



The Wildlife of Bedfordshire, Cambridgeshire and Northamptonshire

Towards a wilder future for the habitats, species and conservation in our region



The Wildlife Trust for Bedfordshire, Cambridgeshire and Northamptonshire

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Front page: Common blue butterfly *Polyommatus icarus* by Matthew Hazleton. This image was featured in the 2020 Wildlife Trust for Bedfordshire, Cambridgeshire and Northamptonshire photographic competition.

This page: Broad-bodied chaser *Libellula depressa* © Ryan Clark

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Introduction

Our area is undoubtedly a special place for wildlife. At The Wildlife Trust for Bedfordshire, Cambridgeshire and Northamptonshire we are very proud to be a local charity that can make a local difference to wildlife across the three counties. The challenge to deliver this should not be underestimated as we are in the middle of a global ecological and climate crisis. By working together, we can make a difference to wildlife in our area and provide support to others to do the same.

Our area played a significant part in the formation of the nature reserve network that we see today. Our reserves also support internationally important populations of species, attracting visitors from all over the UK. The three counties support a large diversity of species, some of which are found nowhere else in the world. By protecting sites in this area we look after a wealth of species and consider all of their needs in our practical management work.

Climate change will have unforeseen effects on our wildlife and we need to be forward-thinking, adaptable and science-led to help mitigate those effects. Research on our reserves is helping look at how we can ensure they remain habitable for species in the future. Nature reserves alone are no longer enough, we need a complete nature recovery network. We play a leading role in nature recovery and work with others to influence land management beyond our reserves.

We are science-led, carrying out monitoring and research to ensure that our reserve management is benefiting a wide range of species, no matter how small or underappreciated they may be. We share our findings with others to establish best practice. The three Local Environmental Records Centres are hosted by the Trust and hold over 5 million records of where species and habitats are found. This information is crucial for making evidence-based decisions.

This publication is a celebration of local conservation that works, paving the way for the nature recovery network needed for wildlife and people. The series of case studies in this publication act to provide a snapshot of just some of the many reasons why this area is special for wildlife and why we are passionate about protecting it.



Our Wilder Past

The gently rolling landscape of Bedfordshire, Cambridgeshire and Northamptonshire, sitting astride the major Roman roads of Watling Street and Ermine Street, has long been host to significant historic events. In 1464, at Grafton Regis, Elizabeth Woodville reputedly waited under an oak tree to waylay the new King Edward IV and secretly married him there on the 1st of May. Further down the Nene Valley in 1587, at Fotheringhay, Mary Queen of Scots was beheaded on the orders of Elizabeth I. Over in Cambridgeshire, Huntingdon will forever be known as the home of Oliver Cromwell, Lord protector of the British Isles from 1653 -58. All this high ranking activity was supported by a well-settled and farmed landscape and wilder elements were represented by extensive royal hunting forests such as those at Rockingham and Whittlewood in the north and west. To the east lay the wild windblown marshes and meres of the Cambridgeshire fens, bisected by the two major rivers, the Nene and the Great Ouse, as they meandered their way to the Wash.

Into this landscape in the 19th Century, there appeared the Rothschild family. Charles Rothschild, a skilled and enthusiastic naturalist, purchased one of the last remaining undrained sections of that wild fenland in 1910 and set about exploring and looking after what is now Woodwalton Fen National Nature Reserve. Charles Rothschild was a pioneer of nature conservation. In May 1912, he held a meeting to discuss his radical idea about preserving natural wildlife habitats. He aimed to organise "persons interested in the preservation of the natural fauna and flora of the United Kingdom." This meeting led to the formation of the Society for the Promotion of Nature Reserves (SPNR). In 1919, the Society acquired Woodwalton Fen as its first reserve and exactly 100 years later the freehold of that reserve was transferred to The Wildlife Trust for Bedfordshire, Cambridgeshire, and Northamptonshire.

From 1912 Charles Rothschild coordinated a national survey of wildlife sites 'worthy of preservation' in Britain and Ireland. What was new about this approach to preserving 'wild life' was that it focused on preserving the habitat rather than just the individual species within it. At a time when the majority of conservationists were focusing on individual species, Rothschild recognised that places needed protection too. By 1915, the SNPR had compiled a list of 284 sites 'worthy of preservation' - the Rothschild Reserves. Of these, 15 were in the Wildlife Trust BCN area and include such familiar names as Barton Hills, Harleston Heath, Devils Dyke and of course the famous fens of Chippenham, Holme and Wicken.

Two world wars and a major economic depression rather slowed the development of the SPNR and county-based conservation organisations but, with new legislation in the early 1950s and a growing realisation that important places were rapidly disappearing, influential figures began to push for action. Cambridgeshire was fortunate in being home to Cambridge University. Founded in 1209, Cambridge University is one of the oldest universities in the world and its scholars have long had a major influence on our understanding of natural history. It is perhaps not surprising that Cambridgeshire was the first county to form a new conservation organisation and in 1957 the Cambridge and Isle of Ely Naturalist's Trust (CAMBIENT) was born, just a year after Leicestershire and the sixth to be formed in the whole of the UK. Not to be outdone, Bedfordshire and Huntingdonshire Naturalist's Trust (BHNT) was founded in 1961 and Northamptonshire Naturalist's Trust in 1963.

During the 1960s and 1970s, all three Trusts were very active, run for the most part, entirely by volunteers. The founders and their committed successors secured sites like Felmersham nature reserve, campaigned for the cessation of grubbing up of woodland to secure the future of important places like Waresley and Gransden Woods, and bought land in the Ouse Washes whenever they could. They entered groundbreaking partnerships with what would eventually become Anglian Water at the new reservoir built at Grafham in 1965.

By the 1980s the number of County Trusts across the UK had grown to almost 50 and the growth in membership, and support from statutory bodies had enabled many Trusts to begin to recruit paid staff. None of our three trusts covered large areas and local populations from which to draw membership were not huge. In 1989 CAMBIENT and BHNT considered a move that had not been attempted by any other Trusts. They agreed to merge to make most efficient use of resources and form the new Bedfordshire and Cambridgeshire Wildlife Trust. Both had begun to work closely with Northamptonshire and in 1995 they joined the merged organisation. It took considerable courage for the trustees and members of all three Trusts to risk losing a little of their local identity and still very few small Trusts have followed this lead.

In the early days of the Trust, everything was done by volunteers. Now the organisation is much larger with a core professional staff, but volunteering remains a mainstay of the organisation. From voluntary wardens looking after over 100 nature reserves through to those tending livestock and managing habitats to the local groups who raise funds and spread information and those who lead walks and educational activities. The work of our trust has come a very long way since the idea of a society to promote nature reserves was formed, perhaps in the bungalow in the centre of Woodwalton Fen.

John Comont recently retired as Conservation Director for the Wildlife trust for Bedfordshire, Cambridgeshire and Northamptonshire. He spent 35 years working in nature conservation roles in the BCN area, 15 of those for the Wildlife Trust.

Find out more <u>wildlifebcn.org/our-history</u>



Nationally and Internationally Important Populations

Our area and the reserves we manage are home to nationally and internationally important populations of species that we ensure are protected through appropriate management and monitoring. We have a global responsibility to protect these species and their habitats and this is a key part of our work.



Introduction

The Nene Valley in Northamptonshire is home to a diverse array of special wildlife and is made up of a series of flooded gravel pits, wet grassland and woodland. The Nene Valley is an internationally important area for its overwintering bird populations. Within this area lies the Upper Nene Valley Gravel Pits Special Protection Area (SPA), which is specifically recognised for the importance to this group. The Wildlife Trust BCN manages around a quarter of the wetlands within the SPA, attracting thousands of overwintering birds every year.

The Nene Valley

The River Nene flows out of the hills of West Northamptonshire through a long valley that stretches the length of the county to Peterborough. The Nene and its numerous tributaries and wetlands form a connected landscape that provides a haven for a wonderful mix of wildlife. Throughout history, the Nene Valley has been shaped by people and nature. It has been of vital importance to the county's industry, including agriculture, the famous leather industry and gravel extraction. In many cases, these quarries now leave behind flooded gravel pits that are home to a wide variety of aquatic invertebrates and plants, alongside internationally important overwintering bird populations. In 2005, 1,370ha of Northamptonshire's Nene Valley was notified as a Site of Special Scientific Interest (SSSI). Much of the land was subsequently classified as a SPA and Ramsar site. The area comprises a chain of flooded sand and gravel pits, extending for approximately 35km along the alluvial deposits of the River Nene floodplain from Clifford Hill on the southern outskirts of Northampton, downstream to Thorpe Waterville north of Thrapston. (Anon, 2015).

Wintering birds in the Nene Valley

The Upper Nene Valley SPA was designated for several reasons. Firstly, it has internationally important wintering populations of golden plover Pluvialis apricaria and bittern Botaurus stellaris. These species are both on Annex I of the Wild Birds Directive, which lists birds that are particularly threatened. It also gualifies under Article 4.2 of the Directive as it is used regularly by over 20,000 waterbirds. These waterbirds include; wigeon Anas penelope, gadwall Anas strepera, mallard Anas platyrhynchos, shoveler Anas clypeata, pochard Aythya ferina, tufted duck Aythya fuligula, great crested grebe Podiceps cristatus, cormorant Phalacrocorax carbo, bittern Botaurus stellaris, golden plover Pluvialis apricaria, lapwing Vanellus vanellus and coot Fulica atra.





Wintering birds on BCN Wildlife Trust reserves

The Wildlife Trust manages 329ha of land within the SPA, this is around 25% of the SPA area. These sites include the Nene Wetlands, Summer Leys and Titchmarsh. All of these sites are flooded gravel pits surrounded by extensive grassland that is essential habitat for overwintering birds.

To monitor populations of these important birds, the British Trust for Ornithology (BTO) set up the Wetland Bird Survey (WeBS). WeBS monitors nonbreeding waterbirds in the UK. Surveys began in 1947 with sites counted once per month, providing data for population, and trends in abundance and distribution. Volunteer surveyors mainly carry out these counts and this data is essential to protect these very special sites. WeBs provides a snapshot of the birds in the area on that day, with each surveyor covering a section of the wider series of gravel pits. This gives us an invaluable insight into how these birds are faring.

The table shows the 10-year averages (2010 – 2019) of the number of waterbirds on our sites, demonstrating the sheer number of birds that can be seen. The table also shows the averages of the peak



number of each species recorded in a year, known as the annual maxima. The number of birds wintering in the area and on our sites varies dramatically from year to year due to international weather patterns and food availability. The WeBs data shows that our sites within the SPA support significant numbers of wintering birds. The bittern *Botaurus stellaris* is difficult to record on the WeBs counts as they are an elusive species that often skulks in reedbeds. They are increasing in numbers on our sites and within the wider SPA area.

	Designation			Average Annual Maxima of birds recorded on our sites in the last 10 year period
	SSSI	SPA	Ramsar	
>20,000 Non-breeding waterbirds	Y	Y	Y	4816
Aggregations of non-breeding birds: bittern <i>Botaurus stellaris</i>	Y	Y		Ο
Aggregations of non-breeding birds: coot <i>Fulica atra</i>	Y	*		352
Aggregations of non-breeding birds: cormorant <i>Phalacrocorax</i> <i>carbo</i>	Y	*		98
Aggregations of non-breeding birds: gadwall <i>Anas strepera</i>	Y	Y	Y	423
Aggregations of non-breeding birds: golden plover <i>Pluvialis</i> <i>apricaria</i>	Y	Y		447
Aggregations of non-breeding birds: great crested grebe <i>Podiceps cristatus</i>	Y	*		65
Aggregations of non-breeding birds: mute swan <i>Cygnus olor</i>	Y	*	Y	214
Aggregations of non-breeding birds: pochard <i>Aythiya farina</i>	Y	*		126
Aggregations of non-breeding birds: shoveler <i>Anas clypeata</i>	Y	*		123
Aggregations of non-breeding birds: tufted duck <i>Aythya</i> <i>fuligula</i>	Y	*		482
Aggregations of non-breeding birds: wigeon <i>Anas penelope</i>	Y	*		755

The features for which the SPA is designated for its overwintering birds, alongside those that are also listed on the SSSI or Ramsar designations. The average annual maxima of birds recorded on our sites in the last 10 years are also shown.¹



Annual maxima of SPA listed birds on Wildlife BCN reserves within the SPA

The annual maxima for each species listed on the SPA designation on our reserves, based on WeBS data. The numbers of overwintering birds in Britain fluctuates dramatically every year due to climatic conditions and food availability.



Annual maxima of waterbirds on Wildlife BCN reserves within the SPA

The overall number of waterbirds (annual maxima) recorded on our reserves over the last 8 year period, based on WeBS data. The numbers of overwintering birds in Britain fluctuates dramatically every year due to climatic conditions and food availability. Taking into account this annual variability, the overall trend appears to be stable on our sites, which against a background of decline by 26% in the SPA since 2001/2002 (Woodwood et al., 2019), is welcome news.

The Ouse Washes in Cambridgeshire

Stretching from near St Ives in Cambridgeshire to Downham Market in Norfolk, the Ouse Washes is another internationally important area for overwintering birds in our area. The parallel rivers, ditches and banks of the Ouse Washes form a distinctive feature in this otherwise flat landscape.

The washlands were created 360 years ago to retain winter floodwater from the Ouse. Alongside flood alleviation, they are an amazing resource for a variety of wildlife including overwintering birds and breeding waders. Spanning over 2,500 hectares, the Ouse Washes is the largest washland in the UK. The Wildlife Trust BCN owns part of the Ouse Washes alongside other conservation organisations such as the Wildfowl and Wetlands Trust and RSPB who also manage sections of this fantastic area. Over winter, this area can support over 70,000 wintering birds, an incredible sight for visitors.

Along with the Nene Washes, the Ouse Washes are host to a population of breeding common crane *Grus grus*. The Wildlife Trust works in partnership to protect this unique and precious area and planned habitat creation is going to increase the suitable breeding habitat for waders by at least 500 hectares.

> Environmental education is very important to our Wildlife Trust. The Nene Wetlands visitor centre, right at the heart of the SPA, engages families with the wildlife that they will see. From tailored guided walks and bird watching to pond dipping and bug hunting, there is always something going on. Across the Wildlife Trust, we have a strong programme for engaging families with wildlife.

Find out more wildlifebcn.org/activity-centres

Engaging families with wildlife is a key part of our work. We have activity centres across the three counties that teach a wide range of audiences about the natural world. Photo © Katie King



Maintaining suitable habitats for overwintering birds

Without management, these sites would quickly become less suitable for overwintering birds and the wide variety of other species present on the sites. We cut and manage the reedbeds and scrub to ensure that the areas of open water are maintained while ensuring that the habitats are suitable for bitterns and breeding wetland birds. We also ensure appropriate management of our grasslands, which are important for roosting and feeding over-wintering birds, through scrub control and grazing. As the wintering habitats have been improved in areas like Irthlingborough, more birds are consequently being attracted to use them. We have also created new ditches and re-profiled some lake edges, which seems to be having a positive effect. Ensuring safe access for everyone that visits the area is of vital importance too, paths and hides are well maintained and accessible to all. To protect species from disturbance we need to maintain quiet areas of reserves, where public access is restricted. Advances in technology have allowed us to monitor visitor numbers to ensure everyone can enjoy amazing views of these birds without disturbing them.

We allocate a huge amount of effort during the year to design and implement habitat management actions to make the sites as attractive as possible for wintering birds. It is really hard and challenging work, but very rewarding when we see that our modest, local work, is contributing positively to the conservation of many bird species at the international level, and to the enjoyment of the public who visit our nature reserves

Toni Castello, Nene Wetlands Senior Ranger

Grazing our reserves

Alongside staff and volunteers, grazing animals are a key component to the management of many of our reserves. Getting the grazing right on our reserves is a delicate art and we approach it very carefully. We ensure that we use the correct breeds and amount of grazing pressure to create and maintain the best habitats possible. Too little grazing and scrub and rank grasses will develop, too much grazing and fragile habitats can be damaged. We use sheep and cattle, depending on what we want to achieve for a specific site, to control scrub growth, keep areas open or help manage the structure of the plant life to benefit certain species. Forty-seven of our reserves are currently grazed. Looking after all these animals takes a lot of work and is heavily reliant on the expertise of our livestock officers, graziers and volunteers. Our grassland monitoring tells us how the site is responding to grazing and feeds back into stocking rates for the following year.



Summary

Our area is extremely important for overwintering waterbirds and our reserves support internationally important populations. Our management ensures that these areas are havens for birds, as well as for people to enjoy. Alongside the populations in the Nene Valley, our area supports other important populations of birds. The Great Fen supports large numbers of raptors every year. Grafham Water nature reserve is also one of the most important sites for a diversity of passage migrants and wintering birds in the East Midlands.

Explore more online wildlifebcn.org/nene-valley



The Nene Valley SPA provides highly valuable habitat for good numbers of wintering birds across a wide variety of species. Wildfowl and waders feature heavily of course, but the marginal parts of the sites also attract a range of passerines including wintering thrushes, chats and, increasingly, warblers such as chiffchaff and Cetti's warbler. The location of the SPA, close to several residential areas, provides convenient access for many of the county's birders, meaning that high-quality birding can be had year-round, almost on the doorstep. Featuring several sites in close proximity, the SPA also gives the opportunity to create an itinerary with enough interest to easily fill a varied day out in the field Jon Cook, Northamptonshire County Bird Recorder

Acknowledgements

We would like to thank the British Trust for Ornithology for the use of the WeBS data and all the volunteers who carry out these counts. Thanks also to Jon Cook for information about wetland birds in the area.

Data were provided by WeBS, a Partnership jointly funded by the British Trust for Ornithology, Royal Society for the Protection of Birds and Joint Nature Conservation Committee, in association with The Wildfowl & Wetlands Trust, with fieldwork conducted by volunteers. Although WeBS data are presented within this report, in some cases the figures may not have been fully checked and validated. Therefore, for any detailed analyses of WeBS data, enquiries should be directed to the WeBS team at the British Trust for Ornithology, The Nunnery, Thetford, IP24 2PU (webs@bto.org)

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Rare and Precious Species

The Bedfordshire, Cambridgeshire and Northamptonshire area is a very special place for wildlife for a variety of reasons. Many people do not realise our area is home to some species found on less than a handful of sites in Britain; and in some cases the world. The following examples highlight some of the special species that call our area home.



Introduction

A glimmering jewel in the reedbed, the tansy beetle *Chrysolina graminis* is a large and striking iridescent green beetle. Until relatively recently this species was thought to be confined to a 45km stretch of the Yorkshire Ouse, centred on York (Oxford and Millington, 2013). However, in 2014 it was rediscovered at Woodwalton Fen in Cambridgeshire after a 40-year absence of records. Acquired by Charles Rothschild in 1910, Woodwalton Fen was one of the first nature reserves in England. The Wildlife Trust BCN now owns this spectacular site, which holds incredibly important assemblages of fenland species. We are working to discover more about this rare and spectacular species to ensure it flourishes on our site.

Tansy beetle distribution

Relatively little is known about this intriguing species. It has a similar appearance to the mint leaf beetle *Chrysolina herbacea* and some records for the tansy beetle were found to be this species, which is widespread and locally common in southern England (Oxford et al., 2003). Authenticated records show that the distribution of this species in Britain has always been centred on the Yorkshire Ouse and the East Anglian Fens, with the odd outpost elsewhere (G. Oxford, 2020, pers. comm.). Currently, the tansy beetle is only found on three sites; the Yorkshire Ouse, Woodwalton Fen, and Welney reserve. Welney is a Wildfowl and Wetlands Trust nature reserve in Norfolk where the tansy beetle was discovered in 2018.



Tansy beetle ecology

As this species is so rare and elusive, relatively little is known about its ecology. Tansy beetles have not been seen flying in Britain. They find new food-plants and habitats by walking and only travel around 200m in search of food. This limits how far populations can spread and interbreed with one another. The York population mainly feeds on tansy *Tanacetum* vulgare, occasionally feeding on gypsywort Lycopus europaeus and marsh woundwort Stachys palustris where these are adjacent to tansy. Adults and larvae both feed on the leaves of these plants (Hubble, 2014). However, the fenland populations do not appear to feed on tansy. Instead, their main food plants are water mint, gypsywort Lycopus europaeus, hemp-nettle Galeopsis sp. and marsh woundwort Stachys palustris.

Understanding the overwintering habits of the tansy beetle is important if we are to protect this species. The York population burrow deep into the soil over winter, whereas in the Fens, with the winter water table often at or above ground level, this would not be possible (G. Oxford, 2020, pers. comm.). More research is needed into the ecology of the tansy beetles in the fens. As the differences between these populations in terms of their ecologies are so vast, this may mean that they are separate subspecies or even species. Further research needs to be carried out into this species to establish its ecology to secure its future.

It became very clear to me back in 2017 just how little was known about the beetles at Woodwalton Fen.

Julian Hodgson, volunteer tansy beetle surveyor at Woodwalton Fen

Tansy beetle conservation

The tansy beetle is listed as Endangered in Britain (Hubble, 2014). The decline in this species is likely due to habitat loss and lack of appropriate management on the sites in which it is found leading to a loss of its foodplant. To help conserve the population in York, the Tansy Beetle Action Group (TBAG) was formed. Conservation measures there have been remarkably successful and the beetle can be quite common in the right area (Oxford et al., 2003).

As the species has more recently been discovered on the other sites, there have been fewer opportunities to monitor these populations. We also have a lot more to discover about the ecology of this species on these sites. Summer flooding can significantly detrimentally affect populations (Oxford, 2019). Five ark populations have been established near to the Yorkshire Ouse to ensure that flooding does not wipe out the entire population. These ark populations are not currently in place for other populations (Oxford, 2019).



Tansy beetles at Woodwalton Fen

Woodwalton Fen is owned by the Wildlife Trust BCN and managed by Natural England. The reserve is a haven for many rare fen species due to the quality and longevity of appropriate management. Woodwalton Fen is a National Nature Reserve, a Ramsar site and a Special Area of Conservation. The tansy beetle was previously known from Woodwalton Fen and was thought to have been lost from the area until it was rediscovered in 2014. The tansy beetle has been found to inhabit not just the ditches on the site, but deep into the fen areas. To avoid disturbing and damaging the habitat, surveys of these areas must be limited, therefore not every individual beetle can be counted. The York population is more of a linear population so potentially every individual can be counted by volunteers without damaging the habitat. Transects, therefore, have to be used to give a proxy for how many beetles are present on the whole site and to map out their distribution (Oxford, 2019). This is ongoing research and it will inform the management of the site to ensure that this amazing species can thrive. Julian Hodgson has been surveying the tansy beetle and its foodplants on the site since 2017. He could see how little was known about these stunning, precious and rare beetles and volunteered to map out the beetles and their foodplants. His work has dramatically increased our knowledge of this species but there is still lots we need to know about this species' ecology to protect it.

The areas in which the tansy beetle is found are cut later than other areas to avoid negatively affecting the species; this has to be carefully balanced with maintaining a cutting regime that maintains the diversity of food plants that the beetle requires (K. Smith, 2020, pers. comm.)

Outside of Woodwalton Fen, we are surveying the wider Great Fen area to see if the tansy beetle is more widespread in this area. The meadows in the area are drier than Woodwalton Fen so may be more suitable for this species, if suitable food plants are available (H. Stanier, 2020, pers. comm.)





Summary

The tansy beetle is a rare and enigmatic species for which Woodwalton Fen is incredibly important. Further research into its ecology through survey work will enable an increase in targeted management for this endangered species. Further survey work in the wider Great Fen area will help establish if the species is present more widely and inform habitat management, which will benefit a wide variety of species including the tansy beetle.

Acknowledgements

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Introduction

The elm has a deep and mythical rooting in our history. In Celtic mythology, the elm was associated with the underworld, with elves and faeries that were said to dwell in the boughs of the trees. Elm timber is also a key part of our past, as its strong and flexible wood was used for all manner of items: from boats to wheel covers, and even coffins. Today the story of the elm tree more often brings melancholy, as we think of Dutch Elm Disease which nearly wiped out our elm trees in Britain. This story is far from the complete picture though, and elms remain a quintessential part of the landscape. Our area is especially important for elms and we hold several species found nowhere else in the world.

Dutch elm disease

Dutch Elm Disease first spread to Britain in the 1920s. Although the initial epidemic died down, a more aggressive species of Dutch elm disease fungus was accidentally introduced into Britain in the 1960s, leading to the death of over 25 million trees. They do however remain abundant and diverse trees over much of Britain. This is especially true in eastern and central England, where they may constitute 10-30% of total tree cover (B. Eversham, 2020, pers. comm.).



A large and striking specimen of curve-leaved elm *Ulmus curvifolia*. Globally, this species is confined to north Hertfordshire, Cambridgeshire and Essex. Photo © Brian Eversham

The naming of elms

The history of elm classification and naming in Britain has been controversial and remains unresolved. Prior to the Flora of Great Britain and Ireland (Sell and Murrell, 2018), the classification of elms (genus *Ulmus*) in Britain has ranged from one variable species to seven species, often with numerous named hybrids and varieties. Largely based on Armstrong (1992), Sell and Murrell (2018) describes 62 different elm microspecies – species that differ in minor features - from Britain and Ireland. 58 of these are thought to be native and 40 are new to science.

There are discrepancies between whether or not these are indeed separate microspecies, but they appear to inhabit different ecological niches and may even support different invertebrates (Eversham, 2020). If our rarer elmfeeding insects, such as white-letter hairstreak butterfly *Satyrium w-album* and white-spotted pinion moth *Cosmia diffinis* are to be conserved, we need to know which elms they are using.



Are these species native?

The origins of elm species are also unclear. It is unknown whether one species colonised after the last Ice Age and others were introduced by humans over subsequent millennia. Alternatively many could have arrived naturally before the English Channel opened and Doggerland vanished.

Elm pollen trapped in peat and lake sediments dates back to before humans had a major influence on the environment. Their rich insect fauna, as diverse as many native trees, also suggests a long native presence. The unusually high diversity of elms in central England and the south-west suggests that national colonisation may be more likely than repeated human introduction (B. Eversham, 2020, pers. comm.). The geographic routes that other species have assumed to arrive converge in central England, where elms from different areas of mainland Europe may have met and repeated hybridisation added to the diversity. A final argument in favour of native status is that most English elm species appear to be absent from mainland Europe. 50 of the 58 microspecies considered native by Sell & Murrell (2018) are listed as British endemics.

Elms in the Beds, Cambs and Northants area

15 of the 58 native elm microspecies that were described new to science in Sell & Murrell (2018) were from sites in the BCN area. Three of these sites were Trust reserves (*U. cantabrigiensis* and *U. sylvatica* from Buff Wood, and *U. crenata* from

Ash dieback

Ash dieback is set to change the way that our woodlands look forever. It is a serious disease of ash trees caused by the fungus *Hymenoscyphus fraxineus*. The disease causes leaf loss and crown dieback in affected trees and can lead to the death of the tree. For safety reasons we will have to fell large areas of ash.

Although this will be a major loss to our woodlands, we have to be forward-thinking and see the opportunities that this brings. It will enable us to diversify our woodlands and the felled trees will be host to large numbers of saproxylic (dead wood associated) invertebrates and fungi for years to come.

Find out more about our approach wildlifebcn.org/ash-dieback

Hayley Wood). It would be valuable to safeguard these populations for future study. There is a strong bias in favour of Cambridgeshire because both Sell and Armstrong were based in Cambridge, but much of the difference is real. At least 44 of the 58 are recorded from the BCN area, and nine of them appear to be confined to the BCN area, and a further seven are rare outside our area.

Letton Eln, Ulnus crasse at its type locality in Latton, Northamptonshire. There are only three known trees of this species anywhere the world. Photo ® Brian Eversham

Scientific Name	English Name	Population Estimate	Notes	Status
Ulmus cantabrigiensis	Woodland Elm	2	Probably 80-100	Confined to BCN
Ulmus coriaceifolia	Leathery-leaved Elm	2	Probably 60-80	Confined to BCN
Ulmus crassa	Laxton Elm	1	3 trees known	Confined to BCN
Ulmus crenata	Hayley Elm	2	Probably 30-50	Confined to BCN
Ulmus Iongidentata	Jagged-leaved Elm	3	600-700	Confined to BCN
Ulmus madingleyensis	Madingley Elm	2	Probably 20-30	Confined to BCN
Ulmus platyphylla	Bassingbourn	2	Perhaps 10-20	Confined to BCN
Ulmus serratifrons	Burred Elm	4	3000-5000	Confined to BCN
Ulmus sylvatica	Hatley Elm	2	Probably 10-20	Confined to BCN
Ulmus atrovirens	Dark-leaved Elm	2	50-100	Rare outside BCN
Ulmus cuneiformis	Wedge-leaved Elm	3	700-900	Rare outside BCN
Ulmus Iongicaudata	Long-tailed Elm	3	700-900	Rare outside BCN
Ulmus incisa	Cut-leaved Elm	1-2	Probably 10-20	Rare outside BCN
Ulmus minor	Cambridge Elm	4	6000-8000	Rare outside BCN
Ulmus obesidens	Fat-toothed Elm	1	Probably 5-10	Rare outside BCN
Ulmus oblanceolata	Narrow-leaved Elm	3	500-600	Rare outside BCN
Ulmus mossii	Moss's Elm	4	1000-5000	Widespread, described from BCN
Ulmus procera	English Elm	5	Potentially 50,000-100,000 (very common as scrub)	Widespread, described from BCN

British population estimates for the species that the Bedfordshire, Cambridgeshire and Northamptonshire area is especially important (Eversham, 2020). Only *Ulmus procera* is thought to occur outside of Britain. Population estimate categories: 1 = single figures, 2 = 10s of trees, 3 = 100s of trees, 4 = 1000s of trees, 5= 10,000s or more

Note that population estimates are for Britain; only U. procera is believed to occur outside of Britain

Conclusion

Our area is home to a wide diversity of elm species, many of which are found nowhere else in the world and are globally rare. Many of these species are present in the woodlands that we manage and by protecting these woodlands for the future, we can protect these elms. Further research is needed to confirm genetically how many elm species we have in Britain and their origins.

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Conserving Overlooked Species

Our nature reserves benefit a wide range of species from charismatic well-studied species to those that are obscure and often overlooked, but no less important. We believe that conservation should take into account the needs of a wide range of species and their habitats and this is what we advocate on our reserves. Our management is informed by the species present on the reserves, no matter how small and obscure they may be. Many of these overlooked species are essential for a healthy ecosystem, support a diversity of life, and are fascinating in their own right. This section focuses on a selection of these overlooked species and our work to conserve them.

The reserves we manage are home to thousands of different species, each one unique and special in its own right. Through our reserve management, we try to take into account the needs of as many species as possible, no matter how small and obscure the species may be. Photo: Rhinoceros beetle *Sinodendron cylindricum* © Ryan Clark

Introduction

Peer through the crystal-clear water in an old brick pit and you may see a carpet of emerald green whorled vegetation, encrusted with calcium and bustling with life. Look closely and you will see that these are not plants as we know them, they are stoneworts. Stoneworts are a unique group of complex algae that look similar to vascular plants found elsewhere on the land and in water.

Stoneworts, otherwise known as *Charophytes*, are extremely sensitive indicators of good water quality. They need clean, unpolluted water to survive. As the quality of our fresh and brackish water bodies has declined, so have these amazing algae. Out of the 28 native species of stonewort in the UK, over half are listed in the Red Data Book or are Nationally Scarce (Stewart and Church, 1993). They are among the most severely threatened group of plants or animals in the United Kingdom (Stewart, 1996). Within the Bedfordshire, Cambridgeshire and Northamptonshire area, the commoner species of stonewort can be widespread. These species can turn up in unexpected places, providing there is good water quality, including water troughs and vehicle ruts. Due to its location and history of industry, our area is also home to important assemblages of rarer species.

Stoneworts get their name from their encrusted appearance as they build an external skeleton of calcium carbonate. They live in water bodies up to 10m in depth and as many have an annual life cycle, they can be some of the earliest colonisers of newly formed water bodies. They are an incredibly important part of aquatic ecosystems and help to ensure the water is suitable for a wide range of aquatic life by reducing flow rates and aiding sediment deposition (Lambert, 2009).



Northamptonshire area since 2000

EN = Endangered, NS = Nationally Scarce S8 = Section 8 of the Wildlife and Countryside Act.

Chara aculeolata (NS) Chara aspera Chara canescens (EN_S8) Chara contraria Chara contraria var. hispidula Chara curta (NS) Chara globularis Chara hispida Chara virgata Chara vulgaris Chara vulgaris var. longibracteata Chara vulgaris var. papillata Nitella flexilis (NS) Nitella mucronata (NS) Nitella mucronata var. gracillima (NS) Nitella opaca Nitella tenuissima Tolypella glomerata (NS) Tolypella intricata (EN) Tolypella prolifera (EN)

Stoneworts are a type of algae that grow in fresh and brackish water. They get their name from their encrusted appearance as they build an external skeleton of calcium carbonate. Photo © Judy Webb



Stoneworts in the fens

The Cambridgeshire fens, extending into the edges of Norfolk and Lincolnshire are one of most speciesrich areas for stoneworts in the country, with over half of the British stonewort flora recorded from this area (Stewart, 2004). Many stonewort sites in the Cambridgeshire fens have disappeared or lost their interest (Stewart, 1996). Many ditches in this area are now dominated by coarse fen vegetation, which makes them unsuitable for stoneworts (Stewart, 2004).

In some cases, the main interest lies in the ditches not connected to the main drainage systems, but these are often undermanaged. The regular cycle of ditch cleaning of main waterways provides the early successional stages that stoneworts require. *Tolypella prolifera* and *Tolypella intricata* are both Endangered in the UK and are characteristic of recently managed fen drains, establishing one or two years after disturbance. These two species are more frequent in the Fens of Cambridgeshire and South Lincolnshire than anywhere else in the UK (S. Lambert, 2020, pers. comm.). Freshly created or disturbed ponds within the fens are of particular importance too (Stewart, 2004).



Peterborough and Whittlesey brick pits

Peterborough and Whittlesey have long been famous for brick making, and this has left behind a series of abandoned clay pits on the south and east sides of the city. Some of these clay pits are now amazing habitats for a wide variety of species. One such example is Orton Pit where clay was excavated in channels creating lines of ridges and troughs. These troughs filled with water over time and were colonised by wildlife.

Today, these linear ponds provide a remarkable example of aquatic succession. Moving across the site, each line of pools is around a year younger than the one before it (Stewart, 1996). At Orton Pit, 10 stonewort species have been recorded (Stewart, 2004), this is over a third of all species found in Britain. This includes large populations of the Endangered bearded stonewort *Chara canescens* and the Nationally Scarce hedgehog stonewort *Chara aculeolata*.

Chara canescens is usually found in brackish water, so is unusual inland and forms the only English population. This species is also listed on section 8 of the Wildlife and Countryside act. The Peterborough and Whittlesey Brick Pits are of European importance for their stonewort flora.



Stoneworts of the Peterborough Brick Pits

EN = Endangered, NS = Nationally Scarce, S8 = Section 8 of the Wildlife and Countryside Act. (Stewart, 2004)

Chara aculeolata (NS) Chara aspera Chara canescens (EN, S8) Chara contraria Chara curta (NS) Chara globularis Chara hispida Chara virgata Chara vulgaris Nitella flexilis agg Tolypella glomerata (NS)

Chara canescens is an Endangered species. The only English site for this species is the Peterborough Brick Pits. Photo Chris Carter



Stoneworts on our reserves

Stoneworts are found on a number of our reserves including Cople Pits, Barnes Meadows, Dogsthorpe Star Pit, Felmersham Gravel Pits, Pitsford Water, Summer Leys, Titchmarsh, Upwood Meadows and Woodwalton Fen.

As part of the Great Fen Project, two areas were surveyed in 2019; these were Engine Farm and Rymes Reedbed. During the survey, seven stonewort species were recorded, including the Nationally Scarce Clustered Stonewort Tolypella glomerata (Lambert and Kirby-Lambert, 2019). Woodwalton Fen, now a Wildlife Trust reserve, also has records for five stonewort species. The reserve forms part of the Ramsey Fens Important Plant Area, which is of European importance for its stoneworts (Stewart, 2004). The ditches here are maintained to ensure some are suitable for stonewort species. The Great Fen project is creating a wide range of water bodies, many of which will be suitable for stoneworts, as long as new waterbodies are continuously created or kept at an early successional stage. It is clear that the area is already important for this fascinating group and it has the potential to become increasingly important.

Dogsthorpe Star Pit is an old clay pit and is the perfect home for a variety of stoneworts including some rare and scarce species. Removing encroaching vegetation ensures areas of open water and early successional ponds are maintained. Our gravel and chalk pits usually have fewer species of stonewort than smaller waterbodies but can support large populations of these species. Areas of the river Nene, especially the backwater channels, can support large stonewort populations including species in the genus *Nitella* which are adapted to living at the bottom of these channels.

Outside of our reserves we actively carry out surveys on a wide variety of local wildlife sites, several of which are designated for their stonewort floras. We provide advice to landowners to ensure that the habitat is managed appropriately for these species.



Stonewort conservation

Over half of the species of Stonewort in the UK are listed in the Red Data Book for this group or are Nationally Scarce. Therefore, proactive conservation measures are needed to conserve these species. Eutrophication is quite possibly the biggest threat to stoneworts due to their high sensitivity to nutrients. Succession is thought to be the second biggest threat, as stoneworts thrive in newly created or disturbed habitats and cannot compete with vascular plants in many cases. Encroachment from common reed *Phragmites australis* is a key component of this problem and needs to be actively managed.

The decline of the brick-making industry is also negatively effecting stoneworts in the area. The Whittlesey brickpits is the only brickpit in the Peterborough area still carrying out excavations and therefore providing extensive new stonewort habitat. It is difficult and expensive to maintain extensive early successional stages once the extraction has ceased. If left undisturbed the waterbodies become rapidly less suitable for stoneworts due to succession. Other problems facing stoneworts include sedimentation, non-native species, grazing by waterfowl and sea level rises (Lambert, 2009).

Acknowledgements

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Introduction

Tucked away, off the beaten track, Flitwick Moor is not the first place that many people would think to visit for a wildlife spectacle. However, this site is incredibly important for a wide variety of species and is nationally, if not internationally important for its fungi, invertebrates and bryophytes. Carpets of Sphagnum mosses flourish in the acidic mire, whilst mosses and liverworts coat the trees and woodland floor alongside a wealth of fungi. All of these support important invertebrate populations.

Flitwick is home to a wide variety of special habitats including this bottle-sedge mire. Photo © Gwen Hitchcock

Flitwick Moor

Flitwick Moor, located in Bedfordshire, is a remnant of a nutrient-rich valley mire and is a very special place to many naturalists. This type of habitat is vanishingly uncommon, especially in South East England. This 31-hectare site is designated as a Site of Special Scientific Interest, due to the wealth of important species and habitats that it contains. This includes acid mire, fen, open water, acidic and neutral grasslands, alder carr and oak/ birch woodland. This makes it a really unique site and one of the most important sites in South East England for fungi, bryophytes and a range of invertebrate groups. Due to the site's location, many local people walk through the site, but not everyone stops here to appreciate the wealth of habitats and the hidden wildlife around them.

Flitwick's bryophytes

Flitwick Moor is incredibly important for its bryophytes, the group that contains mosses, liverworts and hornworts. This often-overlooked group of plants is incredibly important. They are significant primary colonists in pioneer communities, allowing other species such as vascular plants to colonise. They can thrive in the harshest environments where other groups cannot, such as seemingly dry bare rock surfaces and areas of high acidity with waterlogging, as we see at Flitwick Moor. There are also large numbers of microfungi and invertebrates that are completely reliant on bryophytes for them to survive. Bryophytes are also incredibly beautiful and fascinating in their own right.

The site was first recognised as being particularly important for bryophytes in the 1880s when James Saunders collected samples there. By the 1950s, the number of species recorded on the site had significantly increased through the work of Tom Laflin and Peter Taylor. Alan Outen started recording bryophytes on the site in the 1970s and has kept a checklist of species on the site ever since. To date, over 140 species of bryophyte have been recorded on the site and it is often said to be the best site in South East England for bryophytes (A. Outen, 2020, pers. comm.). Many of these species are found very rarely in the three counties and a significant number are rare in the southeast.

Flitwick Moor has a variety of microhabitats on the site, many of which are transient, and only suitable for the bryophytes for a short period before they become colonised by other species. This is the reason why Flitwick is home to such a variety of bryophytes. For example, areas of bare peat allow certain bryophytes to colonise, which in turn provides a niche for other species (e.g. flowering plants) to establish. Our management must ensure that new areas of bare peat are created and that scrub does not encroach on the boggy mire.



Sphagnum palustre. This beautiful moss carpets some areas of the open birch woodland at Flitwick. As it grows, the moss decomposes from the bottom, laying down peat and creating habitats for a vast variety of species. Photo © Brian Eversham

For many bryologists, the boggy mire is the real star of the show at Flitwick. Located away from the footpath, it is an area that members of the general public probably don't realise exists. This area is comprised of sphagnum mosses, which break down over time to lay down peat.

Over ten species of Sphagnum mosses have been recorded on the site, most of which are found nowhere else in Bedfordshire. Some Sphagnum species are found in other areas of the county but never in the quantities that are present at Flitwick. Flitwick is the only site in South East England for Girgensohn's Bog-moss Sphagnum girgensohnii which is present in small areas at the edge of the mire, under the shade of trees.

Another fascinating species present on the site is Ghostwort *Cryptothallus mirabilis*. This liverwort species is a parasite on birch roots and lives deep below the sphagnum tussocks. It is often thought that its fruiting bodies look like ghostly hands reaching up from below.





The Wildlife of Bedfordshire, Cambridgeshire and Northamptonshire

A selection of just some of the species of mosses and liverworts which Flitwick is especially important for. The rare species on the site have very particular habitat requirements

Group	Species	Comments
Liverwort	Cephaloziella rubella	Found on peaty ground. 2 Bedfordshire sites and uncommon in the UK
Liverwort	Chiloscyphus pallescens	4 Bedfordshire sites
Liverwort	Cololejeunea minutissima	This species is rare in South East England
Liverwort	Cryptothallus mirabilis	Only Bedfordshire site for this strange and mysterious liverwort
Liverwort	Gymnocolea inflata	Found at Flitwick on water-soaked bare peat. Only Bedfordshire site
Liverwort	Ptilidium ciliare	At Flitwick, this species is found on upturned wet tree roots. It is only found on two sites in Bedfordshire and is rare in South East England
Liverwort	Riccia fluitans	In pools from former peat diggings. Only three Bedfordshire sites
Moss	Calliergon stramineum	Flitwick is the only Bedfordshire site for this species which is rare in South East England
Moss	Climacium dendroides	An increasing scarce species in South East England
Moss	Dicranella cerviculata	Only one other Bedfordshire site for this species which is rare in South East England
Moss	Dicranum polysetum	Only one other Bedfordshire site for this species which is scarce in Britain
Moss	Eurhynchium speciosum	Flitwick is the only Bedfordshire site for this species which is uncommon in Britain
Moss	Philonotis fontana	Only one other Bedfordshire site for this species which is scarce in South East England
Moss	Sphagnum girgensohnii	Only Bedfordshire site and the only site in South East England. Flitwick holds over 10 species of Sphagnum, all of which are uncommon in Bedfordshire

Wildlife Trust BCN

We manage a wide variety of nature reserves which are special for bryophytes. Some of our woodlands are rich in bryophytes, such as Brampton Wood in Cambridgeshire and High Wood in Northamptonshire. At these sites, the trees and woodland floor are coated in a vast array of different bryophyte species.

Bare chalk is another important microhabitat for bryophytes in our area, supporting specialist species. Our Cherry Hinton Chalk Pits reserve in Cambridgeshire has large expanses of bare chalk on the ground and cliff faces. Alongside the boulders left in the quarry, these provide perfect habitats for a wide variety of uncommon bryophytes such as *Seligeria calycina* and *Seligeria calcarea*. In total, the site supports around 90 bryophyte species.

During 2010 we carried out clearance work at Cherry Hinton, removing large patches of buddleia scrub. This has allowed calcicolous species (specialists of base-rich microhabitats) to flourish. This includes species such as the golden feather-moss *Campyliadelphus chrysophyllus*, and top notchwort *Leiocolea turbinata* which have become more abundant onsite now they are no longer shaded by scrub and rank grassland. This site has been visited by botanists since the 17th century for both its bryophytes and vascular plants, and the scrapes in the eastern pit have benefited the calcicole species dramatically.



Growing up to 2mm tall, the English Rock-bristle moss *Seligeria calycina* is tiny. This species is a specialist of bare chalk. Areas of bare chalk must be maintained to retain the bryophyte interest of the Cherry Hinton Chalk Pits reserve. Photo © Brian Eversham



Flitwick's fungi

Flitwick Moor is home to a wealth of fungi with over 500 species recorded on the site. It was described by eminent British mycologist Peter Orton as "potentially the most important site for fungi in the South-East" (Evans, Marren and Harper, 2004). Fungi are essential for a variety of reasons but are often overlooked due to the complexity of their identification. Fungi are vitally important agents of organic decay, breaking down organic matter. They also form complex relationships with higher plants such as orchids. These associations are of enormous benefit to the higher plant as well as to the fungus. Fungi are also important sources of food, medication and antibiotics.

Flitwick Moor is recognised by the 2004 Important Fungus Areas report as being at least of national importance for several reasons (Evans, Marren and Harper, 2004). Firstly, the site holds over 500 species of fungi, a testament to the wide variety of habitats found on the site. Secondly, the site holds outstanding examples of some of these habitats which have known mycological importance. These include alder and willow carr, oak and birch woodland, pasture, and acid bog. The alder and willow carr are particularly important, with many scarce alder-associated species present on the site. Lastly, the site is recognised as an important fungus area due to the array of rare species that it supports. These include a brittlegill fungus Russula raoultii and a roundhead fungus Naucoria scolecina, which are all red-listed species. It is also the type location for a deceiver fungus Laccaria purpureobadia which is regularly found on the site (A. Outen, 2020, pers. comm.).

Some of the best Wildlife Trust nature reserves for fungi in our area:

Brampton Wood, Flitwick Moor, Gamlingay Wood, Hayley Wood, Kings Wood Heath and Reach, Old Sulehay, Sewell Cutting, Shepherds Close, Totternhoe Knolls, Woodwalton Fen

Explore more at wildlifebcn.org/reserves

Management of Flitwick nature reserve

It takes a lot of effort to keep Flitwick in good condition, and there must be a perfect balance between the special habitats found on the site. The open areas of the site are annually cut and grazed (where appropriate), with the vegetation stacked on the site. This cutting of the vegetation replicates natural processes and allows the mire vegetation to thrive. To ensure that the scrub and woodland doesn't encroach on these open areas, cutting and pollarding occurs. Within the wet woodland, away from the footpaths, we have a minimum intervention approach allowing trees to grow and decay without management. This is important for the fungi, bryophytes and invertebrates to thrive at the site. This careful balance of sensitive management of some areas and minimum intervention in others is what makes Flitwick so special.





Summary

Flitwick Moor is an internationally important site for a wide variety of species; many of these are easily overlooked but are of vital importance. By working alongside local experts, we ensure that the needs of these species are taken into account in the management of our reserves and we can protect these special areas for future generations.

Acknowledgements

Our thanks go to Alan Outen who provided invaluable information for this case study and to Chris Preston for information about other bryophyte rich habitats in our area.

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Fantastic Fenland Drains and Waterways

The Cambridgeshire fenlands are one of the treasures of our area. These captivating habitats are home to a huge variety of species (over 13,000), many of which are found nowhere else in Britain. The area is characteristically made up of low lying, often marshy, ground. Through the Great Fen Project, the Wildlife Trust BCN is playing a leading role in restoring and protecting this unique and precious landscape and the species that call it home. Essential to the fens are the ditches that distribute water across the landscape in this area. This section focuses on some of the special species found in the fenland ditches and how we care for them through our management.



Introduction

The plants within an area are a key component of a healthy ecosystem, and the species present tell you a lot about the habitats and their importance. Before large-scale reclamation and drainage, fenland was probably the most extensive wetland in England and holds unique and special plants. Despite intensive use for agriculture, the fenland basin still holds relics of the remarkable wetland flora that originally occurred within the primaeval landscape and habitats.

Fenland ditch flora

To reclaim and drain the land, ditches, drains and dikes were created. These artificial features have now become probably the most important habitats for aquatic plants in the fens. Their banks also make a significant contribution to the conservation of wetland and wet grassland plants. This is especially true where the watercourse contains clear nutrientpoor water. In these drains, the aquatic flora can be very rich with many local species.

Several species that are Nationally Scarce have significant populations in Fenland ditches, including greater water-parsnip *Sium latifolium*, a species listed as Endangered on the England vascular plant red list (Stroh et al., 2014).



of very wet, species-rich, tall-herb fen, it is now generally found in ditches, growing amongst other emergent species. This species is listed as Endangered on the England vascular plant red list (Stroh et al., 2014). Photo © Brian Eversham

The ditches are just a part of what makes the fenland area unique for plants. There is currently a project led by Owen Mountford and Jonathan Graham to highlight just how important the fens are for plants. The Fenland Flora project is mapping the distribution of the entire vascular flora and characterising the plant assemblages within the fens.

Threats and conservation

Except for a few small areas protected as National Nature Reserves (e.g Wicken Fen, Woodwalton Fen and Holme Fen), most of the surviving wetland and aquatic flora of Fenland is found in modified or even artificial habitats. These are increasingly in restored or re-created landscapes such as the Wicken Fen Vision area and the Great Fen. These areas need to be managed appropriately to allow the aquatic flora to flourish while balancing the needs for drainage and flood mitigation. Too much management removes the plants from the waterways and the banks, whereas too little management and many plants become outcompeted by reeds.

The Great Fen flora

Cambridgeshire forms a key part of the Fenland basin and, together with the adjacent south-western fens of Lincolnshire, holds the most diverse aquatic and wetland flora in its ditches (O. Mountford & J. Graham, 2020, pers. comm.). In contrast to the more recently reclaimed parts of Fenland near the Wash, the channels here may be on peat, may be sinuous (derived from natural channels) and are long-established. Those around the edge of Fenland or Fenland islands also often have high water quality. Many of the early studies of Fenland and its drainage channels by botanists such as Alfred Fryer, Edward Hunnybun and G.C. Druce occurred within Cambridgeshire. Sites that they discovered still hold rich aquatic floras today and are therefore designated as Local Wildlife Sites for their flora.

One of the key areas for wetland plants within the Great Fen area is Woodwalton Fen NNR. The Wildlife Trust owns this site and we work in partnership with Natural England to conserve the vast array of species present here. This site still holds incredibly important populations of wetland plants in its ditches and on their banks. Over 20 years ago, fen ragwort *Senecio paludosus* was reintroduced to Woodwalton Fen. This site now holds c.95% of the GB population of this critically rare species which is only found on one other site in Great Britain (Stroh et al., 2014).
Halting the declines in wildlife are no longer enough, a nature recovery network needs to be established. Since 2001, the Wildlife Trust's Great Fen project has been restoring vast areas of fenland, including large expanses (over 15km) of drainage channel habitat. We have also been managing the land more sympathetically, reducing agrochemical inputs into the water. Monitoring of the ditches has occurred since the start of the Great Fen Project. Every year considerable lengths of the ditches are surveyed, focussing on the plants present in the water and on the banks. These surveys are showing that there has been an increase in the number of plants colonising the ditches, indicating an increase in water quality.



Landscape-scale conservation

The Great Fen Project is an example of how well landscape-scale conservation can work. During the 17th Century, the fens of Eastern England were drained to create peat-rich farmland. This resulted in 99% of the wild fen being destroyed. Woodwalton Fen and Holme Fen are two of the last areas that remained, but they were too small and isolated to continue to support the special fenland wildlife that had survived.

In 2001, five organisations including the Wildlife Trust BCN, came together to set out a vision for the Great Fen. The aim was to provide a more sustainable future for the area. This ambitious project aimed to connect existing habitats through habitat creation and restoration, bringing benefits to wildlife and people. The project received the largest ever grant for the natural environment awarded by the National Heritage Lottery Fund. Since then, the project has achieved even better than anticipated positive outcomes for wildlife, with species lost from the area now thriving.

Nature is back on the map and local communities are engaged with the landscape around them. Landscape-scale conservation work is at the heart of what we do as an organisation and through partnership working, we can reverse the declines in wildlife in our area.

Find out more greatfen.org.uk

Summary

The fens are a very special place for plants. The ditches and associated banks are of particular importance and support unique botanical assemblages. This in turn supports special invertebrates and other organisms. Restoring ditches is just one of the many aims of the Great Fen Project, delivering a living landscape for both wildlife and people.

The water violet *Hottonia palustris* is another special aquatic plant; it produces beautiful spikes of flowers which emerge from the water. This species is now fairly common in some areas of the Great Fen. Photo © Ryan Clark



Acknowledgements

Our thanks go to Fenland Flora authors Owen Mountford and Jonathan Graham for information for this case study.

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Introduction

Skulking away in the mud at the bottom of the ditches in the Great Fen lives a survivor from when there was a land bridge between Britain and the rest of Europe 10,000 years ago. The spined loach *Cobitis taenia* is a relatively small, inconspicuous, bottom-dwelling fish.

Very few people have been lucky enough to see this intriguing species. Due to its small size, the species is mainly nocturnal to avoid the risk of predation. Anglers rarely catch it and traditional monitoring methods do not work well for this species, as it hides in the silt and vegetation by day (Perrow and Jowitt, 2000).

The spined loach gets its name from the downwards pointing spine-like protrusions found underneath its eyes; these are thought to be used in courtship (Perrow and Jowitt, 2000). This species is scarce in Europe and is listed on Annex II of the EC Habitats and Species Directive, affording it some protection (English Nature, 1998).

Some of the reserves where it can be found

- Woodwalton Fen
- Paxton Pits
- Great Fen
- Ouse Washes

Distribution and habitat of the spined loach

This species swam across Europe, via the continental Rhine system, and into Britain before the North Sea was formed at the end of the last ice age (10000 years ago). Since then, it has been confined to these waterways (Perrow and Jowitt, 2000). In Britain, this species is only found naturally in five eastflowing river systems and their associated waterways (English Nature, 1998). These are the Trent, Welland, Witham, Nene and Great Ouse. Further north, the rivers are too cold for this species and are often not silty enough for it to survive (English Nature, 1998). This distribution has been maintained by a lack of angler interest in the species and consequent lack of artificial spread by man.

The Bedfordshire, Cambridgeshire and Northamptonshire area covers a significant proportion of the spined loach's range. It can be locally abundant in its restricted range but seems to have a particular need for a sandy substrate with patchy dense aquatic plants (English Nature, 1998). These sandy substrates are needed due to the fish's specialised feeding mechanism and are needed for breeding (English Nature, 1998). There is little or no gene flow between individuals in different waterways, which has led to the populations in Trent/Whitham and Welland/Nene/Great Ouse being genetically distinct from one another; they may even be on their way to becoming separate subspecies or even species (Culling and Côté, 2005). Therefore, the species must be conserved across the whole of its range.





The distribution of the spined loach in Great Britain and across the three counties.

Fenland ditches

Fenland ditches can be especially important for this species, and the spined loach is listed on the Fenland Special Area of Conservation designation. These ditches provide similar habitat to rivers but often do not suffer from the same catastrophic flooding events (Comont and Denham, n.d.). Fenland ditches like those in the Great Fen need to be managed to ensure that they remain suitable for this species and a whole suite of other species too. This sympathetic management is carried out in a variety of ways, with wider corners and pools at ditch junctions created where possible (P. Beckenham, 2020, pers. comm.). This works alongside a generally sensitive approach to drain management, providing the species with quiet, sediment-rich areas in which to rest, feed and spawn.



A fenland ditch at Woodwalton Fen Wildlife Trust reserve highlighting the range of habitats that one ditch can contain, essential for a wide variety of species including the spined loach. Photo © Brian Eversham

Summary

Our area is particularly important for this fascinating and often overlooked fish species. We must work to ensure that our waterways are kept in good ecological condition for our wildlife to thrive. If the spined loach is lost from our area, it is more likely to become extinct in Britain.

Acknowledgements

Our thanks go to the Northamptonshire Biodiversity Records Centre, Cambridgeshire and Peterborough Environmental Records Centre, and Bedfordshire and Luton Recording and Monitoring Centre for data on the spined loach.

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Introduction

Plop... the unmistakable sound of a water vole as it drops into the water. A glimpse of one of these elusive mammals is always a welcome occasion. Famous for being 'Ratty' in Kenneth Grahame's 1908 'Wind in the Willows', the water vole is familiar to many people. However, this species is in danger; it is Britain's fastest declining mammal and is listed as 'Endangered' (Mathews and Harrower, 2020). The fens still hold strong populations of this species and our Wider Countryside work is helping to secure the future of this species across the whole area.

Seeing water voles is quite the privilege. Many people I speak to about water voles reminisce about how they used to see and hear them all the time down by the river and now not anymore

Lewis Dickinson, Water for Wildlife Officer

Water vole ecology

The water vole *Arvicola amphibious* is one of our most charismatic and well-known mammals. Water voles live in a wide variety of still and slowflowing waterways. They nest in the banks of these watercourses, excavating their own burrows. They are herbivorous and must eat around 80% of their body weight in vegetation each day; this means that they require at least a two-metre width of bankside vegetation. Water voles have been shown to eat over a hundred different species of waterside plants, leaving characteristic patches of vegetation chewed off at 45-degree angles. Water voles are a prey species for many other species, so the vegetation also provides somewhere for them to hide.

When we think of ecosystem engineers, we quite rightly think of the beaver. The water vole is also considered an important ecosystem engineer. Studies have shown that where there are more water vole burrows, there is a higher diversity of plant life surrounding these burrows (Bryce, 2006). This is because they affect the root structure of plants, which stops nettles and grasses becoming dominant on banksides, this allows a higher diversity of plant species to flourish (Roos, n.d).

> Water voles have been shown to eat over 100 different bankside plant species. At least a 2m width of vegetation is required to provide them with enough food and cover to hide. Photo © Terry Whittaker/2020VISION







As it is a prey species, the water vole is an elusive animal, fleeing when it detects movement. Therefore, surveys are carried out by looking for signs of water vole presence. Their burrows near the water are a good indication of their presence, but not conclusive. Water voles leave behind distinctive feeding signs with vegetation chewed off at a 45-degree angle, and their droppings are distinctively shaped and have a black glossy colouration. These droppings and feeding signs show there are water voles present. Photos © Ruth Hawksley

Water vole conservation

The water vole was once common in our streams, brooks, rivers, canals and wetlands throughout Britain. When 'Wind in the Willows' was written in 1908, this species would have been familiar to many people, yet many people now will never see a water vole in their lifetime. Water voles used to be found in nearly every waterway in England, Scotland and Wales but are now thought to have been lost at up to 90% of these sites (Mathews and Harrower, 2020). These declines in distribution are still occurring, with one study showing that between 2006 and 2015 their distribution had declined by 30% (McGuire and Whitfield, 2017).

Population sizes of this elusive mammal are hard to establish but show clear declines. They are Britain's fastest declining mammal. In 1990, the population of water voles was thought to be around 1,169,000 (Harris et al., 1995), by 1999, the population had dramatically declined to around 262,500 (Strachan, Strachan and Jefferies, 2000). The latest estimates were carried out in 2016 and show that there may be as few as 132,000 water voles left in Britain with 77,000 in England (Harris et al., 1995). Despite conservation efforts, further population reductions are suspected to be seen in the future in many areas.

There are many reasons for the water vole's decline. The removal of bankside vegetation in the first and second world wars to grow crops and farm cattle caused habitat loss, degradation and fragmentation (Strachan, Moorhouse and Gelling, 2011). These effects were compounded by the introduction of the American mink Neovision vison to Britain. Mink farms started in the 1920s and were booming by the 1970s, due to the demand for mink fur. Some of these farms had over 5000 mink and many escaped. Animal activists released large numbers of mink from fur farms in the 1980s and '90s. Since then the American mink has decimated the population of water voles, even in areas where the habitat is now suitable for them (Strachan, Moorhouse and Gelling, 2011). It is possible that many water vole populations would have been more resilient to mink if their complex habitats had not been lost and degraded. Other threats to the species come from inappropriate management of watercourse vegetation, attacks from domestic pets, development, pollution and litter (Strachan, Moorhouse and Gelling, 2011).



Water voles in Beds, Cambs and Northants

The whole of the Nene Wetlands area in Northamptonshire and many watercourses in Bedfordshire and Northamptonshire have suitable habitats for water voles. Water voles would have once been found in all of these areas. Due to all the impacts detailed here, the vast majority of these populations have disappeared.

The Wildlife Trust is working with partners to reverse this decline through invasive species control and working with landowners on habitat restoration. The aim is to restore this iconic species to our area. Another threat that this species faces in our area is water abstraction. Many Cambridgeshire chalk streams (internationally important habitats in their own right) have suffered due to increased water abstraction. We are working in partnership to protect and restore these waterbodies, safeguarding habitat for a wide variety of species.

Water for Wildlife project

Our freshwaters are home to a wealth of wildlife. Although the condition of our rivers has improved in the last 60 years, there is a long way to go. Only 35% of surface waters were classed as 'Good' in a 2016 Environment Agency report. The demand for water has never been higher, from drinking water supply, development and recreational use.

Our Water for Wildlife project helps landowners to restore and protect their river habitats. We use a variety of management techniques to improve rivers: laying gravel, rebuilding and reprofiling banks, carrying out tree work, installing woody material, and installing cattle drinks. Our wider countryside work is essential to expand, connect and improve habitats for wildlife across the whole of our area.

Find out more wildlifebcn.org/water-for-wildlife

Good numbers of water vole are present throughout the catchment of the River Cam, and in 2011 they even reappeared on the main river after years of absence

Water voles in fenland ditches

Due to large populations of water voles in the fens, the area is considered to be of national importance for the species. Fenland ditches have a long continuity of management on rotation, resulting in good water vole habitat (Carson, n.d.). There is a large amount of fenland drain habitat and it is well connected. This allows water vole metapopulations to move around the area and breed and also enables them to evade mink predation. On rivers with few side channels, mink can quickly wipe out a population, but a complex network of smaller channels allows water voles more opportunity to escape. On the fenland drains, we work in partnership with the Middle Level Commissioners and internal drainage boards to carry out surveys and habitat restoration. In these areas, our surveys have shown that water vole populations are stable, which is very different from the national picture of continued declines (Hawksley, 2016). As ditches are restored as part of the Great Fen project, they are becoming less linear and more floristically diverse. Wide strips of four metres are left alongside the channels, providing a wide variety of habitats. Water voles and otters thrive in these areas.

Otters

Another water mammal that we have in our area is the otter Lutra lutra. The otter is a great success story, as it has made a comeback in Britain over the past few decades. Otters are apex predators and therefore make great indicator species. If their populations are doing well then so are the fish and the invertebrates lower down the food chain. Otters are an important part of a functioning ecosystem, keeping populations of other species in balance. In our area, otters are widespread on a variety of watercourses but are not common in the fens. Otters tend to prefer running water and trees beside watercourses for them to build their holts. These habitats are not frequent in the fens. Artificial holts installed in the area have helped create suitable habitat and monitoring has shown they are frequently used.

Studies carried out in Bedfordshire in 2008 – 2009 (Lawrence, 2009), showed that otters were found on an increased number of sites compared with previous surveys. They were found on 52% of the sites in 2008/2009 compared with 18% of the same sites in 1996/1997. This study also showed that mink were on the decrease as they were only recorded on 8% of the sites in 2008/2009 compared with 35% of the sites in 1996/1997.

In Cambridgeshire, otter surveys have been carried out every five years since 1992. They are coordinated by the Cambridgeshire Mammal Group, with the Wildlife Trust BCN now jointly coordinating. The results have shown an increase in otter presence, from almost none in 1992 to now being present on all of Cambridgeshire's main rivers and many of its streams.

Summary

Although water vole populations are continuing to decline in many areas of Britain, our work in the Beds, Cambs and Northants area is helping this species to hold on and fight back. The Cambridgeshire fens remain an important area for this threatened and charismatic species. Protecting wildlife on nature reserves is no longer enough, we need to extend our efforts to the wider landscape. Our Water for Wildlife project is successfully doing this by liaising with landowners, carrying out surveys and through habitat restoration. There is a long way to go to reverse the declines seen in the freshwater environment, but we are confident, due to our successes so far, that we can make a significant difference.

Acknowledgements

Our thanks go to Peter Beckenham from Middle Level Commissioners for information for this case study.

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Successful Reintroductions

The reintroduction of species to areas where they were once found can be an effective conservation tool. This is true for the target species but also the wider ecosystem by restoring ecological balance. Reintroductions require extensive planning, habitat management, and monitoring to ensure success. This section focuses on an example where we have achieved a successful reintroduction of an endearing flagship species and effective woodland management.

The Hazel *Dormouse Muscardinus* avellanarius is one of Britain's most endangered mammals and listed as vulnerable to extinction in the UK. A reintroduction project on one of our sites is helping this species to recolonise. Photo © Gwen Hitchcock



The Hazel Dormouse

Introduction

Tucked up inside a tree hollow, the hazel dormouse is a shy secretive species that spends its life up in trees, rarely coming to the ground. The hazel or common dormouse *Muscardinus avellanarius* is one of Britain's most endangered mammals and is listed as vulnerable to extinction in the UK (Wembridge et al., 2019).

Due to their rarity and specific habitat requirements, dormice are considered flagship species for woodland conservation, and bio-indicators of habitat condition. This makes them an ideal species to monitor to help assess both woodland reserves and living landscapes.

Check out the award winning video by Ellie Bladon on our dormouse project wildlifebcn.org/dormouse

Dormouse ecology

Dormice are specialists of early-mid successional woodland and hedgerow habitats (Bright, Morris and Mitchell-Jones, 2006). They are arboreal, living up in the woodland canopy and rarely coming down to the ground. They are reluctant to cross open spaces where they are vulnerable to predation (Bright, Morris and Mitchell-Jones, 2006). This means that they require interconnected woodlands, hedgerows and scrub. High forests are less suitable since the dense canopy shades the understory meaning there are fewer flowering and fruiting shrubs, a key food resource for this species (Juškaitis, 2007).

Their optimal habitat is coppiced woodland with sensitive management of rides and glades, together with rotational coppicing. This creates a suitable mix of early successional trees and shrubs (Bright, Morris and Mitchell-Jones, 2006; Juškaitis, 2007). Small woodlands cannot sustain healthy dormouse populations and connection with other woodlands is key (Bright, Morris and Mitchell-Jones, 2006).

The hazel dormouse is an elusive species due to their rarity and nocturnal habits (Bright, Morris and Mitchell-Jones, 2006). The 'dor' part of their name comes from the French for sleep as they have a long hibernation over the winter when there is not much food around (Bright, Morris and Mitchell-Jones, 2006).



A licence holder carefully holding a sleepy dormouse after it has been weighed. Monitoring is essential to ensure that reintroduction programmes are working. Photo © Alistair Grant

Dormouse distribution

In Britain, the hazel dormouse is largely restricted to southern England, Wales and the Welsh borders, with a single population in the Lake District (I. White, 2020, pers. comm.). They are found in low densities, even in the best habitats. The distribution of this species has shrunk dramatically and it is now extinct in half of its former range (Bright, Morris and Mitchell-Jones, 2006). In our three counties, the species is scarce with records primarily in the Rockingham Forest area in Northamptonshire. They are also found on the borders of Bedfordshire and Northamptonshire with Buckinghamshire. There are two populations in Cambridgeshire.



Dormouse distribution across the three counties based on data held in the National Dormouse Database (NDD), PTES (2020)



Dormouse conservation

The hazel dormouse is a European protected species on the edge of its European range in the UK. It is classed as Vulnerable or possibly Endangered due to this range contraction and decline in populations (Wembridge et al., 2019; Mathews and Harrower, 2020). Populations have been monitored for longer than any other British mammal and these studies have shown that numbers of this species have halved since 2000 (Wembridge et al., 2019). This decline is due to the loss, fragmentation and inappropriate long-term management of woodlands and hedgerows (Bright, Morris and Mitchell-Jones, 2006).

Brampton Wood

Designated as a Site of Special Scientific Interest (SSSI) in 1954, Brampton Wood is an exceptional example of ancient woodland and the second-largest woodland in Cambridgeshire. At least 900 years old and spanning 132 hectares, the woodland hosts a myriad of plant, animal and fungi species. Following a successful appeal to conserve this magnificent area, the Trust purchased the site in 1992. Unlike many ancient woodlands, Brampton Wood has not become 'high forest', due to its history of coppice management and extensive felling (up to two-thirds of the wood during the 1950s). This management makes the woodland suitable habitat for dormice (Bright, Morris and Mitchell-Jones, 2006).

Dormouse reintroduction to Brampton Wood

The People's Trust for Endangered Species (PTES) co-ordinate the National Dormouse Database (NDD) and National Dormouse Monitoring Programme (NDMP), collecting and analysing data on dormouse populations from across the country. In 1992, a program of dormouse reintroduction was initiated to restore dormice to areas of England from which they had been lost and where natural recolonisation was unlikely (due to the dormouse's poor dispersal abilities). Twenty-four reintroductions have been made (Wembridge et al., 2019) with two-thirds of the sites proving successful in the medium term (Mitchell-Jones and White, 2009; Chanin, 2014).

Before the re-introduction, the dormouse had been extinct in Cambridgeshire since at least 1904. It is thought to have been lost from Brampton Wood due to a previous lack of management, resulting in the loss of early successional trees and shrubs. Brampton Wood was the location of the first official dormouse reintroduction project in the UK (Mitchell-Jones and White, 2009) with 11 wild-caught and 8 captive-bred dormice being released into the wood in June 1993 (Bright and Morris, 2002). A further 30 captivebred dormice were also released in summer 1994 to supplement the population. Captive breeding is often used, as we avoid taking dormice from fragile wild populations. It is considered that captive-bred animals are less successful than translocating wild bred animals but more individuals can be released (Bright and Morris, 2002). Dormouse boxes were placed within the wood to monitor the success of the reintroduction and track their dispersal.

Monitoring post reintroduction

Monitoring is essential to ensure that conservation measures are working. Since their release, dormice have been monitored in the wood every year and monitoring was incorporated into the Wildlife Trust's monitoring programme in 2011. The number of boxes, visits and box locations has changed over the years,



There are over 300 boxes in the wood, many of which are a special design, which limits the number of birds nesting in the boxes. Volunteers check the nest boxes for nests and dormice every month through the spring and summer. If dormice are found, they are measured and weighed to establish the population dynamics of the species on the site. As this species lives in low population densities and uses natural nest sites as well as boxes, the actual count is considered to be an underestimate. The results of this monitoring have shown that the reintroduction has been a success with dormice spreading throughout the wood by 2007 and beyond the wood by 2016 (Hitchcock, 2019).



Volunteers carefully checking a box for dormice. Boxes provide places for dormice to nest and sleep and also make monitoring of this species easier. Photo © Gwen Hitchcock

The spread of dormice throughout Brampton Wood from their original release site



The dormouse reintroduction in Brampton wood in 1993 was the first as part of the English Nature Species Recovery Programme. That dormice are still present in the wood and have been shown to be dispersing into the wider countryside is a testament to the ongoing work of the local Wildlife Trust and the many volunteers that have made this project a success. The dormouse reintroduction programme continues and now nearly 1,000 dormice have been reintroduced to 24 sites across midland and northern counties. We know dormouse reintroductions can work because of the ongoing success at Brampton wood.

Ian White, Dormouse Officer, People's Trust for Endangered Species

Summary

The results show that the reintroduction of dormice has been successful at Brampton wood. The lessons learnt through this reintroduction program have allowed this species to be successfully reintroduced elsewhere in the UK. The ongoing program of monitoring will allow us to establish the long-term success of dormice in Cambridgeshire and inform further reintroductions across the three counties.

Acknowledgements

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Managing Early Successional Habitats

Early successional habitats are resource-intensive to maintain but support unique and uncommon species. These species often thrive on open, disturbed land where there is no competition from other species or may require bare earth for nesting or basking. This section looks at examples of early successional freshwater and terrestrial habitats, the species they support, and our work to protect them.

Arable plants are one example of species that require early successional habitats in which to thrive. Our area is home to some internationally important assemblages of arable plants. Photo © Ryan Clark

Early Successional Freshwater Habitats

Introduction

Ponds can support a larger proportion of freshwater biodiversity than lakes or rivers and are especially important for uncommon freshwater species (Céréghino et al., 2007). A range of different ponds at a site supports the largest diversity of wildlife. Different parts of a pond can be at different stages of succession and attract different species.

Temporary pools such as this one at Dogsthorpe Star Pit nature reserve are home to a wide variety of invertebrates, including an array of specialised species, many of which are rare. Photo: Josh Hellon One area that is often overlooked is the presence of early successional freshwater habitats. This includes ponds that dry up seasonally, new ponds, ditches and scrapes. Temporary pools are often not valued enough, they can be seen as an inconvenience or may be deepened to hold water for longer, to the detriment of the specialist fauna dependant on them (Kirby, 1993). The invertebrates that live in temporary pools are often not able to cope with the competition and predation from other animals in permanent water. They have specialist adaptations to allow them to cope with periodic drying out of the temporary pools, this means that many species are not found in other habitats.



Habitat Creation and Maintenance

Water depths of 20 cm to 50 cm have been shown to support higher numbers and diversity of aquatic invertebrates than deeper waterbodies (Kirby, 1993). These waterbodies can gradually dry out if not disturbed and new ponds may have to be created to replace them. This is energy-intensive, often requiring heavy machinery, but is essential to maintain these habitats and the species they support.

Maintaining early successional features of existing pools is also resource-intensive. Scrub management must occur around the pools to ensure excessive vegetation does not drop in and to prevent excessive over-siltation. Early successional reedbed can be important for reedbed and wetland specialist invertebrates. However, reedbeds must be maintained so the reed does not become too dense and spread into open water, a habitat which many aquatic invertebrates and other species groups require. Smaller temporary water bodies are also important. Trampling from grazing animals and wheel ruts create temporary pools, vital for a wide variety of species. Water beetles can be effective colonisers of temporary pools due to their strong flight muscles.



This pond at Flitwick Moor nature reserve was excavated in 2011, recreating the historic peat diggings that would once have been common in the area and allowed early successional habitats and their associated species to develop. Surveys of this new pond have shown that it has attracted a wide range of aquatic invertebrates including several uncommon water beetle species associated with acidic waters. Photo © Gwen Hitchcock

Cruel to be Kind

Conservation work may sometimes look destructive. We sometimes have to play the part of large mammals, which have been lost from Britain, to fell trees and manage scrub. Historically, areas of grassland and bare earth would have been created by large mammals such as aurochs, bison and elks. Many species are reliant on these habitats rather than dense woodland; modern-day practical conservation involves taking the place of these animals to maintain habitats. This is both resource and energy-intensive.

Similarly, beavers used to maintain wetland habitats in a way that benefited a large number of species. Now conservation work tries to replicate the work that beavers would have performed. In many cases, we are also replicating old farming and forestry techniques to conserve the biodiverse habitats that are associated with traditionally managed areas such as hay meadows and coppice woodlands.

Although this work may look destructive at first, it is essential if we are to maintain a wide variety of habitats for wildlife to thrive. Bare earth is colonised by lichens and mosses, which support flowering plants and eventually scrub and trees. Resetting the balance of these different habitats is essential. Without management, our reserves would quickly become relatively uniform woodland, which is only beneficial to a select group of species.

Read our article from Local Wildlife wildlifebcn.org/cruel-to-be-kind

Volunteer work parties are an essential component of our reserve work, over 1000 volunteers support us with our work and we could not do what we do without them. Photo © Toni Castello



Monitoring our Freshwaters -Water Beetles and Bugs

Water beetles (Coleoptera) and bugs (Hemiptera) are great indicators of freshwater guality and are also fascinating and important in their own right. There are approximately 283 water beetle species in the UK. Of these 283 species, five are Regionally Extinct, 34 are Threatened, 37 are Near-Threatened and 84 are Nationally Scarce (Foster, 2010). There are 69 water bug species found in the UK. Water beetles vary dramatically in size and shape from tiny 1.5mm beetles up to 40mm great diving beetles. Similarly, water bugs vary from tiny 2mm bugs to those around 50mm in length. The ecology of water beetles is diverse, with some species feeding on algae and detritus and others feeding on other invertebrates and fish. The majority of water bugs are predators of other invertebrates and prefer shallow areas around vegetation or close to pond edges.

One reason why these groups are such good indicators is that there are a large number of habitatspecialist species. Some prefer well-vegetated ponds and others require very early successional ponds. There are also several species of flowing water. Some

What makes water beetles and bugs good indicator species:

- Diverse enough to give fine discrimination between good, mediocre and poor sites
- Several species found in almost all habitats
- A manageable number of species, 283 water beetles and 69 water bugs in Britain
- Identification less difficult than most invertebrates
- Their ecology is well understood and documented - we know their response to habitat and water quality

species are only found in the cleanest freshwaters so can tell us a lot about water quality that impacts a wide variety of species.

We started surveying water beetles and bugs on our reserves in 2012. Surveyors used a standard method (Palmer, Drake and Stewart, 2010) to collect a sample of invertebrates using a long-handled pond net. The samples were sorted on the bankside with specimens taken for identification to species-level.

G These surveys have not only given us information about the distribution and rarity of species in our area through the generation of biological records, but it has also told us a lot about the condition of freshwaters on our sites and their relative importance.

Josh Hellon, Monitoring and Research Manager, Wildlife Trust for Bedfordshire, Cambridgeshire and Northamptonshire

Nature reserves with a CCI of 20 or above (Hellon, 2016)

Reserve	ссі	sqs	Number of Species of Conservation Interest
Lattersey	33.19	3.67	13
Dogsthorpe Star Pit	29.31	2.85	8
Wilson's Pits	27.72	2.86	7
Irthlingborough Lakes and Meadows	25.05	2.38	12
Pitsford Reservoir	24.75	2.83	16
Stanground Wash	24.49	1.90	4
Godmanchester	24.09	2.78	2
Summer Leys	23.39	2.60	9

Species of conservation interest were categorised as being species with a CCI of 7 or above.

Shown in the table are the nature reserves surveyed that have a CCI of 20 or above, these are considered the top sites for aquatic invertebrates. We also analysed the waterbodies on the sites individually to determine which are the most important for aquatic invertebrates. The majority of these waterbodies that hold particularly special assemblages are early successional habitats. They all have at least one rare species present with a CCI of 8 and an overall CCI > 30 so are considered priority waterbodies for conservation.

Summary

Different species thrive in ponds at different stages of succession. Habitat maintenance is essential to ensure that we have a mosaic of freshwater habitats. These diverse habitats can support diverse invertebrate populations including rare and declining species. Monitoring is essential to ensure that our management of these unique habitats is as effective as possible.

Acknowledgements

Our thanks go to everyone that helps out with aquatic invertebrate monitoring on our reserves and also to Graham Warnes for providing information for this case study.

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Water Beetles at Dogsthorpe Star Pit

Dogsthorpe Star Pit near Peterborough is home to a wide variety of ponds, four of which are the top ten waterbodies for rare species on our reserves. The site is a Site of Special Scientific Interest primarily due to the rare invertebrate species found in the shallow ponds on site. Over 64 different water beetle species have been recorded on the site including several fenland relic species and scarce coastal species.

Large areas of open water are not as beneficial to many invertebrates as smaller ponds with more microhabitats. So some of the ponds at Dogsthorpe have been separated from the main lake and reprofiled so that they have shallower sides, which makes them more suitable for a wide range of invertebrates. The water levels of the lake are carefully maintained by pumping the water out of the site. The idea of the management on-site is to create ponds with varying depths, some of which dry up in the summer. These ponds are created on an ongoing basis, every three years. Some of the deeper ponds are good for stoneworts as well.

Creating the new ponds or re-exposing the clay creates the early successional habitat that many invertebrates prefer. Exposing the clay can create brackish pools, home to a wide variety of scarce species. Some spur ditches are allowed to dry out during the summer months. This creates pockets of water of varying salinity and areas of bare mud. Some ponds have also been dug in the gravel-rich areas of the site which provide habitats for a different suite of species. To stop reeds encroaching, constant work is needed to manage the vegetation in these areas.



Arable Plants

Introduction

Often overlooked, arable plants are the fastest declining and most threatened group of plants in Britain (Wilson and King, 2003). Arable plants thrive on the disturbance associated with arable farming but have been lost from many areas. The arable plant community remains the least studied of any major habitat in Britain (Byfield and Wilson, 2005) and there is lots still to discover. The Bedfordshire, Cambridgeshire and Northamptonshire area is really important for these beautiful plants due to the wide variety of soils present in the area and history of arable farming.

Arable plant ecology

Arable plants thrive on disturbance and could be better characterised as 'disturbed land plants'. Far from being ubiquitous 'weeds', many of these species are very specific about where they grow. The communities are diverse with over 150 plant species characteristic of arable areas in Britain. These fall into 48 different arable communities or subcommunities (Still and Byfield, 2007). Fields with the longest history of arable cultivation are often home to the richest communities of arable plants.

Although some species do contribute to a decreased crop yield through competition with crops and could be considered problem species, other plants are actually beneficial to the farmed environment. Arable plants are attractive and important in their own right, but also are important for other species. They are the foodplants for a wide variety of insects and provide nectar and pollen for a range of pollinating insects. The invertebrates and other wildlife they support are also a form of integrated pest control. As the majority of arable plants have an annual life cycle, they produce large amounts of seeds which in turn feed a variety of birds and small mammals.

Arable plant conservation

Arable farming has been a feature of the British landscape for some 8000 years. Even though 30% of the landscape is under cultivation (Byfield and Wilson, 2005), arable plants are in trouble. 121 plant species in Britain are classified as important arable plants (Byfield and Wilson, 2005). Of these, 54 species are rare or threatened and seven are now extinct in the arable setting (Still and Byfield, 2007). Twenty-three species of arable plants are noted as being of conservation concern and are therefore listed on Section 41 of the Natural Environment and Communities Act 2006 (Plantlife International, 2015). Species listed on this act are "of principal importance for the purpose of conserving biodiversity". Britain's arable plant communities are particularly important



as they occupy the north-western edge of the range of communities spreading across Europe and into Asia. Most have declined across their entire European range during the last century.

The factors that have contributed to the decline in arable plants are an all too common story familiar to conservationists. The use of broad-spectrum herbicides means that farmers have become more efficient at removing these weeds from their fields. There is now a greater proportion of autumn-sown cereals compared with the historical spring-sown cereals; this is not as suitable for arable plant germination. Seed cleaning (removing the seeds of unwanted species) has become more efficient, and fertiliser use has increased. Modern crop varieties can take-up large quantities of nutrients and grow faster than the arable plants that lived alongside them (Plantlife International, 2015).

Historically there were low-intensity periods of agriculture, such as during crop rotation cycles, that enabled arable plants to establish. As more pressure was put on the land to deliver more food, these periods were lost. Many farms now cultivate using minimum tillage, which may not create enough disturbance for some arable plants to establish, while others can do better under this management.

Arable areas themselves have been lost as farms convert to pastoral systems and maize or are lost to development. The best areas for arable plants now are in the field edges, the metre or so where the crop is not planted or sprayed/fertilised so intensively, or not cultivated every year. This provides an occasional bare fallow for arable plants to grow and set seed. Some other arable plants have declined as the season of cultivation has changed (Wilson and King, 2003). Changing from spring to autumn cultivation affects spring germinating arable plants adversely. Some of the species that have declined dramatically have relatively short seedbanks ad once lost from a site it is difficult to get them to re-establish without reintroductions (e.g. Field cow-wheat *Melampyrum arvense*). Several species, including some of the rarest arable plants in Britain, respond well to sympathetic management (Still and Byfield, 2007).

Ground pine *Ajuga chamaepitys* has a long-lived seedbank so can sometimes weather unfavourable conditions and appear again when conditions are favourable. It is a case of providing the right type of management in the right place. This management often benefits other species such as invertebrates, lichens and bryophytes.



BCN arable plants

Cambridgeshire is the seventh richest vice-county and Bedfordshire the 15th richest vice county for arable plants in Britain (Still and Byfield, 2007). Southern and eastern counties of Britain score most highly, demonstrating the species richness of the areas, at least in terms of rare and/or declining species (Still and Byfield, 2007). Most arable plant areas fall outside of nature reserves so our work in the wider landscape is important.

A study in Bedfordshire carried out in 2007 found that the county holds 16 sites of national importance for arable plant assemblages (Bedfordshire & Luton Biodiversity Partnership, 2007b; Byfield and Wilson, 2005). These are known as Important Arable Plant Areas. Each broad soil type - defined as calcareous soils, clay and slowly permeable soils and sandy and shale free-draining soils - has different thresholds using a scoring system ranking rare and threatened arable plant species between 1-9 on a scale of increasing threat of extinction.

Thresholds have been applied to indicate the importance of the arable plant community in each area, to give an IAPA score. Approximately half of the National Important Arable Plant Areas in Bedfordshire are located on the shallow chalk soils of the Chilterns in the south of the county. A quarter are located on clay soils, and the remaining quarter on the sandy soils of the county's rivers and the Greensand Ridge (Bedfordshire & Luton Biodiversity Partnership, 2007b). Thirty-four sites were found to be of county importance (Bedfordshire & Luton Biodiversity Partnership, 2007b).



This map shows the Important Arable Plant Areas within our three counties

These are strongly associated with the natural character areas shown below. The Chilterns, East Anglian Chalk and Greensand Ridge are especially important for arable plants in our area. Several sites in our area are of European importance for their arable plants. Data provided by Plantlife. In 2019, an arable field near Scaldwell in Northamptonshire was designated as a Local Wildlife Site in Northamptonshire and is thought to represent the best arable plant flora in the county. Several of the arable flowers in the field are listed in the Northants rare plant register; annual knawel *Scleranthus annuus*, corn marigold *Glebionis* segetum, corn spurrey Spergula arvensis, field woundwort Stachys arvensis and Venus's-lookingglass Legousia hybrida. This designation ensures that the value of this area is recognised and ongoing discussions with the landowner will ensure that this site continues to be managed effectively for these amazing plants.



Field woundwort *Stachys arvensis*, corn marigold *Glebionis segetum* and Venus's-looking-glass *Legousia hybrida.* These three plants are listed on the Northamptonshire rare plant register and were recorded in an arable field near Scaldwell, the first Local Wildlife Site designated for arable plants in the area., Photos © Ryan Clark

Some of the arable plants for which our area is particularly important:

Ground-pine Ajuga chamaepitys

This member of the dead nettle family is found on only 32 sites in Britain, 3 of which are in Bedfordshire. It is a species that needs disturbed areas on calcareous soils. One of the sites for this species is our Barton Gravel Pits reserve.

Wild candytuft Iberis amara

This is a species of bare, open ground on chalk. The populations of this species in chalk grassland are stable, but the populations in arable margins are declining drastically and this species is therefore listed as Vulnerable. There are good populations of this species in the calcareous parts of our area. Field Gromwell Lithospermum arvense

This is a species of disturbed, dry calcareous areas. This is an uncommon species but there are lots of records for our area.

Grass-poly Lythrum hyssopifolium

This species is an annual of disturbed ground that is flooded in winter, including hollows and ruts in arable fields. Cambridgeshire is one of only a few places where this species occurs now.

Field cow-wheat Melampyrum arvense

This species is now found only on four sites in the

whole of the UK, including a site in Bedfordshire. This species used to be a fairly common arable plant but has been completely lost from arable areas and is only present in other disturbed habitats.

Spreading hedge-parsley Torilis arvensis

Once frequent, this species had already been lost from nearly half its sites by 1930, and since then its accelerating decline has been one of the most dramatic shown by any arable plant. This is a species most often associated with calcareous clays. It has been successfully reintroduced to our Pegsdon nature reserve.



Ground-pine Ajuga chamaepitys – This species is found on only 32 sites in Britain, 3 of which are in Bedfordshire. It is a species that needs disturbed areas on calcareous soils. One of the sites for this species is our Barton Gravel Pits reserve. Photo C Brian Eversham

Field cow-wheat Melampyrum arvense was once a fairly common arable plant. This species is no longe found in arable settings and is only found on four sites in the whole of the UK, including one site in Bedfordshire. Photo © Ryan Clark



Local Wildlife Sites

Local Wildlife Sites (also known as County Wildlife Sites) are the most important areas for wildlife outside of legally protected sites such as Sites of Special Scientific Interest (SSSI) and National Nature Reserves (NNR). Across the three counties, there are over 1600 Local Wildlife Sites. These areas are designated for the special habitats or species that they contain. Alongside nature reserves, NNRs and SSSIs, they form part of a network of sites for wildlife to thrive in and move between.

The Wildlife Trust BCN established and now maintains the LWS system in the area. We provide free advice and information to landowners on managing these sites. We also run a monitoring programme that aims to visit each site periodically to find out what wildlife is there. We can also help landowners with information about sources of grant aid for nature-friendly management. We are extremely proud of our Local Wildlife Site system and it forms a key part of our work in the wider countryside.

Example 2 Find out more <u>wildlifebcn.org/local-wildlife-sites</u>

Further information on Arable Farmland

https://www.plantlife.org.uk/uk/discover-wild-plants-nature/habitats/arable-farmland https://naturebftb.co.uk/the-projects/colour-in-the-margins/

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The Importance of Bare Ground

The importance of bare ground can often be overlooked but is an essential part of all habitats including grasslands, woodlands, wetlands and heathlands. Areas of bare ground provide localised warm spots, essential for species such as the dingy skipper butterfly Erynnis tages and reptiles like the common lizard *Zootoca vivipara*. Bare ground also provides germination spots for a wide range of annual species including arable plants. This benefits a variety of specialist seed feeding invertebrate species such as the ground beetle *Ophonus laticollis*. This species had declined by 88% between 1900-69 and 1970-2004 and is now only found in five counties, including Cambridgeshire (Buglife, n.d.)

Many lichens and bryophytes (mosses and liverworts) cannot compete with other species so are reliant on bare ground to survive. The recent flora of Cambridgeshire's bryophytes showed that many species associated with these habitats have been lost from sites due to succession (Preston and Hill, 2019). A recent article on the bryophytes of Devil's Dyke in Cambridgeshire revealed that this site holds over 120 bryophyte species, including 32 calcicoles (specialists of base-rich microhabitats) the majority of these needing bare earth to establish (Preston and Hill, 2020). Bare ground, especially patches on loose soils are also important for invertebrate species to nest, including a large range of solitary bee and wasp species.

Tuft stripping at our Cooper's Hill reserve to restore the heathland has the added benefit of creating bare earth. This is a crucial nesting habitat for a wide variety of insects including solitary bees and wasps. Shown here are (from top to bottom): the beewolf *Philanthus triangulum*, a jewel wasp *Hedychrum sp.*, sandpit mining bee *Andrena barbilabris* and hairy-legged mining bee *Dasypoda hirtipes*. Photos © Ryan Clark









Bare ground is a transient habitat, over time developing into a vegetated habitat. Bare ground would have historically been created through the impact of large herbivorous mammals through trampling and grazing. We use grazing animals to attempt to replicate this effect on our reserves. Where this is not possible, active management is required to create large areas of bare ground through processes such as turf stripping and soil reprofiling. In woodlands, the exposed root plates of fallen trees are also a significant source of bare ground and, when safe to do so, we leave fallen trees in place.

Resetting habitats to early successional states is resource-intensive, as the areas have to be large enough to ensure that they take a significant period to revegetate. This process is needed to create bare ground, essential in its own right, but also to encourage sparsely vegetated areas to develop. This leads to a mosaic of habitats that are beneficial to a wide variety of species. The amount of bare earth on a site is factored into the management plans for our heathlands and grasslands, to ensure that we are maintaining the correct balance.

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Bare ground is essential for a wide variety of species. This patch of bare ground at Cooper's Hill nature reserve is home to large colonies of solitary bees, solitary wasps and tiger beetles. It is also used by a wide variety of species such as butterflies and lizards for basking purposes. Photo © Ryan Clark



Evidence-led Conservation

Monitoring and research are at the heart of our conservation work. We have a dedicated monitoring and research team who carry out extensive surveys every year. With the help of staff and volunteers, they have carried out hundreds of surveys encompassing a wide variety of habitats and taxonomic groups. The monitoring and research work feeds into management plans and informs conservation measures across the whole of the three counties.

Ensuring that our nature reserves are in good condition is essential. Monitoring gives us the evidence base to show that our conservation work is working. Research informs future conservation practices. Photo © Josh Hellon

Monitoring and Research

Introduction

One of our core values has long been that conservation depends on local knowledge and good science. Existing regional conservation organisations combined to form the Wildlife Trust BCN as we know it today and we remain evidence-led in our approach to conservation. This is especially important as the challenges of wildlife conservation increase with climate change and an ever-growing human population.

The environment is changing in many ways and it cannot be assumed that established conservation techniques will be successful in the future (Fuller et al., 2016). Data is essential to everything we do and allows us to make informed decisions about habitat management and species conservation. This data is collected by staff and volunteers, both carrying out essential work. We could not do our work without volunteers, from data crunchers to those on the ground carrying out a vast variety of surveys alongside staff.

Find out more and read our latest news and blog posts wildlifebcn.org/monitoring-and-research

We will always do what we think is best for a nature reserve, but only the response of species will confirm that we are right

Brian Eversham, Chief Executive Officer (CEO), Wildlife Trust for Bedfordshire, Cambridgeshire and Northamptonshire

> We have a program of grassland surveys, which are carried out on a rotational basis. These tell us how our grasslands are faring and how our management is influencing them. Photo © Gwen Hitchcock



Evidence champions

Conservation Evidence, a Cambridge University initiative promoting evidence-based conservation, recognises us as being an Evidence Champion. This means that we consider scientific evidence when carrying out our conservation work. When we are planning the management of our reserves, we consider the evidence to ensure we use the most effective management techniques. Our monitoring tells us if we are getting our practical habitat management right. Where possible we then publish the results of our research so that others can learn from our experience.

Monitoring using drones

The advent of affordable drones has allowed us to take advantage of this exciting and incredibly useful technology. We now have several staff licenced to fly a drone within the Trust and this is enabling us to see our reserves in new ways. We can now fly over a site and take detailed aerial images. These images, through special analysis tools, allow us to determine the extent of scrub or bare earth on a site and inform management plans. Drones have also allowed us to map out the extent of non-native species on sites. This technology has increasingly become an important aspect of our work and there are many exciting possibilities for its use in the future.

Shepreth L Moor nature reserve



Heathland restoration trial

Heathland is an extremely rare and precious habitat in our area. Our Cooper's Hill reserve is the best remaining example in Bedfordshire of the once more extensive heathland situated on the thin acidic soils of the Lower Greensand ridge. Whilst the extent of heathland on this site has remained constant, some of the older heather *Calluna vulgaris* was being replaced by dense grassy swards. This was due to outbreaks of the heather beetle *Lochmaea suturalis*, which killed areas of heather, allowing grass to establish. The age structure of the heather was also biased towards mature heather. It was hypothesised that any heather seedlings would have difficulty competing with the grasses and we tested this by removing the turf to expose the nutrient-poor sandy soil in seven small plots across the reserve. Some plots also had seed-rich heather brash added to them (Hitchcock, 2018). We ensured that we had control plots and carried out systematic surveying of the plots to ensure accurate results. The trial showed that tuft stripping is an effective way to restore heather rich areas and that adding seedrich heather brash did not increase the amount of heather growing in the plots. This work was published in 'Conservation Evidence', a journal that shares the results of management interventions to help develop best practice in this area.



The percentage cover of heather in the treatment and control plots over time (Hitchcock, 2018).



The Wildlife of **Bedfordshire**, **Cambridgeshire and Northamptonshire**

Bat monitoring and research

Bats can tell us a lot about the condition of our woodland sites and habitat connectivity. Bats are highly mobile yet dependant on a network of landscape features and connectivity within that network. Each night, bats can commute several kilometres to their foraging sites, so their activity is spread over a large area of the landscape. This means that bat populations are not affected solely by the condition of a particular reserve but also its place in the landscape.

Within the Trust, we have several licensed bat surveyors who carry out monitoring and research on our sites and in the wider landscape. Our Big Wetland Bat surveys highlight the importance of our wetlands for bats and tell us about the condition of them. This information feeds back into the management of the sites. Alongside this, we have been carrying out a long programme of Bat Pathfinders surveys.

The Bat Pathfinder surveys aim to instigate landscape-scale monitoring of woodland linkage projects and use information on bat behaviour to monitor the success of these. This project is giving us valuable data about the importance of a wide variety of linear features for bats including hedgerows, trees and canals. As this is a landscape-scale project, cross-organisational working is essential and we work closely with a wide variety of organisations and groups to generate robust data.

Advances in equipment are allowing us to survey bats on our reserves and the wider landscape in new and exciting ways. Until now, we have been completely reliant on large numbers of volunteers and bat detectors to survey bats.



As its name suggests, the brown long-eared bat Plecotus auritus has large ears, allowing it to call quietly. This means that it is usually not picked up on bat detectors. Trapping of bats will allow us to find out more about the populations of a wide variety of species on our reserves. Photo © Gwen Hitchcock

In 2019 we obtained a project licence to survey bats using mist nets and harp traps and plan to do more so in the future. This process is carried out by experienced surveyors trained in the use of these methods and bat handling. This will vastly improve our knowledge of the species in the area, as we can survey species not suited to bat detectors such as brown long-eared bats and acoustically cryptic Myotis species. It will also tell us about the importance of our sites during different life stages such as breeding. Getting a close look at the bats allows us to establish population age structures and breeding condition and the importance of sites for maternity roosts.

We also are looking to purchase small static bat detectors called AudioMoths. These will allow us to survey new areas efficiently and survey for longer periods, allowing us to target our volunteer bat surveyors on key areas.

Finally, we are looking to carry out radio tracking in the future. This technique would allow us to see exactly where individual bats fly in a night. This will further improve our knowledge of habitat connectivity in some key areas for bats. Our work on bats is really exciting and will generate knowledge of how the landscape is functioning for a wide variety of other species.

Calcareous grassland restoration

In autumn of 2008, the Wildlife Trust purchased Cherry Hinton East Pit, part of Cherry Hinton Chalk Pits Site of Special Scientific Interest (SSSI). This site had been unmanaged since quarrying ceased in the 1980s. The ridges and bowls left by quarrying were still present, but most of the pit had been colonised by buddleia. This invasive plant was shading out the calcareous grassland species for which the SSSI was selected. Therefore, the Trust reprofiled the site and removed buddleia using heavy machinery, which returned large areas to bare chalk.

Monitoring work was then carried out to see how long it took chalk grassland herbs to colonise the bare chalk. This sat alongside extensive invertebrate surveys which highlighted that every successional stage had important invertebrates associated with it and that a mosaic of habitats was required.



Change in frequency of chalk grassland indicator species over time

A graph showing the increase in frequency of chalk grassland indicator species over time in an area of Cherry Hinton Chalk Pit (Williams, 2017)



East Pit of Cherry Hinton Chalk Pit was originally covered in buddleia and scrub when the Wildlife Trust purchased the site. The site was reprofiled and returned to bare chalk, important for a wide variety of species. The chalk grassland for which the site is designated has returned benefitting a wide variety of invertebrates, plants, lichens and bryophytes. Photos © Jonathan Graham and Siân Williams

Orchid monitoring

Our nature reserves across the three counties are important for several orchid species. One example of this is Totternhoe Nature Reserve. Totternhoe is a chalk grassland reserve, which is home to a wide variety of amazing species, including three rare specialist calcareous grassland orchids. These are the man *Orchis anthropophora*, musk *Herminium monorchis* and frog *Dactylorhiza viridis* orchids. The populations of these species peaked in the 1980s (Revels, Boon and Bellamy, 2015). In 2012, the Wildlife Trust set up a programme to monitor these orchids, following on from previous work by local naturalist Terry Wells dating back to 1966.

Our work not only looked at where on the site the orchids are found but also gave us an insight into their ecology. We monitored individual orchids to establish the percentage that flower and set seed each year and the microhabitats that the orchids are found in. We also looked at the effect of caging orchids; this is where a wire mesh is placed over the plants to stop the damage from grazing and trampling. We found that caging orchids protects them from grazing and trampling while not effecting the likelihood of successful pollination (Revels, Boon and Bellamy, 2015; Hitchcock, 2019).

All this work fed back into the management of the site including targetted scrub removal around key areas for these species. It also informed attempts to recreate similar habitats in other areas. Early indications suggest that the number of man orchids on the site has increased in areas where we have targeted scrub removal.



Wildlife Training Workshops

Species identification and habitat knowledge are at the heart of our work. For over twenty years we have organised a programme of training workshops. These started with guided walks on some of our best reserves but are now more specialised. The workshops are now mainly focused on species identification, habitat knowledge and survey skills.

On average, we run between 40 – 45 workshops per year with between 400 - 500 people attending across the three counties. We have organised over 1000 workshops (over 10,000 bookings) focussing on everything from identifying bryophytes, to using trail cams to monitor wildlife. Many of the participants are members of the public from across the three counties and beyond, providing an affordable way for the public to learn about local wildlife from knowledgeable local naturalists. We also use these workshops to train staff and volunteers, this being the initial reason we started the programme. We believe that habitat and species knowledge are fundamental to our work, and it is essential that we invest in training staff and volunteers in these skills. The training workshop programme is an area that we are very proud of as a Trust. Some participants have even gone on to become county recorders or enjoy a lifelong passion following attendance.

Explore our current programme wildlifebcn.org/training-workshops

Local Environmental Records Centres

The Wildlife Trust hosts three local environmental records centres, which collectively cover the whole of our area. Although they are independent of the Trust, we work with them extremely closely. They are the guardians of the species, habitat, and site designation data, that is essential for every aspect of our conservation work. They currently hold over 5 million records of species in their databases; every record gives us a better picture of how our wildlife is faring. Our work also generates a significant amount of data, which we feed back into the records centres to ensure this data can be used as part of wider conservation measures locally and nationally.

Find out more wildlifebcn.org/record-centres

Acknowledgements

Our monitoring and research would not be possible without the volunteers who help us survey sites in all weathers and help process the data from surveys; we would like to thank them for all of their hard work in monitoring our area.

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A Wilder Future in a Changing Climate

Climate change is one of the biggest issues of our time. We are already seeing fundamental changes in the ecology and the timing of life-history events such as flight periods and flowering period of species. These changes are only going to become more evident over time. Our conservation efforts need to take into account these changes to enable species to continue to thrive in our area. We need to ensure that species can successfully move throughout the landscape, as managing reserves is not enough on its own. Nature reserves will always be essential for wildlife conservation and need to be dynamic to allow species to explore new niches within sites. The following examples will look at how climate change may affect our wildlife through the arrival of new species. It will also focus on what we can do to conserve the species our sites currently support, through habitat creation.

The little egret *Egretta garzetta* was once a rare visitor to Britain. It is now widespread and commonly breeds. This shift in distribution is thought to be due to climate change. Species that cannot move further north due to lack of suitable habitats are vulnerable to extinction in Britain. Photo © Terry Whittaker/2020VISION

Introduction

Ecosystems operate at a landscape level so conservation needs to as well. The Trust was at the forefront of the move towards landscape-scale conservation and restoration of habitats, alongside preservation. Around the turn of the century, we were pushing for large scale projects outside of nature reserves with the desire to reverse decades of habitat loss and deterioration through bold creative conservation and ecological restoration (Colston, 1997). Our Living Landscape work followed on from this and took into account the need for species to move between areas and the potential value that many sites other than nature reserves hold. In 2010, the Lawton report was released and landscape-scale conservation became more mainstream. Landscapescale conservation continues to play a key part in our work. This section details how we are influencing wildlife conservation across the three counties and beyond, to build the joined-up network of habitats that will allow wildlife and people to thrive. This will be a nature recovery network to not only preserve what we have but to also enhance our local area for wildlife.

Find out more wildlifebcn.org/nature-recovery-network



Core sites contain the best examples of habitats in the area. Wildlife needs to be able to move between these areas and to colonise new areas. Photo © James Adler

Key components

These are the gems in the crown, key sites for wildlife conservation.

Nature reserves

Nature reserve management is at the heart of our work. We manage over 100 nature reserves, covering over 4,000 hectares of land. These are the strongholds for a large number of species and habitats and we work tirelessly, spending over £2 million a year, to ensure that the reserves are the best that they can be for people and wildlife. The majority of people in the three counties live less than five miles away from a Wildlife Trust nature reserve.

Sites of Special Scientific Interest and National Nature Reserves

Some of the sites we manage are of international importance and many of our reserves are designated as Sites of Special Scientific Interest, reflecting how precious they are for wildlife. A small number have the additional accolade of National Nature Reserve, reflecting their value to people in addition to containing some of the most valuable wildlife habitats and species assemblages in the country. The Trust is proud to be the holder of "approved body" status in recognition of our site management standards.

Local Wildlife Sites

Local Wildlife Sites recognise all known examples of special sites for wildlife that do not have statutory protection. Alongside nature reserves, these are the core sites containing critical reservoirs of biodiversity with wildlife populations that can spread out into sites managed with wildlife in mind. There are over 1600 Local Wildlife Sites across the three counties. We work closely with partner organisations to survey sites and keep site information up to date. Wherever we can, we help encourage and advise site owners on managing their sites for wildlife.

Other components

The primary purpose of these sites is not for nature conservation, but all of these sites have the potential to play a vital part in the nature recovery network.

Churchyards

Many of these sites hold the oldest examples of managed grasslands in the area and have amazing potential for wildlife. The ancient buildings, walls and memorials are especially important for unique lichen communities. We provide advice and encouragement to those wanting to manage their churchyards in a wildlife-friendly way.

Churchyard Advice

We provide advice to churchyards across the three counties to enable local people to maintain wildlife-friendly burial grounds. In Northamptonshire, there was a churchyard scheme established in 1983 that recognises the work of churchyards in the county to enhance their sites for wildlife. The Wildlife Trust BCN administers this scheme, arranges judging and advisory visits and keeps in regular touch with over 90 churchyards in the county. There are currently 21 churchyards that hold a current bronze, silver or gold award. There are similar schemes in Bedfordshire and Cambridgeshire, often working in partnership with others to achieve positive outcomes for wildlife in these special habitats.

OFind out more wildlifebcn.org/churchyards

Gardens

The area of gardens in Britain covers a much larger area than nature reserves do. A recent study in Bedfordshire showed that gardens make up over 5% of the land area of the county. Through our education programme, we try to encourage people to manage their gardens with nature in mind. We have a network of over 33,000 members across the three counties and communicate in a wide variety of ways to be the voice for nature. Everyone can play their part in nature's recovery.

Development

We recognise the need for development for our growing population and we work with developers to ensure that developments can achieve more

for wildlife. Building nature into the heart of development is essential for our future. Inappropriate development can harm our natural heritage, but well-considered planning has the potential to protect or even enhance our environment and help nature's recovery - by restoring and creating wildlife habitats. We advise on planning applications and formally object to those that will detrimentally affect wildlife. We support the change in emphasis for development to deliver 'no net loss' to delivering 'biodiversity net gain' and have advocated for this approach for a long time.

Farmland

Over 60% of the UK's land cover is farmed in some way. We work alongside farmers to help them create spaces for nature on their land by providing advice and support. Our Farming for the Future project in Northamptonshire advises and provides financial support for farmers in the Nene Valley to restore wetland and meadow habitats. Farmland is essential to provide the links between sites needed to build a nature recovery network, as well as having the potential to support important habitats in its own right. By working with landowners there is also an opportunity to help reduce the use of pesticides, decrease carbon emissions and to create and manage new habitats.



Climate change campaigning

As an organisation, we campaign at both local and national levels to ensure that nature is at the heart of decisions that are made. At the local level, we need the support of local government, councils and communities to ensure nature is considered at every turn. At a national level, we believe our existing laws are currently too weak and that the climate and ecological crisis we face is not being taken seriously enough. We need ambitious natural climate solutions that reduce and capture carbon, stop ecosystem destruction and make our towns and cities cleaner and greener. We are one of 46 independent Wildlife Trusts across the country, connected by the work of the Royal Society of Wildlife Trusts. As a part of this larger network, we have an even stronger voice to lobby for effective protection for the natural world.

Keep up to date wildlifebcn.org/e-news

Linkages

These habitats are important in their own right but are also key features that allow species to disperse through the landscape. This is especially important for climate change mitigation.

Watercourses

Our waterway network is one of the most significant features in the landscape. The channels themselves support a diverse array of species. Alongside the channels, there are associated grasslands, ponds, pollard willows and old river channels. Our watercourses are also under severe pressure from the changing climate, abstraction and pollution. Our water for wildlife project is helping to restore watercourses across the three counties. This includes laying gravel, rebuilding and reprofiling banks, carrying out tree work, and installing cattle drinks.

Road verges

There are nearly 313,500 miles of rural road verge in the UK – equivalent in area to our remaining lowland species-rich grassland (Bromley, McCarthy and Shellswell, 2019). They are a complex mix of a variety of habitats; from broken ground to grassland, scrub, ditch banks, wet or dry ditch bottoms and hedges (sometimes with significant hedgerow trees). This provides significant habitat in itself but is also a key asset in linking up larger sites. We campaign for the appropriate management of road verges and designate those with particularly important assemblages of wildlife as Local Wildlife Sites. We work with councils to ensure they are safeguarded for the future.

Other linear features

Hedgerows, ditches and farmland borders are also really important linear features, linking up larger areas of habitat as well as providing essential habitat in their own right. Our Wider Countryside and Reserves teams are involved in multiple projects to protect and enhance these habitats.

Thinking big

We work in partnership to achieve larger-scale outcomes for nature.

Nature recovery strategies and maps

With partners, we have developed nature recovery maps which highlight key areas where targeted restoration work would achieve the greatest outcomes for wildlife in the face of climatic change. In 2020, the government published its nature recovery network strategy, the biggest nature restoration project in our nation's history. As leaders in this area, we will work closely with the government to ensure that nature thrives across our area.

Landscape-scale projects

Our Great Fen project was one of the first of its kind in Britain, thinking large and joining up huge areas to restore a functioning ecosystem and buffer existing wildlife strongholds. This project has achieved national and international recognition. The monitoring of how nature has responded to this project has shown that we have the potential to restore functioning landscapes for both wildlife and people.

Evidence for change

Evidence-based conservation is at the heart of everything we do. We host three Local Records Centres, which hold data on species, habitats and designations across the three counties. These records centres hold and manage over 5 million species records between them. Two of the records centres are currently accredited by the Association of Local Environmental Records Centres and were some of the first in the county to receive this accolade. The environmental records centre for Northamptonshire is currently in the process of achieving accreditation. By hosting these records centres, we have easy access to high-quality data to inform our work.



Living Landscapes in Bedfordshire, Cambridgeshire and Northamptonshire

Living landscapes are natural networks allowing wildlife to travel from site to site. Across the three counties, we have established nine living landscape areas that we focus on. By thinking big, we can achieve better outcomes for nature. Map contains Ordnance Survey data C Crown copyright and database right 2012

Summary

It is no longer enough to just protect the existing wildlife and habitats that we have. We need to focus on large-scale restoration to achieve the outcomes we need for wildlife and people, in a changing climate. The Wildlife Trust works locally to make a difference to wildlife across the three counties and joins up with others to be a stronger voice for nature.

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The Challenges and Opportunities of Climate Change

We are in the middle of both an ecological and climatic crisis. The two are intrinsically linked and we cannot solve one without solving the other. The need for action has never been clearer and climate change is set to be one of the biggest challenges facing nature globally.

Climate change brings many challenges to conservation but also brings some opportunities too. Our area may no longer be suitable for some species if we do not put measures in place to help support them. There are ways in which we can help to mitigate these effects, these are discussed in the following cases studies. Allowing species to move through the landscape is essential, meaning that although still of vital importance, we need to think beyond nature reserves. Climate change will bring new species to the area, this in itself has its benefits and problems. Our area may become important for new species and some areas of our fauna and flora will become more biodiverse. On the other hand, climate change is likely to bring new challenges in the form of invasive species that may negatively influence other species and agriculture.

Due to climate change, people are opening their eyes to the challenges affecting our wildlife. This allows us to engage with new people and encourage them to be more environmentally friendly. Nature-based solutions are essential for climate change mitigation. We must therefore use nature as an ally in our efforts to fight climate change by building a nature recovery network for the good of nature and people. This will involve not only looking after the habitats and species we have but allow nature to recover too. The increased reliance on fossil fuels needs to be tackled by nature-based solutions which can work alongside switching to more renewable sources of energy.

Water Works

The Water Works project is piloting, through field-scale trials a new, sustainable system of farming. Wet farming, also known as paludiculture is now taking place at the Great Fen. This system has the potential to change the face of farming in the Fens, whilst protecting peat soils, locking in carbon, supporting wildlife, and creating new economic opportunities for farmers, growers and producers, providing a model for similar initiatives worldwide. The project is managed by a partnership between the Wildlife Trust BCN, Cambridgeshire ACRE, UK Centre For Ecology & Hydrology (UKCEH) and the University of East London. It is funded by a grant awarded in 2019 by the People's Postcode Lottery Dream Fund. Working with climate change experts at UKCEH, Water Works is also producing the site-specific data to demonstrate the high levels of carbon sequestration that can result from this type of land management.

Find out more <u>greatfen.org.uk</u>



One of the most damaging effects of climate change is not the average weather conditions, but the increased frequency and intensity of extreme weather events. Local actions to restore ecosystem complexity and structure can have a profound effect and increase species' resilience to these events. Our work on nature reserves and the wider countryside acts as an essential buffer to mitigate these effects. A key challenge that we face is that we do not yet know how species and ecosystems will be affected by climate change, therefore we need to be proactive in our approach to tackling this problem.

Introduction

Climate change is already having profound effects on species in Britain, with the climatic niches of species (the area in which the climate is suitable for them to live) shifting northwards in many cases, including for butterflies (Parmesan et al., 1999). For some mobile and generalist species, this may not pose too much of a problem, as long as we have the interconnected habitats they require. However, we have many fragile specialist species that will struggle to find suitable habitats further north (Warren et al., 1999), or which disperse too slowly to be able to follow their preferred climate (Hayes et al., 2019). Therefore, we need to look at how we can continue to support species on our sites under climate change. Small-scale variability is of vital importance on a site, especially with regards to temperature. As humans, we need relatively large changes in the landscape to see a noticeable temperature change, but other organisms operate at much smaller scales. This means that a small difference in grassland structure, vegetation height, scrub density and smallscale topographical variation can be important for species (Suggitt et al., 2018). Butterflies can often act as a 'canary in the mine' and can help us understand how other species may react to climate change. Butterfly research on our Totternhoe nature reserve is helping to influence how we continue to manage this site for the benefit of a wide variety of species under changing climatic conditions.



A map of the main vegetation type at Totternhoe nature reserve (Hayes et al., 2018)

There is a diverse array of habitats on the site supporting a wide variety of specialised species. However, constant management by Wildlife Trust staff and volunteers is required to maintain the diverse successional habitat (grassland with areas of encroaching scrub) preferred by many species.

Totternhoe's butterflies

Totternhoe nature reserve in Bedfordshire is a large area of calcareous grassland. The site is home to a wide variety of butterfly species, including the small blue *Cupido minimus* and Duke of Burgundy *Hamearis lucina*. Research carried out by the University of Cambridge at Totternhoe showed that the Duke of Burgundy butterfly has extremely specific habitat requirements and was found using the same small areas of the reserve year after year (Hayes et al., 2018; Hayes et al., 2019). These locations were warm, sheltered valleys surrounding old mine entrances. The species has suffered large declines over the last 50 years, however, numbers appear to be rising again at Totternhoe and other sites (Hayes et al., 2018).



Our research suggests that this spring-flying species needs these locations to warm up and power energetically demanding flights involved with territorial defence and acquiring mates. Therefore, these warm, sheltered habitats need to be maintained to ensure that healthy populations of Duke of Burgundy can be supported Matthew Hayes, University of Cambridge



Further research from the University of Cambridge at our Totternhoe, Pegsdon Hills and Blows Downs reserves investigated how our butterflies respond to local temperature changes (Bladon et al., 2020). Across the community of butterfly species found on our reserves, there are big differences in their ability to tolerate changing temperatures. Some species, such as the brimstone Gonepteryx rhamni and large white *Pieris brassicae*, can cope with quite large changes and maintain a stable body temperature. Other species, including the Duke of Burgundy, really struggle and rely more on the temperature of their environment. Species that rely heavily on their environment to maintain a suitable body temperature (including the small heath Coenonympha pamphilus and small copper Lycaena phlaeas) are more likely to be at risk as the climate changes (Bladon et al., 2020). By highlighting which butterfly species are most susceptible to climate change, this research on our reserves enables us to plan habitat management. This includes considering fine-scale temperature patterns, as well as vegetation type, to help protect the most vulnerable species.

It seems that the species that are more dependent on the temperature of their environment are at the greatest risk when dealing with future climate change.

Dr Andrew Bladon, University of Cambridge

An example of a typical Duke of Burgundy habitat at Totternhoe nature reserve. They require warm, sheltered banks to survive. Photo © Andrew Bladon

Read our blog wildlifebcn.org/butterfly-climate-studies



Nature reserves in a changing climate

To ensure that species can move through the landscape, local populations on reserves need to be connected up with high-quality habitat in the wider countryside. Alongside this, nature reserves need to adjust their management to take into account the changing needs of species due to climatic change. Populations of species need to be monitored so that conservation interventions can respond to detected changes. This research has shown just how important it is to maintain diverse transitional habitats, with topographic and structural variability, to create different temperatures on our sites. This will help maximise the chances of preserving suitable conditions for many different species into the future. The diverse transitional habitats that suit the butterflies will undoubtedly suit a large variety of other species as well. By working in partnership with the Insect Ecology Group at Cambridge we are at the cutting edge of research in this area and results can inform our management of the site straight away.

The combination of monitoring, research and conservation management that is carried out by the Wildlife Trust will be essential for the continued survival of species into the future.

Dr Andrew Bladon and Matthew Hayes, University of Cambridge

Summary

The management of our nature reserves has kept them in fantastic condition and they support a wide variety of special and rare species. Climate change is likely to pose unforeseen challenges to some of the rare species that currently thrive on our sites. We need our management to take into account future climatic conditions. As a local charity, we are well placed to do this. By working with academics at the cutting-edge of research, we can secure a strong future for species in our area.

Acknowledgements

Our thanks go to Dr Andrew Bladon and Matthew Hayes from the University of Cambridge who provided significant information for this case study.



Our reserve management needs to take into account the changing needs of species at the microclimatic level in order to protect these species for future generations. Photo $\textcircled{}{}^{\odot}$ Andrew Bladon

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Introduction

Masters of aerial acrobatics, dragonflies and damselflies (collectively known as Odonata), are a captivating group of insects. They have the highest success rate of any predator at catching their prey. They require not only suitable terrestrial habitats in which to hunt, but clean fresh water to successfully reproduce.

There are 47 species of dragonfly and damselfly which breed in Britain, with others that have not

been recorded breeding appearing as vagrants. They have strong flight muscles relative to their size and are effective colonisers of new areas. High concentrations of individuals often causes dispersal behaviour into new areas and can mean that species travel northwards and westwards. This has led to some species colonising Britain for the first time. Climatic changes have been shown to have affected the distribution of dragonflies and damselflies dramatically.



Expanding ranges and shifting flight periods

Many dragonfly species are benefitting from climate change by expanding their existing ranges or colonising Britain for the first time (Cham et al., 2014; Cham, 2014). Some examples include:

• Small red-eyed damselfly *Erythromma viridulum* – this species was discovered in Essex in 1999 and then spread at a rate of approximately 30km per year. This species is now common in our area.

• Willow emerald damselfly *Chalcolestes viridis* - this species first colonised Britain in 2007 and is now widespread in our area, where willows overhang the water.

Norfolk hawker Anaciaeschna isoceles – as its common name suggests, this species used to be restricted to a small area of Norfolk; it has now spread into our area.

Southern hawker *Aeshna cyanea* – this species used to be restricted to southern England but is now found as far north as Scotland.

• Emperor dragonfly *Anax imperator* – this species used to be restricted to southern England but is now found as far north as Scotland.

Scarce chaser Libellula fulva – this was historically a scarce species. It is no longer scarce and is widespread in Bedfordshire and Northamptonshire. This species favours flowing water but also breeds in gravel pits, such as those found at Felmersham nature reserve.

The flight periods of dragonflies and damselflies are also changing as species shift their flight periods to earlier in the year. In the case of the familiar large red damselfly *Pyrrhosoma nymphula*, it now emerges a month earlier than it did in 1991.



The scarce chaser *Libellula fulva* was historically a scarce species. It is no longer scarce and is widespread in Bedfordshire and Northamptonshire. This species favours flowing water but also uses gravel pits. Photo © Ryan Clark

Dragonflies at Felmersham Gravel Pits

This site, located in Bedfordshire, was an important site for gravel extraction up until the end of the Second World War. It has left behind a series of pools that now form an incredibly important and diverse habitat supporting a vast array of wildlife. There are 21 breeding species of Odonata recorded in Bedfordshire, 18 of which breed at Felmersham Gravel Pits nature reserve. Other species use the site's grassland and open water areas for hunting but do not breed on the site.

Extensive management is needed on the site to maintain a range of successional habitats suitable for a wide variety of species, including those yet to colonise our area. Trees can often overshade open areas of water making them less suitable for Odonata. We invest a lot of resources into managing the vegetation on site to ensure it is suitable for a wide variety of species.



The Norfolk hawker

The Norfolk/ green-eyed hawker *Anaciaeschna isoceles* appeared at Felmersham Gravel Pits in 2018 and is starting to breed there. The Norfolk hawker is Britain's second rarest dragonfly, so Felmersham is an important site for this species. Due to climate change some of the other sites this species is found on may be lost to sea-level rise, higher tides and storm surges. In the UK this species is often associated with sites that have water soldier *Stratiotes aloides* present.

It is considered that the structure of this plant provides an optimal habitat for breeding (Cham, 2019). Water soldier was introduced to these gravel pits around 1975 and has the potential to conflict with the botanical interest of the site. However, through careful management, it can be allowed to thrive while maintaining the rare aquatic plants present on the site. Floating water soldier plants are removed annually, but will now be left untouched in one corner of the lake.

Also, we have put in place controls to stop the water soldier spreading further around the site. Water soldier also provides a habitat for aquatic invertebrates. We are currently carrying out further research to inform the management of this site to balance the needs of a variety of species.



The Norfolk hawker *Anaciaeschna isoceles* is Britain's second rarest dragonfly. In 2018 it was seen at our Felmersham Gravel Pits nature reserve in Bedfordshire and is starting to breed there. Photo © Steve Cham

By maintaining our freshwater habitats in peak condition and creating early successional habitats, we allow a wide variety of species to thrive. Dragonflies are excellent indicator species that tell us about the quality of our freshwater habitats, especially where we have evidence of breeding.

Some species that may become more common in suitable habitats in our area include:

Southern emerald damselfly Lestes barbarus – this species is starting to colonise our adjacent counties. Its range is expanding slower than other species but there have been some sizeable new populations discovered in 2020 (S. Cham, 2020, pers. comm.).

• Southern migrant hawker *Aeshna affinis* – this species is spreading rapidly and favours ditches and pools that are prone to drying out. This species had a good season in 2020, resulting in several new breeding sites in southern England (S. Cham, 2020, pers. comm.).

Lesser emperor Anax parthenope – this is a species that is being recorded in increasing numbers each year across the UK, including in our area, probably in response to warming climates (S. Cham, 2020, pers. comm.).

Climate change is not all good news for dragonflies and damselflies, some ponds may dry out resulting in the loss of habitat. It is essential that where we can, we maintain ponds in a wide variety of successional states to benefit as many species as possible. Some species are also highly sensitive to changes in water temperature, so although the adults may be able to colonise new areas, the larvae may not be able to survive. In some cases, the newly arriving species may also compete with our existing fauna and it is hard to predict what the effect of this might be.

The effect of climate change on bats

Alongside dragonflies, some bat species have become more frequent in Britain due to climate change. Studies have shown that there has been a range expansion of Nathusius' pipistrelle bat Pipistrellus nathusii due to climate change (Lundy, M., Montgomery, I. & Russ, J, 2010). Nathusius' pipistrelle is a migratory species with the UK being at the northern tip of its range. Over time, this species has become more common in the UK and has started to breed in some areas. We contribute to the National Nathusius' Pipistrelle Project, which aims to improve our understanding of the ecology, status and conservation threats for this species in Great Britain. This includes ringing bats under license, which helps us discover more about their migration routes and how they use different areas.



Our monitoring work has shown that we have three pipistrelle species on some sites in our area. Here is Soprano pipistrelle (left), common pipistrelle (centre) & the slightly larger Nathusius' pipistrelle (right). Bats are ringed under license to help us to discover more about their migration routes and how they use different areas. Photo © Gwen Hitchcock.

Summary

Climate change will enable several dragonfly and damselfly species to colonise or expand their ranges in Britain. This is only possible if there are suitable high-quality habitats for them to expand into, which our reserves provide. Some species may experience losses in some areas but our reserves can form an important refuge for them. Our conservation work has to include an element of forward planning to ensure that our reserves are resilient to changes in climatic conditions.

Acknowledgements

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We are grateful to Hubert Bean, whose generous legacy is helping the Trust to ensure that our three counties are a haven for wildlife.

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Ryan Clark is a Monitoring and Research Officer at the Wildlife Trust BCN and author of this report. He is an experienced, allround naturalist with

a passion for evidence-based conservation, biological recording and promoting Britain's lesser-known species. He successfully led the Trust's WILDside Project, which encouraged and supported recorders across Northamptonshire to generate over 10,000 biological records.



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