Saving England's lowland Eurasian Curlews

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Abstract The Eurasian Curlew *Numenius arquata* is classified as globally Near Threatened and is on the UK Red list of Birds of Conservation Concern. Around 25% of the world's breeding population is found in the UK. This article describes the breeding Curlews of southern England, an area which supports an estimated 500 pairs of predominantly lowland-breeding birds. The status of the various lowland populations is described, and the conservation efforts being directed at these birds are outlined. A coordinated approach to the conservation and monitoring efforts is provided by an informal group known as the Curlew Forum.

Introduction

There has been an upsurge in interest in the Eurasian Curlew *Numenius arquata* since 2015, when it moved onto the global Red List (as Near Threatened) and the UK Red list of Birds of Conservation Concern (www.iucnredlist.org; Eaton *et al.* 2015). In the breeding season, the UK supports approximately 25% of the global population (Brown *et al.* 2015).

Current estimates suggest that there are c. 58,000 pairs of breeding Curlews in the UK (Woodward *et al.* 2020). This distribution is not uniform, however, as fewer than 500 pairs breed in southern England, which, for the purposes of this article is the area below a line from The Wash through to the northern border of Shropshire (table 1, fig. 1).

The areas of highest Curlew density in the UK run from the south Pennines up the Pennine chain to the Scottish border, with substantial concentrations also in the Peak District, the Forest of Bowland, North York Moors and the Cheviots. In Scotland, comparable densities are reached in Caithness,

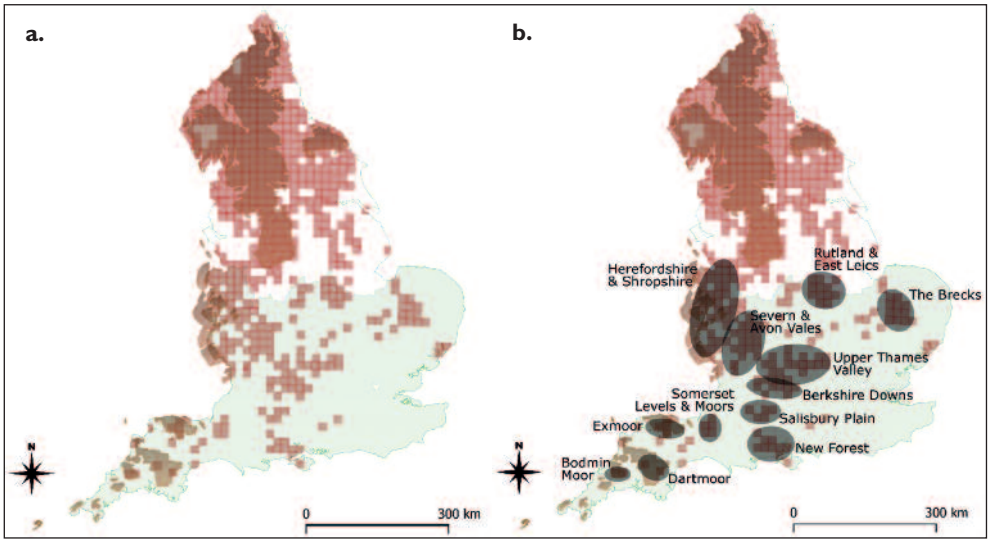

Fig. 1. The breeding distribution of the Eurasian Curlew *Numenius arquata* in England. Fig. 1a shows distribution across the uplands, lowlands and southern England. Pink squares are the 10-km squares for which there were 'probable' or 'confirmed' Curlew breeding records in *Bird Atlas 2007–11* (Balmer *et al.* 2013). Downloaded from www.bto.org/our-science/data/what-data-are-available; see also Gillings *et al.* (2019). Green shading denotes southern English counties (as defined in this paper) and brown shading shows the English uplands defined as Less Favoured Areas; downloaded from https://magic.defra.gov.uk/home.htm. Fig. 1b shows the main Curlew populations in southern England.

the Northern Isles, Inner and Outer Hebrides and patches of the Southern Uplands and eastern Highlands (Balmer *et al.* 2013).

Although the breeding Curlew populations in southern England are thinly spread and mostly of low density, they are of considerable conservation value for two reasons. Firstly, a substantial part of the English Curlew range lies within southern England. The maintenance of range is a legal requirement of the EU Birds Directive (2009/147/EC) and a criterion of the IUCN Red List (www.iucnredlist.org/resources/categories-and-criteria). Fig. 1a shows that the number of 10-km squares occupied by probable or confirmed breeding Curlews in southern England is broadly comparable with that of the English uplands and the northern lowlands. Hence, losing all the breeding Curlews from lowland southern England would reduce the English range by around a third. Secondly, the lowland birds are much loved by local people and provide a link between human populations in urban areas and wildlife, culture and heritage. These experiences are essential for reconnecting the wider public with nature, without which most conservation will not succeed.

Until around the mid-nineteenth century, the Curlew was overwhelmingly an upland and northern species, breeding on moors, in-bye and rough pastures of northern Britain. However, in the late nineteenth century and the first half of the twentieth century, management of the uplands for ground-nesting birds such as Red Grouse *Lagopus lagopus* also benefited Curlews. Perhaps because of overspill from productive upland populations, the Curlew's breeding range expanded and it colonised lowland areas, using floodplain meadows, unimproved grassland, heaths and mires, but also arable crops. When farming was intensified after the Second World War, the species began contracting in southern and lowland areas, a process that has accelerated in the last few decades (Holloway 1996), although with some notable exceptions. The New Forest population increased until the 1990s (Peter Potts pers. comm.), and some areas of eastern England showed 'gains' in occupied 10-km squares between the national bird atlases in 1988–91 and 2007–11 (Balmer *et al.* 2013). By 2015, the situation was considered critical in both southern lowland England and the UK as a whole (Brown *et al.* 2015).

In order to investigate the decline of the Curlew and seek solutions, MC, with support from a range of organisations and through crowdfunding, instigated four national conferences in England, Ireland, Scotland and Wales which brought together a range of stakeholders from across the conservation spectrum. The southern England conference was held in February 2017 at WWT Slimbridge, in Gloucestershire.

Participants at the Slimbridge meeting recognised that, since northern upland areas support the core populations, they would receive most of the conservation effort. For example, the established multi-year RSPB Curlew Trial Management Project (TMP; www.rspb.org.uk/our-work/conservation/projects/curlew-trial-management) is an ambitious landscape-scale experiment involving six paired sites across the uplands of Northern Ireland, Wales, Scotland and northern England. The trial plots are compared with reference sites in each location and test what combination of predator control and habitat management is required to increase Curlew breeding success.

Nevertheless, while the uplands are the Curlew's heartland, there are small, active, locally led projects for Curlew conservation in the south and the lowlands. The desire to represent, connect and support these groups led to the creation of the **Curlew Forum**, which has a steering group of four volunteers (the named authors of this paper). The Curlew Forum is entirely informal, meets annually and communicates findings and advice through a series of newsletters and maintains a website (www.curlewcall.org). The benefits of this coordinated approach across multiple populations and projects are huge, and continue to be developed and improved.

In this paper we aim to describe the research and conservation efforts taking place in southern England and consider the future needs and prospects of lowland Curlew populations.

Damian Money

122. Eurasian Curlew *Numenius arquata*, North York Moors, June 2018.

Table 1. The main Eurasian Curlew *Numenius arquata* populations breeding in southern England.

area	main habitat(s)[1]	population size[2]	population trend[3]	project/organisation
Shropshire	Neutral grassland and improved grassland	130	-77% (1990–2010)	Curlew Country and Shropshire Community Wildlife Groups
Herefordshire	Lowland meadows and neutral grassland	15	-60% (2007–11 to 2019)	Herefordshire Curlew Project
Worcestershire (excl. Severn & Avon Vales)	Neutral grassland	5	-60% (early 1990s–2019)	Worcester Curlew Group
Severn & Avon Vales (Gloucestershire/Worcestershire)	Lowland meadows	35	0% (1982–2019)	WWT Severn Vale Curlew Project/Gloucestershire Naturalists' Society/Worcester Curlew Group
Somerset Levels & Moors	Lowland meadows	40	+20% (1977–2016)	RSPB
Dartmoor (Devon)	Moorland	1	-97% (1988–2019)	Dartmoor wader recovery project (Duchy of Cornwall, Dartmoor National Park, RSPB)
Exmoor (Devon/Somerset)	Moorland	1	Decrease from 40 pairs c. 1980	Exmoor National Park, RSPB surveys; David Ballance (pers. comm.)
Bodmin Moor (Cornwall)	Moorland	2–3	Unknown	RSPB
New Forest (Hampshire)	Lowland mire and wet heathland	40	-67% (1994–2019)	New Forest Curlew Project (Wild New Forest, Forestry England and GWCT)
Salisbury Plain (Wiltshire)	Calcareous grassland	8	Increase from max. 1–2 pairs in 1990s	RSPB
Berkshire Downs	Calcareous grassland	5	+400% from 1986–88 to 2007–11; stable since 2007–11	Berkshire Ornithological Club
Braydon Forest (north Wiltshire)	Lowland meadow and improved grassland	5	-78% (1994–2019)	Wiltshire Wildlife Trust, Wiltshire & Swindon Biological Records Centre
Upper Thames Valley (Oxfordshire, Buckinghamshire)	Lowland meadow	47	-56% (2005–15)	RSPB/Upper Thames Curlew Project
The Brecks (Suffolk/Norfolk)	Lowland dry acid grassland	74[4]	Unknown	University of East Anglia, RSPB, BTO (Harry Ewing)
East Leicestershire & Rutland			Not known to Curlew Forum	

Notes: [1] Based broadly on 'level 4' classifications provided by UK Habitat Classification Working Group (2018). [2] An approximate estimate of the number of territorial pairs, based on recent fieldwork using a variety of methods, as reported to the Curlew Forum in November 2019. These estimates do not, in all cases, represent full surveys of the entire area. [3] Baseline estimates provided by projects, from a variety of sources, including county avifaunas and atlas data, as well as dedicated Curlew monitoring; hence values should be taken as very approximate. [4] May be as high as 150 pairs (Harry Ewing pers. comm.).

The status of Curlews in the lowlands

The remaining populations of breeding Curlews in southern England are widely scattered, and mostly in discrete pockets, although there is a near-continuous distribution between the lower Severn Vale, in Gloucestershire, and Shropshire (fig. 1b). They occupy a range of habitats, including some areas of largely dry habitat (such as Salisbury Plain and the Brecks). As large parts of southern England are either urbanised or farmed intensively, Curlew populations are under pressure from agricultural practices, human disturbance and high levels of generalist predators such as Red Foxes *Vulpes vulpes* and Carrion Crows *Corvus corone*.

A growing number of Curlew populations are the subject of local monitoring and conservation projects (table 1), which are run by a range of NGOs, many of which are local, and the work on the ground is usually delivered by volunteers. They vary greatly in size and capacity, but they all have the aim of mapping territories, monitoring nests and chicks and, in some cases, undertaking direct intervention to help fledge more Curlews. This bottom-up approach has proved successful in communication with landowners and farmers, who are at times reticent about engaging with larger conservation organisations. Undeniably, farmers are crucial to the survival of breeding Curlews in this part of the UK.

In total, we can account for approximately 500 breeding pairs in the region and the recent increase in surveys has led to more pairs and nests being found. The largest populations are in Shropshire and the Brecks, whereas populations on Dartmoor, Bodmin Moor, the Berkshire Downs and Braydon Forest (north Wiltshire) are in single figures and are close to extirpation. It has also come to light that some Curlews in lowland England nest on airfields, where they can easily escape the attentions of bird surveyors. Investigations into the distribution and number of airfield Curlews are ongoing and the true picture remains unclear.

What is being done?

Curlew conservation work in the English lowlands can be divided broadly into: (1) research and monitoring – understanding how Curlews are doing, diagnosing problems, and monitoring to determine whether conservation actions are working; and (2) conservation action – interventions on the ground to improve Curlew breeding productivity. These activities are summarised below.

1. Research and monitoring

Mapping pairs

To understand the status of Curlew populations, projects attempt to identify and locate nesting/territorial pairs and, if possible, monitor breeding success. The standard methodology (O'Brien & Smith 1992) is based on repeated survey visits during the pre-incubation and fledging periods. In practice, however, volunteer availability sometimes means that less-intensive methods are used, while in some areas data gathering is more intensive, closer to a territory-mapping approach.

Finding and monitoring nests

Several projects aim to find Curlew nests. This is a prerequisite if active protection measures are to be put in place (such as nest fencing or delayed mowing – see below). It is also done to determine nest failure rates and identify causes of failure. Nest finding requires time and good fieldcraft and an understanding of the subtleties of bird behaviour. Typically, nests are found by direct observation of the birds and tell-tale behaviours during laying and incubation. Alternative methods being trialled include rope-dragging, and the use of unmanned aerial vehicles (UAVs, or drones) equipped with thermal-imaging cameras. A thermal-imaging UAV was tested (with landowner permission and following the CAA Drone Code of Conduct, www.caa.co.uk/Consumers/Unmanned-aircraft-and-drones) at a Curlew site in the Severn and Avon Vales during 2019 by a commercial company supported by Gloucestershire Naturalists' Society and WWT; results were promising.

Thermal-imaging UAVs present a number of challenges. They are expensive and require specialist skills and training. Concerns have been raised about potential disturbance to nesting birds (Borrelle & Fletcher 2017), and flushing incubating birds from nests may expose them to predation (Israel & Reinhard 2017; Valle & Scarton 2019). Disturbance was not found to be an issue in the Gloucestershire trial, however; and the use of UAVs may

drastically reduce the need for fieldworkers to traverse nesting areas on foot, decreasing the duration and intensity of disturbance.

Hatching success can be determined by revisiting a nest on or around the hatch date. If a nest is found before the full clutch is laid, then hatch date can be estimated using the incubation period of 28–30 days after full incubation starts (usually when the third egg is laid). If the nest is found after the clutch is completed, the formula in Grant *et al.* (2000), based on eggs losing mass at a fairly predictable rate during incubation, can be used to estimate hatch date.

Temperature loggers (these resemble small button batteries, are inserted into the base of the nest and record temperature typically every 10–30 minutes) provide an accurate record of the incubation period and give valuable extra information. A marked fall in temperature followed by a resumption in incubation may reflect disturbance from humans, dogs or livestock, as investigated in the New Forest Curlew Project. Loggers may reveal the time of nest failure, which can be a useful indicator of predator identity: nocturnal failure suggests mammalian predation, whereas diurnal failure is more indicative of avian predation (MacDonald & Bolton 2008). Physical signs at nests, such as chewed eggshells, flattened ground, the disappearance of eggs, can be useful additional cues to identify causes of failure, although this is far from an exact science.

Nest cameras

Nest cameras have been used at a number of locations, including the Upper Thames, Somerset Levels and Moors, Shropshire, Severn and Avon Vales and the Brecks, with the aim of determining the different causes of nest failure. An effective nest camera should be small and inconspicuous, waterproof and require infrequent visits to replace batteries and/or memory card. Most are triggered by movement or heat, although some work continuously. There are no commercial suppliers of suitable cameras in the UK but the RSPB has developed a camera system, using an adapted indoor security camera.

Some fieldworkers voice concerns about whether searching for nests, deployment of nest cameras, or repeat visits for camera maintenance may attract predators. This is a difficult issue, although published reviews suggest that for ground-nesting birds there is usually no effect or even a mildly protective effect of frequent nest visits (Ibanez-Alamo *et al.* 2012).

Stephen Inglis

123. Curlew nest in South Lanarkshire, May 2019.

Stephen Inglis

124. A recently hatched Curlew brood in East Renfrewshire, 19th May 2019.

David Evans/WWT

125. Temperature logger used for monitoring Curlew nest (with £1 coin for scale). The logger on the right is glued to a nail and ready for deployment in a nest; the nail is used to secure the logger into the ground, so that the incubating Curlew is less able to dislodge it from its position at the base of the clutch. Image taken May 2019.

Monitoring chicks

Curlew chicks are precocial: once hatched, they spend at most a couple of days in the nest before wandering as a brood, which raises a new set of challenges for fieldworkers attempting to monitor survival and causes of mortality. Curlew chicks are cryptic in both plumage and behaviour, and usually the best and least invasive way of determining whether any members of a brood are alive is to detect an alarming parent. A metal ring can be fitted while the chick is still in the nest. Colour rings and flags can also be attached, although some fieldworkers prefer to do this only when the birds are at least a week old. Chicks may be radio-tagged from a young age, but attaching tags requires specialist training.

Most lowland Curlew projects have struggled to produce accurate productivity estimates. Direct observation of fledglings, while giving absolute confirmation of breeding success, has a strong tendency to underestimate productivity because the birds are so hard to detect; the degree of underestimate depends on survey effort, which differs greatly between areas. Standardised repeat visits during chick-rearing, and use of alarming adults as an indication that a brood is present, can give more accurate, consistent and complete estimates of chick survival and productivity, but this approach has not yet been widely adopted.

Kane Brides/WWT

126. Curlew chick fitted with radio tag in the Severn Vale, May 2019.

Monitoring adults

Estimating productivity is essential, since Curlew declines are largely driven by poor fledging success (Brown 2015), but adult survival is an important part of the story, especially given that Curlews are long-lived. Loss of wintering habitat is also a real and important threat (for example at Havant, in Hampshire: http://bit.ly/2umHZoU). Consequently, ringing studies are extremely valuable, especially colour-ringing, which allows survival and movements to be tracked without the need for recapture.

Breeding Curlews have been captured for colour-ringing at pre- and post-breeding aggregations, on territory before breeding, and at nests. In several areas, including Shropshire and the Severn and Avon Vales, Curlews congregate in roosts near to the breeding sites from February onwards, and again from June, which provides opportunities for catching adults. Recently, the BTO in Wales has had considerable success at catching Curlews on territory in the pre-breeding period using decoys, tape lures and cannon-nets. Nest trapping has been used in Shropshire, the Brecks and the New Forest, also successfully. This is specialist work, however, requiring experience and strict adherence to best practice.

Some breeding Curlews have been fitted with GPS trackers (Potts *et al.* 2019). The capabilities of modern GPS tags and associated sensors have provided data on home ranges, habitat use and detailed behavioural information. Tags have been attached via leg-loop harnesses in the New Forest project, and glued to the bird's back in the BTO Wales project.

Licensing

Licensing for Curlew fieldwork is complex. While anyone with good fieldcraft is able to monitor nesting birds, a licence is required to handle eggs (to weigh and measure, or lift them from the nest to insert a temperature logger). Under the licensing agreement between the country agencies and BTO, *permitted ringers with a pullus endorsement* are allowed to handle Curlew eggs for measuring or to insert a temperature logger, or temporarily replace real eggs with dummy eggs in order to catch the incubating adult. *Everyone else* (including nest recorders who are not licensed ringers, and licensed ringers without a pullus endorsement) is required to apply to the relevant country agency for a permit to handle eggs. Ringers require the usual BTO permits and relevant endorsements, and attachment of telemetry devices requires permission from the Special Marks Technical Panel. Site-based permissions are also required from landowners and if working in a SSSI or SPA.

Results of research and monitoring studies

The population estimates for southern lowland Curlews given in table 1 derive largely from survey work conducted by local groups in recent years, and our understanding of the size of these breeding populations has improved greatly since 2017. In the majority of cases, declines are evident in the last 10–30 years. Notable exceptions are the populations on downland in Berkshire and Wiltshire, which appear to have increased since the 1990s, and in the Somerset Levels and Moors, where intensive conservation work has yielded positive results for several wader species.

There are strong indications that most lowland Curlew populations are failing to fledge enough chicks to maintain the population, which is borne out by widespread population declines. However, accurate productivity estimates remain problematic. In 2018, a total of 224 confirmed or probable breeding pairs was estimated across the lowland Curlew projects that contribute to the Curlew Forum database, and only six fledglings were confirmed. In 2019, the numbers were 342 pairs and 43 fledglings. This suggests that the number of fledglings per pair is extremely low – in the order 0.1 – but using sightings of fledglings to estimate productivity will inevitably lead to underestimates (see above). A simple population model using published survival figures for the Curlew suggests that with a productivity of 0.1 fledglings per pair per year, a population would decline at c. 5% per annum, and hence would decline by 50% in around 13 years (G. Hilton unpubl. data), which exceeds the observed rate of decline in most populations (table 1).

In areas where Curlews nest in grass crops, such as Shropshire and the Severn and Avon Vales, both egg and chick mortality can be

David Evans/WWT

127. Cutting hay meadows in the Severn Vale, June 2019.

caused by mowing and other agricultural operations, although this is rarely quantified. Data from temperature loggers and nest cameras suggest that Foxes are the most frequent nest predator, followed by Carrion Crows and Badgers *Meles meles*.

On 6th June 2018, a nest camera in the Brecks recorded a sheep forcing a Curlew off its nest and eating the eggs. Similar incidents have occurred elsewhere, including in Oxfordshire and in Wales, and sheep may be responsible for more egg losses than previously realised. This raises questions of why sheep are seeking out the eggs, and whether this is related to stocking densities. A completely empty nest, or very clean eggshells that appear to have been licked clean of any contents, may be an indication of sheep at work, while trampling of nests by cattle has also been reported as an issue (Grant 1997).

GPS tracking data have led to intriguing discoveries and called into question current assumptions and understanding. The Welsh data show that, during incubation, the off-duty bird may fly as much as 1 km to feed and several birds may visit the same 'hotspots', creating overlapping 'feeding territories'. In the evenings, the off-duty bird will often leave the area, and some birds fly 3–5 km to roost sites (Rachel Taylor pers. comm.). In the New Forest, off-duty birds regularly flew 1.0–3.9 km to feed on heath and meadows, and have been detected flying to feed on the intertidal mudflats of The Solent, up to 12.5 km away (Potts *et al.* 2019). As in Wales, several feeding adults were observed on favoured meadows.

2. Conservation action

More than other breeding waders in the lowlands, Curlews tend to occur at low densities in relatively large areas, and are not well covered by existing nature-reserve networks. As a result, reversing Curlew declines will be a difficult, long-term endeavour, requiring landscape-scale solutions and effective, evidence-based, agri-environment measures. However, the current state of Curlew populations in the lowlands is such that we risk losing some populations before such comprehensive procedures are in place. With this in mind, a range of actions have been trialled by lowland Curlew projects in the last few years, in an attempt to boost Curlew productivity.

Predator control

Predation of eggs and chicks is recognised as a major cause of Curlew population decline across the range (Brown 2015). The Shropshire-based project, Curlew Country, discovered that no chicks survived to fledging from any of the 30 nests monitored in 2015 and 2016, and in each of those years only three nests hatched chicks. Foxes were responsible for over 50% of losses and Badgers just under 25%, with other failures due to Carrion Crows, mowing and other agricultural activities. With this clear evidence of unsustainable predation, trial predator control was instigated.

The realisation of the extent of predation on Curlews has brought this difficult and controversial issue to the fore. The RSPB Curlew Trial Management Project undertakes

predator control in the uplands and has been subject to vocal criticism, which has at times spilled over into intimidation of fieldworkers, demonstrating the intense feelings surrounding this practice.

A recent RSPB review indicates that wader populations tend to be limited by high numbers of Foxes and Carrion Crows and that the UK has some of the highest densities of Foxes and corvids among European countries (Roos *et al.* 2018). Furthermore, targeted and proportionate control around nesting areas has been shown to increase breeding success (Fletcher *et al.* 2010). However, while Curlews may benefit from the intensive predator control practised by some gamebird managers, delivering predator control across entire lowland Curlew landscapes would be impractical, expensive, unsustainable and controversial. In addition, many lowland gamekeepers undertake the majority of their predator control in the summer and autumn, to coincide with the release of, and subsequent hunting season for, Common Pheasants *Phasianus colchicus*, and thus mainly after the Curlew breeding season.

In large parts of the lowlands, it seems that both predator control and habitat management for Curlews are currently necessary, and neither is likely to be sufficient on its own to deliver Curlew recovery.

At present, funding for predator control is not a part of existing agri-environment schemes, which raises the prospect of public money being spent on habitat management that does not deliver positive results for Curlews. However, it may well be included in the new Environmental Land Management Scheme (ELMS), which is currently being devised. Effective predator control for conservation requires skilled and well-equipped personnel and so it will be important that any public money provided is targeted at well-justified and effectively delivered programmes.

Nest fences

Temporary electrified fences around Curlew nests have been trialled by NABU (Naturschutzbund Deutschland – Nature and Biodiversity Conservation Union) in Schleswig-Holstein, northern Germany, with the aim of excluding terrestrial predators such as Foxes and Badgers. During 2014–17, fenced nests had a 79% hatching success compared with 18% for unfenced nests (Meyer & Jeronin 2017). Such fences, typically surrounding the nest in a square shape with sides 25 m long, have since been trialled in Shropshire and the Severn and Avon Vales. The key aspects of successful deployment are to erect the fence quickly in order to minimise disturbance and to strim the vegetation under the fence to prevent shorting.

Fieldwork, data collection and best practice

The increasing and widespread interest in monitoring and protecting lowland Curlew populations means that data are generated

David Evans/WWT

128. Electric fence deployed to protect nesting Curlews in the Severn and Avon Vales, May 2019.

Sam Stafford/WWT

Sam Stafford/WWT

129 & 130. Two stages of the headstarting process being undertaken at WWT Slimbridge, Gloucestershire, May/June 2019, showing Mark Roberts, Principal Conservation Breeding Officer, with a recently hatched chick in an incubator, and (right) older chicks in an outdoor rearing pen.

from a range of different sources. Common approaches to data collection facilitate larger sample sizes (from pooled datasets), and powerful inter-site comparisons. The multitude of potential fieldwork activities and the rapid changes in methods and technologies make this challenging, and place a premium on effective sharing of best practice and common standards. With this in mind, the newly formed charity Curlew Action (www.curlewaction.org), in collaboration with WWT, is producing an online 'Curlew Fieldworkers Toolkit': a resource for field-workers on best practice, technical and legal advice as well as case studies from different lowland areas. It will be available from autumn 2020, with the intention that it will be free to download on the websites of WWT, Curlew Action and Curlew Forum.

Headstarting

Headstarting is a conservation measure being used increasingly in wader conservation. Starting with Spoon-billed Sandpipers *Calidris pygmaea* in 2012 and continuing with Black-tailed Godwits *Limosa limosa* in the Fens since 2017, through an EU LIFE partnership between RSPB and WWT (see https://projectgodwit.org.uk), WWT has refined the technique of taking wader eggs from nests in the wild, hatching the eggs and rearing the chicks in captivity, and releasing the chicks at the point of fledging. For the wader species that WWT has been involved in, around 80% of collected eggs can typically be 'converted' to fledglings, giving a productivity of a little over three fledglings per nest, which will increase the annual productivity of those females whose eggs are taken, typically in the order of five- to ten-fold compared with what they would have achieved in the wild. The effect on whole-population productivity depends upon the scale of the headstarting operation relative

to the size of the total population. The effect on the population trend depends on the boost to productivity, but also on the survival of the released fledglings. If they are less successful at surviving or breeding than wild-reared counterparts, then the benefits of headstarting are reduced. Similarly, in general, headstarting would be predicated on the headstarted birds recruiting into the natal population (however defined) as adults. If they recruit elsewhere, they might boost another population, but this is unlikely to be a desired outcome or give a good return on investment.

First-year survival of headstarted Black-tailed Godwits appears to be at, or slightly above, that expected of wild-reared birds, and in the case of both Black-tailed Godwits and Spoon-billed Sandpipers, headstarted birds are breeding successfully (WWT unpubl. data). Nevertheless, it should continue to be seen as an experimental technique.

With this success in mind, the Severn and Avon Vale project began a trial of Curlew headstarting in 2019, while in Shropshire, Curlew Country began headstarting in 2018, and partnered with WWT to continue this in 2019. Fifty fledglings were released at WWT Slimbridge in the Severn Vale, having been reared from eggs that were licensed to be destroyed on military airfields in eastern England due to bird-strike risk. Thirty-three fledglings were released in Shropshire in 2019 from eggs taken from local breeding Curlews. Hatching and rearing success was high, but since Curlews do not breed until their third calendar year, success will not become clear for a few years. Further headstarting initiatives, in eastern England and on Dartmoor, were planned for 2020 (before the coronavirus outbreak).

It is important that headstarting is not seen as a panacea: it can produce a large, short-term boost to small populations, but is expensive and challenging, and can work only as part of a wider programme that ensures suitable habitat and protection from predators. Consequently, working with farmers and landowners is a vital part of the process.

Working with land managers

Most lowland Curlews nest on farmland, in many cases in grass crops. This makes nests and chicks vulnerable to harrowing and rolling operations in early spring, and mowing throughout the breeding season. Silage cutting in lowland England now begins in late April, and up to five cuts are made per year, which can destroy eggs and chicks.

Since agri-environment measures to compensate for lost crops are not widely in place for lowland Curlews, creative solutions, goodwill and cooperation from farmers are the only measures left to protect Curlews in many areas. If nests are found, it is possible to delay mowing or to leave uncut areas around nests. Experience on the ground in Shropshire, Oxfordshire, Wiltshire and the Severn and Avon Vales shows that many farmers are keen to participate and are willing to forego income and incur considerable inconvenience. In the long term, the new ELMS must take these issues into account. It is thus vital to raise the profile of Curlew conservation in farmland areas and make known its wider benefits. Curlew-friendly farming may increase opportunities for other ground-nesting birds, such as Northern Lapwing *Vanellus vanellus* and Skylark *Alauda arvensis*, as well as potentially creating insect- (including pollinator-) rich habitats, improved soil management and providing natural flood management. Research to fully understand the opportunities in agri-environment measures is needed, alongside ongoing advocacy to policy-makers.

The future for England's lowland Curlews

The Curlew Forum is a dynamic and expanding group and is now represented on the UK and Ireland Curlew Action Group, which is a round table of national organisations, including the government conservation agencies. Members of the Forum have been involved with two meetings hosted by HRH Prince Charles (the Dartmoor Curlew Summit in 2018 and the Highgrove Curlew Summit in 2020). In 2019, Lord John Randall and MC held a Downing Street Curlew Summit, attended by members of the Forum and other organisations, which focused the attention of senior civil servants and politicians on the plight of the Curlew. This widespread collaboration across many organisations and within different spheres has helped to create a more compelling picture of the crisis facing Britain's Curlews and has strengthened the impetus for action.

Sam Walker/WWT

131. Curlew Forum meeting at WWT Slimbridge, November 2019.

Since the plight of the Curlew came to prominence, the mobilisation to save it has been almost without precedent in UK conservation. Those involved in the conservation of lowland Curlews have been overwhelmed by the enthusiasm from all stakeholders, including the public. Almost all Curlew populations in lowland southern England now have groups championing them and a variety of practical solutions are being trialled, with information and best practice increasingly shared. Nevertheless, most lowland Curlew populations remain in decline, with several at critically low levels.

To be more effective, Curlew conservation groups need better resources. The bottom-up model works well but relies heavily on volunteers, many of whom would benefit from funding and training. The network could also be expanded to include the little-known 'northern lowlands' populations breeding in farmland in areas such as the Solway coast, the Vale of York and the Lancashire coastal plain. These areas are under-resourced and under-recognised and increased support for these populations is urgently needed.

One contentious subject that requires increased attention is the potential relationship between high numbers of generalist predators and the release of around 50 million pheasants and partridges into the countryside every year (Avery 2019). Pringle *et al.* (2019) highlighted the link and lead author Henrietta Pringle commented: 'The idea that gamebird releases might enhance populations of generalist predators is not new, but our results are the first to indicate this may actually be happening on a national scale. While gamebirds are only one of the factors that could shape predator populations, our work emphasises the need to better understand the impacts of releasing roughly 46,000 tonnes of gamebird biomass into the countryside annually.' The role of roadkill in sustaining predator populations is also poorly understood. It is important to note that a causal link between gamebird release and wader predation is not yet proven.

The Curlew crisis has helped to bring the issue of predator control to the fore. Many individuals and conservation organisations find it a difficult topic to discuss. An open and honest public debate is needed on how to protect threatened species, such as the Curlew, in a country such as the UK with such high numbers of predators.

As the UK faces ever greater losses in biodiversity, a re-connection with nature is the only way to galvanise sufficient public support to push through government action to help wildlife. Returning the haunting and evocative call of the Curlew to lowland Britain will help to reignite the British love of the natural world, which has long been a part of the national character. There has never been a more important time to do this.

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