Curlew Recovery Project - Nest monitoring Year 1 (2015) Report

Introduction

The Stiperstones and Corndon Hill Country Landscape Partnership Scheme (LPS) is working with local landowners, residents and communities to increase people's awareness of this special landscape and to develop appropriate projects and activities for the area.

The Ground-nesting Birds Recovery Project (GnBR) which aims to raise awareness of the plight of Curlew, Lapwing and Snipe is one of 15 projects that make up the Scheme. The nest monitoring project will provide research into factors influencing Curlew population dynamics and ecology in the scheme area, to identify measures that can be taken in the LPS area to achieve a stable and increasing Curlew population, to prevent their local extinction. This report provides site-specific information on nest locations, breeding success and causes of nest failure for the remaining Curlew population in this area for the 2015 breeding season.

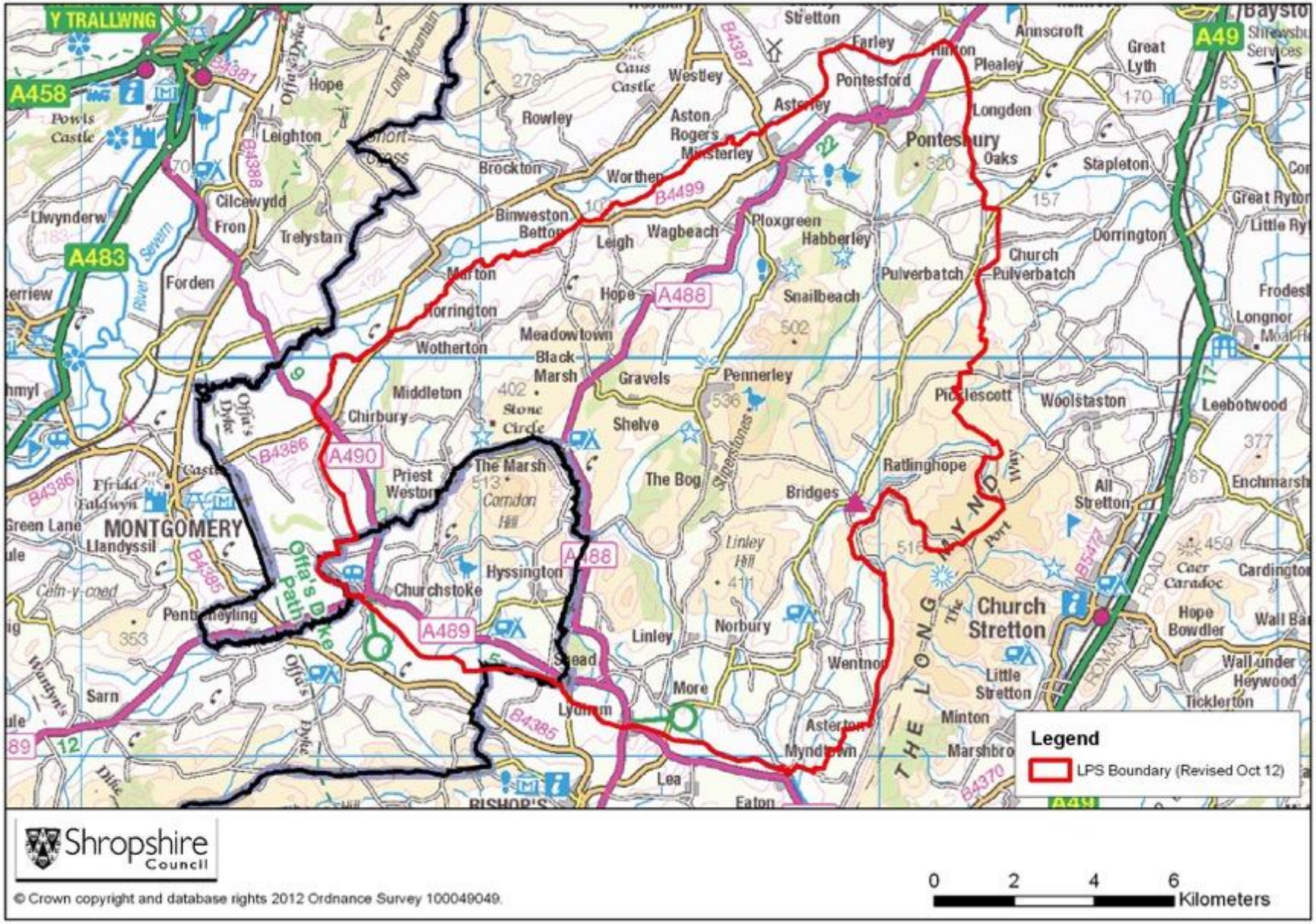
Background

The Eurasian Curlew *Numenius arquata* has experienced considerable declines across much of its global range in recent decades and is listed as globally near threatened by the International Union for the Conservation of Nature (IUCN). A large proportion of the global population (ca.25%) breeds in the United Kingdom and even greater numbers spend the winter here. This makes the UK of international importance for this species.

Curlews declined in the Upper Onny part of the LPS area by around 26% from 2004 to 2014. In 2014 the LPS area (Map 1) held around 47 breeding pairs of Curlew - 40 pairs in England and approximately seven in Wales. This is a high proportion of the remaining Shropshire population, which is now below 200 pairs.

These declines are not restricted to the LPS, with comparable declines seen in Shropshire as a whole and other parts of the UK. In Shropshire, comparison of the Breeding Bird Atlas maps, published in 1992, with comparable maps from the 2007-12 Atlas survey, shows that Curlew now has a much more restricted range. Local surveys suggest that the Curlew population has fallen by 85% in only nine years in the 50 survey plots monitored by the BTO Breeding Bird Survey in Shropshire.

The decline in Curlew populations in the UK has been linked to a number of factors. These include habitat fragmentation and a loss of habitat quality through agricultural intensification and drainage; agricultural operations, such as early cutting of silage and hay, reducing the number of chicks that fledge successfully and predation which is known to be a key in causing low productivity and population declines in some areas. The relative importance of these factors however differs between different areas and a deeper understanding of their local relevance may be needed to achieve a recovery.



Map of the Stiperstones and Corndon Hill Country Landscape Partnership Scheme Area

Curlew Recovery Project Group

The project was overseen by a Project Steering Group consisting of the following representatives:

Amanda Perkins – Stiperstones and Corndon Hill Country LPS Countryside Officer, Curlew Recovery Project Manager
Leo Smith – LPS Consultant Ornithologist and Bird Surveyor Group co-ordinator for Upper Onny, Camlad and Rea Valley Community Wildlife Groups
Simon Cooter – Natural England, Senior Reserve Manager Stiperstones NNR*"
Dave Cragg – Natural England Countryside Stewardship Officer*
Peter Carty – National Trust, Countryside and Parklands Manager, South Shropshire*"
Mike Shurmer – RSPB Senior Conservation Officer
Ian Coghill, Andrew Hoodless and Roger Draycott – Game Conservation and Wildlife Trust Chairman and scientific officers, keeping a watching brief and offering advice where needed.
Key: * Funding partner in year 1 of scheme, " Land manager in scheme area

Project Brief

To provide research into factors influencing Curlew population dynamics and ecology in the LPS area to identify measures that can be taken in that area to achieve a stable and increasing Curlew population into the future.
The brief was designed by Mike Shurmer, RSPB.

Surveyor Details

The field ornithologist employed under contract was Tony Cross who has been an ornithological consultant for over 20 years, lives locally and knows the study area very well. Although the consultant has not worked specifically on Curlews previously he has worked on various projects monitoring the breeding ecology of a wide range of other British species including waders and is an experienced nest-finder. He is also a qualified bird-ringer with endorsements for ringing, colour-ringing and radio-tagging Curlews and their chicks. Additional support was provided by Amanda Perkins, Leo Smith and a small army of volunteers within the three local Community Wildlife Groups (the Upper Onny Wildlife Group, the Camlad Valley Community Wildlife Group and the Rea Valley Community Wildlife Group hereafter referred to as the CWGs).

Summary of Year 1 (2015 findings)

13 nests were located, 1 nest was not used for egg laying. 38 eggs laid – 4 x 4 egg, 5 x 3 egg and 2 x 2 egg.
Nest failure at egg stage – 1 desertion, 6 mammalian (1 fox, 1 badger, 4 almost certainly fox), 1 avian, 1 unknown.
9 eggs from 3 clutches hatched and all chicks tagged, none survived. All chicks assumed predated, evidence of fox and avian predation in a couple of cases.
Three nests were accidentally mown before their precise location in fields as was found. A farmer reported a nest of 4 abandoned eggs that he found when turning grass in a silage crop, having mown over the nest without seeing it.

Method

Field Surveys/nest location

The project fieldwork started on 1st April. The contract ornithologist targeted field surveys in four "cluster areas" (these areas having been selected based on results of surveys conducted in 2014 by volunteers from the three CWGs) looking for observations of feeding and displaying Curlews.

Pairs present in suitable breeding habitat where marked on maps and revisited at frequent intervals until either an active nest was found or the pair were no longer being seen. Curlews were present in the area right at the start of the contract and had been in some instances for over two weeks according to farmers in the area. Grass height at this time of the year was favourable for observing foraging birds and much could be achieved by scanning fields with a telescope from considerable distance. Problems occurred in parts of the study area (including most of the Welsh portion) where field sizes were relatively small and they were bounded by thick hedges. This was exacerbated by the fact that the ground was relatively flat making it impossible to get a view of most fields without going into them and hence disturbing or altering the behaviour of the birds.

Most nests were located by careful and often prolonged observation of a feeding bird until it walked back to the nest and relieved a sitting partner. One nest was found by scanning suitable habitat with binoculars and spotting the sitting bird. This nest was unusual though, in that the vegetation was relatively low and the sitting bird clearly visible. In most instances, especially after the nest had been active for a while, the sitting bird was completely invisible at any distance and had a tendency to sit very tight. Cold searching for nests was possible on common land and grazed pastures but was not generally practised in silage or hay meadows were it may have resulted in considerable damage to the crop. Only one nest was located during this survey by cold searching and that was the nest at. Three nests were found by the farmers themselves who then informed the contract ornithologist.

A table of nests and territories is at **Appendix 1**

Nest surveillance

Once identified, the nest was monitored with either an RSPB designed remote camera using Memocam security camera software, or a Ltl Acorn Trail camera. Cameras were installed at approximately 1 m distance from the nest and hidden in a tussock or dock plant if possible. Where the field vegetation was short and fairly uniform some attempt was made to break-up the outline of the trail cameras using dock-leaves or long grass cable-tied to the camera mount (usually a fiberglass tent pole or alternatively a cut sapling with a straight stem and a "leafy" top). The RSPB cameras were run by sealed lead-acid motorbike batteries buried in a waterproof box and connected via a short length of cable buried in the ground. The batteries and SD cards needed changing at approximately 3-4 day intervals, especially in windy weather when the movement of the grass triggered the camera. The Ltl Acorn Trail cameras were self-contained and lasted for at least twice as long depending on the settings applied.

Nest monitoring

Nests were monitored with the minimum amount of disturbance in order to ascertain the following information; clutch size, egg size and weight, hatching date, hatching success rate and in order to tag the chicks whilst they were still in the nest (chicks only stay in the nest for 24-48 hours after hatching). As the main aim of the project was to study nest success rates and chick survival rates so there was a great need to avoid doing anything that might increase the chances of a nest being predated. Such activities might include visiting the nest too frequently (causing the adults to alarm-call), leaving an obvious trail to the nest, exposing the nest by flattening or cutting vegetation in front of the camera or by creating a predator perch in the form of the camera itself. During all visits to an active nest the duration of stay was kept to a minimum, trampling of the immediate area around the nest was avoided by reaching in the last 1m or so, and any trampled grass was restored as much as possible afterwards for at least 10m distance from the nest. Access to, and return from, the nest were by different routes each time and not by a direct straight-line approach. Wherever possible nest-visits were only conducted in suitable circumstances; - in good weather, not late in the day, when no obvious predators were around and with no other human activity nearby.

A table of Site Observations is at **Appendix 2**

Egg weights and measures

Whilst there was a tendency to be over-cautious about visiting the nest because of the concerns of farmers and the ultimate aims of the project it was however possible to collect some extra data on egg size and weight that could help in timing nest visits for chick tagging and in assessing the fitness of breeding pairs. Egg length and maximum breadth were measured using vernier callipers to the nearest 0.1mm and eggs were weighed to the nearest 0.1g using digital weighing scales.

A table of Egg Measurements is at **Appendix 3**

Chick monitoring

The aim, subject to the availability of sufficient tags, was to tag all chicks in the brood with Pip31 radio-transmitters supplied by Biotrack Limited. These would be fitted under licence from the unconventional marking methods panel of the British Trust for Ornithology. The agreed method was to stick the tag, attached to a small gauze patch, to the down on the back of the Curlew chicks using Copydex. The technique has previously been used successfully by RSPB and GWCT researchers on Lapwing and Avocet chicks with no associated problems (R. Bamford and A. Hoodless pers comm). Chicks would be located every 4-5 days, weighed and measured and tags checked for secure fitting and re-fitted where necessary.

Adult monitoring

During spring 2015 20 adult Curlews were individually colour-ringed by the contract ornithologist at a communal roost on the Montgomeryshire Wildlife Trust's Dolydd Hafren reserve on the River Severn between Welshpool and Newtown. Numbers here peaked at just under 150 birds in March and were assumed to contain mainly local breeding birds. Birds were mist-netted at their nocturnal roosts with the aid of tape lures. Each bird was fitted with a unique two-digit engraved yellow 'Darvic' ring on the left tibia and a plain orange colour-ring on the right tibia. A conventional BTO metal ring was also fitted on the right tarsus. Each bird was weighed and measurements taken of the maximum wing chord and bill to feathering. Most birds could be sexed on these three measurements. The birds were also assigned to one of two age categories - Juvenile = any bird less than 12 months old and Adult = all birds more than 12 months old. Ageing was conducted using feather wear, pattern of tertials and state of moult as described in Prater et al 1977).

During survey work on the project all birds encountered were checked for the presence of colour-rings where possible and the presence or absence of rings noted.

Results

Breeding surveys

A total of 24 territorial pairs were located and observed during the spring within or just on the border of the LPS area

The results of the breeding surveys conducted by the field contractor in the four cluster areas, and elsewhere (25 territorial pairs), had a high level of agreement with those of the three CWG's which were continued concurrently (28 pairs) as shown in the attached maps at **Appendix 5.** This finding helps validate the results of previous surveys by these voluntary bodies, showing how accurate and valuable their information resource has been in initiating and steering the GnBR Project.

Nest locations

From these 24 territorial pairs a total of 13 nest sites were identified during the year. One of these was just a well-formed scrape that may never have contained eggs or may have been predated during egg laying. Another was a nest containing 3 eggs that was found inadvertently by farmers doing mole control (and had already failed when looked for by the field contractor). The other 11 nests were all observed with eggs. The location of all nests is shown in Table 2. Also recorded is the altitude, land use type, vegetation height during egg-laying, distance to nearest field boundary and whether the farmer knew where the nest was before being told of its location.

Nest surveillance

Of the 12 nests located or known to have had eggs, nine had cameras installed successfully and two unsuccessfully. The other had failed before being told of its location. Four of the successfully installed cameras were the RSPB type cameras and the remainder were the Ltl Acorn type trail cameras. The installation of the RSPB cameras was the least straightforward, needing the burial of battery/SD reader

boxes and associated wiring, but the cameras themselves caused no problems in terms of acceptance by the Curlews. All four nests where this type of camera was used were watched from a distance immediately after installation to ensure that the birds had accepted them OK. At one site, where the nest was in short vegetation and the camera was therefore very noticeable, the male bird was seen to walk up to the camera and walk away again on three occasions. On the next approach he sat for a few seconds then walked off again. On the third attempt he sat tight and things progressed normally from then until, the nest was predated? days later. On the first night however the camera revealed how the incubating bird had suddenly flushed off the nest just before midnight and did not return until over 7 hours later (and nearly 2 hours after dawn). This incident was not thought to be related to the presence of the camera and was probably due to a near miss with a mammalian predator. At the other three sites, where the camera was positioned in fairly long grass, the returning bird walked straight onto the nest and resumed incubation immediately.

Curlew nest with installed RSPB camera in typical silage field site.

The Trail cameras proved slightly more problematic. At four nests, birds returned immediately with no visible signs of concern. At another however the sitting bird took a considerable time to come back, walked around the camera looking very unnerved and then flew off again. As it was late in the day by then the decision was made to just drive off and leave things to chance, which thankfully proved to be the best choice as the bird returned and sat normally subsequently.

At two other nests the birds took great exception to the cameras. At one nest the female was seen powering across the field in a low fast flight immediately after the camera had been installed and initially it was thought she was seeing off an unseen predator. She then hit the

Trail camera (mounted on a small fiberglass tent-pole, covered in dock leaves) with flailing legs and knocked it slightly off target. The male then also flew at the camera and hit it with enough force to dislodge a few feathers and turn it through nearly 90$^{o.}$ Both birds then stood in the field, crouched low and alarm calling. The camera was removed immediately and the birds left alone to settle down. In the second instance the Trail camera was installed on a nest in a fairly open rushy hay meadow at a distance of approx.1.5 m. After installing the camera and vacating the site the adults continued to alarm call continuously and one bird was seen to fly at the camera, but less aggressively than at the other site. After approx. 90 mins, when the birds still hadn't calmed down, the camera was removed. On inspection of the footage the male bird did return to the nest and sit briefly in the 90 minutes the camera was on the nest but then came off suddenly and seemingly unprovoked and didn't return. It had been planned to try again later when the vegetation had grown up a bit more but the nest was predated in the intervening seven days.

Effectiveness of cameras in recording predation events

Problems were experienced with the operation of the RSPB cameras which did not always record crucial events Cameras at two sites both appeared to be working correctly, recording the comings and goings of the pair both day and night over a period of several days but then frustratingly, and for no apparent reason, both stopped working for a period of hours during which the nest was predated. If these problems could be ironed-out the cameras provided good images and were clearly accepted more readily by the birds, and were less noticeable to potential predators, than the bulkier Trail cameras.

Curlew sat on 'exposed' nest in short grass on common land

The trail cameras were tried on various settings. The trigger setting, set to sensitive, was the initial setting trialed with the camera set to record 10 sec video clips. This was reasonably effective, and produced some nice video clips, but the movement of grass in the wind triggered the camera every few minutes and the batteries drained faster than expected. Cameras were then trialed set to time-lapse mode recording an image every 5 or 9 secs. This was thought to be a much better option long-term. Firstly it allowed better estimation of the duration of the batteries and how often the SD card needed changing. Secondly it was thought unlikely that a predation event could be

missed because the sensor hadn't detected the predator. It is also possible to analyse the recorded images and collect data on which bird was on the nest, for how long each day and how often and regular the changeovers were. This was not possible with the sensor-triggered cameras as there were clearly periods and events when the sensor failed to fire the camera.

The main problem encountered with the camera surveillance was the rate at which the vegetation grew! Cameras that were providing clear and accurate pictures of the nest one day were just showing a mass of waving grass-stems less than a week later. When the silage/hay was at its maximum height it was almost impossible to get a view into the nest even from a distance of 1m or less. To do so the cameras would need to be mounted above the nest looking in or the vegetation between the nest and the camera would need to be flattened or cut. Clearly both of these options would have implications in terms of attracting attention to the nest and thereby biasing the results obtained.

.

Curlew standing on a nest immediately in front of an RSPB camera. This demonstrates how difficult it was maintaining visibility in the tall grass. When this bird sat down it completely disappeared from view.

Clutch size and egg survival to hatching

Clutch size was taken as the maximum number of eggs recorded in a nest on at least two occasions several days apart or at least a week after the nest had been located with eggs already present. Eleven clutch sizes were obtained, 5 x 3, 4 x 4 and 2 x 2 with a mean of 3.18. Grant at al (1999) had mean clutch sizes of 3.82 and 3.73 in 2 study sites in Northern Ireland so this figure seems rather low. There is a good possibility that the two clutches of 2 eggs were replacement clutches for earlier failed nests (both were found late in the season). If these two clutch sizes are excluded then the mean clutch size for known first clutch nests is still only 3.44.

Of the 12 nests located with eggs 75% failed during the incubation stage. One nest was deserted for unknown reasons not connected with the camera installation and another nest was possibly partially predated or deserted prior to a badger raiding it on camera later the following night. An avian predator predated one nest, almost certainly a crow or raven, and five nests were predated by foxes (one of

these caught on camera the others inferred by signs at the nest or time of predation event). The final nest, which was not seen by the surveyor, had already failed prior to being told about it.

Survival rates of hatched chicks

Only 3 of the 12 nests with eggs located (25%) successfully hatched. In two of the nests all the eggs of the clutched produced hatched chicks. The third nest initially had a clutch of 4 eggs but one disappeared during incubation by unknown means and another was smashed in the nest so was removed to avoid the possibility that the scent would give the nest away to predators. Grant et al (1999) in their much more extensive research on Curlews in Northern Ireland report partial losses of clutches in 70% and 53% of successfully hatched nests at two study sites. The equivalent figure in this current study is 33.3%, which is much lower, but obviously the sample size is very small.

At one site, trampling by livestock can be ruled out as a possible cause for egg-loss so the activities of a predator must be suspected although this was not caught on the Ltl Acorn Trail camera installed on the nest. In fact, all except one of the nests located were in fields that were free of livestock at the time of egg-laying and for the immediate 2 weeks before. The nest in a livestock area was on open ground with a low stocking density.

Chicks were relocated every 4-5 days as it was thought that more frequent visits would create too much disturbance and might lead to an increase in predation or chilling. All nine chicks produced at the three successful nests were tagged. At the first nest tagged, at the brood of four chicks had all disappeared by the fourth day after hatching when the first attempt was made to relocate them. The farmer found one tagged chick on his concrete road in the early evening of the day following tagging, accompanied by two very vocal adults. It/they had already made their way 200 yards across a dense silage field and were probably trying to access nearby cattle-grazed pastures where the adults had been feeding. The neighbouring farmer at reported a commotion in one of his adjacent hay fields three days after tagging and when checked on the fourth day after hatching a single adult Curlew flushed from the same field, flew in a big loop of the valley and landed in there again with some calling. It didn't however show the level of concern it should have and on the second time of flushing flew directly away and didn't return. No signal could be obtained from any of the four tagged chicks despite a wide search of the area.

It is assumed these chicks were removed by avian predators or taken underground by mammalian predators. The three chicks at the second nest at suffered a similar fate. Four days after tagging one of the tags was recovered from under a fence post in an adjacent pasture field grazed by sheep indicating corvid predation. The remaining two chicks were not located. An adult bird was still present and alarm calling mildly suggesting that either the predation was quite recent or a surviving chick(s) had shed, or had a failed, tag. There were no further observations at this site suggesting that none of the chicks had survived.

The third nest fared a little better. Both chicks were still alive 7 days after tagging and had moved out into the neighbouring cattle-grazed field favoured by the foraging adults prior to egg-laying. On 13th day 1 chick was still alive in the same field but the other tag was recovered ca. 100+ m away, close to the edge of a neighbouring conifer plantation. The tag was buried in the grass with no obvious signs of chewing and no chick remains. There was an adult alarm calling in the immediate vicinity so again it is possible the tag had been shed but it is thought more likely that the chick had been recently predated. There was no subsequent evidence that it had survived. The final chick was still alive on day 25 and had moved back into the nest-field which had been mown and baled since the previous visit. The tag was still working well and hadn't required any re-attachment during the previous 25 days. The chick was growing well and was fitted with colour-rings as described for adults earlier. On day 29 the tag and all the rings (chewed and broken in the case of the plastic colour-rings) were recovered from the cattle-grazed pasture field along with a few pin feathers showing the bird had been predated by a mammalian predator, almost certainly a fox.

Out of a total of 12 nests located on eggs and nine chicks hatched in 3 successful nests zero chicks survived to fledging age at 31days+

The observations that all three tagged broods, within a day or two of hatching, seemed to leave the security of the tall vegetation in which the nest was located and head for neighbouring grazed pasture is significant. Grazed pasture with animal dung is likely to provide far more in the way of invertebrate food for small Curlew chicks than highly improved grassland which has been shown to have a much reduced invertebrate fauna. It was also thought that the dense sward may have been a hindrance to the free movement of the small chicks and put them at increased risk of chilling and hypothermia should the grass become wet through rain or dew. Unfortunately, improved pasture with short grass and reduced heterogeneity, almost certainly increase the chances of chicks being predated.

Other Factors to be taken into consideration

2015 was considered an atypical spring in many ways.

Birds failed to return to the Scheme Area
An unusually high number of the 2014 pairs, which farmers or bird surveyors had anticipated returning to the same spot each year, failed to return or turned up briefly and then vanished again.

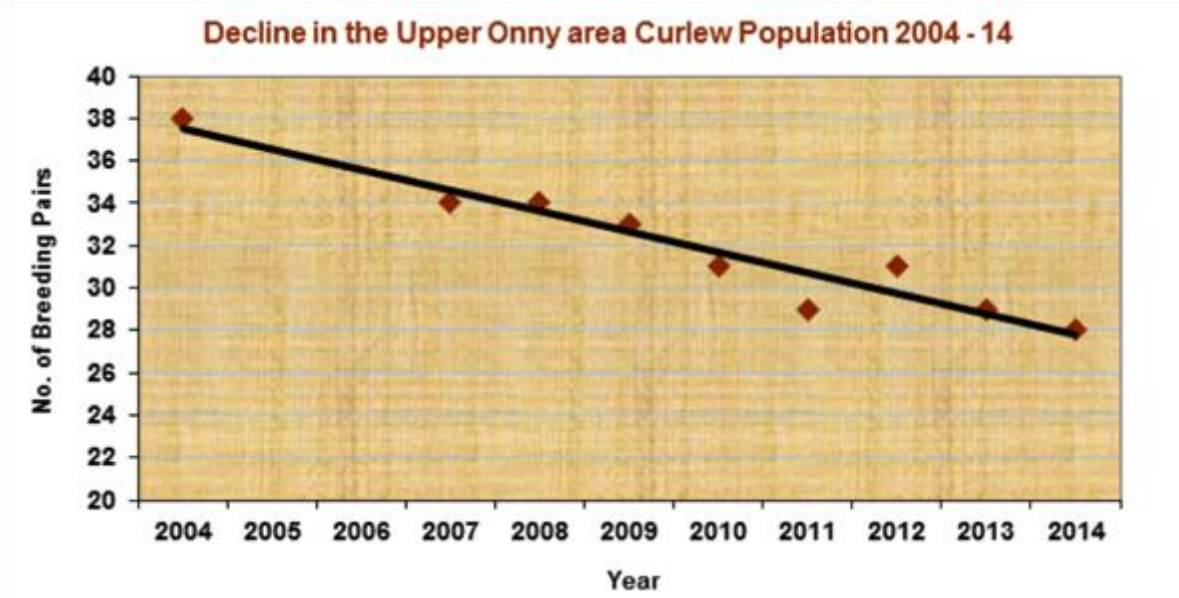
Weather
A prolonged dry spell was experienced in late March and April which lead to fields being a lot drier than usual for that time of the year and this perhaps influenced the distribution and timing of nesting attempts. Adult Curlews are feeding primarily on earthworms and tipulid larvae (leather jackets) at this time of the year and the dry conditions would have reduced access to these important prey items. Reduced foraging efficiency may have delayed females from reaching egg-laying condition. Because of the dry weather and unusually cold temperatures, the grass too was very slow to get going and once again this may have affected the timing of clutch initiation in breeding pairs if birds delayed laying until the grass was sufficiently high to conceal the nest. First egg dates for known first clutches ranged from 1st – 21st May. Cramp and Simmons (1983) however give first egg dates in the UK from early April. There were many reports that the breeding season in other species was delayed by up to 2 weeks in 2015 and research by the Game and Wildlife Conservation Trust showed 2015 to be a very poor and unusual breeding season for Lapwings too.

Predation Control
In one of the cluster areas, previously considered to be a curlew breeding hotspot there had been a high level of predation control for a number of years, but this had not been carried out during the nesting season this year.

Conclusions

The aim of the 2015 project was to install cameras on a minimum of 12 Curlew nests and record nest outcomes. In total the existence and locations of 13 nests were identified although one of these was never seen with eggs and another, located by the landowner, had failed before it could be examined. Of these 13 nests only 3 produced hatched chicks and none of them succeeded in producing fledged young. This low reproductive success is widely believed to be the main factor driving current declines in Eurasian Curlew populations.

Survey results from the Upper Onny Wildlife Groups (UOWG) volunteer surveys over the past 11 years have demonstrated a decline of just over 26% in the Curlew breeding population in that area from 38 pairs in 2004 to 28 pairs in 2014. Curlews are long-lived birds with adults having annual survival rates measured between 75 – 90% in several different studies (Grant *et el* 1999, Taylor and Dodd 2013). They have naturally evolved to cope with low productivity but even so, without any juvenile recruitment into the breeding population (as was the case this year) the 38 pairs located in 2004 would have declined to just 4 in 2015. This is clearly not the case. Using a conservative adult survival rate of 80%, a juvenile survival rate (in the first year) of 50% and an age of first-breeding of 3 years the local population in the UOWG area (without immigration from outside) must have been producing in the region of 0.5 young/breeding pair to have maintained the population levels it has. Using the same figures it would have needed to produce 12 young/breeding pair/annum to have maintained a stable population. If the zero level of juvenile survival found this year is maintained, and in the absence of immigration from outside, using the same conservative estimate of adult survival the local population can be expected to become extinct in less than 12 years or approx. 20 years with a higher adult survival rate of 90% as suggested by some studies (Taylor & Dodd 2014). However, if the population has already been dogged by low recruitment for a number of years then it may already be biased towards older birds so adult survival rates will decline as the individuals becomes senescent and the population may become extinct much sooner.



The reasons for low reproductive success are thought to be a combination of habitat degradation and fragmentation, high levels of nest and chick predation and high levels of nest and chick destruction due to agricultural activities. Many of the farmers spoken to reminisce at the high numbers of Curlews present in their youth, when the land was “a lot more rushy”. However, of the 13 nests located during 2015 only two were in what would have been described as rush pasture and in one of these no eggs were laid (or it was predated very soon after laying). A single nest was located in rough grassland on a common but the majority, eight out of 13, were in what would be described as highly improved silage/haylage fields. The remaining nest was in a traditional hay meadow. Obviously, Curlews have taken a liking to the dense swards where nests are well-

concealed from predators. Despite the high level of agricultural activity witnessed in some of these fields prior to egg-laying (rolling, chain-harrowing etc.) all instances of nest failure at egg stage (at known nests) was due to predation rather than agricultural activity and all tagged chicks were thought to have been predated. In contrast, at four territories, where nests could not be precisely located, observations strongly suggest that most, if not all, were destroyed by mowing in early-mid June rather than by predation.

The estimated fledging dates for the eight curlew nests where the first egg-date was known to within a day or two ranged from 8th to 27th July with 50% of them estimated to have still not fledged by 15th July - the earliest allowable mowing date under HLS agreements. Clearly, if more chicks had survived the pressures of predation, then agricultural activities may have become of increased significance in reducing survival rates right at the very end of the nesting-attempt.

Nest predation was by far the most important factor in nest-failure during the first year of monitoring under this project. Of the seven nests predated on eggs, five were known or suspected to have been due to foxes, 1 to corvids and 1 to a badger (although this nest may have been deserted earlier the same day). If declines in Curlew populations in the area are to be reversed the most practical and cost-effective method, in the short-term, will be an increase in the legal control of the Curlew's main predator, the fox. Longer term there is a need to look at land-use methods within key areas and investigate how the timing of farming operations, the management of grazing and the use of grassland set-a-side might help to increase the chances of breeding pairs successfully fledging young.

Recommendations for future years following the results of the Nest Monitoring first year.

1. **Continue nest monitoring** for a minimum of a further two years to get a bigger picture of nest success or failure without significant overall impact of other factors such as weather. The results from the 2015 pilot project are probably atypical or curlews would have become locally almost extinct already.

2. **Re-locating chicks that have been tagged** should be carried out daily to gain better data on their survival rate or the causes for loss.

3. **Deployment of thermacrons -** It had been intended to use thermacrons (small temperature sensors), provided by the RSPB and previously used successfully in Lapwing and Stone Curlew nests to detect the timing of any predation events and hence the probability of it being avian vs. mammalian predation. Some landowners were concerned about perceived excessive disturbance and thermacrons were not deployed this year.

4. **Cameras –** Ideally more of the smaller RSPB designed cameras would be used reserving the potentially more disruptive Trail/trap type cameras for field edge observations.

5. **Camera Batteries** – More assistant time is needed to help service the cameras and keep them running properly.

6. **Recording** – More details such as weather conditions and dates of cropping and will be recorded.

7. **Fox Scats –** Surveys to be carried out around the sites.

8. **Additional help needed to precisely locate nest sites –** Training volunteer bird surveyors about curlew behaviour will enable them to help locate nests better.

9. **Assistance for Field Ornithologist** – In order to fulfil recommendations 2,3,5 and 7.

10. **Predation Control** – Introduce control to be carefully supervised and monitored at sites to be agreed, where the impact will be most effective to consider the effect on Curlew breeding outcomes.

REFS.

Amar, A., Redpath, S. Sim, I. & G. Buchanan. 2010. Spatial and temporal associations between recovering populations of common raven Corvus corax and British upland wader populations. Journal of Applied Ecology 47: 253-262.

Brown, D.J. in prep. International Single Species Action Plan for the Conservation of the Eurasian Curlew Numenius arquata arquata, N. a. orientalis and N. a. suschkini. AEWA Technical Series No. XX. Bonn, Germany.

Cramp, S. & Simmons, K.E.L. 1983. Handbook of the birds of Europe, the Middle East and North Africa. The Birds of the Western Palearctic. Volume 3: Waders to Gulls. University Press, Oxford.

Grant, M., Orsman, C., Easton, J., Lodge, C., Smith, M., Thompson, G., Rodwell, S. & Moore, N. 1999. Breeding success and causes of breeding failure of curlew Numenius arquata in Northern Ireland. Journal of Applied Ecology 36: 59-74.

Prater, A. J., Marchant, J. H. & Vuorinen, 1977. Guide to the Identification and ageing of Holarctic waders. BTO Guide no 17. British Trust for Ornithology, Tring.

Taylor, R.C. & Dodd, S.G. 2013. Negative impacts of hunting and suction-dredging on otherwise high and stable survival rates in Curlew Numenius arquata. Bird Study 60(2): 221-228.

Appendix 1. Summary of nests and nesting territories found in 2015

SITE	STATUS	TERRITORY/NEST NUMBER	GRID REF	DATE NEST FOUND	AULT MALE CR	ADULT FEMALE CR	CLUTCH AT FINDING	FULL CLUTCH	1st EGG DATE	HATCHING DATE	EST. HATCHING DATE	EST. FLEDGING DATE (@ 35 days)	No. HATCHED	No. TAGGED	OUTCOME	DATE FAILED
	NEST WITH EGGS	2015-01		08/05/2015	Unringed	Unringed	2	4	07/05/2015		09/06/2015	14/07/2015	0	0	Failed at egg stage - deserted	42139
	NEST WITH EGGS	2015-02		19/05/2015	Unringed	Unringed	1	3	19/05/2015		21/06/2015	25/07/2015	0	0	Failed at egg stage - Fox by inference	By 14/06/2015
	NEST WITH EGGS	2015-03		05/05/2015	Unringed	Unringed	3	4	03/05/2015		05/06/2015	10/07/2015	0	0	Failed at egg stage - Badger seen on camera	42136
	NEST WITH EGGS	2015-04		09/05/2015	YELLOW AI	Unringed	2	3	08/05/2015	10/06/2015		15/07/2015	3	3	All chicks assumed dead in first 5 days. No radio signals, no adult activity	By 15/06/2015
	NEST WITH EGGS	2015-05		04/05/2015	Unringed	Unringed	3	3	02/05/2015		04/06/2015	09/07/2015	0	0	Failed at egg stage - Fox by inference	
	NEST WITH EGGS	2015-06		04/05/2015	Unringed	Unringed	4	4	01/05/2015	03/06/2015		08/07/2015	4	4	All chicks assumed dead in first 5 days. No radio signals, no adult activity	By 08/06/2015
	NEST WITH EGGS	2015-07		13/05/2015	Unringed	Unringed	4	4	09/05/2015	11/06/2015		16/07/2015	2	2	Failed at chick stage. 1 after min. 8 days the other after min. 25 days	By 09/07/2015
	NEST WITH EGGS	2015-08		28/05/2015	Unringed	Unringed	2	2					0	0	Failed at egg stage - Crow by inference	42163
	NEST WITH EGGS	2015-09		Unknown	Not seen	Not seen	3	?					0	0	Failed at egg stage - unknown	Not known
	NEST WITH EGGS	2015-10		24/05/2015	Unringed	Unringed	2	2					0	0	Failed at egg stage - Fox by inference	By 15/06/2015
	NEST WITH EGGS	2015-11		03/06/2015	Unringed	Unringed	3	3					0	0	Failed at egg stage - Fox by inference	By 10/06/2015
	NEST WITH EGGS	2015-12		22/05/2015	Unringed	Unringed	2	3	21/05/2015		23/06/2015	27/07/2015	0	0	Failed at egg stage - Fox seen on camera	42159
	NEST WITH NO EGGS	2015-13		16/05/2015	Unringed	Unringed	0	0							Good nest scrape but not seen with eggs. Didn't lay or failed on partial clutch	
	TERRITORIAL PAIR-NESTED BUT NOT FOUND	2015-14			Unringed	Unringed									Pair behaving as if they have nest nearby. Failed by	
	TERRITORIAL PAIR-NESTED BUT NOT FOUND	2015-15			Unringed	Unringed									Pair behaving as if they have nest nearby. Failed by 09/06/2015 Recent mowing all around. Agricultural activity by inference	By 09/06/2015
	TERRITORIAL PAIR-NESTED BUT NOT FOUND	2015-16			Unringed	Unringed									Pair behaving as if they have nest nearby. Failed by 09/06/2015 Recent mowing all around. Agricultural activity by inference	By 09/06/2015
	TERRITORIAL PAIR-NESTED BUT NOT FOUND	2015-17			Unringed	Unringed									Pair in suitable habitat but no nest located. No evidence of young being reared	
	TERRITORIAL PAIR-NESTED BUT NOT FOUND	2015-18			YELLOW AH	Unringed									Pair in suitable habitat but no nest located. No evidence of young being reared	
	UNKNOWN,PROBABLY NESTED BUT NOT FOUND	2015-19			Unringed	Unringed									Pair in suitable habitat but no nest located. No evidence of young being reared	
	UNKNOWN,PROBABLY NESTED BUT NOT FOUND	2015-20			Unringed	Unringed									Pair in suitable habitat but no nest located. No evidence of young being reared	
	UNKNOWN,PROBABLY NESTED BUT NOT FOUND	2015-21			Unringed	Unringed									Pair in suitable habitat but no nest located. No evidence of young being reared	
	UNKNOWN,PROBABLY NESTED BUT NOT FOUND	2015-22			Unringed	Unringed									Pair in suitable habitat but no nest located. No evidence of young being reared	
	UNKNOWN,PROBABLY NESTED BUT NOT FOUND	2015-23			Not seen	Not seen									Pair in suitable habitat but no nest located. No evidence of young being reared	
	UNKNOWN,PROBABLY NESTED BUT NOT FOUND	2015-24			Not seen	Not seen									Pair in suitable habitat but no nest located. No evidence of young being reared	

APPENDIX 2 – Site Observations

Nest Reference			Altitude	Vegetation Height during laying		Distance from nearest field boundary (M)	Farmer knew of presence of the birds	Farmer knew of precise nest location before being told
2015-01			105	Ca. 250mm		70	YES	NO
2015-02			104	Ca. 150mm		64	YES	NO
2015-03			328	Ca. 200mm		52	YES	NO
2015-04			329	Ca. 200mm		85	YES	NO
2015-05			310	< 50mm		70	YES	NO
2015-06			290	Ca. 250mm		44	YES	YES
2015-07			355	Ca. 100mm		90	YES	NO
2015-08			330	Ca. 200mm		50	YES	NO
2015-09			292	N/K		56	YES	YES
2015-10			268	<50mm		35	YES	YES
2015-11			264	150mm		22	YES	NO
2015-12			301	<100mm		24	YES	NO
2015-13			360	Didn't lay?		25	YES	NO

APPENDIX 3 - Curlew Egg Weights and Measurements

Egg measurements were taken for a total of 21 eggs in seven complete clutches and an additional clutch were weighed but not measured.

DATE	TIME	NEST	GRID REF	EGG NUMBER	LENGTH (mm)	WIDTH (mm)	WEIGHT (g)	
11/05/15	11:40			1			76.9	No callipers
11/05/15	11:40			2			73.1	No callipers
11/05/15	11:40			3			74.7	No callipers
11/05/15	11:40			4			77.8	No callipers
22/05/15	18:40			1	70.8	44.5	68.3	
22/05/15	18:40			2	69.4	45.3	64.1	
22/05/15	18:40			3	69.0	45.2	66.2	
24/05/15	17:00			1	71.4	47.5	78.0	
24/05/15	17:00			2	73.5	45.7	77.1	
24/05/15	17:00			3	74.4	46.3	81.5	
24/05/15	17:00			4	71.3	46.0	76.4	
24/05/15	19:30			1	72.7	48.6	90.2	
24/05/15	19:30			2	71.0	48.0	84.9	
24/05/15	19:30			3	71.0	46.6	80.8	
24/05/15	20:00			1	68.7	46.8	75.1	
24/05/15	20:00			2	70.7	48.3	82.0	
28/05/15	14:20			1	66.3	47.1	66.2	
28/05/15	14:20			2	69.0	46.9	68.3	
28/05/15	14:20			3	64.4	47.1	64.7	
28/05/15	14:20			4	66.5	47.7	68.1	
28/05/15	15:45			1	67.8	44.0	53.2	This egg had small hole in shell and had leaked a bit
28/05/15	15:45			2	66.3	43.5	64.8	
03/06/15	14:00			1	66.3	44.0	64.9	
03/06/15	14:00			2	67.3	45.5	69.4	
03/06/15	14:00			3	66.8	44.7	68.2	