Practical Solutions

Introduction

One of the most exciting aspects of our work is using scientific evidence to develop practical solutions to important conservation problems. This is where science really begins to make a difference that people can see. This section describes some of our recent work in this area. It broadly covers two themes: how we are helping species to recover and form viable populations; and solutions for specific places across the country, from individual farms to the extension of a National Park boundary.

We showcase our work on safeguarding the future of individual species through captive breeding and reintroductions (dormice and the freshwater pearl mussel), the health screening and reintroduction of beavers to the River Otter in Devon and translocation of wild wart-biters (bush crickets) to establish a new population. We also describe how our partnership with the Zoological Society of London provides us with a risk-based approach to counter disease threats when planning and undertaking species reintroductions. Two further articles then outline research conducted to improve the delivery of agri-environment schemes, one of the most important mechanisms for conservation management across the country, for birds and for moths.

Our practical solutions extend to places in both urban and rural areas. We describe how our geological sites are being used as reference points for international research; how our research and trials of new green infrastructure design at Barking Riverside in East London show how

Turtle dove

we can build nature into new housing developments; how our advice and evaluation of evidence have been central to the implementation of designations such as Marine Conservation Zones and the extension of the Lake District and Yorkshire Dales National Parks. We summarise the spatial evidence we collated that played a vital role in the flagship project opening up the new National Trail around England's coastline. We also describe how evidence we have collected has improved our understanding of the effects of offshore wind turbine pilings on porpoises, which will enable us to help future developments minimise impacts on marine mammals.

Reintroducing the dormouse to its former range

by Kate Morris

This year saw the 25th release of dormice into the countryside to help expand its populations and geographic range after a serious decline over the last century.

Hazel dormice were once widespread throughout much of England and Wales, but over the past 100 years their range and population has contracted significantly due to the loss and fragmentation of woodlands and hedgerows; diminishing traditional management practices; and climatic factors. The species is now restricted in range and vulnerable to extinction.

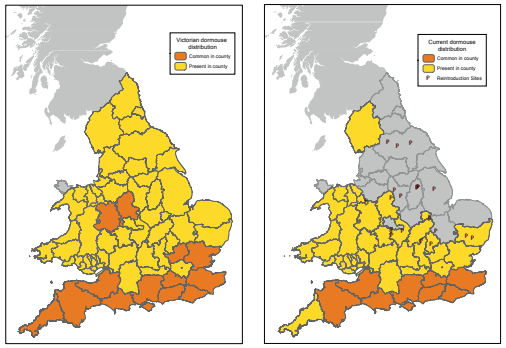
The dormouse reintroduction programme, part of the Species Recovery Programme, was initiated in order to restore dormice to areas of England from which they had been lost and where natural re-colonisation was unlikely. The first re-introduction took place in 1993 and since then more than 750 dormice have been released at 19 different sites across 12 counties (Figure 1). These reintroductions are coordinated by the People's Trust for Endangered Species (PTES) and supported by Natural England both financially and through chairing the UK steering group and providing expert advice.

2015 marked the 25th release of dormice into the English countryside. Twenty breeding pairs of dormice were released at a woodland site in Nottinghamshire, close to locations where dormice had been released in 2013 and 2014. This cluster of reintroduction sites was created in an attempt to produce a more resilient metapopulation and PTES worked closely with Nottinghamshire Wildlife Trust to achieve this.

Dormouse

There are plans to improve woodland and hedgerows between the Nottinghamshire reintroduction sites, so that once the separate populations become established they will have the opportunity to disperse and merge. It is hoped that this approach will improve the long-term survival of the species in this county.

Figure 1: The range of the hazel dormouse in 1885 compared with the range in 2013. The dormouse is now considered to be extinct in at least seven counties where it occurred in the past century. Red dots indicate reintroductions up to 2013.



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Dormice released as part of the reintroduction programme are bred in captivity. Prior to release, they undergo thorough health screening with vets at the Institute of Zoology (Zoological Society of London) and Paignton Zoo to ensure they are healthy and have the best chance of survival. This health screening, and any post-release health surveillance, is financially supported by Natural England (see Managing the disease risk of moving wild animals article later in this section).

The dormice at release sites are monitored by enthusiastic groups of local volunteers. The information collected contributes to the National Dormouse Monitoring Programme, which helps us to keep track of the overall status of the species and informs decisions about dormouse conservation at a national scale.

This collaboration between Natural England, partner organisations and volunteers is increasing our knowledge of this enigmatic and endearing species and is making an important contribution towards its long-term conservation and recovery. More detail about the reintroductions and what has been achieved through the programme can be found in a recent report by Paul Chanin[1].

The return of beavers to the River Otter

by Elaine Gill

The high-profile study of beavers in a river in Devon, started in 2015, provides an important test case for the reintroduction of an ecologically-important species and a fascinating opportunity to study how it affects the environment.

The Eurasian beaver

Often described as an 'ecological engineer' (an organism that alters the abiotic environment, creating and maintaining habitat for itself and other species[2]), beavers can have a significant impact on their local environment through digging burrows and channels, felling trees and creating dams. In just a few years they can transform a small stream into a flourishing wetland comprising ribbon channels and pools. This moderates peaks and troughs of water flow and provides habitat for a greater diversity of plants, invertebrates, fish, amphibians and birds[3, 4, 5].

Beavers became extinct in Britain between the 1600s and 1700s as a result of hunting. In recent years, the possibility of reintroducing beavers into the wild in England has been extensively discussed, both on the basis of restoring lost biodiversity and for the ecological benefits that beavers can bring to river and wetland management. In addition, the European Habitats Directive requires Member States to consider the reintroduction of extinct native species. A feasibility study commissioned by Natural England[6] concluded that it would be possible to reintroduce beavers into England and that this could assist with river and floodplain restoration.

The River Otter

On the River Otter in East Devon there had been incidental reports of beavers of unknown origin since 2007, including a dead male beaver found in 2012. Then in February 2014, a BBC film crew captured footage of beavers with kits. This was believed to be the first time that breeding had been confirmed in free-living beavers in England since their extinction. The beaver family received extensive national media attention and, with few exceptions, was very much welcomed by local residents.

There were some concerns about the tapeworm *Echinococcus multilocularis (Em)* being present in the River Otter beavers, so the Animal and Plant Health Agency (APHA), on behalf of Defra, obtained a licence from Natural England to trap the beavers and permanently remove them from the river into captivity. But faced with strong public opposition and local and national campaigns to 'save the River Otter beavers', all attempts to monitor and trap the beavers by APHA had to stop. In response, Devon Wildlife Trust (DWT), in collaboration with beaver biologists, veterinarians and river and hydrology specialists, developed a proposal to re-release the beavers into the River Otter, following health checks, as part of a trial reintroduction. The trial, which would run for five years, would involve monitoring of the beavers and their impacts on the river, adjacent areas, land use and the local economy, and developing appropriate management processes.

The application for this reintroduction was considered by Natural England wildlife specialists in line with appropriate international guidelines[7]. Following consultation with local and national interested parties, including two public meetings hosted by Natural England, in early 2015 Natural England licenced DWT to release up to 10 beavers within the River Otter catchment. The licence was subject to all beavers being Eurasian (as opposed to North American), healthy and fit for release, together with confirmation of support from landowners at the release sites and within the catchment. A clear exit strategy was also required that could be triggered if the presence of beavers on the River Otter became unsustainable. The licensing decision was widely reported in the national media and generally well-received.

The licensed trial

It was believed that there were four adults with five 1-2 year old kits. Traps were set in February 2015 and all four adults and one female kit were trapped and taken to nearby holding facilities. The remaining young beavers were left in the river on welfare grounds and because they could not be infected with Em (the parasite cannot be passed between mothers and offspring). Beaver biologists and veterinarians from the Royal Zoological Society of Scotland, who are advisers to the DWT project, checked the beavers thoroughly for injury and diseases, and also did genetic analysis to identify where they originated from.

A beaver being released into the river Otter as part of the trial reintroduction

All captured beavers were micro-chipped and fitted with coloured ear-tags; individual scarring of the tail was also documented as a further aid to identification. The young beavers that were not caught in 2015 will be trapped on the river bank in 2016 and micro-chipped and tagged.

All beavers were confirmed to be Eurasian and in good body condition with no physical abnormalities or obvious health or welfare concerns. Both females were pregnant. All individuals tested negative for *Em* and other diseases.

As soon as all the test results had been received, the beavers were re-released into the river at the location where they had been caught. Both the physical examination of the beavers and their release were filmed by the BBC and screened in June 2015 as part of 'Springwatch'.

Following the release of the beavers, their impacts and movements (as far as is possible) have been closely monitored. Beavers have been reported moving up and down the Otter catchment, and three kits were born to one of the females in summer 2015.

The future of the River Otter beavers

Detailed genetic analysis has revealed that the trapped individuals (and consequently their offspring) are very closely related. This situation needs to be addressed as soon as possible to avoid problems caused by inbreeding and Natural England has given permission to introduce up to five unrelated beavers in 2016. These unrelated individuals (likely to be sub-adults) will be released at suitable locations in the river Otter catchment in late spring/early summer, subject to health screening and landowners' consent.

To date, the impact of the beavers on the river and adjacent areas has been quite subtle, with occasional damage to trees or other structures. At the end of January 2016 the first dam was reported in a ditch; this was removed within a few days by the landowner.

Natural England will continue to work closely with DWT throughout the project through regular meetings, annual reporting and direct involvement with steering groups and landowners. DWT is intending to produce recommendations on the longer term management of free-living beavers in early 2019. This timing, a year in advance of the trial conclusion, will allow time for Natural England to consider the outcomes of the trial and arrangements to be made for either permanently managing beavers in the wider environment or, should this not be sustainable, for their removal from the river. In the meantime it is hoped that the project will generate sufficient opportunities to demonstrate how beavers and people can exist in close proximity in an English landscape.

The first translocation of the wart-biter in England

by Jon Curson

The wart-biter, a large bush-cricket, is one of our rarest invertebrates. Only a few small populations remain, all on calcareous grassland in southern England. In 2015 the first attempt was made at translocating wild wart-biters to establish a new population.

The wart-biter is one of our rarest invertebrates and has been declining seriously for many decades. It is on the edge of its climatic range in England, and is now confined to a small number of sites on calcareous grassland in southern England. It requires a warm microclimate (favouring south-facing slopes on all sites) and a very intricate structural mosaic of dense tussocks of grass, short turf and bare ground (Figure 2) Conservation of this species requires very careful and precise habitat management, with winter grazing by cattle or Exmoor ponies being a very important element. Wart-biter numbers fluctuate markedly at all sites, often on a bi-annual basis with alternate 'good' and 'poor' years.

Figure 2: Typical wart-biter habitat at Mt Caburn in Sussex: bare ground, short turf and tussocky grass clumps occurring in close proximity.

A male wart-biter of the common green form

The reasons for this are not known in detail, but are probably related to the species' life cycle, with eggs remaining in the ground for one (or more often two) winters before hatching in early spring. This can result in very low numbers on many of the sites in 'poor' years.

There are only five populations of wart-biters in England: three in East Sussex, one in Wiltshire and one in Kent. At the strongest site population numbers are estimated to be in the thousands in good years. Three of the other populations are much smaller, at most in the low hundreds in good years. The fifth site has become overgrown and the intricate structure that wart-biters need has been lost. Grazing has been re-instated, but a survey in 2013 found only a single adult and systematic searches in 2014 and 2015 failed to find any.

With the prospect of this colony being lost, Oliver Cheesman (the acknowledged expert on this species), Buglife and Natural England decided that another colony was needed in order to safeguard the species' future in England.

A captive breeding programme was not feasible because of limited time and money, so we decided that a translocation should be attempted using Castle Hill NNR in East Sussex as the donor site. We identified a nearby area of calcareous grassland – Deep Dene – as a suitable site for the new population. The landowner, South-East Water, was very receptive to the idea and willing to work with the tenant farmer to change the grazing regime to produce good habitat for wart-biters.

The timing of this trial translocation was important. Our intention was to move mostly pregnant females, in the hope that they would lay at least some eggs on the receptor site at Deep Dene. We also wanted to move a few males in case any of the females we caught hadn't mated. Adult wart-biters usually appear from late June and mate soon afterwards, with a peak in adult numbers usually from late July through to mid-August, depending on the weather. For that reason, mid-August was identified as the optimum time, though this ended up being delayed slightly by wet weather.

Wart-biters are elusive creatures (especially the females) but can be found by careful searching of grass tussocks. They are omnivorous but can be quite aggressive towards each other (and towards humans who handle them!) so we used old plastic containers to catch them and keep them separate from each other for the few hours it took to move them to the new site.

This simple approach proved effective: 73 individuals were caught at Castle Hill in August and the beginning of September 2015, and released in groups of two or three on south-facing slopes at Deep Dene. The majority of the individuals that were caught and moved were female. Among the translocated wart-biters there were a few of the rare 'yellow and purple' form which had not been seen for many years (Figure 3). As well as being exciting to find, this might increase the genetic diversity at Deep Dene.

Figure 3: A female wart-biter of the rare purple and yellow form.

To ensure the success of this project, we carried out a second translocation in the summer of 2016. It was a 'poor year' at Castle Hill and numbers were lower than in 2015, but we managed to move a further 21 females and 27 males to Deep Dene. Ideally we would like to carry out further translocations in 2017 and 2018 to help ensure a viable population is established. We will monitor the new population closely and hope that it will become successfully established and make an important contribution towards securing the future of this rare insect in England.

Saving the freshwater pearl mussel

by Gavin Measures

The freshwater pearl mussel is threatened not just in England but across Europe. Natural England and its partners have developed a detailed conservation plan for the species, based on an ambitious captive breeding programme that is producing valuable new information about the species' ecology.

The freshwater pearl mussel lives in cold fast flowing rivers and streams. It is considered one of most threatened widespread freshwater mussel species in Europe, where it has suffered severe declines in the 20th century and is currently listed as 'critically endangered' [8,9]. The decline in England and Wales has been especially marked [10]. In England, mussels are now found in a handful of rivers in the north, with outliers in Shropshire and Devon. All populations in England (except one in Cumbria) are in poor condition due to low abundance of mussels and inadequate recruitment of juvenile mussels to the population [10].

The life cycle of the freshwater pearl mussel is complex, involving an obligate parasitic stage on a salmonid fish host. Due to the essential role young fish play in the life cycle of the mussel, the conservation of the fish host populations is central to the survival of the freshwater pearl mussel.

Adult mussels in the River Ehen

Freshwater pearl mussel 'ark' and captive breeding programme

In 2007, Natural England, the Environment Agency and the Freshwater Biological Association established, in Cumbria, a national holding facility and captive breeding programme for the conservation of threatened freshwater pearl mussel populations in England. The initial phase of the captive breeding programme investigated the important question of which fish host species the mussels prefer and showed that each mussel population has one (in some cases two) specific preferred host (e.g. salmon or trout).

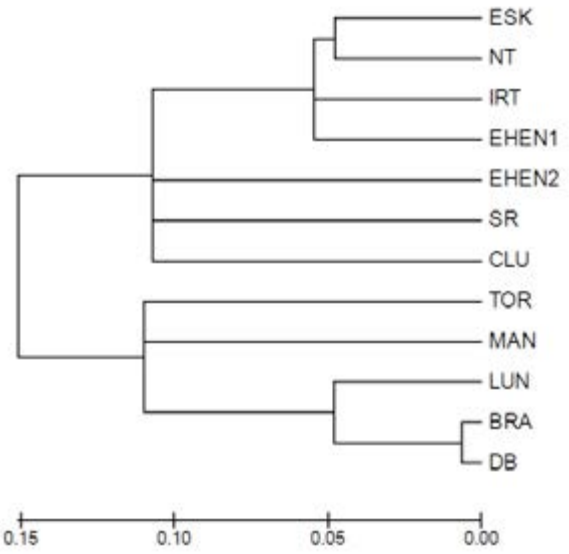
Holding trays for juvenile mussels at FBA facility. Each tray holds separate populations from each year

The project is now in its ninth year and there are currently populations of mussels from seven English rivers held at the facility. Each year, captive breeding activities have been carried out for these populations, with the juvenile mussels kept in special holding trays.

Juvenile mussels from a single cohort (the Irt population 2008), showing the variation in growth

The hatchery facilities have also enabled ongoing research into the ecology of juvenile mussels and improving culture techniques. This has produced valuable information about productivity across populations; about growth rates within yearly cohorts of mussels; timing of glochidia release (mussel larvae); stages of development and mortality of juveniles over time; and about how juveniles attach to a solid surface using a byssus thread.

In parallel, a study on genetic diversity of pearl mussel populations across Britain [11] has shown that mussels within most rivers appear to form a single breeding population, separate from those in other rivers. It also indicated that mussel populations in Britain show a major evolutionary split into distinct northern and southern phylogenetic groups (Figure 4), which has implications for conservation management of this species.



Northern group:
ESK – River Esk (north Yorkshire)
NT – North Tyne (Northumberland)
IRT – River Irt (west Cumbria)
Ehen 1 – River Ehen (west Cumbria)
Ehen 2 – River Ehen (west Cumbria)
SR – Control (Germany)
CLU – River Clun (Shropshire)

Southern group:
TOR – River Torridge (Devon)
MAN – Control (Spain)
LUN – River Lune (Lancashire)
BRA – River Brathay (south Cumbria)
DB – Dubbs Beck (south Cumbria)
ancestor)

Figure 4: Dendrogram showing the genetic relationships between English populations, with distinct northern and southern phylogenetic groups (i.e. groups containing all the descendants of a common ancestor).

Conservation management

Based on scientific evidence that has been gathered through the project, a conservation plan for freshwater pearl mussels in England and Wales produced in 2010[10], practical action is getting under way to help the species recover.

Local partnerships have identified a number of catchments across England that have the potential to provide 'recovery sites' for the freshwater pearl mussel. In these catchments a range of conservation management actions are underway to restore natural riverine conditions and address the issues known to be causing the decline in mussel populations and their fish hosts (for example water pollution, and removal or alteration of habitat through development, drainage systems, flow regulation and fisheries management).

In addition to conserving existing populations, juvenile mussels and fish encysted with glochidia (mussel larvae) will be released, with a view to establishing and enhancing existing populations and establishing new ones. We intend to reintroduce captive-bred mussels in three catchments across England (Irt, Ehen, Brathay) over the next three years. Further reintroductions are planned once these initial trials are completed.

Ongoing work will also be carried out through the rest of the catchments to improve water quality and habitat conditions and will include liaison with landowners to implement land management regimes for the benefit of this species and its fish hosts (e.g. through uptake of agri-environment schemes, the planting of riparian woodlands and floodplain/wetland restoration and creation). This approach relies on changes to land management practices, both locally and at a catchment scale.

Managing the disease risks of moving wild animals

by Katherine Walsh

In 2015 Natural England and the Zoological Society of London celebrated 25 years of working together to manage the risks associated with translocating wild animals.

In recent decades, translocations (movement of species from one place to another) and reintroductions of wild plants and animals for conservation purposes have increased greatly across the world[7]. As the earlier articles in this section show, they can make an important contribution to addressing collapsing populations and local species extinction. As part of the Species Recovery Programme, Natural England works with a variety of organisations to reintroduce species to areas where they had once been common. A wide range of species have been reintroduced.

Translocations can alter host-parasite interactions in the destination site and consequently increase the risk of disease outbreaks. To manage this risk, Natural England works closely with the Institute of Zoology (IoZ) at the Zoological Society of London (ZSL).

The IoZ provides Natural England and its partners with four broad disease risk analysis strategies to counter disease threats when undertaking species reintroduction work:

- Assessment of the risk from disease prior to translocation
- Alerting managers to serious disease threats

- Recommendation of mitigation measures
- Developing plans for post-release health monitoring.

To celebrate the 25 years of partnership between Natural England and ZSL, a major international **symposium** was held in May 2015.

Pool frog

The talks and discussions at the event underlined the need for good scientific evidence to guide species translocations.

Conserving farmland birds through agri-environment schemes

by Phil Grice

Agri-environment schemes are the major mechanism through which the wildlife inhabiting England's farmed landscapes can be conserved. Recent analysis of results from a major programme of research commissioned by Defra and Natural England has highlighted the benefits these schemes can have, and how they can be improved.

Bird populations associated with lowland farmland have fallen dramatically in recent decades[12]. Detailed research has shown that the major cause of these declines is intensification of agriculture[13].

This has affected farmland birds in three main ways: through the loss of nesting habitat, the loss of food (especially invertebrates) for chicks, and the loss of food (especially seeds) for adult birds.

The research identified the specific resources needed by the declining farmland bird species. A set of practical management measures was developed and subsequently incorporated into agri-environment schemes, particularly Environmental Stewardship (ES), introduced in 2005[14]. A programme to monitor the response of farmland birds to ES was developed by Natural England, working closely with partners.

This article highlights the results of three recent studies carried out within the programme looking at the responses of farmland birds to ES at different scales, and discusses how these results have influenced the design of the new agri-environment scheme, Countryside Stewardship.

Response of seed-eating farmland birds to supplementary feeding

Most declining farmland birds are predominantly seed-eaters for most of the year, and their declines were strongly linked to reduced rates of overwinter survival caused by the loss of seed resources during the non-breeding season [15]. Subsequent studies of agri-environment scheme options designed to deliver seed food, such as wild bird mix [16], found that there was a major gap in seed provision in late winter/early spring.

There was also some evidence suggesting that the provision of supplementary seed food could increase the body condition, survival rates and breeding densities of seed-eating birds [17, 18]. As a result, a 'supplementary feeding in winter for farmland birds' option was introduced into both levels of ES in winter 2011/12, supporting direct feeding of birds in late winter using a specific, dedicated seed mix.

Natural England commissioned the British Trust for Ornithology (BTO) to survey a selection of relevant farms to see how effective the option was. Bird surveys were undertaken in 2014 on each farm to count birds on fed patches and in surrounding areas. All but one of the declining seed-eating species showed significant use of the fed patches. On occasions, large flocks of birds were recorded on fed patches [19].

The survey also found that, although seed delivery was highly variable between agreement holders, supplementary feeding could contribute a significant additional seed resource.

Corn bunting

Response of farmland birds to agri-environment schemes at the farm scale

The decisive test of delivery for birds by agri-environment schemes is being able to confirm whether over time (as agreement options mature to deliver valuable resources, such as food and nest sites) population trends are more favourable on sites with targeted agri-environment agreements compared to those with no or basic agreements.

In 2014, birds on 68 farms in the Higher Level Scheme (HLS) of ES undertaking 'bird-friendly' options were surveyed. The results were compared with previous surveys on the same farms done in 2008 (at the start of the management agreements) and in 2011, and the wider farmed countryside (as measured on 291 BTO/JNCC/RSPB Breeding Bird Survey (BBS) squares lacking bird-friendly AES options) to provide a control.

The farms were spread across three regions: arable-dominated eastern England, the grassland-dominated west midlands and an area of mixed farming centred around Oxfordshire. A comparison of the two earlier surveys had suggested that standard AE management, without substantial ongoing advisory support, could increase or maintain the densities of several widespread, declining bird species[20]. But would the positive response be maintained?

Six of the 15 species (bullfinch, dunnock, house sparrow, reed bunting, starling and tree sparrow) exhibited 'sustained' positive responses to HLS management in at least one region over the entire study period (Figure 5).

Figure 5: Two examples of a 'sustained' response to HLS management (i.e. where a positive effect of HLS was maintained over the whole period from 2008 to 2014). The first graph shows results for reed bunting; the second results for the Farmland Bird Index assemblage as a whole. The left hand axis and open bars indicate mean predicted densities (± SE) on HLS farms (birds / sq km); the right hand axis and black dots indicate mean predicted counts (± SE) on BBS squares (birds / square). The letters in brackets indicate the study regions: East Anglia (EA), Oxfordshire (OX) and West Midlands (WM).

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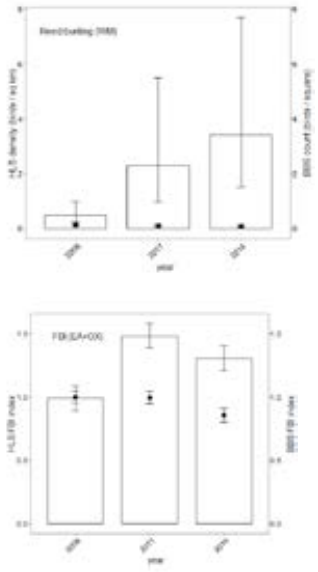


The average response of the 19 FBI species to HLS management was also positive and sustained in all three regions. Seven species (dunnock, corn bunting, grey partridge, linnet, skylark, whitethroat and yellowhammer) exhibited a 'temporary' positive response to HLS management in at least one region, characterised by a positive response during the period 2008-11 that was subsequently lost by 2014. These temporary responses are thought to result from two periods of highly unsuitable weather (the very wet summer of 2012 and the cold, dry spring of 2013) affecting both the birds and the delivery of key ES options[19].

These results demonstrate that higher-level agri-environment schemes have the potential to deliver farm-scale increases in breeding densities for some priority farmland birds. The increases in abundance recorded were large enough to suggest that the recovery of some farmland bird species with depleted populations is an achievable prospect provided that AE agreements are numerous enough to influence a sufficient proportion of the national populations of the target species.

Response of farmland birds to agri-environment schemes at the landscape scale

At its zenith, ES agreements (all schemes combined) were having an influence over around 70% of English farmland, yet there is little evidence of national-scale responses by widespread farmland birds. This is probably because only a small proportion of the farmed land within most ES agreements is in fact under active conservation management, so 'bird-friendly' management options might not be deployed at a sufficient scale to produce a widespread effect. However, it was thought possible that in landscapes where there had been a high uptake of certain key options, landscape-scale bird responses may be occurring. To investigate this, Natural England

commissioned BTO to analyse Breeding Bird Survey farmland data to assess whether there were significant effects of individual agri-environment option types (stubble management, field margins, etc.) on the population growth rates of farmland bird species that might plausibly benefit.

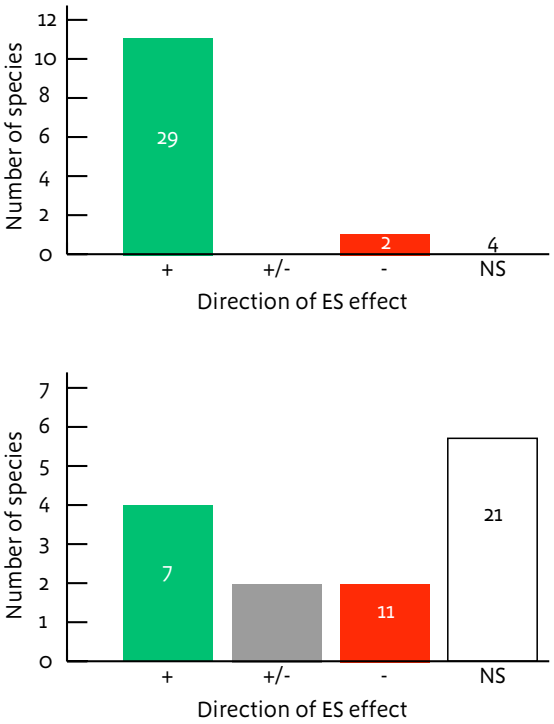


Figure 6: Numbers of species (bars) and individual tests (numbers in bars) that showed positive, negative, mixed and non-significant effects of ES on farmland bird population growth rates for (top) stubble management and (bottom) wild bird seed mix (WBSM) crops.

Positive ('+') refers to a statistically significant positive association between the population growth rate of a species and the option type; Negative ('-') refers to a statistically significant negative association between the population growth rate of a species and the option type; Mixed ('+/-') refers to species that showed different effects in different landscapes (i.e. arable, pastoral, mixed); Non-significant ('NS') refers to species that showed no significant effects across all landscapes for which tests were possible.

All but one species (skylark) benefited from stubbles in one or more landscapes, but the effects of WBSM were mixed.

Bullfinch

The research covered the period 2005-2013 (building on an earlier analysis for 2005-2010 [21]). It found that management of stubble in fields had a landscape-scale positive effect on almost all species tested (Figure 6), but patterns were less clear for other management options. In particular, there were very mixed effects of wild bird seed mix, including both positive and negative significant associations with population growth rates across species and landscapes, in contrast to findings from the first analysis, which had found predominantly positive effects. There were net positive associations between population growth rates and ES management for several individual species (such as yellowhammer, grey partridge, linnet, bullfinch, reed bunting and corn bunting). But there were negative or mixed results for others (such as skylark, lapwing, tree sparrow, stock dove and song thrush) [19].

Lapwings in flight

This analysis, combined with earlier results, provides good evidence that ES management – chiefly, but far from exclusively, over-winter stubble management – has contributed to an ongoing reversal or slowing of the population declines of several key species. However, some management has clearly failed to deliver the intended benefits for priority species.

Applying the findings

The studies described above showed that agri-environment schemes can help conserve farmland birds, but that they need to be more focused and targeted. The findings had a major influence on both the review of what ES had achieved and the design of the new agri-environment scheme, Countryside Stewardship (CS), launched in July 2015 to replace ES. In particular, they helped inform Natural England's work to design the new 'wild pollinator and farm wildlife packages', which aim to provide the essential resources needed by wild pollinators and farmland birds (such as pollen and nectar sources, insect and seed food for birds, and sites for nesting and sheltering) through bundles of management options suited to different farm types. The findings have also been used to improve both option prescriptions and guidance to land managers.

CS has the potential to build on the benefits to farmland birds delivered by ES, but uncertainties remain as to whether this potential will be realised. It is vital, therefore, that the new scheme is monitored carefully, so that its effectiveness can be properly assessed and to provide the necessary evidence upon which to base future changes to the scheme's design or operational delivery.

Optimising agri-environment schemes: what works for moths?

by Jamie Alison and Simon Duffield

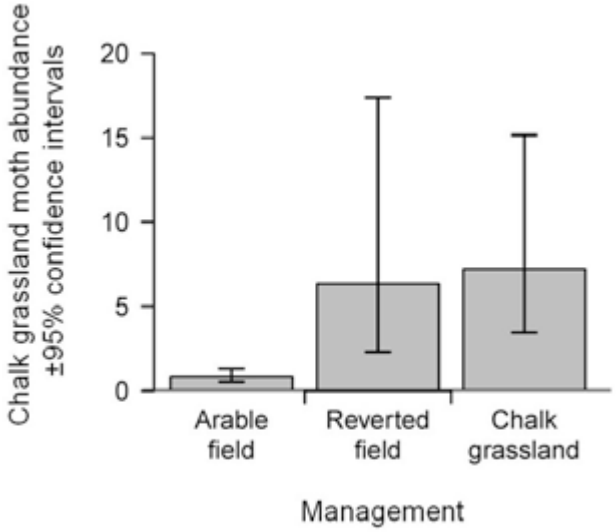
Moths are major nocturnal pollinators, and they have declined steeply over the last 30 years with the rise of intensive farming. Habitat creation on farmland through agri-environment schemes may help to reverse declines, but just how good are created habitats, and how can we optimise the benefits they provide to wildlife?

We investigated how agri-environment schemes might be optimised for moths in a PhD project co-supervised by the University of Liverpool and Natural England. Using two landscape-scale field studies in southern England, we investigated how the creation of (a) grass margins and (b) species-rich grasslands can be best used to increase the abundance and species richness of moths.

In 2014 we surveyed moths on arable fields with/without created grass margins at a range of distances from existing chalk grassland. We found that grass margins significantly increased the abundance of grassland generalist moths. For chalk grassland moths, we found that the benefits of grass margins were greatest when positioned close (<1km) to large areas (>10ha) of existing chalk grassland. We demonstrated that spatial targeting could improve agri-environment scheme outcomes for target insect groups [22].

In 2015 we looked at habitat creation at larger scales, through arable reversion to species-rich grassland. This time we collected data on the age of reverted grasslands and the frequency of chalk grassland indicator wildflowers. We found no difference in the abundance or species richness of chalk grassland moths between reverted grasslands and long standing chalk grassland (Figure 7). Furthermore, abundance of moths was high on reverted grasslands even after short time periods (<5yrs) or at fair distances from chalk grassland habitat (~5km). However, we found that an increased frequency of chalk grassland indicator wildflowers was associated with an increased abundance of chalk grassland moths.

Figure 7: The abundance of chalk grassland moths on arable fields, arable fields that have been reverted to grassland, and established chalk grassland



Putting the science into practice

Our results confirm the pivotal role that habitat created through agri-environment schemes can play in ecological networks for wildlife. In the case of moths, we believe that created habitats provide food-plants for caterpillars and nectar for adults. If insect species associated with semi-natural habitat are considered a priority, our results suggest that:

- Establishing grass margins near existing semi-natural habitats has the potential to improve conservation outcomes.
- Management to achieve target floral communities during arable reversion to species-rich grassland can help to increase the abundance of associated insects.

A ghost moth in a reverted grassland field at dawn.

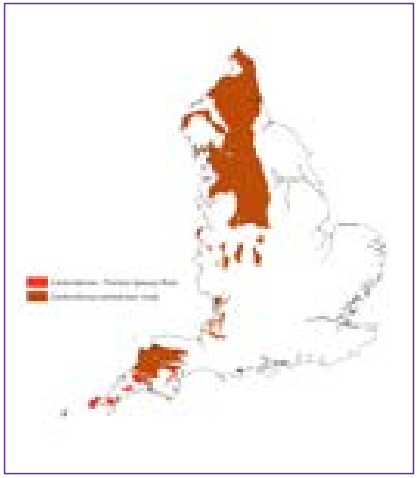
We also found evidence that shrubs and trees, which were absent on reverted grasslands, provide resources for a wider range of moth species on chalk grassland. Furthermore, the value of hedgerows in providing shelter for all kinds of moths on farmland was very clear.

Carboniferous revisited

by Jonathan Larwood

Natural England is keen to promote research and study which includes making better use of our network of NNRs and SSSIs. This article shows how we have used our geological SSSIs to help international scientists with their research.

The Carboniferous Period stretches from about 354 to 290 million years ago. An initially tropical marine environment was replaced gradually by extensive deltas fed from the north (a consequence of uplift and mountain building) and the emergence of terrestrial conditions.



Carboniferous England

CLICK MAP TO ENLARGE

Marine limestone deposited during the Lower Carboniferous now outcrops widely across England including such iconic areas as the Mendip Hills, Avon Gorge, Derbyshire Peak District and the Yorkshire and Northumberland Dales. Sandstones, such as Millstone Grit, and extensive Coal Measure deposits, reflect the change to terrestrial conditions and form areas such as the Derbyshire Dark Peak and the coalfields of northern England. Today a number of Carboniferous sites are notified for their geology as SSSIs, reflecting their national and international significance.

Blake Brook

Orchard Common

In October 2015 the Yorkshire Geological Society (YGS) organised a field visit for the International Union of Geological Sciences (IUGS). IUGS members were keen to visit rock exposures used as reference points when describing and comparing rocks of similar age around the world.

In advance of the visit, Natural England's Area Teams, working with national specialists, facilitated access to each of the SSSIs and provided consent for re-excavation of key geological sections, work which was undertaken by the YGS. Samples of the rock exposures, collected during the IUGS visit are now being used to re-investigate Carboniferous environmental change.

The work is set to continue and a repeat visit is anticipated as part of the Carboniferous-Permian stratigraphy international congress in 2019. In the meantime, Natural England is now working closely with the YGS who are helping monitor and maintain the sections visited in 2015, in readiness for the 2019 visit.

Designating new places for their natural beauty and opportunities for outdoor recreation: extending the Lake District and Yorkshire Dales National Parks

by David Vose and Susannah England

Natural England has a duty under the National Parks and Access to the Countryside Act 1949 to consider which areas meet the statutory criteria for designation as National Parks. The legislation establishes that Natural England can only designate land as National Park if it has sufficient natural beauty and opportunities for open-air recreation. It must also be satisfied that it is '*especially desirable*' that the special purposes of National Parks should apply.

On the 23rd October 2015 the Secretary of State for Food, Environment and Rural Affairs signed legal orders extending the boundaries of the Lake District and Yorkshire Dales National Parks representing the culmination of a very thorough evidence gathering, evaluation, stakeholder engagement and consultation exercise.

The project to extend the boundaries began in 2009, with a study to identify broad areas with designation potential using landscape character assessment techniques. Guidance was produced drawing on past designation experience and was circulated widely for consultation. The first step in the process defined 'evaluation areas' based on an assessment of landscape character. To do this we evaluated the different factors that influence whether people are likely to perceive these landscapes as having natural beauty and whether each evaluation area was capable of offering opportunities for open-air recreation.

These factors included:

- Landscape quality. The physical state or condition of the landscape.
- Relative wildness and tranquillity. The degree to which relatively wild or tranquil character can be perceived.
- Scenic quality. How the landscape appeals to our senses.
- Natural and cultural heritage features and cultural associations. The degree to which associations with particular people such as artists and writers or events in history contribute to people's perception of natural beauty.
- Opportunities for recreation that are compatible with the conservation and enhancement of the area's special qualities. These are generally quiet outdoor recreation pursuits such as walking, cycling, horse riding, fishing, canoeing, rock climbing and paragliding.

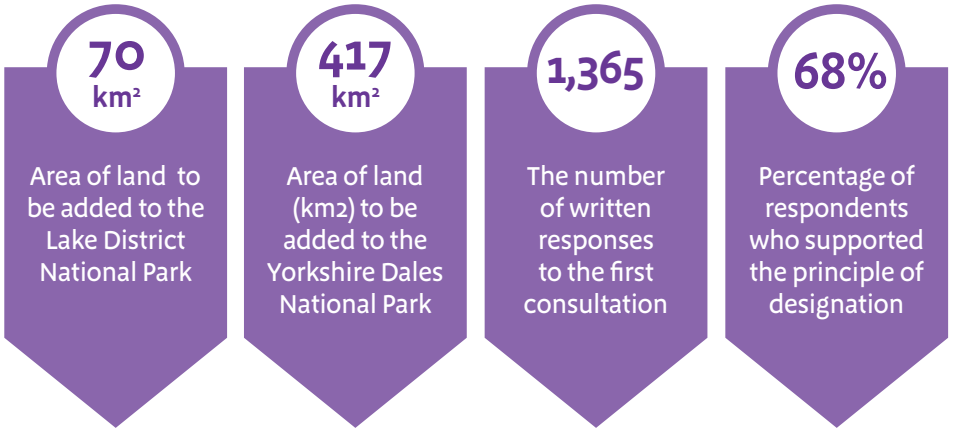
The Lune Gorge and Northern Howgill Fells from the A685 on Jeffrey's Mount

Signpost at Middle Busk on the Orton Fells, looking south towards the Howgill Fells

Areas scoring strongly against these criteria were identified as 'candidate areas'. For each of these, a further assessment was undertaken to see if it would be especially desirable for national park purposes to be applied to the area. Boundaries were drawn up for all areas considered suitable for designation and these were subjected to a comprehensive statutory and public consultation. Many groups and individuals were involved and **their responses** led to a number of amendments being made to our original boundary proposals, which were subject to a second statutory consultation.

The Secretary of State's subsequent decision to designate is an endorsement of our approach to the identification, analysis and evaluation of the evidence required to determine landscape designation proposals. The Orders came into effect on 1st August 2016.

The National Park extensions in numbers



Designating Marine Conservation Zones

by James Highfield, Ross Bullimore and Ian Saunders

Natural England delivered its advice to Defra on the second tranche of Marine Conservation Zones (MCZs) in 2015. Based on this advice, Defra announced 16 new inshore MCZs, bringing the total to 50. In this article we describe how Natural England was instrumental in Defra's decision-making by providing robust, evidence-based and transparent confidence assessments of the presence and extent of the marine habitats and species proposed for designation.

Development of Marine Conservation Zones

The 2009 Marine and Coastal Access Act introduced a new type of Marine Protected Area called Marine Conservation Zones (MCZ). MCZs protect a range of nationally important marine wildlife, habitats, geology and geomorphology, and can be designated anywhere in English and Welsh territorial and UK offshore waters.

As part of the MCZ designation project, the Joint Nature Conservation Committee (JNCC) and Natural England set up four regional stakeholder projects in 2011 which recommended a network of 127 possible sites. On receiving the advice, the scientists overseeing the proposals recommended that the evidence base for all the proposed sites should be scrutinised. They advised that an assessment of confidence should be conducted to aid government decisions regarding designations.

Tackling the problem – confidence assessments

Working together, Natural England and the JNCC developed a method to assess confidence in the presence and extent of features (e.g. species and habitats) in the proposed 127 sites.

The method, known as **Technical Protocol E**, asks between 9 and 19 questions, depending on the type of habitat or species being assessed, from each piece of data that support the presence and/or extent of the proposed marine habitats or species.
Data were submitted from the regional projects, stakeholders, Defra-funded monitoring surveys, and survey data from other agencies. To put the volume of data into perspective, in the 2015 advice covering 16 inshore sites, we assessed 34,993 data points and 71,269 data polygons from a total of 367 datasets. There were literally millions of questions asked of these data to deliver seemingly simple assessments of confidence, a score ranging from high to no confidence for both presence and extent of habitats and species.

Given the magnitude of the task, Natural England and **Marine Mapping Ltd** worked closely together in developing an automated geographic information system to analyse each of these evidence sources against the relevant questions, to deliver the confidence scores. The results of this automated analysis were rigorously checked by Natural England staff at both national and local levels to eliminate any computer based errors. This has ensured our advice to Defra has provided extremely high levels of accuracy, transparency and accountability for decision-making and safeguarded our scientific rigour in the face of challenging timelines.

Closing knowledge gaps

The results of confidence assessments, since 2012, have allowed us to focus our data collection on habitats and species where we have low confidence in their presence and extent within a given MCZ. This has been achieved through dedicated verification surveys with our partners at Defra, Environment Agency and the Centre for Environment, Fisheries and Aquaculture Science, as well as closer working with stakeholders such as the Wildlife Trusts and the Marine Conservation Society to provide **guidelines** on how best to collect and submit data for the MCZ confidence assessment process. In many cases, these datasets are of higher quality than those available prior to our 2012 advice.

Mount's Bay

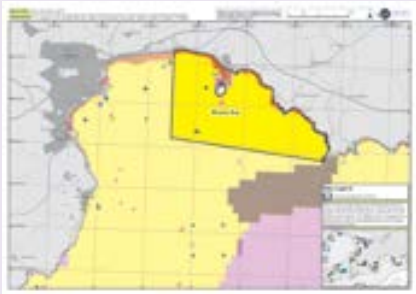
Mount's Bay proposed MCZ: working with partners to expand our evidence

Dedicated verification surveys of both the sub-tidal and inter-tidal habitats present within Mounts Bay in south west Cornwall have been conducted since the original regional project recommendations, enabling a more detailed habitat map to be produced. The improvement in both the quality and quantity of available data increased the confidence we have for both presence and extent for many of the features originally proposed. It has also identified previously unknown features. The improvements in the data gathered between 2011 and 2015 can be seen in the following series of maps.

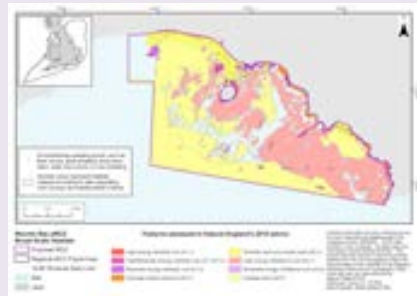
In 2011 we thought that sub-tidal sand covered almost the entire site, with some rock occurring around St Michael's Mount itself. The two maps produced in 2015 demonstrate the significant additions to our knowledge since 2011, reflecting the dedicated surveys and additional calls for data. It is maps and data like this that supported our 2015 advice for the second tranche of MCZs.

Increased evidence collection and collation by Natural England, our partners, and stakeholders has increased the number of records for certain species and habitats within the site. This has led to an extension of the site to encompass extensive seagrass beds where multiple observations of the three stalked jellyfish species proposed for designation within the site were found.

Habitat map for Mount's Bay produced by the Finding Sanctuary Regional Project in their **2011 recommendations**



Current understanding of broad-scale habitats in Mount's Bay



Current understanding of habitat 'features of conversation importance' in Mount's Bay

CLICK MAPS TO ENLARGE

Stalked jellyfish

From our analyses, we have been successful at improving both our understanding of seabed features around the UK and the spatial resolution of data available for accurately mapping these features. This will both improve the designation potential for more MCZs and lead to more effective protection of habitats and species within MCZs through appropriate management of damaging activities.

Assessing the impacts of development on marine mammals

by Rebecca Walker

Over the last five years, Natural England together with the other statutory nature conservation agencies has supported development of an innovative method of cumulatively assessing disturbance to marine mammals.

SMRU Consulting originally developed the Population Consequences of Disturbance (PCoD) model to evaluate the potential effects of wind farm construction and operational noise on marine mammal populations. Now, with funding and input from Natural England and the Joint Nature Conservation Committee (JNCC), the model has been further developed to help UK advisers and regulators make consenting decisions on whether current and planned levels of wind farm development in the English North Sea are likely to cause a significant decline in the harbour porpoise population.

Various data, including the sound level produced during pile driving (the main method of installing wind turbines), the number of animals that could be affected and a schedule for construction, are put into the model. The model then runs different scenarios of wind farm construction, with and without pile driving. The resulting difference in each set of scenarios provides the risk of harbour porpoise population decline due to wind farm construction.

Natural England is very supportive of offshore renewables and has formed an industry steering group to engage developers throughout the project to make sure offshore windfarm development continues whilst safeguarding populations of porpoises and other marine mammals.

A bee's eye view of sustainable living:
green infrastructure design at Barking Riverside

by Samantha Davenport

Designing ecosystem services into our urban environments, through green infrastructure, is important for both people and nature. The research at Barking Riverside contributes significantly to our knowledge of how this can work in urban areas.

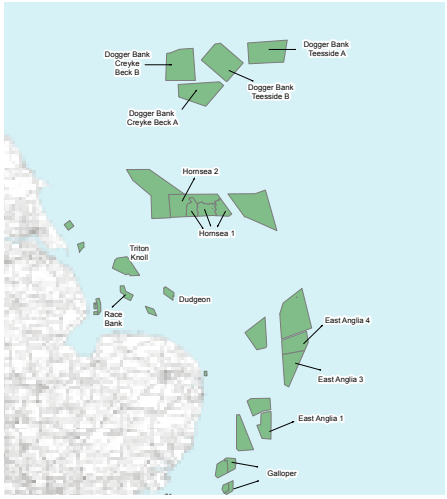
Harbour porpoise

At 180 hectares, Barking Riverside in East London is one of the largest brownfield redevelopment sites in the country. The site of a former power station, it is home to protected and notable species including rare and scarce invertebrates that are closely associated with the flower-rich early successional habitat mosaics often found on brownfield sites.

Natural England first became involved through its role as a statutory planning consultee. Our Area Team worked with the Development Corporation, Local Planning Authority and other partners to ensure that the existing nature conservation value and opportunities to use green infrastructure were considered throughout the planning process.

The resulting planning permission for 10,800 new homes set out a number of planning conditions to weave green infrastructure into the development and recognise the ecosystem services the site provides. These included conserving the site's valuable biodiversity; retaining 40% of the site as green space and developing a Sustainable Urban Drainage Systems plan.

Natural England continues to push the development of innovative modelling techniques that aid in the assessment of cumulative effects of noise in European waters, including that from offshore construction but also with the potential to incorporate other sources of noise such as seismic surveys.



CLICK MAP TO ENLARGE

English North Sea wind farms assessed within the project

This aspiration for Barking Riverside to become a benchmark for sustainable design and living raised questions about the best way to deliver the green infrastructure.

A Knowledge Transfer Partnership was established between Barking Riverside Ltd, the London Borough of Barking and Dagenham, the University of East London and Natural England to investigate these questions as part of an EU funded programme called TURAS (Transitioning to Urban Resilience and Sustainability). A PhD was established in 2012, which Natural England contributed to via our Evidence Programme funding.

Wetland habitats created on green roofs in 2015

The research tested how municipal areas within a development can be designed to deliver truly multi-functional green infrastructure, including the development and assessment of a new, ecologically led approach to green roof design. The new roofs incorporated ephemeral wetland habitats, typical of high quality brownfield habitats, a niche missing in the existing green roof designs that are often used to compensate for the loss of biodiverse brownfield habitats. The work also trialled a range of terrestrial landscaping options designed to incorporate ecological niches required by the species at Barking. Monitoring of these areas showed they were quickly colonised by notable invertebrate species such as the shrill carder bee, and produced new records for the site. Species diversity was found to be much greater on the ecologically designed areas than the traditional landscaping control areas.

Already the results from the work are influencing the detailed design stages of the development. Natural England has been able to use the outputs to provide evidence based advice to developers and Local Planning Authorities, in our statutory planning role, both at Barking and for sites in the surrounding area with similar issues and biodiversity. The Knowledge Transfer Partnership will continue to promote and share this knowledge, seeking to inspire other places to adopt and benefit from biodiverse green infrastructure.

The long and winding path:
evidence behind the creation of the England Coast Path

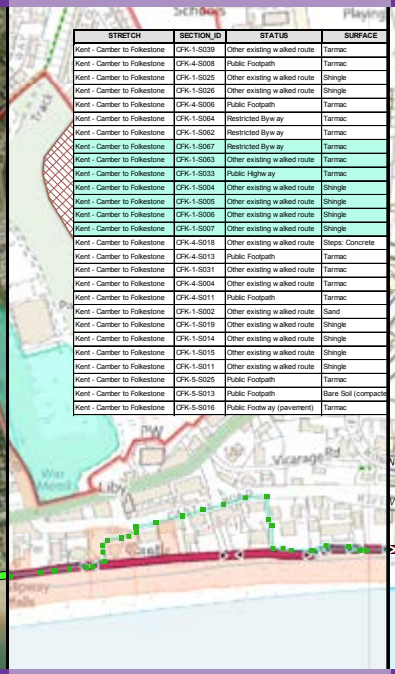
by Chris Burstow

The Long and Winding Path - five steps to map the new National Trail around England's coastline

Natural England's Evidence GI team plays a vital role in delivering the new England Coast Path - here's how...

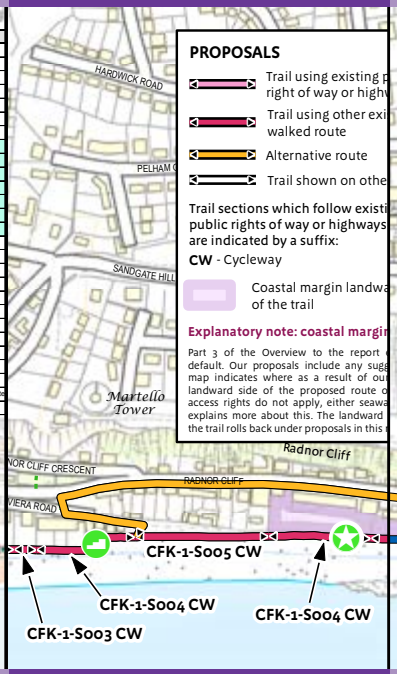
The England Coast Path will provide people with the right of access around all our open coast for the first time.

As well as the trail, the access rights will include additional land, where appropriate, such as beaches and foreshore as part of a wider 'coastal margin'.

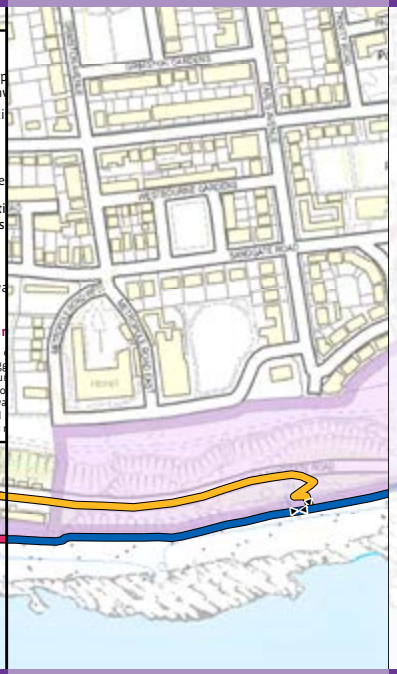


STRETCH	SECTION_ID	STATUS	SURFACE
Kent - Camber to Folkestone	CFK-1-S039	Other existing walked route	Tarmac
Kent - Camber to Folkestone	CFK-4-S008	Public Footpath	Tarmac
Kent - Camber to Folkestone	CFK-1-S025	Other existing walked route	Shingle
Kent - Camber to Folkestone	CFK-1-S026	Other existing walked route	Shingle
Kent - Camber to Folkestone	CFK-4-S006	Public Footpath	Tarmac
Kent - Camber to Folkestone	CFK-1-S064	Restricted Byw ay	Tarmac
Kent - Camber to Folkestone	CFK-1-S062	Restricted Byw ay	Tarmac
Kent - Camber to Folkestone	CFK-1-S067	Restricted Byw ay	Tarmac
Kent - Camber to Folkestone	CFK-1-S063	Other existing walked route	Tarmac
Kent - Camber to Folkestone	CFK-1-S033	Public Highw ay	Tarmac
Kent - Camber to Folkestone	CFK-1-S004	Other existing walked route	Shingle
Kent - Camber to Folkestone	CFK-1-S005	Other existing walked route	Shingle
Kent - Camber to Folkestone	CFK-1-S006	Other existing walked route	Shingle
Kent - Camber to Folkestone	CFK-1-S007	Other existing walked route	Shingle
Kent - Camber to Folkestone	CFK-4-S018	Other existing walked route	Steps: Concrete
Kent - Camber to Folkestone	CFK-4-S013	Public Footpath	Tarmac
Kent - Camber to Folkestone	CFK-1-S031	Other existing walked route	Tarmac
Kent - Camber to Folkestone	CFK-4-S004	Other existing walked route	Tarmac
Kent - Camber to Folkestone	CFK-4-S011	Public Footpath	Tarmac
Kent - Camber to Folkestone	CFK-1-S002	Other existing walked route	Sand
Kent - Camber to Folkestone	CFK-1-S019	Other existing walked route	Shingle
Kent - Camber to Folkestone	CFK-1-S014	Other existing walked route	Shingle
Kent - Camber to Folkestone	CFK-1-S015	Other existing walked route	Shingle
Kent - Camber to Folkestone	CFK-1-S011	Other existing walked route	Shingle
Kent - Camber to Folkestone	CFK-5-S025	Public Footpath	Tarmac
Kent - Camber to Folkestone	CFK-5-S013	Public Footpath	Bare Soil (compacte
Kent - Camber to Folkestone	CFK-5-S016	Public Footw ay (pavement)	Tarmac

Natural England has a duty to engage with landowners and interested parties throughout the process. Reports detailing our proposals are produced for Secretary of State (SoS) approval.



The England Coast Path will deliver a wide range of benefits such as improving people's health and wellbeing and boosting national and local tourism.



We aim to have the path complete by 2020. It will be one of the longest coastal trails in the world at around 4,300km. As of November 2016:

506 km
open to the public

67 km
approved and being installed

2201 km
in development

1595 km
remaining

Stage 1 - Prepare

We prepare the GIS data and tools for use by the Area based delivery staff:

52,420 Land Registry ownership titles processed so far

25 New GPS devices set up for on site data capture

Stage 2 - Develop

We process and quality assue the GPS site visit data. To date we have aligned:

4,194 Trail sections

48,013 Hectares of Coastal Margin

Stage 3 - Propose

We produce all the maps in the reports to the SoS. So far we have created:

514 Maps

and worked with the Web Team to publish these on

Gov.uk

Stage 4 - Determine

We make any amendments required by the SoS to produce the approved route data and maps.

This data is published under the

Open Government Licence

so that it can be used freely, even for commercial purposes.

Stage 5 - Open

The data is published on:

NE Data Download Site
magic.defra.gov.uk
nationaltrail.co.uk

We worked closely with

Ordnance Survey

to define how the new rights will be shown in their products