other LIFE and/or non-LIFE projects

Relationships with new organisations and projects have been developed and existing ones strengthened. Relationships that have in cases led to current and future collaboration on expanding work started by LIFE Waders for Real and on the development of entirely new projects.

Over 40 networking events were organised or attended over the course of the project, covering at over 50 organisations and/or projects. Events range from 2-day networking workshops with specific organisations and projects, to smaller discussion meetings and attendance at our end of project, regional and international conferences. Often networking events were accompanied by seminars by the project team which generates discussion. For case studies see: Deliverable F2 Report on interactions and results of working with other projects

"The experience of interacting with the Waders for Real Project has been extremely beneficial for our own breeding wader conservation work in N Ireland. The Waders for Real staff have been invaluable through their knowledge sharing and by offering practical advice to improve breeding wader habitat/ increase productivity – all underpinned by the robust evidence base they have gathered through the Waders for Real Project. Michael Stinson Boa Island Breeding Wader Project"

The opportunities provided by the LIFE programme to undertake networking activities have been valuable to the development of the project team and partner organisations. In many cases, networking with other projects led to the development of protocols for surveys, methods or approaches based on shared experience and knowledge. An important and extremely valuable outcome of the LIFE Waders for Real project are the strong relationships built with staff at many other conservation organisations, universities and projects. The team now have a large network of contacts, working on similar ecological issues with which they can openly discuss ideas, solve problems and collaborate.

Deliverable F2 Report on interactions and results of working with other projects

F.3 After LIFE communication plan

During the project, we aimed to raise the profile of issues concerning wader conservation and to disseminate project results to local, national and international audiences. These included:

- Farmers, landowners and gamekeepers within the Avon Valley, and on wet grassland sites throughout the UK.
- Local statutory agency officers working for Natural England, the Environment Agency and New Forest National Park.
- Local government bodies with responsibility for biodiversity and policy issues.
- The local community surrounding the Avon Valley, including the general public, schools, students in higher education and voluntary interest groups.
- National environmental policy makers – Defra, Natural England, JNCC, Environment Agency.
- Wetland conservation organisations at a national level (e.g. RSPB, The Wildlife Trusts, WWT).
- The European research community (e.g. universities, NGOs, International Wader Study Group).

Vision and targets

We aim to restore Avon Valley wader numbers to 140 pairs of lapwing and 60 pairs of redshank by 2025. We plan to deliver this by facilitating the creation of at least 12 additional scrapes and c.1,000 m of ditches in the Avon Valley over the next five years and ensuring that electric fences are deployed in key locations to protect wader nests and chicks each spring.

We believe this is achievable as stakeholders now understand what is required for adequate wader productivity. The recent creation of an Avon Valley farmer cluster, with the LIFE Waders for Real Project Officer acting as facilitator for at least the next three years, means that the group should be able to capitalise on the project achievements to date.

Continuation of project actions

Some project actions will need to be continued at hotspot sites to ensure habitat remains suitable for waders and necessary numbers of chicks are fledged each year. Emergent vegetation will gradually make scrape and ditch edges less suitable for broods and will need to be cleared every 4-5 years. Willow and reed growth will have to be removed at least every other year. Although not 100% fox-proof, temporary electric fences have increased lapwing nest survival, and brood survival where broods remained inside the fences. Continuing to protect nests and broods with electric fences will be essential to ensure high breeding success. Although not funded through the Waders for Real project, our analysis of long-term influences on wader productivity indicates that lethal predator control is beneficial and should be continued according to best practice where funded by the landowner.

The main challenge now is to aid small farms outside hotspots to work with neighbours across the landscape and help them access funding for wader management. Our aim is to expand project actions throughout the Avon Valley and we see the formation of the farmer

cluster as a good starting point. Building on successful partnerships made during the project, such as that with Sparsholt College for help with habitat works, will also be important.

Key objectives of the After-LIFE communication plan

- To continue to publicise the project outcomes and lessons learned, to local, national and international audiences.
- To continue to build stakeholder capacity for implementing appropriate management for waders within the Avon Valley, through continued advice and training.
- To expand project actions through engagement with more farmers in the Avon Valley and other similar situations.
- To advocate for appropriate options and adequate financial support for farmers within the new Environmental Land Management agri-environment scheme.
- To continue monitoring of waders, feedback to stakeholders and reporting of long-term results.
- To educate farmers and communities about the wider biodiversity benefits of wetland management and facilitate new farmer initiatives directed at other taxa.

These actions will be implemented by Lizzie Grayshon. Lizzie was the LIFE Waders for Real Project Officer and she has been retained on staff with the new role of Avon Valley facilitator. This post will run for 2020-2022 and is partly funded by Natural England through the Farmer Cluster Facilitation Fund.

Deliverable F3 After-LIFE Communication Plan, 2020-2024 (electronic version and Dissemination Annex 7.3.2)

5.2 Dissemination actions

E.1 Communication Plan and Obligatory actions

The dissemination activities sought to share the approach and outcomes of LIFE Waders for Real widely to stakeholders, relevant audiences and relevant networks. Dissemination to European environmental networks, UK government agencies, local and regional government and other organisations responsible for wetland restoration and wader management were also conducted. Attendance at scientific meetings provided a platform for networking between stakeholders, project staff and other relevant institutions and projects within the European Union. Through the planned communication, dissemination and community engagement activities there was an increased awareness of the surrounding wetlands and waders.

Online engagement grew slowly throughout the project, with a significant rise in outputs after 2018 after expansion of the project team allowed more resources to be dedicated to dissemination. Press releases and written materials were well received throughout. Press releases were posted by regional news and national environmental, farming and field sport outlets, suggesting significant interest in wetland restoration and wading bird recovery with our audience. Significant interest was shown at direct communications events, in particular Open Farm Sunday's and seminars to local environmental groups.

Dissemination Objectives (Annex 7.3.3 Communication strategy)

- The development and maintenance of an interactive website
- The use of established networks, other stakeholder networks and contacts identified from other programmes and projects
- Present at conferences, workshops and public events
- Ensure the LIFE programme and the EU's contribution is recognised in all dissemination activities.
- Regularly inform and update the 22,000 GWCT members about the project.
- Provide opportunities for local community and students to engauge with the project.
- Organise visits to local schools and colleges to link the work of the project to education.
- Use social media to disseminate key messages
- Produce dissemination materials such as leaflets, noticeboards and peer-reviewed scientific papers (Annex 7.3.3).
- Utilise the press to disseminate key messages
- Continue the communication and dissemination activities beyond the project lifetime.

Our project website (www.gwct.org.uk/wadersforreal/) has seen steady growth in the number of page in total we had 8,863 visits to our website over the duration of the project. 25 project blogs have been posted and many new contacts with practitioners and researchers have been made through the project Twitter feed during 2015-2019, the total number of followers on twitter reached 721 while the total number of tweets was 950. Our overall number of impressions was 534,100 and grew each year. From 2018, updates have been posted on a project Facebook page.

During the project, 7 press releases to national, regional and local broadcast and print media were produced. These were picked up by a range of publications from newspapers to specialist-interest magazines (14 different new outlooks). Four scientific papers have been prepared for submission to journals to ensure that project results reach researchers and policy makers.

Over 40 networking events were organised or attended over the course of the project, covering at over 50 organisations and/or projects. Events range from 2-day networking workshops with specific organisations and projects, to smaller discussion meetings and attendance at our end of project, regional and international conferences. Often networking events were accompanied by seminars by the project team which generates discussion. Our end-of-project conference was a great success, providing an opportunity for 60 people from 30 organisations to share their experiences and provide feedback and suggestions on our project. See Deliverable F2 Report on interactions and results of working with other projects.

Deliverable E1 Communication Strategy produced 30/09/2014

Deliverable E1 100 leaflets produced 2014

Deliverable E1 Production of 2 display boards presenting the project and the EU contribution

Deliverable E1 Production and distribution of leaflets

Deliverable E1 100 leaflets produced 2018

Deliverable E1 Scientific paper on the importance of wet in-field features for increasing lapwing chick survival (in writing)

Deliverable E1 Scientific paper on lapwing breeding success in the Avon Valley before and during the LIFE project and contributing factors (in writing)

Deliverable E1 Technical publication on the direct and indirect predator management techniques for wader population stabilisation and increase, including implementation and efficacy of indirect measures

Deliverable E1 Layman's Report electric and Dissemination annex 7.3.1

Deliverable E1 Leaflet for wetland site managers summarizing the Avon Valley results on fox density and diet

Deliverable E1 Scientific paper on fox behaviour on wet meadows based GPS collar data (in writing)

E.2 Planning for Real Implementation and organisation of events

Planning for Real allows for communities to have a direct impact on their liveable space and how it is transformed. The Waders for Real project involved local parties and stakeholders in the planning, evaluation and development process to increase awareness and create an action plan for the sustainable delivery of the project's conservation actions.

This approach is a community planning process and outreach tool to allow for residents to organically work together and provide their views, in partnership with local organisations, to work towards a plan for sustainable change. The process involves an initial 'Project Planning' stage to understand the routes to the community to ensure as many people from the local community have the opportunity to be involved. This can be achieved by setting out methods of raising awareness, how contact will be achieved, what publicity and promotion will be utilised and to look for venues to hold workshops and meetings. All these aspects will bring together a plan of action to achieve change in a collective way.

To capture local knowledge, habits, expertise and opinion, the Planning for Real approach uses pin boards with suggestion cards to enable individuals to have their say about the project's actions or what they know or feel about local conservation initiatives. This method of data collection allows people to have a say about what they think should be happening and if there are any specific issues in relation to their local area.

Suggestion cards and pin boards helped gather data from the wider community at a number of events during the course of the Waders for Real project. A selection of pin and flag boards were developed through the Planning for Real process in order to gather information on;

- Age and gender
- Frequency of use of the Avon Valley
- Time of use throughout the year in the Avon Valley
- Visitor perceptions on the key issues facing the Avon Valley
- National and International importance of the valley
- Key species of importance in the valley
- Trend of breeding and wintering waders and the issues facing breeding waders in the valley

The pin board and flag system creates an interactive activity for people to take part in, providing useful anonymous data without people having to give any personal details or fill out any forms. It gives good insight of how people are using the valley and what changes they would like to see.

Initial consultations and awareness raising using pin boards enabled the project's Planning for Real actions to respond to community needs and evolve organically as the project went forward. These materials were first trialled at Blashford Lakes Nature Reserve, located in the Avon Valley, near to Fordingbridge. The map of the Avon Valley where people indicated with flags, areas of activity and how they used these areas, was very effective. The "perceptions" board worked well and generated useful information particularly relating to people's thoughts about why there had been a decline in wading birds. However The "activity" pin board was less useful because it mainly related to the activities that people came to Blashford Lakes Nature Reserve but the activity "flags" on the map, whilst the majority 57 were placed on Blashford, the remaining 27 were placed on a variety of locations; Fordingbridge 9; Downton 7; Ibsey 6; The Common 2; Ringwood 2; and Avon 1 –

with most popular activities being photography, walking, walking with children and dog walking.

Overall this activity gave important insight into people's awareness about breeding waders, habitat management, predation management, conservation priorities and provided understanding of their general use of the Valley. This allowed the project to plan and tailor further community engagement activities, carrying them out around the project's primary concern of increasing breeding wader productivity.

The project team used a number of other methods to involve the community and stakeholders (as well as incorporating pin board activities where the opportunity arose) to not only raise general awareness of the project's actions but to also ensure farmers and land owners were enthused to carry out actions on the ground and to assist with community engagement activities, with the aim to broaden our outreach as far as possible within the local community. These trusted relationships enabled the project's actions to be shared more widely with the local community, by land managers and farmers actively being involved in community engagement, whether that be providing workshop venues, invitations to country shows and speaking to students and other conservation organisations about the project and wider conservation issues.

The project was invited to events such as Open Farm Sunday, the New Forest Show in consecutive years and the gamekeeper on one of our 'hotspots' would regularly engage with local game and wildlife students and host other conservation organisations on their water meadows to demonstrate their conservation work. Establishing trusted relationships with stakeholders has been crucial to forming and growing our Planning for Real approach and has given the project the opportunity to gauge perceptions at a greater scale and allow us to increase and target our dissemination more effectively.

Over the duration of the project, community engagement has been carried out through face to face discussions at many events with the general public, seminars for educational organisations, conference networking, questionnaires and direct interviews, as well as arranging regular focused meetings for the Avon Valley farmers and land managers.

Deliverable E2 Planning for Real Working with conservation unique protocol and information pack

Deliverable E2 Dissemination repot

5.3 Evaluation of Project Implementation

Overall project objectives

The LIFE+ Waders for Real project sought to reverse the decline of breeding waders in the Avon Valley, a river valley of high biodiversity interest, part of which is designated as a SPA. Lapwing and redshank numbers had declined by more than 50% since 1982 and numbers of breeding snipe had collapsed, such that this species probably no longer bred in the valley by the mid-2000s. Monitoring prior to the start of the project had identified low lapwing breeding success as the demographic driver of population decline, with high predation of nests and a scarcity of adequate chick rearing areas as likely limiting factors. By focusing on hotspots where at least 5-10 pairs of lapwings remained, and landowners and farmers were amenable to changing their management practices, we were able to increase breeding success considerably at these sites in most years and to raise overall productivity in the Avon Valley to a level sufficient for a stable lapwing population.

Wader breeding success and pair numbers increased most in fields where in-field wet features for broods were created. There was some initial reluctance by some farmers to create scrapes and new ditches, which led to slower implementation of all habitat measures than envisaged at the project outset. Similarly, deployment of electric fences to exclude foxes and badgers took longer than expected to roll out, but was better accepted once farmers saw that they were effective in improving lapwing and redshank breeding success. The key to the success of the project was having a dedicated project officer who spent a large part of the year on the ground recording what the birds were doing, feeding back the results to farmers and discussing further possible actions.

The original project objectives in terms of increasing lapwing breeding success at hotspot sites and stabilising lapwing and redshank numbers in the Avon Valley as a whole were achieved, with details given in the table below. The Planning for Real approach could not be fully implemented, but valuable lessons in farmer engagement were learnt.

Objective	Achieved	Evaluation
Increase lapwing numbers in the Avon Valley through creation of strategic hotspots of optimum habitat with reduced predation pressure.	Yes	Monitoring before and during the project shows that numbers of breeding pairs were declining at an average rate of 11% per annum until 2015, but started to increase at an average rate of 14% per annum during the project. The change in numbers has been greater on hotspot sites, particularly those where both habitat and predator management were implemented.
Increase numbers of lapwing chicks fledged at hotspots to the point where lapwing densities are sufficient to enable lapwings to better fend off predators on their own.	Partially	Lapwing productivity in terms of chicks fledged per pair was increased above the level required for a stable breeding population in over half of hotspot-years and averaged 0.75 chick/pair on hotspots compared to 0.52 chick/pair on comparison farms. However, lapwing densities are still at a level where continued intervention to exclude predators is considered important.
Halt the decline of redshank in the valley by increasing productivity.	Exceeded	Counts of breeding pairs indicate an increase in the redshank population from 19 to 35 pairs during the project. It has been difficult to record redshank breeding success accurately, but the fact that redshank are confined to the floodplain, along with an increase in the frequency of alarm-calling pairs in May, is suggestive that the increase is driven by improved breeding success.
Create conditions to encourage snipe to return to breed.	Yes	Changes in sward management and water control in targeted fields have resulted in more suitable conditions for snipe over 32 ha in spring. In 2018 and 2019, snipe were present or recorded displaying in May and June at two locations, after all winter migrants had departed. No evidence of breeding in the form of eggs or chicks has yet been recorded.
Use a new approach called Planning for Real to deliver sustainable conservation actions.	Partially	We found that the Planning for Real approach used in previous projects was not directly transferrable to working with individual farmers and landowners across the landscape, but elements of the approach for gauging receptiveness to different management techniques and for monitoring change in farmer understanding and engagement were valuable.
Demonstrate how far habitat manipulation can be used to push the balance in favour of waders rather than predators.	Yes	Determining the exact effects of habitat on wader productivity was not possible due to the combined management approach with predator management techniques. However, we have documented here that the use of a management package which includes habitat improvement

		and exclusion fencing can achieve positive results for breeding waders. Habitat management and predator exclusion was predominantly used on hotspot sites. An increase in productivity on hotspot sites of 0.24 was observed compared to 0.06 on other sites.
Demonstrate the most efficient techniques for exclusion of predators.	Yes	We quickly discovered that lapwings were very wary of nest cages, with only about 1 in 10 birds prepared to enter the cage and continue incubation. With practice and a team of 3-4 people, temporary electric fences were practical to erect and, on average, increased lapwing hatching success. In the Avon Valley, it was not necessary to fence whole fields, but fenced areas of 0.6-1.9 ha were sufficient to benefit both lapwing and redshank. A solar energiser generated adequate voltage (5,000-7,000 volts), but strimming of vegetation beneath the fence was usually necessary from mid-May. Experience showed that plastic fence supports alone were not sufficiently rigid, but that the fence-wire insulators on more expensive metal supports became detached when deer or livestock came into contact with the fence. We found the best solution to be alternating plastic and metal fence supports, with a minimum of eight electric strands.
Quantify the costs of different techniques for increasing wader breeding success and the timescale over which this translates into higher wader numbers.	Yes	The cost of habitat management and temporary electric fences to increase breeding success by 0.24 chick/pair to reach 0.75 is £219.66 per lapwing/redshank pair. This calculation does not include the cost of lethal predator control, which was present on most hotspot sites, or an advisor/facilitator. With c.65 % of the population within managed hotspots, the rate of increase over four years was 14% for lapwing 15% for redshank.
Monitor the effects of restoration for waders on other key elements of floodplain biodiversity, particularly the flora, invertebrates and wintering wildfowl.	Yes	Hay fields were more floristically diverse than grazed fields, but floristic diversity increased during the project, possibly due to more sensitive grazing. There is a potential conflict between the level of cattle grazing required for breeding waders and for diverse swards, so careful targeting of management is required. Colonising species of dragonflies and damselflies benefitted from ditch renewal, but this should be staggered across a site to account for more sedentary species. Wintering wildfowl

		numbers were higher with more areas of standing water in fields in winter.

Stakeholder engagement

Through regular (every six months) farmer meetings and face-to-face discussions, farmer knowledge of the requirements of breeding waders has increased, farmers have been reassured that wader management can be accommodated within their farm businesses and farmers have developed a collective sense of wanting to do more for wildlife on their farms.

The Planning for Real model was developed to enable local communities to comment on and influence the design of new housing developments, so that a collective decision is reached on more controversial aspects. It became apparent early in the project that, unlike with a housing development, finding one model that worked across all Avon Valley farms was not realistic, because each farm business operated differently according to the location and size of the farm, and the number and type of livestock. There was also an initial wariness of the new approach from landowners and farmers and a reluctance to divulge details of the running of the farm. However, the SROI approach of questionnaires to gauge and then monitor levels of understanding on the problems facing waders, the management required and common perceptions of obstacles to implementation was informative and enabled better targeted advice.

Time required for wader recovery

Bird responses to wetland habitat management were typically rapid. For instance, following the first major ditch and scrape work of the project at Hucklesbrook hotspot in autumn 2015, lapwing pair numbers on the site increased by 200% in the following spring. Observations of colour-ringed lapwings have also shown that individuals will relocate within the valley according to habitat suitability each year. This is important because it validates the hotspot approach to management: focusing on the farms where the landowners and farmers are most engaged and willing to change their practices could result in aggregation of waders in areas where they have the best chance of breeding successfully.

As well as a redistribution of waders, immediate increases in breeding productivity were seen as a result of in-field wet features and electric fencing. Responses varied between sites, but variation between years was greater, with lower breeding success still recorded in project years with lower winter rainfall and dry spring weather. Despite this variation, during the four years of active management within the project the five-year running mean of lapwing productivity increased from 0.50 to 0.66 chick/pair. Prior to project inception, the five-year mean productivity for 2011-2013 was 0.41-0.43 chick/pair. A figure of 0.70 chick/pair is considered the level of productivity required for a stable breeding lapwing population and hence in four years the project has stabilised the population and, in fact, a small increase in breeding numbers has been recorded. With maintenance of habitat and predator management measures at the same level as during the project, we expect to continue to increase the running mean level of productivity above 0.7 chick/pair and record a more pronounced increase in pair numbers. A greater rate of increase should be possible if the effects of low winter rainfall can be mitigated and this should now be a priority. Creation of more in-field wet features should help, but improved water control measures are also needed to ensure that ditches and scrapes remain wet at the peak of chick hatching every year.

Owing to the time taken to fully engage with stakeholders and agree management plans during the first year of the project, combined with the annual variability in wader breeding success in relation to winter rainfall, the project extension to a fifth year was extremely useful in enabling us to demonstrate the value of the measures implemented during the project. Had the project finished on the original end date, the results would not have been as clear. The extra year gave us the opportunity to deploy more electric fences and achieve high levels of lapwing and redshank productivity in a year that was relatively dry.

Dissemination

Through the SROI approach, we have demonstrated that low-cost dissemination of messages and results to local stakeholders, through leaflets and feedback emails/letters, has been sufficient to create a change in levels of understanding and engagement with wader management in the Avon Valley. Press releases have been picked up and well received by wider audiences throughout the project, but online outputs have been the most effective form of communication. We were initially slow to capitalise on this, with a much stronger online presence from early 2018 with a staff member dedicated to this and more results to talk about. A lesson we have taken for future projects is to invest more time and resources in a good webpage and Twitter feed from the outset.

Recognition of the work of GWCT's Wetland team has been raised considerably as a result of the project. The project website and Twitter have been particularly useful in making new contacts with other wader recovery projects and wader researchers. Attendance at conferences has helped get the project noticed in other European countries and to share experiences more widely. Presentations at these conferences have resulted in further invitations to speak at meetings concerning wader recovery and future agri-environment schemes, and the chance to contribute to technical publications by a consortium of researchers. The production of scientific papers provides a lasting record of the project, with researchers and policy makers able to scrutinise the results and judge the value of the measures implemented and their potential application in other situations. The raised team profile resulting from the project has enabled us to tender for and win new contract work to track wintering waders on nearby Southampton Water towards the end of the project.

5.4 Analysis of long-term benefits

5.4.1 Environmental benefits

The LIFE+ Waders for Real project has secured the breeding populations of lapwing and redshank in the Avon Valley and started to turn a declining trend into an increasing one for both species. Ongoing work is required to capitalise on this success, but landowners and farmers now better understand what is required and it should be possible to maintain an improving trend with lower levels of support over the next three to five years. As a result of habitat improvements for breeding waders, habitat has been created for aquatic invertebrates, dragonflies and damselflies, and wintering waterfowl. The success of the project is important in a regional context because breeding waders are also declining in the New Forest, a national park adjoining the Avon Valley, and colour-ringing of lapwings has demonstrated emigration of fledged lapwings to the New Forest.

The project has demonstrated that with relatively minor changes to agri-environment schemes, the options for breeding waders could be more effective and hence represent better value for money. Support through agri-environment schemes is already in place in the UK for most of the habitat management measures required by farmers to create and maintain suitable nesting and chick-rearing areas. The current level of funding for measures such as creating scrapes and shallow ditches, and removal of trees and willow scrub is adequate, but funding for electric fencing is very low and does not provide an adequate incentive for farmers to undertake it.

Our experience during the project, and feedback from stakeholders, suggested that high quality advice from a trusted advisor was essential for project buy-in from farmers and for successful implementation of measures. In a national context, this may explain why breeding waders have typically fared better on nature reserves, where there is input from more knowledgeable staff and greater flexibility and control over management, than on wet grassland areas with multiple small, private landholdings over the last 20 years. With increasing cuts to the budgets of statutory authorities such as Natural England, numbers of experienced staff have dropped and the ability of advisers to provide tailored advice for individual farmers within agri-environment schemes has reduced. At a recent wader recovery meeting hosted by Prince Charles at Highgrove House we advocated to senior Defra and Natural England staff that the new Environmental Land Management (ELM) scheme within the UK should address this for breeding wader options by striking a different balance to previous schemes between the funding allocation for farmer actions and for high quality advice. This is likely to necessitate difficult decisions on farmer eligibility and more focused targeting at areas with the best chance of success.

5.4.2 Long-term benefits and sustainability

The outlook for the breeding wader population in the Avon Valley is considerably more positive as a result of the project, with lapwing and redshank numbers now on an increasing trajectory and snipe reappearing in the valley in summer. The breeding waders have been given an essential boost before numbers became too low to make recovery unfeasible and, crucially, stakeholders now understand what is required to continue to manage habitat and reduce predation. Ongoing advice will be important, but this can be scaled back at hotspot sites where farmers and land managers are now familiar with necessary techniques and taken out to other farms with lower numbers of birds. With the support of the Facilitation Fund via Natural England to set up a formal farmer cluster throughout the Avon Valley and continued funding from GWCT, the Project Officer role will continue until at least 2022. By retaining the same

advisor (Lizzie Grayshon), who is well-known and trusted by the farmers, in this role, we see great potential for building on the success of the LIFE+ project. Future work will have a continued focus on breeding waders, but we aim to instigate more targeted action to benefit other floodplain taxa, particularly to engage farmers who do not currently have waders on their land. Seven farmers will continue work started during the project and a further seven have signed up to the farmer cluster to date. The Senior Officer (Andrew Hoodless), who conceived the project, is on a permanent contract at GWCT and will seek new funding to maintain core wader and habitat monitoring in the Avon Valley. We aim to continue to offer year placements to undergraduate students and MSc student projects, both of which have been extremely beneficial and cost-effective during the project.

To maintain suitable conditions for waders and other wildlife at hotspot sites and other farms that we are able to bring into wader management, scrapes and ditches will need to be renewed every four to five years and continued management of willow and reed growth along ditches will be required. Three of the four hotspot sites are now sufficiently engaged in delivering wader recovery to be prepared to fund this work themselves. At one hotspot, we had a discussion with the farm manager and RSPB staff following our end-of-project conference about using a rotary ditcher to create footdrains and increase the length of wet features in key fields. These hotspots sites, however, all comprise parts of relatively large landholdings where the owners typically have more working capital than on small farms. The challenge now is to better aid small farms to work with neighbours across the landscape and help them access funding for ongoing habitat management. One way of doing this may be to build on the successful partnership developed with Sparsholt College through the project. The college requires sites where students can gain practical experience each year and in her new role the Project Officer is able to determine priorities for work and co-ordinate work parties.

The project has resulted in a much-improved relationship with Statutory bodies, Natural England and the Environment Agency, such that the Project Officer and Senior Officer are respected and frequently consulted. This working relationship, coupled with greater flexibility in ELMs, should enable specific issues arising on individual farms to be resolved more quickly than in previous years. Data analysis has shown the importance of winter rainfall for filling up in-field wet features and the consequent benefit to lapwing chick survival and annual breeding success. To ensure consistently high levels of wader productivity in the Avon Valley, we need to ensure that scrapes and ditches can be topped up by farmers in dry springs. Abstraction licences are costly for small farms and there is no guarantee that they will be granted for conservation purposes, but currently up to 20 m^3 per day can be taken from the river without a licence. We have initiated discussion with farmers and the Environment Agency about how small daily amounts of water could be pumped to important wader fields in dry springs.

Agri-environment scheme payments have provided an important source of income for farms in the Avon Valley, with c.70% of farms having some scheme options. The project has highlighted the importance of the Avon Valley for waders in a regional context and continued work to build on the success of the project should help farmers continue to access agri-environment scheme funding. ELMs is likely to be more competitive and targeted than previous schemes and the ability of Avon Valley farmers to demonstrate an understanding of management required and success to date will put them in a better position when applying to enter the scheme.

The Avon Valley is visited by birdwatchers and footpaths are used by the local communities for exercise. The project has raised awareness of the wildlife and associated management in

the valley through notice boards, open farm days and articles in local newspapers. Improved habitats and more birds contribute to a better experience by people visiting the valley, potentially improving their mental wellbeing and resulting in them encouraging others to spend time in the valley. The Project Officer aims for broader public engagement through the new farmer cluster, with consideration of more interaction with schools and use of tools such as webcams. The project has provided valuable experience for students in higher education, potentially increasing their employment opportunities, and we intend to continue to offer opportunities for undergraduate and MSc students to undertake projects in the Avon Valley.

5.4.3 Replication, demonstration, transferability, co-operation

The 'bottom up' approach of gathering farmers together to discuss the problem of wader declines and agree practical solutions marked a major shift in thinking from previous 'top down' agri-environment schemes, which were often considered by farmers to be overly prescriptive. The initial Avon Valley farmer meetings were precursors for the development, by GWCT with Natural England, of a more formal farmer concept. There are now 112 farmer clusters in England covering a whole range of landscapes and key habitats, but operating on the principle originally developed with Avon Valley farmers of working towards habitat and species targets agreed collectively as priorities and achievable. A farmer cluster has been started in the Arun Valley in Sussex, where there is floodplain grassland that still supports low numbers of breeding lapwings. We have been in discussion with the cluster facilitator about replicating the measures which have been successful in the Avon Valley, with the aim of starting to implement them in 2020.

Water companies in southern England are looking to farmers to help them improve water quality in river catchments and, where possible, to reduce the number or scale of new water treatment works needed in the next ten years. Farmers are already engaged in catchment-sensitive farming and are aware of the main causes of rainwater run-off and the transport of nitrogen and phosphorus into watercourses. Nevertheless, there may be further measures, such as buffer strips and settlement ponds, which farmers could implement, and water companies would be prepared to pay for. With careful consideration of species needs and landscape-level planning there is scope for a business-stakeholder partnership to deliver both wildlife habitat and improved water quality. Having heard about our LIFE+ project, a water company operating on the River Avon approached GWCT to facilitate meetings with a group of Avon Valley farmers with a view to piloting a water improvement scheme. This process has a long way to go, but two meetings between water company representatives and interested farmers in 2019 identified a need for more detail on which measures were feasible, how priority habitats and species could benefit, and a clearer funding structure.

5.4.4 Best practice lessons

Analyses of our project monitoring data suggested that a greater improvement in lapwing breeding success was seen when both habitat improvements and measures to reduce predation were implemented in combination. The longer-term Avon Valley data also suggested that the rate of previous wader decline was slower at sites where some lethal predator control was undertaken in spring. It is now clear that both habitat management and predator management (electric fences and, where feasible, both electric fences and lethal control) are required in order to achieve the required level of productivity for a stable or increasing lapwing population. This has implications for the design of future agri-environment schemes: predator management is controversial, and a funding structure is harder to devise than for habitat measures. However,

a revised approach to wader options with payment for delivery of a complete package of measures, and emphasis on results, is likely to be more cost effective that the previous prescriptions within Higher Level Stewardship which focused solely on habitat improvements.

We recommend to farmers siting of new scrapes and ditches in fields that lapwings are known to favour for nesting, based on previous observations. This should reduce the distance travelled by broods and using temporary electric fencing to enclose areas of c.2 ha around new in-field wet features will improve nest survival and contribute to better chick survival. We found that alternating plastic and metal fence supports provided the best compromise between fence stability and cost. Our fox tracking work showed that foxes regularly follow linear features, so we suggest minimising linkages between ditches and creating isolated scrapes as well as ditches.

5.4.5 Innovation and demonstration value

One of the most innovative aspects of the project has been the fox tracking. Although GPS collars had been used on many species of mammals previously, except for one study in Norway, GPS tracking of rural foxes had never been undertaken. Safe capture and fitting of collars to foxes takes great skill and the resource provided by the LIFE programme enabled us to perfect this. The tracking has revealed several unexpected findings, such as the high density of foxes in parts of the Avon Valley and the movements of foxes away from apparent territories in spring. Dissemination of the results has been timely because many wader researchers are finding that the fox is the main egg predator at breeding wader sites across Europe. There is great interest in the work, which has opened up discussion with many new contacts.

The effectiveness of temporary electric fences at excluding foxes has never been tested and, although our trials were of limited scale, we have evidence indicating that foxes do modify their movements to go around fences, but do sometimes breach them. A larger trial to evaluate how frequently and in what circumstances fences are breached and this is something we are currently contemplating.

5.4.6 Long-term indicators of success

The project has been successful in increasing lapwing breeding success and numbers of redshank pairs (probably through improved breeding success). Now that stakeholders better understand what is required to achieve this, and with the Project Officer retained in a role where she can continue to engage and advise farmers for at least the next three years, we expect to be able to capitalise on the achievements of the project over the next five years. Now that GWCT has been built with landowners and farmers, and results have been visible, we expect to be able to facilitate more extensive habitat measures at some sites (e.g. Kingston, Wattons Ford) and instigate them at additional sites (e.g. Folds Farm, Ogber). Along with continued maintenance of wet features created during the project, we would regard the creation of a further 12 scrapes and c.1000 m of ditches in the next five years as a success. Given the rate of wader response to date, we aim to reach a population of 140 lapwing pairs and 60 pairs of redshank in the valley by 2025, along with confirming the presence of breeding snipe. Another important indicator of project success will be the adoption of our recommendations for support for advice and predator management in the new ELM scheme.

6. Project Gannt Chart

TIMETABLE																															
Action		2014				2015				2016				2017				2018				2019				2020			
Action Number	Name of the action	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV
A. Preparatory actions, elaboration of management plants and/or of action plans:																															
A.1	Recruitment and appointment of key staff members and purchase of equipment																														
A.2	Meeting with statutory agencies and initial Stakeholder meetings																														
A.3	Scrutiny agri-environment scheme management plans and identification of 'hotspot' site fields and farms																														
A.4	Write monitoring protocols for habitat, predators and waders																														
C. Concrete conservation actions:																															
C.1	Implementaion of new habitat works																														
C.2	Predator tracking and monitoring																														
C.3	Implementation of indirect predation reduction measures																														
D. Monitoring of the impact of the project actions:																															
D.1	Annual monitoring of wader numbers and breeding success																														
D.2	Documentation of habitat actions and annual monitoring of habitat suitability																														
D.3	Documentation and annual monitoring of predator abundance																														
D.4	Assessment of restoration of ecosystem functions																														
D.5	Assessment of socio-economic impacts of the project																														
E. Public awareness and dissemination of results:																															
E.1	Communications plan and obligatory actions																														
E.2	Planning for Real implemented and organisation of events																														
F. Overall project operation and monitoring of the project progress:																															
F.1	Project management																														
F.2	Networking with other LIFE and/or non-LIFE projects																														
F.3	After LIFE Communication plan																														