Sheffield
State of Nature

nature counts

2018

Foreword

Despite a childhood in the West Midlands and a career now based in the West Country, I've always had a special connection to the city of Sheffield. My father's side of the family were all born and bred in Britain's city of steel, you see, and I have clear recollection of countless trips up to Shiregreen to visit my Nan and Aunty. Reporting on the wildlife for The One Show and Inside Out has enabled me to travel all over the UK, but it is the filming trips up to South Yorkshire that I particularly enjoy. In essence it's like dropping in on an old friend.

An impressive statistic I recently learnt about my dad's city is that it has more trees per person than any other urban conurbation in Europe. But to understand why this city has such green credentials you need to look beyond the trees. With an estimated two million trees Sheffield also houses or borders an impressive array of habitats in addition to the woodland, ranging from clean rivers to internationally important moorlands and urban parks to ancient hay meadows.

This Sheffield State of Nature 2018 report is about marking a moment in time. In the year 2018, it's crucial for us to know what we've actually got. In essence, how are our local habitats and species faring in modern Britain? Inevitably the report will be an uncomfortable read in places, as it both records the decline or even loss of certain species and charts the continued degradation or fragmentation of key habitats. The report has a duty to inform us, for example, that the white-clawed crayfish and water voles are in danger of local extinction due to issues with invasive species. It is also a warning that our impact on the natural environment cannot be taken for granted, particularly as we gauge the impact that factors such as climate change will make across town and country.

But like the proverbial curate's egg, the report also (and fortunately) has some good news as well. Who'd have thought 30 years ago that otters would now be a regular fixture along the Don? Sightings have even been made right in the heart of the city and are testament to both cleaner rivers and comprehensive protection of this once elusive mammal. There has also been a major investment in Sheffield's moorlands over the last 20 years which has resulted in huge landscape improvements across peat bogs and heather-clad moors. With the work never done, however, our next job is to ensure that the birds of prey are allowed to both return and breed unmolested in their traditional upland homes.

In addition to documenting the current state of Sheffield's wildlife and habitats, the report also looks forward, by proactively making a number of recommendations for anyone interested in looking after Sheffield's natural environment for both its people and wildlife. This report should not gather dust on a shelf but instead be used as a catalyst – a call to arms for local people and organisations to work together to reverse some of the declines, whilst also celebrating what we *do* have. The future will only be brighter for the peregrines, mountain hares, adder's tongue ferns, great crested newts and green tiger beetles living alongside us when enough good people care sufficiently to protect them from the ignorant and uninformed. Also if a good example of environmental stewardship can be set in the one jigsaw piece represented by Sheffield, think of the boost it will provide to the whole puzzle that stretches across South Yorkshire and beyond.

Finally, it is clear in reading this Sheffield State of Nature 2018 report that it has only come about as a result of the combined effort of a huge number of dedicated people, volunteers and professionals. These green guardians have not just given their time over many years to the studying and recording of Sheffield's natural heritage, but also to activities which promote its active recovery and ongoing conservation. Without their vast wealth of knowledge and experience this report would simply not have been possible. While thanking them on behalf of the Nature Counts team for all their contributions, we must also continue to support and encourage them in the uncertain times ahead. Nothing less than Sheffield's biodiversity is at stake and believe me, it's worth fighting for.

Michael J Dilger

Mike Dilger
Naturalist,
TV Presenter
and Writer

Autumn leaves
© Ben Hall/2020VISION

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Red deer on Blacka Moor
© Mark Smith

Key Headlines

Sheffield has a variety of habitats, from moorlands and uplands in the west, through to grasslands, farmlands, rivers and reservoirs in the district's centre, to a wooded and green urban landscape in the east. This mosaic of habitats has the potential to support a rich diversity of species and provides people with opportunities to connect with nature.

Sheffield has 253 Local Wildlife Sites (LWSs) and 17 Local Nature Reserves (LNRs). Over 36% of the Sheffield district is covered by designated sites with 25% protected at European level. Over 99% of Sheffield's Sites of Special Scientific Interest (SSSIs) are in 'favourable' or 'unfavourable recovering' condition, higher than the UK figure of 94%. Over half of Sheffield's LWSs are in positive conservation management; however, over 100 are still not.

Sixteen percent of Sheffield is wooded, far higher than the UK average of 10%. Sheffield supports over a third of South Yorkshire's woodland, despite covering less than a quarter of the area, and 1,256ha of ancient woodland can be found across the district, 92% of which is covered by site designations. Over 90% of Sheffield's residents have access to a large area of woodland within 4km.

Sheffield's woodland birds are doing well but others are mirroring national declines. Four out of the five most severe declines of local bird species correspond to farmland specialists.

Rivers are central to Sheffield's ecology and draw wildlife into the heart of the city. Twenty-six out of 31 fish species have recolonised the Don and otters have returned to Sheffield's waters. Many people and organisations have worked hard to reverse the negative impacts of Sheffield's industrial past on its waterways.

Local threats to wildlife mirror many national trends, such as habitat loss and fragmentation, pressure from development and non-native species introductions. Such threats are all too real with the near-disappearance of priority species including white-clawed crayfish, turtle dove and water vole from the district.

There are many dedicated individuals, groups and organisations that work tirelessly to record, monitor and protect Sheffield's habitats and species. Their contributions to wildlife conservation are reflected in both the knowledge we have of Sheffield's wildlife and the recovery of some species and habitats.

Despite these efforts, there is still a great deal we don't know about Sheffield's habitats and the wildlife they support. Despite having a wealth of data, there are still gaps for some species or a lack of consistency in data collection that make it difficult for us to identify and report changes over time with confidence. Some additional areas of priority habitats are known but unmapped. This leaves them unprotected and vulnerable to degradation.

Wood warbler

Background to the Sheffield State of Nature 2018 report

Why compile a State of Nature report for Sheffield?

The UK State of Nature report was released in 2013 with a follow-up report in 2016. These UK reports aimed to use the best available information, in order to reach conclusions on the current state of species and habitats. Both reports highlighted worrying trends, with 60% of assessed species declining over the past 50 years and 31% of species showing a strong decline. In addition, species with specific habitat requirements were deemed to be worst affected by current and predicted changes in the environment. The report indicated that a lack of systematic data in many cases prevented robust analyses of trends in species abundances and distributions.

These national findings give an indication about the state of the natural environment overall but cannot consider local variations in the distribution, abundance or status of species and habitats. This report for Sheffield is an attempt to provide a more local picture, ensuring that we are better informed, and so better able, to protect nature both now and in the future.

Compiling the Sheffield State of Nature 2018 report

This report was compiled as part of the two-year Nature Counts partnership project funded by the National Lottery through the Heritage Lottery Fund. The report has been produced by Sheffield & Rotherham Wildlife Trust under the guidance of a steering group, and with support from many local and national organisations and individuals who have provided data and written content. This report represents a huge body of knowledge about nature that is held within the Sheffield district and its compilation would not have been possible without the input of these organisations and individuals. We extend huge thanks to all of those who have helped make this work possible. A list of report contributors and steering group members is included in the Appendix.

Aims of the report

The main aim of this report is to bring together the huge amount of information and data that already exists about Sheffield's natural environment, in one place, for interpretation. Not all data have been used in this final report (see caveats below) but key elements have been extracted along with examples of recent work and current understanding of species and habitats in Sheffield.

In doing so, this provides us with an overview of how nature is faring in Sheffield and helps to identify key issues affecting our local wildlife. This report also aims to serve as a baseline document for future conservation efforts by providing a current snapshot of local habitats, plus information, where possible, on how local nature has changed. Finally, the report also aims to showcase key species and habitats within the Sheffield area, highlight conservation success stories, and set Sheffield in context with the rest of the UK. In order to help achieve this final point, we have included some assessments of the UK Biodiversity Indicators as outlined by the Joint Nature Conservation Committee. Information on data sources and analyses is given in the methods section of the Appendix.

Recommendations and future action

We want this report to act as a catalyst - to inspire and guide positive action for nature. Whether you are a decision maker, local politician, developer, planner, land manager, farmer, park manager, 'friends of' group, conservation organisation, amateur naturalist, volunteer or just someone with an interest in our natural world – this report is relevant to you. We have identified the current threats and opportunities from the information we have gathered and translated them into key recommendations. We hope we can work together across Sheffield to deliver these recommendations and secure a healthy and thriving natural environment for both people and wildlife for the future.

Speckled wood
© Amy Lewis

Caveats

Data availability and resolution

It is important to note that the way species data can be assessed, plus their reliability, depends both on how much data exists and how they were collected. There are hundreds of thousands of records available through the Sheffield Biological Records Centre (SBRC), National Biodiversity Network (NBN) and local recording groups such as Sheffield Bird Study Group (SBSG) and Sorby Natural History Society (SNHS), with records covering many years and for thousands of species. However, most are incidental records and have no associated measure of recording effort. For these records it is not possible to disentangle actual changes (for example, in a species' distribution or abundance) from variations in survey effort. Whilst many national recording bodies exist for specific species groups and habitats, these organisations may not record locally at a sufficiently fine resolution to allow us to be confident about apparent changes in these measures. Additionally, some data have not been available for use in the report due to data usage restrictions, and inevitably some data will have been omitted.

In all cases, we have been conservative and only chosen to use data when standardised survey effort means that observations are likely to be real signals of trends and not just a relic of survey effort. This means that we have not been able to present most species data to the level of detail that we would have liked or at the level of the UK reports. However, this does not mean that the data we have on Sheffield's species are not useful or valuable. They can help us identify where a species is present, allowing us to apply effective conservation methods to specific habitats and regions. This is particularly relevant for the species of conservation concern highlighted in this report.

Many existing reports and studies have looked at Sheffield's species over the years, for example, SNHS and SBSG annual reports and publications. Unless they have been used in a case study, most of these have not been presented here, but can be found in the references listed within the Appendix. Opinions of case study authors are not necessarily those of the report authors and partners.

Choice of content and subject representation

Whilst we have attempted to provide fair coverage of all taxonomic groups and habitats, it is important to note that not all species can be represented equally. This may be because local recording efforts favour certain species more than others, or because particular species are harder to study due to being rare or cryptic. It would be impossible to discuss all species and habitats present in Sheffield, but we have attempted to include the most locally relevant and important species either for interest or to meet the aims of the report. Including a large number of case studies and bringing in local experts have been two ways in which we have done this. Case studies have only been edited for space and formatting reasons and final versions have been checked with authors. For original, often longer, versions of the case studies see **wildsheffield.com/stateofnature**

Habitat definitions and coverage

There are different methods available for defining and mapping habitats, and as such, regional estimates can differ. In order to present the most detailed and accurate habitat information we have used a method that includes data from a variety of sources, outlined in the Appendix. Habitat definitions are still, however, open to interpretation. Most data sources are also on a national level, meaning that information on a smaller, local scale may be coarser. Care should therefore be taken when comparing habitat coverage to other UK figures that may have used different methods and habitat definitions. Habitat definitions, a glossary and acronyms are also included in the Appendix.

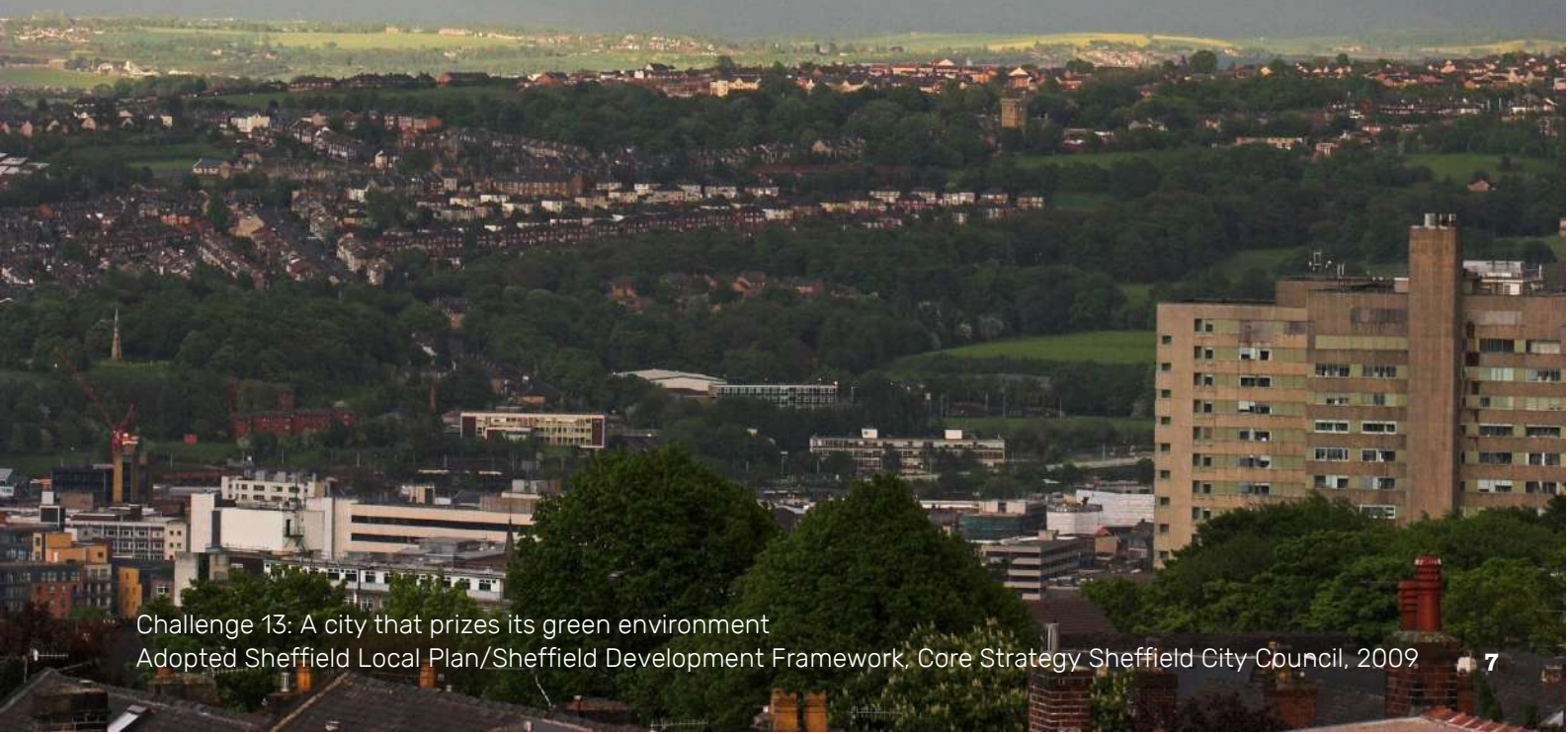
The UK Priority Habitat Inventory (PHI) that we have used contains information on habitats only where data have been provided and has been conducted on a national scale. This means that it is likely that fine-scale or local areas of habitat may have been missed or excluded. These figures should therefore be taken as a minimum estimate and do not necessarily mean that additional UK PHI habitat is not present in the Sheffield area.

Dunlin

Clouds over Sheffield © Paul Richards

Sheffield Overview

"The setting of Sheffield in its 'golden frame', with its hills and valleys and the heritage of trees and parks, continues to be a major asset that is appreciated by residents and visitors alike. The natural environment with its variety of wildlife is valuable in its own right but can also contribute to the economic and social vitality of the city. The green spaces within the built-up areas make an important contribution to the life of the city. The challenge is to protect and enhance the city's natural assets both to support the regeneration of the city and as features of value in their own right."



Challenge 13: A city that prizes its green environment
Adopted Sheffield Local Plan/Sheffield Development Framework, Core Strategy Sheffield City Council, 2009

Sheffield in context: landscape and topography

For the purpose of this report, the 'Sheffield district' is the whole Sheffield region, including areas of the Peak District National Park in Sheffield, and is shown below (Figure 1). Sheffield sits within the south-west corner of South Yorkshire with a third of its area falling within the Peak District National Park boundary (shaded area). The district is defined by the Unitary Authority boundary (Sheffield City Council; SCC) but is divided between two planning authorities: SCC and the Peak District National Park Authority (PDNPA) which covers the western area.

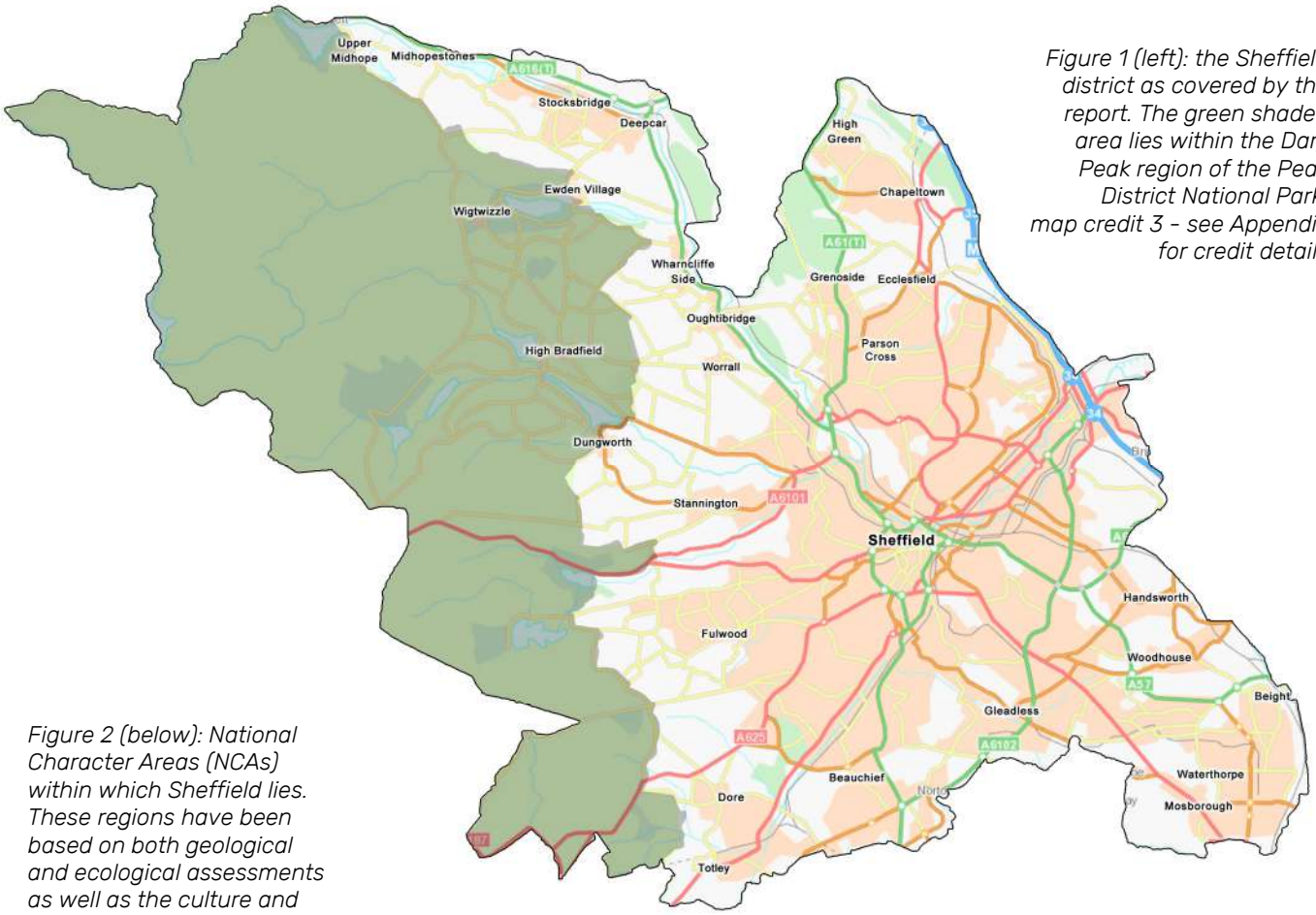
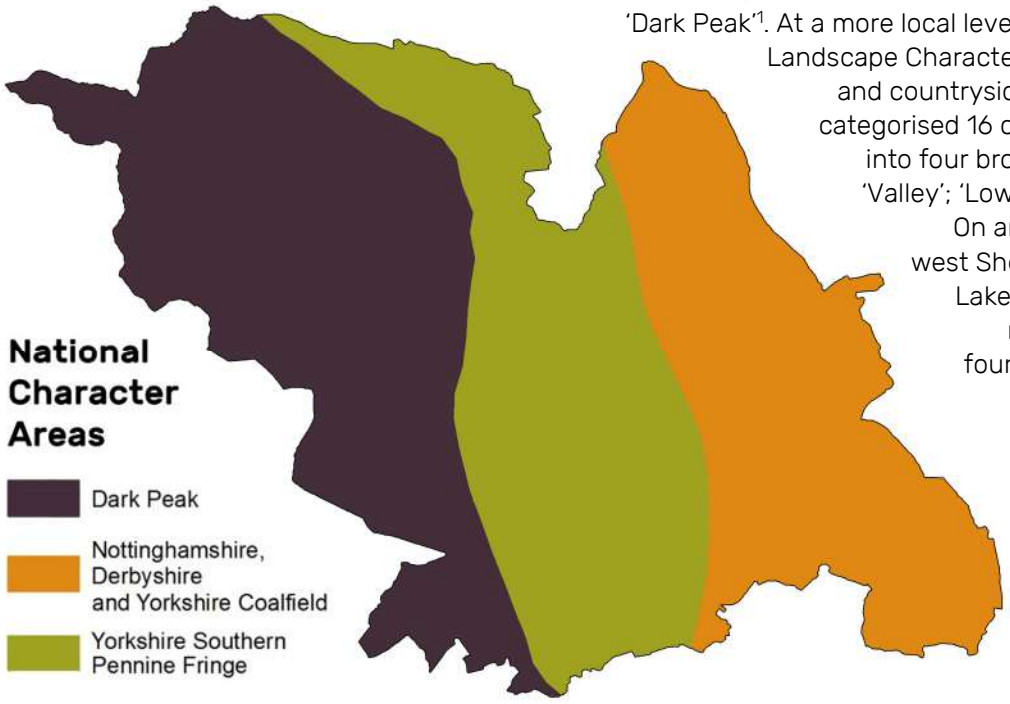


Figure 1 (left): the Sheffield district as covered by the report. The green shaded area lies within the Dark Peak region of the Peak District National Park; map credit 3 - see Appendix for credit details

Figure 2 (below): National Character Areas (NCAs) within which Sheffield lies. These regions have been based on both geological and ecological assessments as well as the culture and heritage that has helped to shape the landscape; map credit 2



National and Landscape Character Areas

The district straddles three National Character Areas: 'Nottinghamshire, Derbyshire and Yorkshire Coalfield', 'Yorkshire Southern Pennine Fringe' and part of the 'Dark Peak'[1]. At a more local level, SCC undertook a preliminary Landscape Character Assessment of its green belt and countryside areas[2]. The assessment has categorised 16 character types further divided into four broad 'Character Areas': 'Upland'; 'Valley'; 'Lowland' and 'Highly Maintained'[2]. On an even more local level, north-west Sheffield (known as the Sheffield Lakeland area, see case study) has recently been categorised into four 'Landscape Character Types': 'Enclosed Gritland Uplands'; 'Slopes and Valleys with Woodlands'; 'Moorland, Moorland Slopes & Cloughs'; and 'Developed', with detailed descriptions of each[3].

View from Ringinglow
© Paul Richards

Sheffield contains a huge variety of landscapes for a city, ranging from the dense urban centre, through the built-up housing and industrial areas of the city, to its hills, lakes and moorlands[4]. The countryside in Sheffield ranges from exposed upland heath and moorland fringes, with deep valleys to the west, to gentler rolling wooded farmlands and former marshland in the eastern lowlands. These landscapes have been shaped by variations in geology and landform as well as the city's industrial history[5]. The latter has resulted in a large urban conurbation centred on the meeting of five rivers: the Don; Sheaf (after which the city is named); Porter; Rivelin, and Loxley. A sixth, the Rother, forms the boundary between Sheffield and Rotherham. The underlying geology and deep cut valleys carved by these watercourses create an east-facing amphitheatre formed by the 'seven hills', with a 500m high, western upland backdrop (maximum: High Stones, 550m) sloping down towards the eastern lowlands of around 30m (minimum: Blackburn Meadows, 29m). From every part of Sheffield the hills dominate the skyline; over 12% of the district is above 400m high and over 52% lies above 200m[2]. In Sheffield, 94% of all housing land is over 100m and 15% is over 200m (the normal limit for development in the UK is 200m)[4]. There are strong advantages for wildlife in the way in which these hills and valleys form natural green corridors and help to connect areas of woodland and domestic gardens, reducing urban fragmentation[6].

The varied topography and landscape means that, as a city, Sheffield supports a surprisingly wide range of natural habitats and biodiversity[4], as detailed in this report. Sheffield has often been described as the 'greenest city' in the UK or in Europe and a study undertaken by A. Middleton provided some evidence to support this[6]. A wide range of statistics were used to determine levels of 'greenness' by comparing against population size, wooded areas, open country etc. and the study found that Sheffield did perform well when compared to other major population centres[6]. For more general information about Sheffield and its population, please see the 'State of Sheffield 2018' report[7].

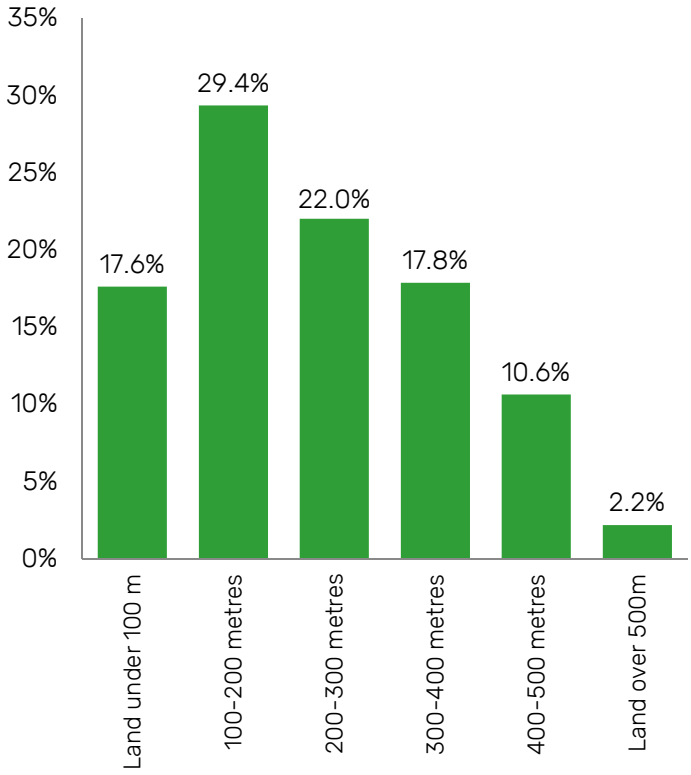


Figure 3 (right): amount of land at various heights within the Sheffield district. Most land lies between 100-300m.

Sheffield in context: geology

The surface geology of the Sheffield area is of Silesian, Upper Carboniferous origin (333-299 million years ago) with some more recent alluvial deposits along the river valleys. Travelling from west to east across the district, the underlying landscape of the Eastern Pennine Anticline consists of the mudstone, shale and coarse sandstone (and minor coal seams) of the Millstone Grit (Namurian) of the Dark Peak, giving way to the more widespread Coal Measures (Westfalian). These also comprise mudstone, shale and sandstone, with rich workable seams of coal. Prominent features of the landscape are the inland cliffs or 'edges', the longest of which is Stanage Edge at 6km in length, part of which forms the western boundary of the district and runs south-east into the Derbyshire Peak District. This is formed by the hard sandstone horizon of the Millstone Grit where the softer shales and mudstones have eroded away. The Lower Coal Measures form the fine sandstone edges of Sky Edge in the heart of the city and Wharncliffe at the northern boundary with Barnsley. The variation in the coarseness of these sandstones offered different grades of abrasive gritstone in recent times for many uses including the grinding of high quality knife blades. The major consequence of the coming together of the geological characteristics of the region is the steel industry upon which Sheffield is built. The combination of coal for heat, multiple fast flowing streams running down from the upland watershed for power generation, locally occurring iron ore and the charcoal provided by the many forests provide the perfect combination for the creation of steel. The seat earths, fire-clay and ganister beneath the coal seams also provided ideal materials for furnaces.

Stanage Edge
© Paul Richards

Sheffield in context: climate and the effects of climate change on nature

Sheffield's position in the UK, combined with its varied landscape and topography means that the climate across the district varies considerably from the colder, wetter uplands of the western moorland to the relative warmth of the urban heat island within the city centre. The rain shadow that is cast by the Pennines sees the Sheffield area experiencing drier conditions than Manchester, but topography and valley direction deliver variations in temperature that are dramatically different locally depending on altitude, forestation, exposure and aspect[8]. This range has a significant impact on the wildlife that the area can support and the extent to which species can disperse and flourish.

The increase in mean temperature and sun hours per day over time is shown in Figure 4 (right)[8,9]. Vegetation growth and the diversity of plant species within the Sheffield region are strongly linked to climate because of how it influences the growing season. According to the Met Office, in 2016 the national growing season had increased by an average of 29 days from pre-1990 figures[10]. Sheffield figures reflect this and since 1989 there has been a marked extension to the growing season of around a month (Figure 5)[8,9]. This greater local capacity for growth and flowering times has a significant impact further up the food chain as consumers from insects to birds benefit from this extended feeding season. Consequently, there is a longer period for reproduction and dispersal, which may influence the introduction of new species as well as potentially strengthen populations. In recent years long-term changes in climate - such as increased average winter temperatures since around 1989 (Figure 4) - suggest possible effects on overwintering success of species such as dragonflies (see Odonata case study, Waterways & Standing Water chapter)[8,9]. Other factors, including increased rainfall and temperature extremes, can be detrimental to some species.

Non-native species can sometimes flourish in a changing climate. In some urban Sheffield locations some non-native flowering plants are carefully selected to make use of and extend flowering seasons and provide a stable resource for invertebrates (see next case study).

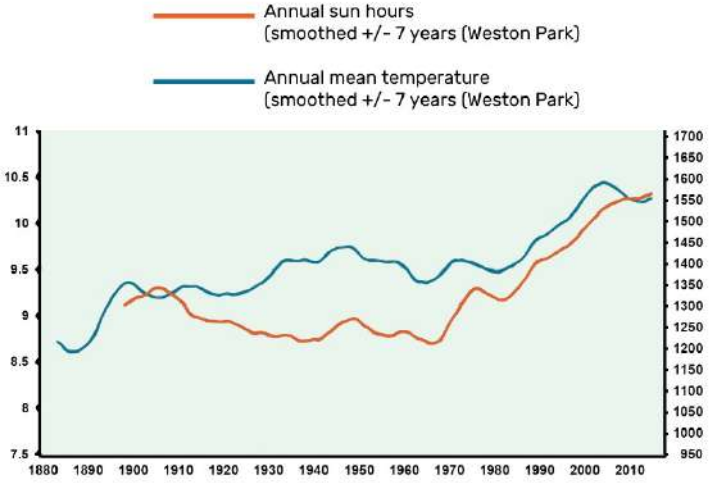


Figure 4 (above): annual mean temperature and annual number of sun hours recorded at Weston Park between 1880 and 2010. Figures are smoothed +/- 7 years[8,9].

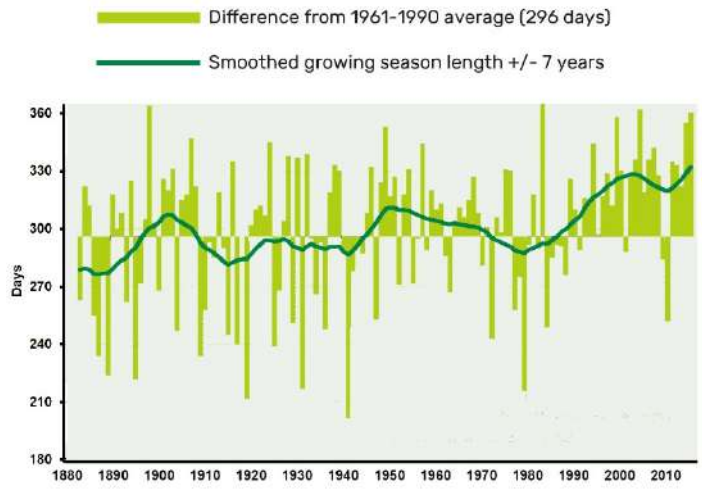


Figure 5 (above): length of growing season as a smoothed figure (+/- 7 years) and annual variation from the 1961-1990 mean[8,9].

Wyming Brook
© Sarah Sidgwick

Case study: Pollinators, flowering seasons and urban meadows
Jack Brodie and Sue France, Green Estate

The much reported decline in insect pollinators is due to several factors but the single most important is believed to be the greatly reduced number of flowers in the landscape. This is mainly due to the 'green revolution' of intensive agriculture in the 20th century during which many flower-rich habitats – unimproved grassland, hay meadows, fallow fields, leguminous forage and hedgerows – were lost[11]. This greatly reduced both the abundance and diversity of floral resources available in the landscape, creating flower shortages in both space and time[12].

Pollinators may have fared the worst in arable landscapes whilst urban areas have retained surprisingly resilient pollinator populations[13]. One recent study even found greater bee diversity in UK urban areas compared with adjacent farmland[14]. This suggests that designed landscapes can, and do, support pollinators, and that we can help maintain pollinator diversity by creating urban landscapes with abundant and diverse flower assemblages. This includes using both native and non-native plant species, according to a body of scientifically rigorous literature quantifying the relative value of different plant species to UK pollinators[15].

These studies show that value to pollinators is primarily based on certain biological characteristics or traits of plants that do not correlate neatly with their original geographical distribution. Non-native species can have characteristics such as abundant nectar provision and pollen rewards and long flowering seasons. They can also help to make less intensively managed areas (such as urban meadows), that may be viewed negatively in an urban context, to become habitat-rich, attractive naturalistic landscapes. Recent studies have confirmed that non-native plants do indeed potentially provide valuable resources and that native pollinators are just as happy, and sometimes even prefer, to utilise these non-native flowers when available[16,17,18]. In our Sheffield trials, we have found strong evidence for the ecological value of non-native plants and particularly near-natives (Figure 6).

Against this background, trial work by the University of Sheffield Landscape Department, Green Estate and Pictorial Meadows in Sheffield has sought to identify just what assemblages of native, near native and non-native species will best work together as new self-sustaining ecological communities in the UK. Previously, both poor quality seed and a lack of understanding of the dynamics of complex herbaceous communities has hampered successful establishment of new meadows from seed, regardless of origin. Trial work is ongoing but research and development has enabled a new approach to urban naturalistic plantings that benefits people and wildlife. We have now created hundreds of urban meadows in Sheffield and our knowledge and understanding of the complex factors involved in selecting the optimum species mix is still increasing. Complexity, scale and connectivity in a landscape remain the best ways of ensuring rich biodiversity. Any flower-rich meadow is better than no vegetation or mown grass, and a matrix of different types of vegetation is better than any one type.

Tree bumblebee
© Jon Hawkins

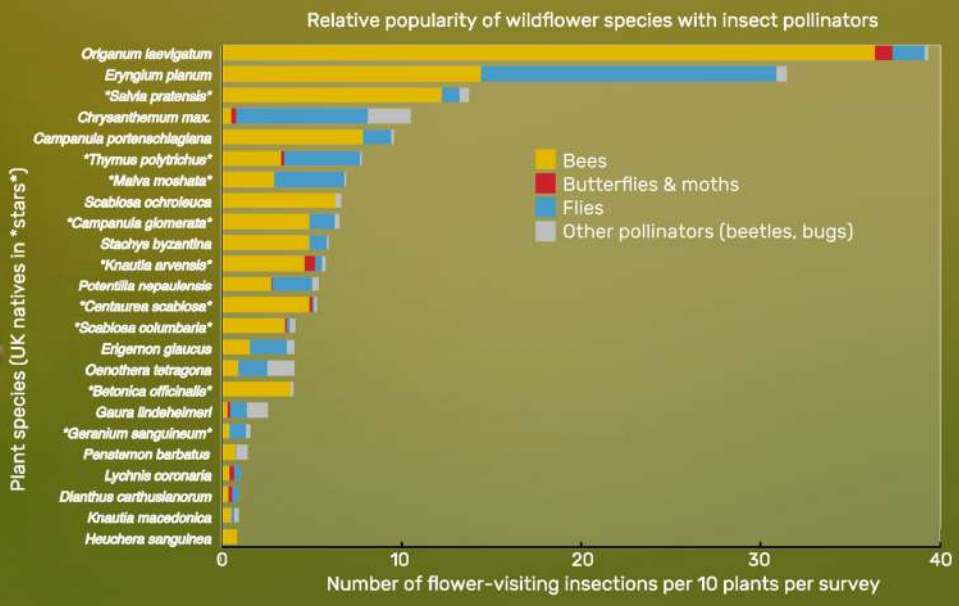


Figure 6: preference of different pollinator groups for a number of native and non-native plant species (source J Brodie, dissertation for the University of Sheffield and Green Estate).

Given the combined effects derived from variations in topography and climate, the Sheffield district is drier and warmer in the south and wetter and colder in the north and west. This leaves the city in the 'cross-hairs' of influences that create a rich mosaic of conditions. Sheffield's habitats support a wide variety of fauna and flora as a result. Laid across this can be distributions of species that meet their northern, southern or altitudinal limits here in Sheffield (Figure 7). This places us at a 'leading edge' where small changes in climate, human activity, pollution or policy can have a marked and observable impact on the distribution or behaviour of wildlife. The result is a city where greenspace can be hugely significant for species at the limits of survival and a place where species are established or lost because of extremes or changes across mere seasons.

In an environment already impacted by human activity it is often the more adaptable, generalist species that survive best. Typically, these are the more common, widespread or invasive species that cope well with change. If unique habitats are threatened, rarer species that are habitat specialists are most at risk, and climatic changes may add further stress to their existence. It is therefore critical to monitor the state of habitats, and the wildlife populations that they support, in order to observe and react to such changes where appropriate.

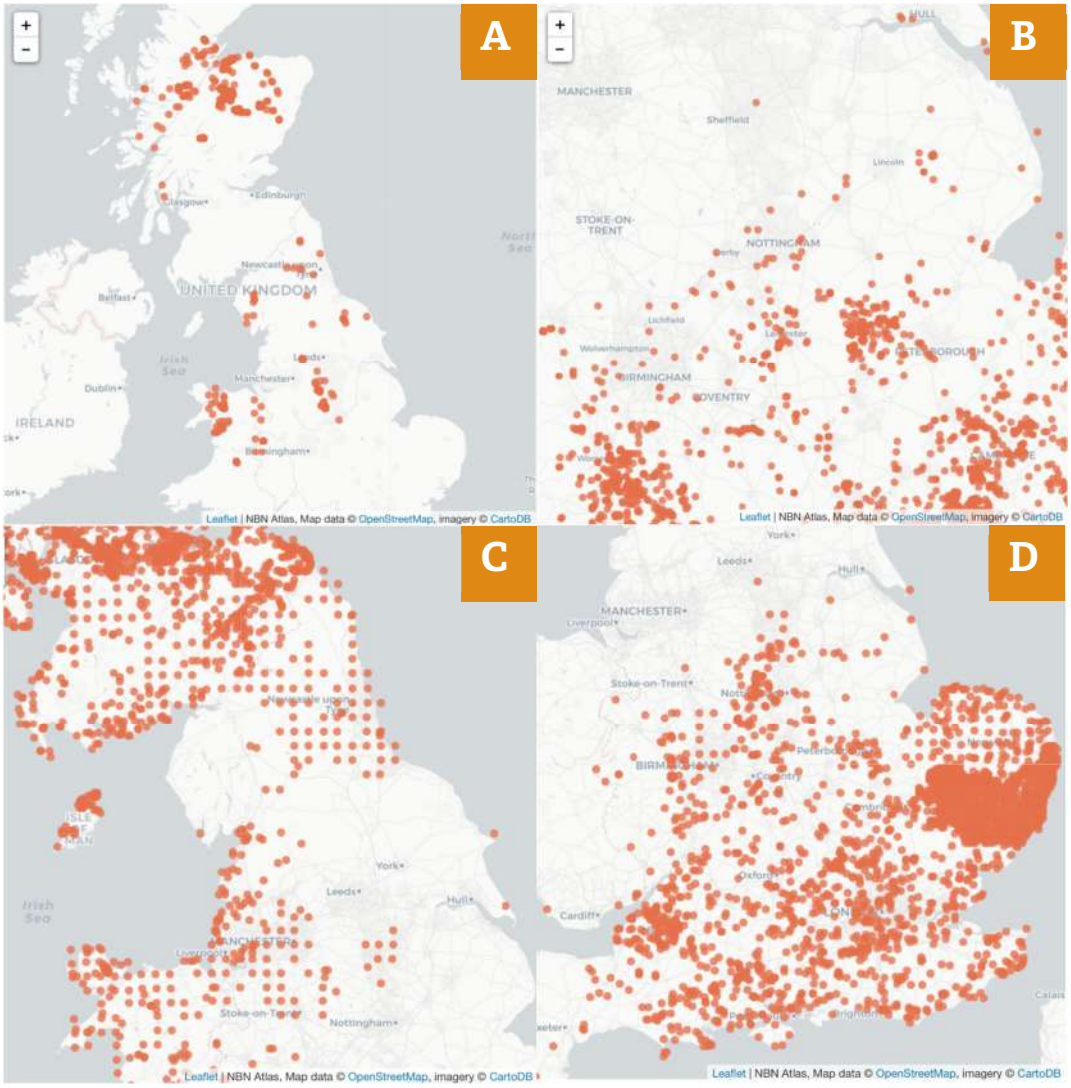


Figure 7: distribution of species that exhibit some limit of their range within the Sheffield district.

A: *Hairy wood ant,* Formica lugubris. *Commonly seen in Greno Woods and Longshaw Estate.*

B: *Roesel's bush cricket,* Metrioptera roeselli *Recorded for the first time at Woodhouse Washlands in 2017*

C: *Northern marsh orchid,* Dactylorhiza purpurella

D: *Essex skipper,* Thymelicus lineola

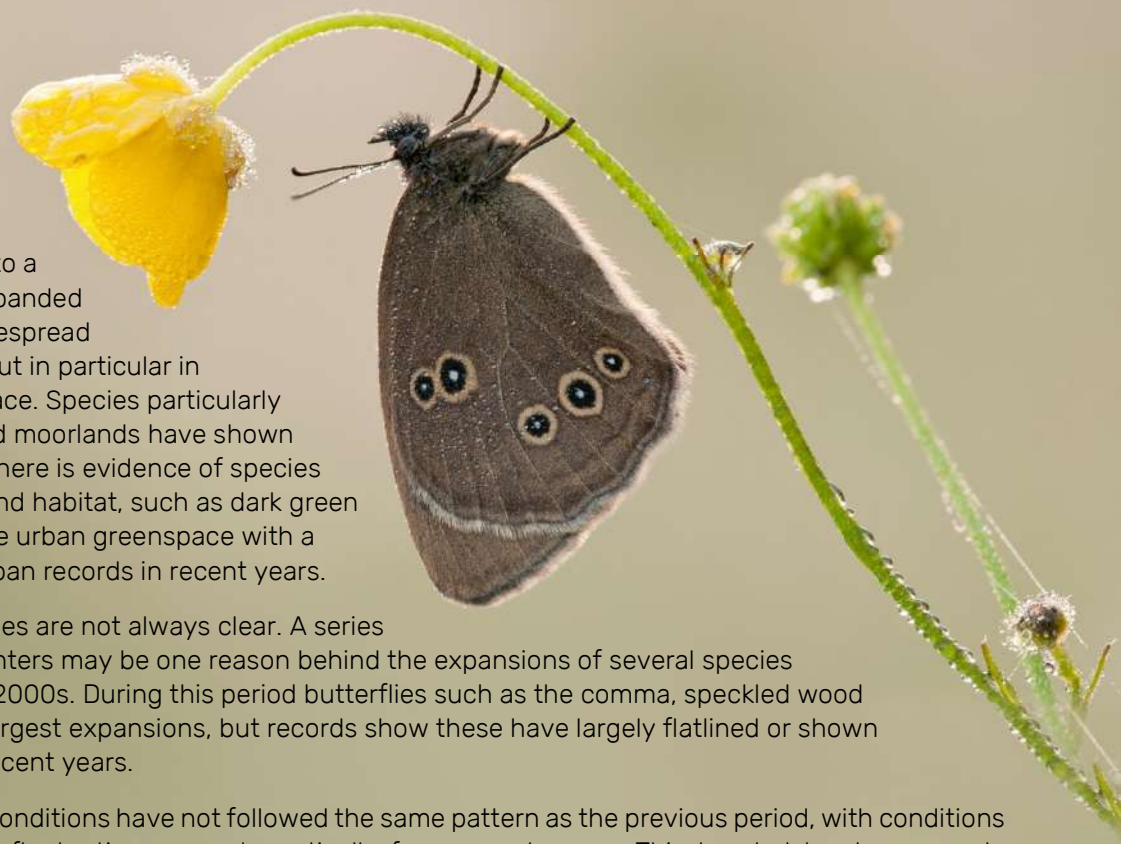
All data: NBN Atlas website accessed on 02/03/2018

species.nbnatlas.org/species

The fluctuation in climatic conditions between one year and the next can also impact wildlife in the short term. The effects of one poor summer (low temperatures, high winds and precipitation) may be felt for two or three years later by species that are dependent on specific conditions for summer reproduction. An easily observed example is the weather impact on first and second brood holly blue butterflies which feed on holly in the spring and ivy in the summer. The effect of weather is often seen in the reduced abundance of the following brood until conditions improve during a subsequent season to enable populations to recover to former levels[19].

Case study: Butterflies in Sheffield's changing urban climate[20-27]

Ben Keywood (FRES), Sheffield & Rotherham Wildlife Trust



Ringlet butterfly
© Ross Hoddinott/
2020VISION

There have been significant changes to the butterfly populations of urban Sheffield over the last two decades. Some species, formerly restricted to a few specialist sites, have expanded their range and become widespread across the city as a whole, but in particular in urban gardens and greenspace. Species particularly associated with the Sheffield moorlands have shown the least change, although there is evidence of species long associated with moorland habitat, such as dark green fritillary, expanding into more urban greenspace with a handful of urban or semi-urban records in recent years.

The reasons for these changes are not always clear. A series of hot summers and mild winters may be one reason behind the expansions of several species from the mid-1990s to mid-2000s. During this period butterflies such as the comma, speckled wood and holly blue showed the largest expansions, but records show these have largely flatlined or shown much smaller increases in recent years.

In the last decade, weather conditions have not followed the same pattern as the previous period, with conditions and seasonal temperatures fluctuating more dramatically from year to year. This has led to strong yearly fluctuations in numbers of many 'common' butterfly species including the orange tip, peacock, small tortoiseshell, small skipper, large skipper and small copper. Future research could potentially show that extreme temperature fluctuations may be partly responsible for an increase in fungal or bacterial infections and parasites that affect the immature stages of butterflies and have a direct impact on populations.

Another area where noticeable changes to butterfly populations have occurred is brownfield sites. Here, the profusion of bird's foot trefoil, the larval foodplant of common blue and dingy skipper, has enabled these species to expand rapidly from their more traditional grassland sites. Both butterflies favour stony sheltered areas where the foodplant grows and they have subsequently formed several small urban colonies across the city. These are now extremely vulnerable as more brownfield sites are being considered for development.

Two species that have shown the largest increases in distribution during the last decade are the ringlet and gatekeeper, following rapid expansion similar to that of the speckled wood the previous decade. All three species are now commonly found in gardens and urban areas where they overwinter as larvae and feed on grasses. Interestingly, the meadow brown and wall brown, which share the same foodplant and lifecycle, have not shown similar increases, with the wall brown suffering a huge decline in Sheffield, reflecting the national pattern.

Although most of our resident species have larvae that feed on low-growing plants, the importance of how ruderal vegetation such as stinging nettle (the singular larval foodplant of the peacock, small tortoiseshell and red admiral) is managed across the city needs to be carefully considered, particularly in an urban context along roadsides and in parks and gardens. In the same context, brambles and thistles are also vital nectar sources for adult butterflies, as well as other insects. The way we manage this vital space can affect a large range of butterfly species reliant on roadsides and other fringe habitats where their foodplants grow and which also provide green corridors for colonies to expand and move.

There are only five species in our area that rely on trees as their larval foodplants: comma and white-letter hairstreak on elms; holly blue on holly (and ivy); brimstone on buckthorns; and purple hairstreak on oaks. In Sheffield, the comma is almost entirely dependent on wych elm as a larval foodplant, rarely choosing its alternative foodplant, stinging nettle. Blackthorn or hawthorn are often chosen to plant in urban parks and hedgerow, but in addition, there is potential to plant buckthorn species to help the brimstone butterfly.

Case study: Long-tailed tits in the Rivelin Valley: investigating effects of climate change
Professor Ben Hatchwell, Animal and Plant Sciences, the University of Sheffield

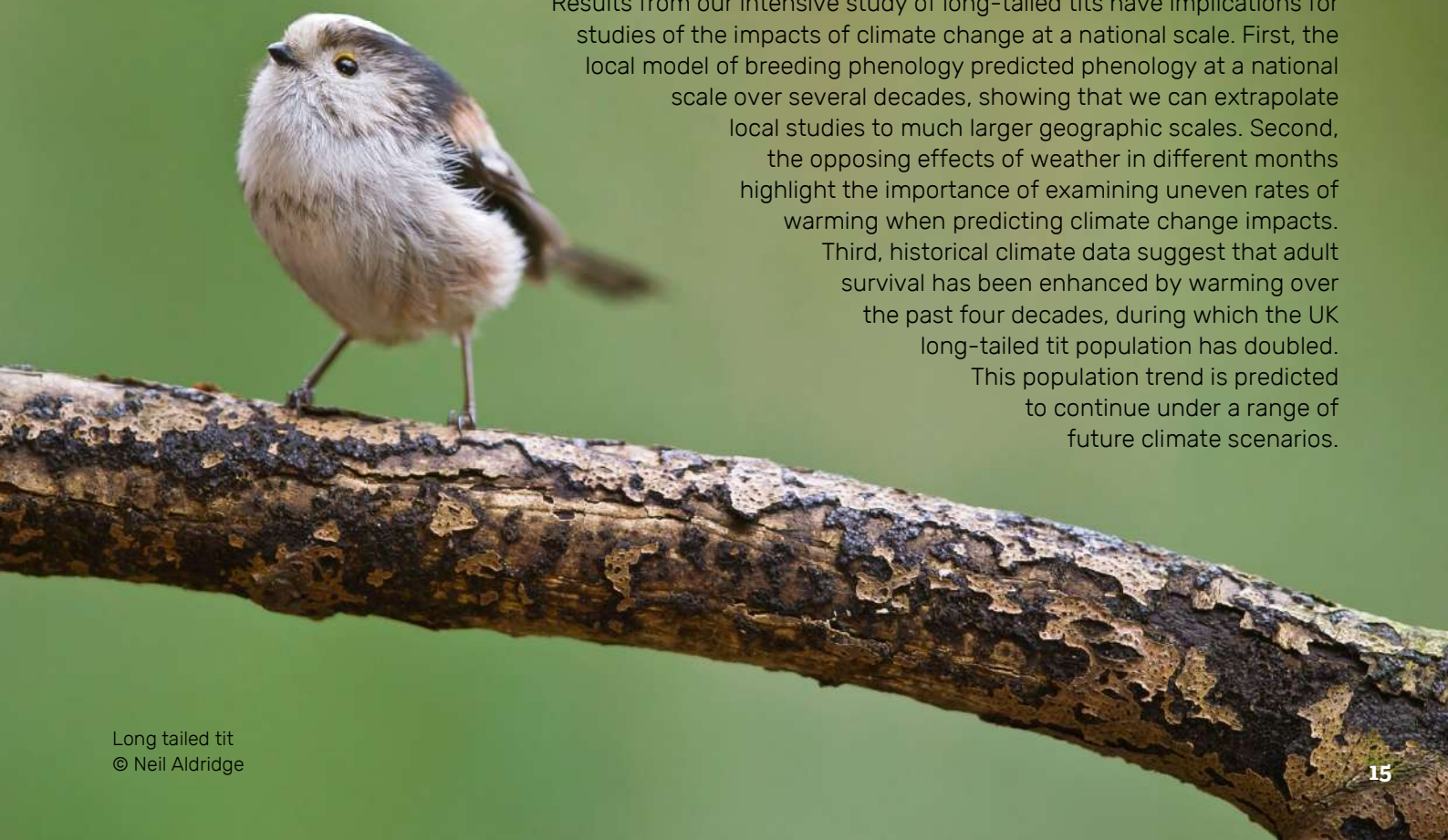
Since 1994, a team of researchers from the University of Sheffield, led by Ben Hatchwell, has been studying long-tailed tits (*Aegithalos caudatus*) in the Rivelin Valley, Sheffield, funded primarily by grants from the Natural Environment Research Council. The initial reason for the study was the co-operative breeding system of long-tailed tits, in which some adults help other pairs to raise their offspring – behaviour that is globally rare and unique among British birds. Since the start of the project the lives of over 3,500 birds have been closely monitored, allowing many questions relating to their extraordinary social system to be answered. These data also allow us to investigate other problems, including the effect of our changing climate on this population of long-tailed tits.

The effect of climate change on biodiversity is typically studied via shifts in the distribution of species and changes in the timing (i.e. phenology) of annual events such as breeding or flowering. National data collected by the British Trust for Ornithology (BTO) over 43 years show that the breeding phenology of long-tailed tits has advanced by 15 days, more than any other UK bird. Using long-term data from the Rivelin Valley, collected over 19 years, Philippa Gullett (PhD student; supervised by Ben Hatchwell and Karl Evans from Sheffield, and Rob Robinson from the BTO) investigated the effects of weather on long-tailed tits in more detail.

The start of egg-laying varies by more than three weeks across years and, as suggested by national data, this variation is related to March temperatures with earlier breeding in warmer years. Similarly, annual variation in the date on which breeding terminated was predicted by April temperatures, with pairs finishing earlier in warmer years. Long-tailed tits prey heavily on defoliating caterpillars when feeding nestlings, so the latter pattern is probably caused by more rapid larval development and hence an earlier peak in caterpillar abundance in warm years; indeed, direct sampling of caterpillars has revealed earlier peak abundance in warmer springs. Importantly, since April temperatures have warmed more rapidly than those in March, the length of the breeding season contracted by about one third between 1995 and 2011[28].

The window of opportunity for reproduction is clearly sensitive to a warming climate, but what about the impact of climate on other stages in the long-tailed tit life history? Offspring survival from fledging to the following breeding season (i.e. recruitment) was affected negatively by warmer March temperatures, and positively by warmer May temperatures. The mechanisms underlying these effects are not completely understood but may be attributable to the effects of weather on food supplies at crucial stages of the season[29]. Much of the annual variation in the survival rate of adult long-tailed tits could also be explained by temperature and rainfall. Specifically, adult survival increased following warm, dry springs and warm autumns, while winter weather had little effect on this key parameter[30]. We speculate that the flocking behaviour of long-tailed tits, and especially their communal roosts, reduces their susceptibility to the adverse effects of harsh weather in winter.

Results from our intensive study of long-tailed tits have implications for studies of the impacts of climate change at a national scale. First, the local model of breeding phenology predicted phenology at a national scale over several decades, showing that we can extrapolate local studies to much larger geographic scales. Second, the opposing effects of weather in different months highlight the importance of examining uneven rates of warming when predicting climate change impacts. Third, historical climate data suggest that adult survival has been enhanced by warming over the past four decades, during which the UK long-tailed tit population has doubled. This population trend is predicted to continue under a range of future climate scenarios.



Long tailed tit
© Neil Aldridge

Case study: Valuing the natural environment in everyday decisions
Dr Alison Holt, Natural Capital Solutions Ltd

Ensuring the growth and development of Sheffield, its economy, and the well-being of its inhabitants, is a complex task. There are the challenges of social inequality, of providing social care, jobs and affordable housing and managing flood risk, all within the context of austerity. Unfortunately, our usual approaches to dealing with these problems (e.g. denser housing, cutting maintenance of parks, using hard engineering to deal with flooding) will erode Sheffield's natural assets. This is very likely to create further undesirable outcomes. However, if we begin to recognise the full value of the natural environment, and make it central to our solutions to these societal challenges, we are more likely to reach our aspirations for the city.

To achieve this, we need to understand what our natural environment does for us. The Sheffield State of Nature 2018 report sets the scene, documenting the extent and variety of our natural assets. The next step is to reveal the benefits (ecosystem services) that these assets deliver to people. A study[31] completed at the University of Sheffield showed that the greenspaces in the city (woodlands, parks, cemeteries, allotments), and the rural component of the district (moorland, woodland, farmland), were vital for soaking up carbon dioxide and harmful air pollutants, alleviating the severity of flood events, cooling the city in very hot temperatures, providing areas in which people can walk, run, cycle, and appreciate natural vistas, and for supporting habitats for wildlife. Thirty-four percent of the district provides a high level of one or several of these benefits (although only 0.02% of the area provides all six of these benefits) – see Figure 8.

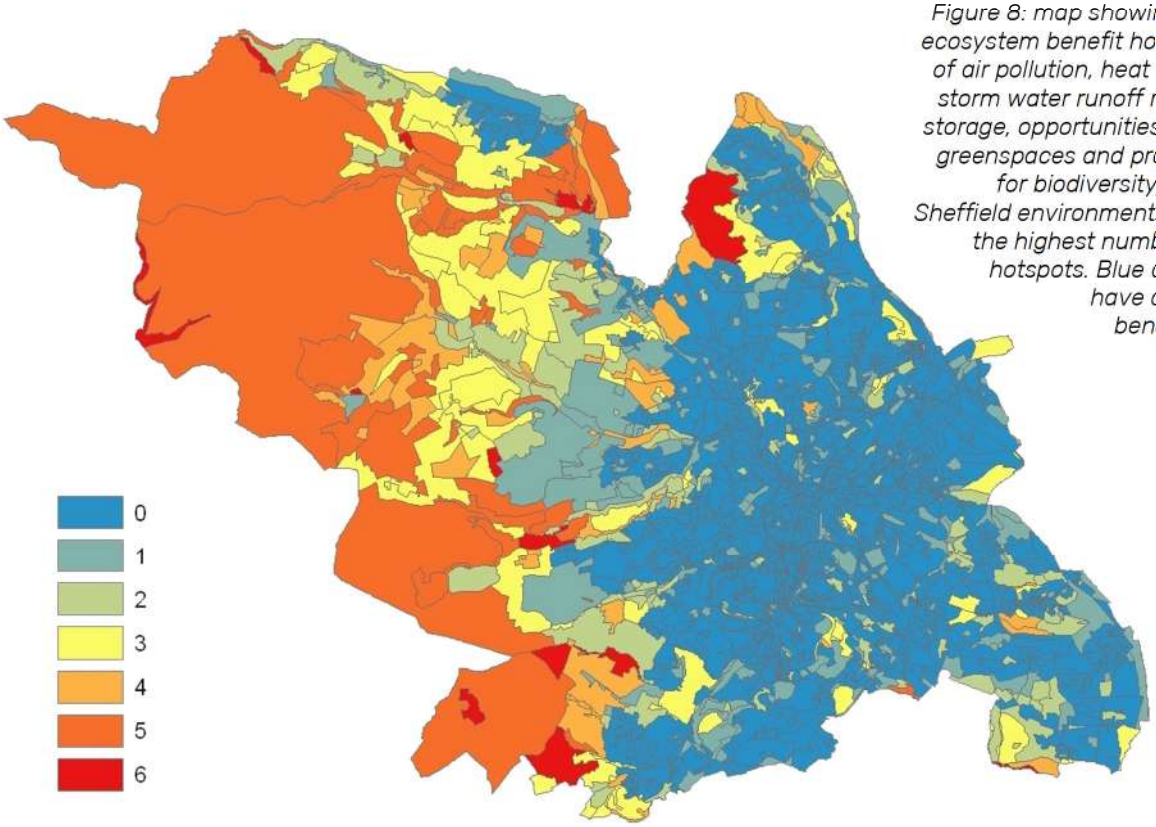


Figure 8: map showing the number of ecosystem benefit hotspots (reduction of air pollution, heat island mitigation, storm water runoff reduction, carbon storage, opportunities for recreation in greenspaces and provision of habitat for biodiversity) provided by the Sheffield environment. Red areas show the highest number of benefits as hotspots. Blue areas (value of 0) have a low provision of benefits as hotspots. Map credit 3

A rapidly increasing body of evidence illustrates the benefits we gain from nature, and the money that can be saved by managing to benefit wildlife. For example, public greenspaces in London save the NHS £580 M per year through increased physical health[32]. Urban trees save Glasgow's local economy approximately £4.5 M in services per year[33] (carbon sequestration, pollution, climate, flood and noise regulation). Working with natural processes can effectively reduce flood risk, whilst enhancing biodiversity and other ecosystem benefits, saving money through avoiding the costs of flood damage, and may be cheaper than hard engineering[34]. For instance, in Sheffield, there are numerous sustainable drainage systems (SUDS) emerging, helping to manage flood risk and provide new habitat for wildlife. There are now many case studies of how approaches focussed on understanding and valuing the benefits from nature can work on the ground[35, 36].

Once we recognise the benefits that Sheffield's natural assets provide us, and the consequences our decisions have on these, we can make more informed policies, regulations and decisions. This will reveal tough choices. However, it is our best chance, using all our tools, to ensure a more prosperous, happier and healthier future for us and for wildlife.

Local Action

Whilst not a definitive history of local voluntary and professional involvement in environmental issues in Sheffield, this section acts as an opportunity to briefly demonstrate that Sheffield has a long history of high quality active involvement in environmental science. There is ongoing academic research from two universities and many local government, non-government, charity and voluntary organisations observing, recording and managing the landscape and its species. Without the commitment and dedication of these people, this report – and many other reports, papers and research – would be much poorer in scope and insight. Much of the data from which statistics are derived and policies made have been painstakingly gathered by passionate professionals and volunteers who, via years of study and time outside in all weathers, engage directly with our outdoor city. Each point on a graph or dot on a map is the result of hours of dedication. The people represented so briefly below and the subjects they embrace are the source and inspiration for this report.

A history of expertise

There is a prominent history of many eminent Sheffield-based scientists recording and collecting items of natural history interest since the 19th century. In 1822 James Montgomery called for the establishment of a society within the city to represent a growing acknowledgement of the value and importance of philosophy and the sciences. A 'Literary and Philosophical Society' was formed, which by 1875 had established the Sheffield Public Museum (now Weston Park Museum). Much of the natural history of the city was recorded, studied and presented to the public through specialist curators. Today, the museum continues to house important collections of specimens whilst attracting and engaging over one million visitors a year to its exhibitions[1,2]. Weston Park Weather Station was established within the museum in 1882 and daily weather readings have been taken ever since, providing environmentalists with one of the country's longest unbroken runs of meteorological data (Figures 4 and 5).

Natural history societies and recording

Chief among those studying the nature of Sheffield is the Sorby Natural History Society (SNHS), a proudly amateur society which celebrates its centenary in 2018[3,4]. SNHS continues to organise lectures, field excursions and surveys to identify and record Sheffield's natural history and to enlighten and inspire. SNHS publishes a monthly newsletter, plus the 'Sorby Record' annually, and a 'special series' of species atlases and reports, for example 'A Flora of the Sheffield Area – 200 years of plant records'[5]. Many additional specialist groups also exist, including the Sheffield Bird Study Group (SBSG); other bird groups detailed in the following case study; the South Yorkshire Badger Group, and the South Yorkshire Bat Group.

In 1964, the Sheffield Biological Records Centre (SBRC) was formed, initially in Weston Park Museum, but now housed and managed by the Sheffield City Council (SCC) Ecology Unit[6]. These data, now comprising >440,000 site and species records, can be accessed by ecologists, planners, researchers and commercial consultancies for a variety of research and practical applications[7]. These data have contributed to the production of key documents to assist with nature conservation including Local Habitat and Biodiversity Action Plans and important precursors to this report: 'The Natural History of the Sheffield District' (1968)[8] and 'The Natural History of the Sheffield Area and the Peak District (1985)'[9]. A 'Sheffield Red Data Book' is due for publication in 2018 by SNHS, highlighting the status of rare species across the district. Sheffield continues to be blessed with national authorities from the academic and amateur fields whose publications have had an impact well beyond the city.

Surveying grasses
© Matthew Roberts

Case study: The history of bird recording in Sheffield
Bob Croxton, Sorby Natural History Society and Sheffield Bird Study Group

Prior to the second World War there exists only a small number of bird records from Sheffield, usually of rarer bird species. Egg and bird skin collections, along with diaries and notes, were donated to Sheffield Museum and serve as important historical records. In 1861 the Yorkshire Naturalists Union was formed which produced a regular journal – 'The Naturalist' – and, later, annual bird reports detailing some of the rarer birds found in Sheffield.

SNHS has continued bird recording since its formation in 1918. Arthur Whitaker wrote notes on 'Birds of the Sheffield Area (1929)'[10] and Weston Park Museum holds summaries of his diaries. Its Ornithological Section was formed in 1946. Early bird reports in the 'Sorby Record' give intriguing reports providing key insights as to how bird numbers and distributions have changed through Sheffield in the last century. An example includes nuthatch - "absent except for one or two pairs in large gardens in the Endcliffe area" – and hawfinch - "resident, thinly distributed throughout the area including gardens well into the city". Nuthatch are now a fairly common woodland bird whilst hawfinch are extinct within the city. SNHS together with Sheffield Museum published 'The Birds of the Sheffield Area' (1974)[11] which contains distribution maps from the Sheffield district and broader area. From 1964 until fairly recently, the SNHS newsletter contained monthly reports on Sheffield's birds and the society has generated a huge number of bird records for the Sheffield Biological Records Centre (SBRC).

A prominent group in Sheffield is the Sheffield Bird Study Group. SBSG has been systematically recording and surveying the birds of the Sheffield area since 1972. Its annual bird report is the definitive statement in Sheffield bird recording and the importance of its consistent and systematic approach is highlighted in their 'Birds of the Sheffield Area' (1985)[12] and 'Breeding Birds of the Sheffield Area' (2013)[13] upon which most bird data within this report is based. The group has also published a bi-monthly bulletin listing local bird records. SBSG's website supports the facility to receive bird records with these being displayed on a daily basis and collated into the annual report. The group has a digital database collected since 1990 of around 830,000 bird records and paper records pre-dating this. Some 45,000 - 50,000 digital records are added each year.
Five editions of the journal 'The Magpie' have been published since 1973 containing detailed studies on Sheffield birds, including rooks and swifts, and a survey of city parks and woodlands.

Sorby Breck Ringing Group, formed in the 1960s, has ringed around 200,000 birds in the greater Sheffield area and many in the city. Apart from gaining information from recovered ringed birds, regular trapping at 'Constant Effort Sites' has provided year on year population data on many bird species.

The BTO, formed in 1933, is a national organisation that also holds much information about Sheffield's birds. Its surveys include Common Bird Censuses and the Wetland and estuary Bird Survey (WeBS) – taking into account the diversity of birds on Sheffield's reservoirs, and the Waterways Bird Survey which considers Sheffield's rivers. The BTO has collected much information from its Sheffield members for national atlases, and the Birdtrack system collects vast amounts of digital bird data via its website.

Looking to the future, the amount of bird data being collected in Sheffield is as big as ever, especially since the introduction of web-based recording systems. The biggest threat to this going forward is finding people to manage the collection of these data. Both data recorders at SNHS (in role since 1970s) and SBSG (1990) have wished to retire for some time now, but sadly no one has come forward.

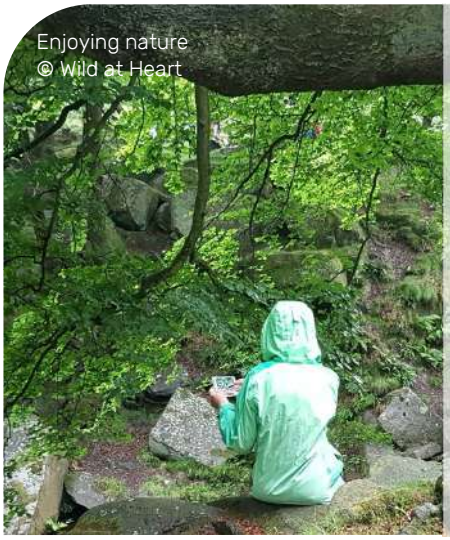
Ringing a wren
© Tom Marshall

Case study: Well-being and health through connections to nature
Jenny King and Susan Smith, Sheffield & Rotherham Wildlife Trust & Clare Rishbeth and Jo Birch, IWUN Project, the University of Sheffield

Wild at Heart is coming to the end of a five-year Reaching Communities in Need, Big Lottery funded project to support older adults and vulnerable people in Sheffield to connect with nature for health and well-being. We have been discovering how and why nature helps to support well-being and what the barriers may be that restrict this. We have overlapped and exchanged findings with the Improving Well-being Through Urban Nature project (IWUN)[18] – a three year University research project by the Natural Environment Research Council's Valuing Nature Programme - which is finding out more about how Sheffield's natural environment can improve the health and well-being of the city's residents, and especially those with disproportionately high levels of poor health.

IWUN is finding that people who live in cities are using not only spaces, but experiences of nature to help their sense of mental well-being. People who feel a health benefit are from different socioeconomic areas of the city, from different ethnic and cultural groups and are of different ages[19]. Findings from one strand of IWUN's research, based on 12 in-depth life stories with Sheffield residents aged over 70, reveal that those living in deprived urban areas recounted very few childhood memories of nature and greenspace. This group reported little current engagement with Sheffield's nature and greenspace in their daily lives, either close to home or further afield, indicating a potential need to address inequalities in 'access' to nature. In most interviews, isolation was a recurring theme; social connection and having regular activities or interests was central to people's sense of well-being. Whilst for a few people, involvement in nature-based interests, such as gardening or photography were solo activities, for most it was the support of other people and social networks that facilitated well-being benefits from urban nature.

Wild at Heart nature-based activities and sessions have been based on the five Ways to Well-being – Connect, Be Active, Take Notice, Keep Learning and Give[20], which supports the principles behind Active Ageing. Sessions have been embedded in the local communities to build inclusive and supportive social groups, as well as offering opportunities for individuals to connect, or often reconnect, with nature-based hobbies and interests. It takes time, many small steps and community support to build confidence and trust for people to be able to engage in building a more mentally, physically and socially active lifestyle.



Enjoying nature
© Wild at Heart

"It is great to visit such an interesting place. I would never have come here before in my previous 60 years of living in Sheffield. It was great to see the views. Coming along to the sessions has increased my confidence to try different challenges."

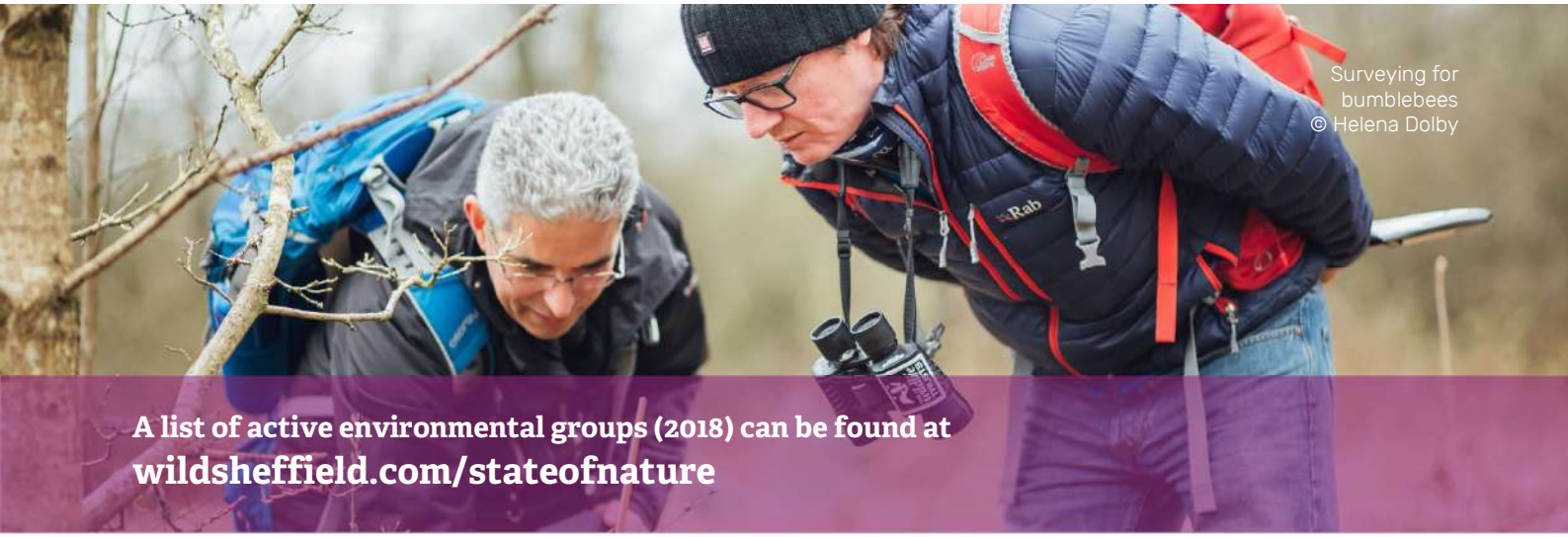
In terms of impact, Wild at Heart has, as of December 2017, delivered 679 sessions with 5,061 attendances. As at the end of its fourth year (July 2016) a survey found that 1,762 people were doing more exercise; 1,384 were demonstrating improved health by walking further and doing more energetic activities; 1,648 felt healthier; 1,280 felt happier or less isolated, 1,173 felt less lonely; and 1,623 had made new friends. This demonstrates how much of a positive impact exposure to wildlife and the outdoors can make to peoples' lives.

"I have enjoyed everything today. I like to be near water as it gives me a sense of peace and happiness. These sessions have given me a life connected with nature. I have done things I have never done before and learnt so much about wildlife."

Pond dipping
© Wild at Heart

Local conservation organisations and groups

1912 saw the birth of the Wildlife Trust movement (now a national network of 47 Wildlife Trusts), initiated by Charles Rothschild[14]. The Yorkshire Trust (est. 1946) originally included Sheffield but in 1985 the Sheffield City Wildlife Group (later to become Sheffield & Rotherham Wildlife Trust, SRWT) was formed to raise awareness of the biodiversity value of the urban environment and focus on particular issues surrounding urban greenspaces[15]. Today, SRWT is a registered charity, with over 6,000 members and 100 volunteers, and works with the local community towards creating a network for nature. The Trust manages 15 nature reserves (almost 600ha), across Sheffield and Rotherham, and connects people with the natural world through innovative programmes, helping thousands of local people to improve their lives through natural experiences and outdoor learning. The Trust also campaigns for a better deal for nature and people, both locally and in the wider world, standing up for wildlife and providing expert evidence on issues such as flood protection, as well as inspiring people to take action for wildlife and wild places in their own lives.



Surveying for bumblebees
© Helena Dolby

A list of active environmental groups (2018) can be found at
wildsheffield.com/stateofnature

There are a number of other conservation organisations also operating in Sheffield: the Steel Valley Project; the Woodland Trust; Sheffield Landscape Trust; North Sheffield Conservation Group; and Sheffield Countryside Conservation Trust operate mainly in the north of the city. Others – including Don Catchment Rivers Trust, River Stewardship Company and the Wild Trout Trust – are connected to the rivers and are detailed in the Waterways and Wetlands chapter. Sheffield Conservation Volunteers, The Conservation Volunteers, Groundwork Sheffield and Sheffield University Conservation Volunteers offer more of a 'flying squad' service across the city.

There are around 50 active environmental groups around Sheffield at any one time. These may be 'Friends of' greenspaces groups, community groups and specialist societies, giving their time to maintain the city's natural environments. Many also submit biological records to the SBRC. Sheffield Green Spaces Forum[16] is a voluntary organisation that brings together and supports many of these local groups. Joining a local group or supporting a city-wide organisation is a readily available way in which every reader of this report can make a difference to Sheffield's natural environment. Even without joining a group, people can still get involved in the many environmentally-related events in the city, in particular through 'Environment Weeks' that has grown from one week in 1984 to over 200 events over a six week period annually in May and June. A group of volunteers administers an online calendar of environmental events throughout the year across the region[17].

Recommendations

Ensure local volunteer groups have the resources, professional support and encouragement they need to make a lasting and meaningful contribution to the conservation and management of wildlife sites.

Encourage user groups to become actively involved in the conservation and management of the wildlife sites they frequent.

Promote involvement by the public in community science projects, recognising the value they have in encouraging people to get close to nature and in monitoring wildlife. This is of particular significance as climate change increasingly affects our local wildlife.

Habitat coverage across the Sheffield district

Sheffield has a wealth of natural, semi-natural and modified habitats that support a rich variety of wildlife. These have been mapped using a standard method, outlined in the Appendix, which also applies to the following habitat-specific chapters unless stated otherwise. As a thriving industrial city, 17% of the landscape consists of constructed features such as buildings and paved roads (Figure 9). Figure 10 shows the extent of these natural and man-made habitats and features across the district. By far the most prominent habitat type is grasslands, including pastoral lands and amenity grasslands contained in the urban landscape. Gardens and landscaped areas – including private gardens plus roadside and railway vegetation – can act as vital refuges for wildlife in built up areas of Sheffield and also serve to increase habitat connectivity. Woodlands and shrub, including single trees, are prominent within Sheffield, making up 15% of the total landscape (this does not include more recent iTree calculations; these are detailed in the Woodland chapter). Finally, a large portion of the natural landscape is upland (heathland and bog), which is concentrated to the west of the district within the Peak District National Park.

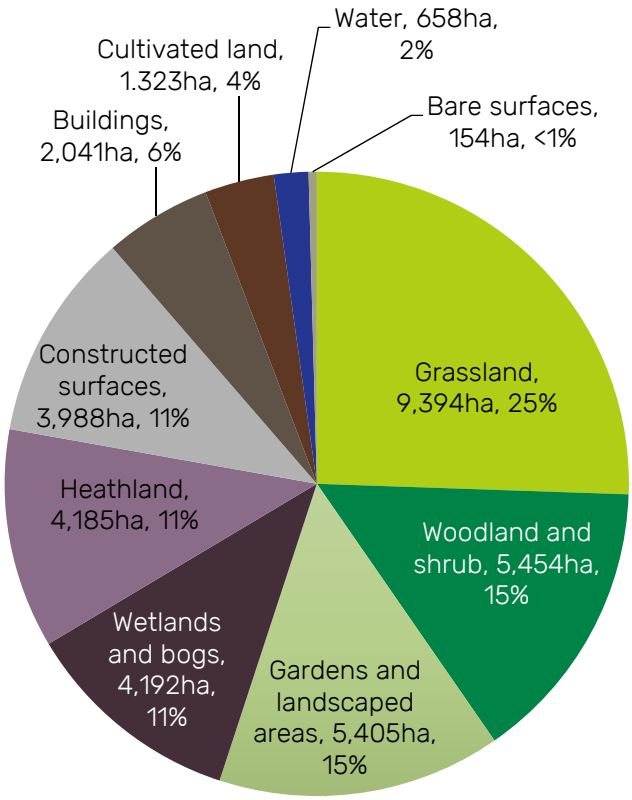


Figure 9 (above): composition of broad habitat types found across the whole of the Sheffield district

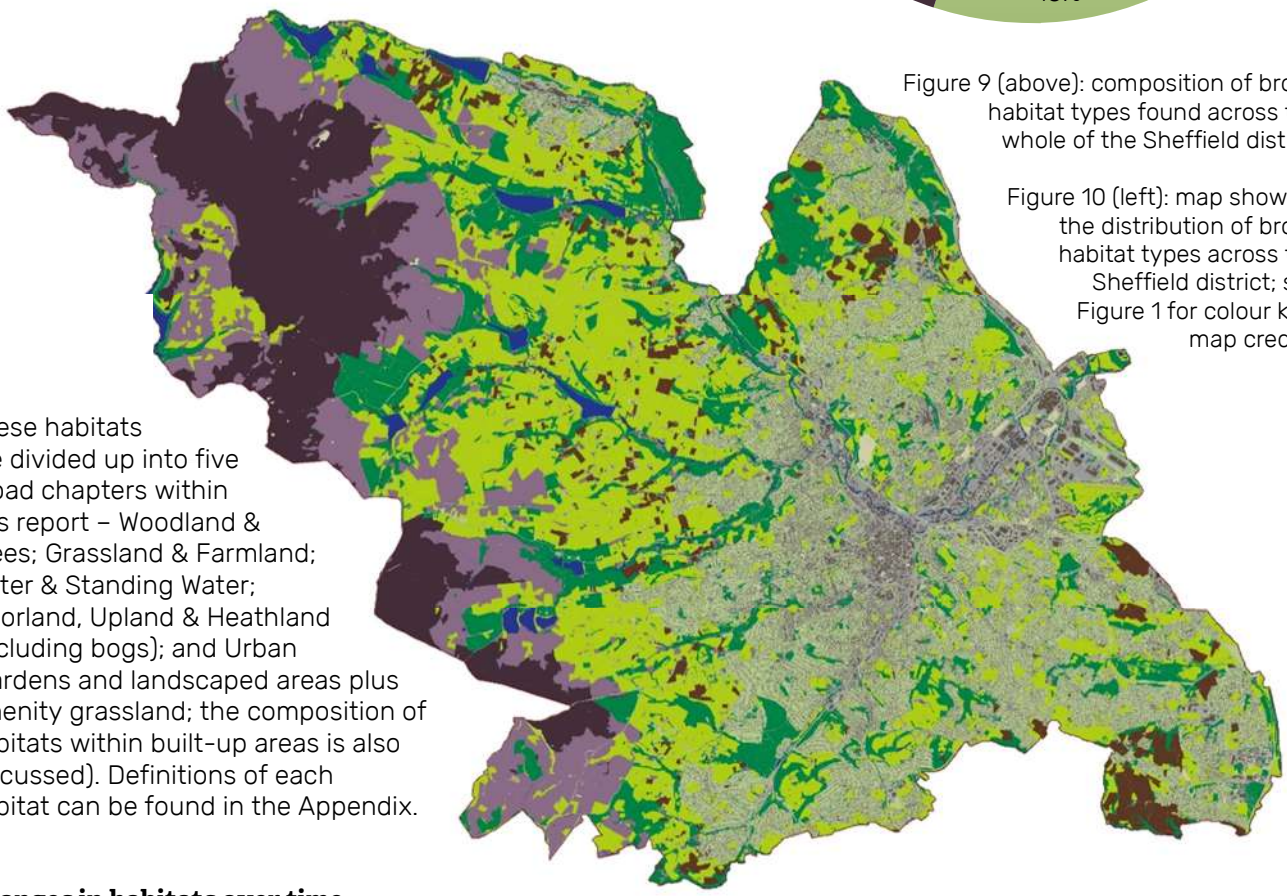


Figure 10 (left): map showing the distribution of broad habitat types across the Sheffield district; see Figure 1 for colour key; map credit 1

These habitats are divided up into five broad chapters within this report – Woodland & Trees; Grassland & Farmland; Water & Standing Water; Moorland, Upland & Heathland (including bogs); and Urban (gardens and landscaped areas plus amenity grassland; the composition of habitats within built-up areas is also discussed). Definitions of each habitat can be found in the Appendix.

Changes in habitats over time

Accurately estimating changes in habitat coverage over time is difficult and it is further complicated by the availability of equivalent, comparable data over different time periods. From the data we have been able to obtain and analyse (see methods) there is a general indication of an increase in improved and unimproved grasslands, possibly by over 750ha, mostly originating from loss of heathland. Changes are also observed in the distribution of cultivated land, most likely resulting from changes in farming practices, although no change in the total amount is shown. There are also increases in broadleaved woodland, possibly more than 300ha, with similar decreases in mixed woodland and shrub observed. This, plus changes in heathland, could be explained by habitat succession or changes in management practices. Finally, the number of young trees and felled woodland has also possibly increased. Although similar data sources have been used for the different time periods examined, some care should be taken when interpreting these figures due to differences in data resolution.

Case study: A landscape-scale approach to improving habitats and connectivity
Keith Tomkins, Sheffield & Rotherham Wildlife Trust

Sheffield Lakeland Landscape Partnership is funded by the Heritage Lottery Fund (HLF) as part of its national Landscape Partnerships programme. The Partnership is managed by SRWT, working with Sheffield City Council (SCC), Bradfield Parish Council, Stocksbridge Town Council, Sheffield United Community Foundation, South Yorkshire Archaeology Service, Yorkshire Water, Natural England and the Environment Agency, and has support from representatives of landowners and local access groups. It offers a unique opportunity to manage the area's natural and built heritage as one, with a common vision, on a landscape scale and for more people to enjoy.

Through some 22 projects, the Partnership aims to achieve four broad outcomes: a more connected and resilient landscape; a bigger, better and more joined-up natural environment for wildlife and people; better-recorded and valued cultural heritage celebrated by local people and visitors; and better understanding of the local heritage with more people helping look after it.

The Landscape Partnership approach concentrates predominantly on habitats and connectivity. The Partnership area of north-west Sheffield is an outstanding example of a 'living landscape', rich in history, with diverse habitats abundant in wildlife, vibrant communities and strong traditions. But now more than ever, wildlife must be given room to move through the countryside and the Partnership is working to restore, recreate and reconnect habitats on a landscape scale.

The area contains UK priority habitats of blanket bog, upland heath and flush, and deciduous and ancient semi-natural woodland. Over half of the area falls within the Peak District National Park and the western margin includes areas designated as Site of Special Scientific Interest, Special Protected Area and Special Area of Conservation. It therefore represents a valuable buffer between protected habitats and Sheffield's urban fringe, which is much more vulnerable to habitat loss.

At a landscape scale the Sheffield Lakeland area includes a wide range of habitats, often in small parcels, set within a varied and attractive mosaic. There is a history of ploughing up heathland, draining wet pasture and other forms of agricultural intensification which has accelerated significantly in recent years. The Partnership will focus on these heathland and grassland mosaics and introduce management practices that can be sustained after investment has been made. Promotion of the area as part of 'The Outdoor City' poses both a potential risk and an opportunity. Appropriate management is needed to improve public access whilst ensuring the area's heritage is enjoyed, understood and protected.

Woodlands and reservoirs form the visual focus of the landscape. SCC and Yorkshire Water are planning to manage their woodland holdings through significant felling and replanting during the project period, encompassing over 200ha of woodland. The Partnership aims to protect woodland species by ensuring a coordinated approach to woodland management, including forestry work, mitigating disturbance and creating a better 'forestry' habitat for wildlife and leisure.

The shaping of the Sheffield Lakeland is a story of water, from the carving of the valleys, through early settlement and industry to the reservoirs that have led to the term 'Sheffield Lakeland'. Water links everything we wish to achieve when working at a landscape scale. Natural flood management, through low-impact habitat creation and management, offers a strong synergy between eco-engineering and wildlife conservation. The Partnership's natural flood management project aims to demonstrate, in a quantitative manner, the potential to conserve species, enhance landscape attractiveness and protect downstream property and infrastructure. Importantly, by focusing on habitats and connectivity, the Partnership aims to protect a number of priority and locally important species.

View from farmland through to Agden, Dale Dike and Strines Reservoirs © Claire Watts

Designated Sites

Headlines

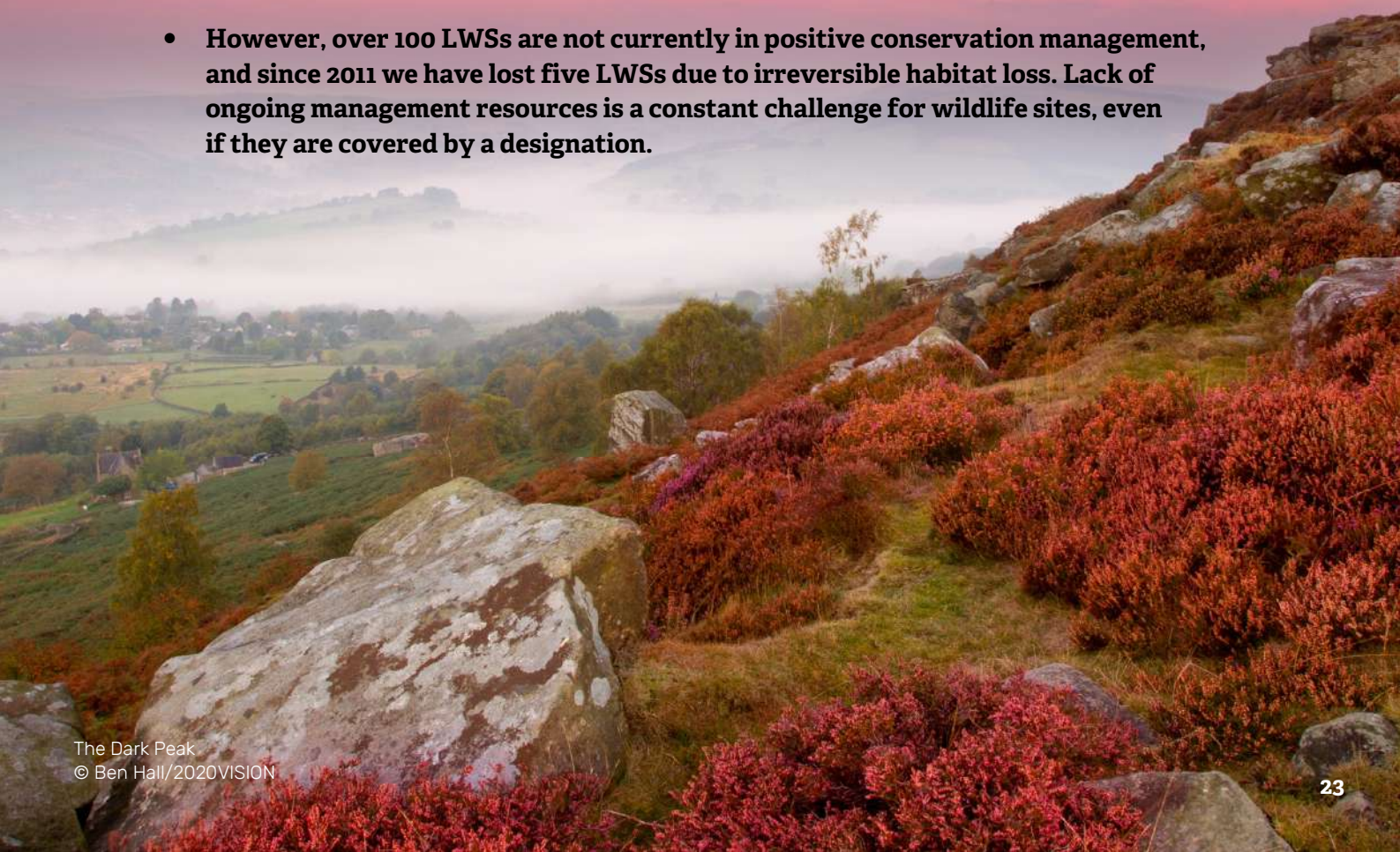
- **Over 36% of the Sheffield district is covered by sites with European, national or local designation. These offer valuable habitats to wildlife, with some level of protection, as well as natural spaces for people. The majority of European designated sites are in the Peak District National Park.**

- **Sixty percent of designated sites are composed of moorland habitats (heathland, upland and bogs). Woodland is the next-best represented habitat, covering nearly a quarter of all designated site land.**

- **Over 99% of Sheffield's biological Sites of Special Scientific Interest (SSSIs) are in 'favourable' or 'unfavourable recovering' condition. This is higher than the UK figure of 94% for all SSSIs.**

- **Sheffield currently has 253 Local Wildlife Sites (LWSs) and 17 Local Nature Reserves (LNRs). Over half of LWSs (140 or 55%) are under positive conservation management.**

- **However, over 100 LWSs are not currently in positive conservation management, and since 2011 we have lost five LWSs due to irreversible habitat loss. Lack of ongoing management resources is a constant challenge for wildlife sites, even if they are covered by a designation.**



The Dark Peak

Introduction to designated sites

Nature sites and areas of countryside can be 'designated', which means they have special status as protected areas because of their natural and cultural importance. Sites that are important for nature conservation can be designated at different levels. The highest level of protection is offered to sites that are of European significance: Special Protection Areas (SPAs) and Special Areas of Conservation (SACs). The next level of protection is for nationally important sites: Sites of Special Scientific Interest (SSSIs) and National Nature Reserves (NNRs). There are then locally designated or 'third tier' sites: Local Nature Reserves (LNRs) and Local Wildlife Sites (LWSs). Sheffield contains a mixture of these designated areas, with the exception of NNRs, and designations can overlap.

Designation means that these places have clear boundaries; in most cases, laws and/or policies make sure that the habitat and wildlife are not harmed or destroyed and some sites can be used by people for recreation and study. Places are made into designated areas by organisations, such as Natural England (NE) and local councils, through application where appropriate of national and international laws and policies. There are restrictions on activities and developments that might affect a designated or protected area, for example building new houses or roads. The level of restriction depends on the level of designation of the place and can include areas next to as well as in those areas. In total, 36.4% (13,341ha) of the district is covered by one or more designations with 24.7% having European level protection, 24.9% with national protection and 11.4% with local site designation.

What habitats are covered by designated sites?

Upland habitats, comprising of bogs and heathland, make up the majority of habitats within designated sites (60%; Figure 1). This is primarily because of the large Peak District National Park (PDNP) which is designated as a SPA, SAC and SSSI. Nearly a quarter of the designated area is woodland (23%) with this habitat distributed mostly to the central and eastern parts of the district and often as part of a mosaic of habitats associated with grasslands (Figure 2). These sites are mostly LWSs and LNRs (see overleaf) that provide quality and accessible natural habitats to people within urban areas. Key regions of standing and running water designated as LWSs include large reservoirs which serve as important breeding sites for birds.

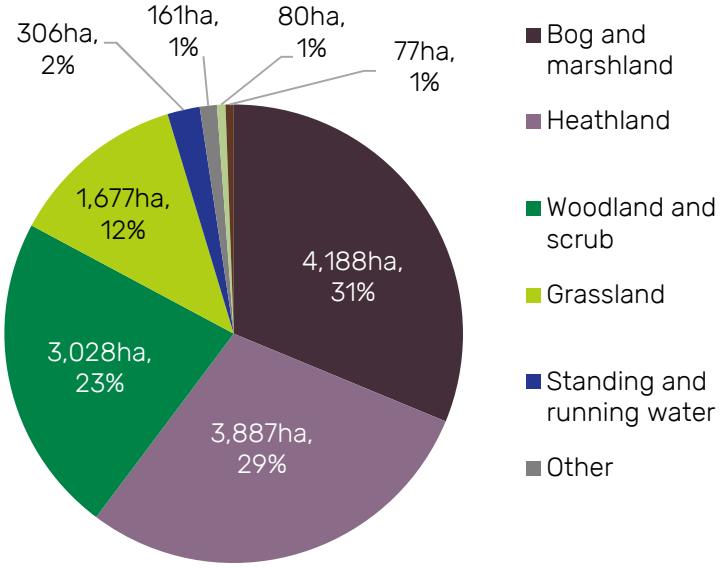


Figure 1 (above): composition of broad habitats within designated sites. Moorland habitats and woodlands are well represented.

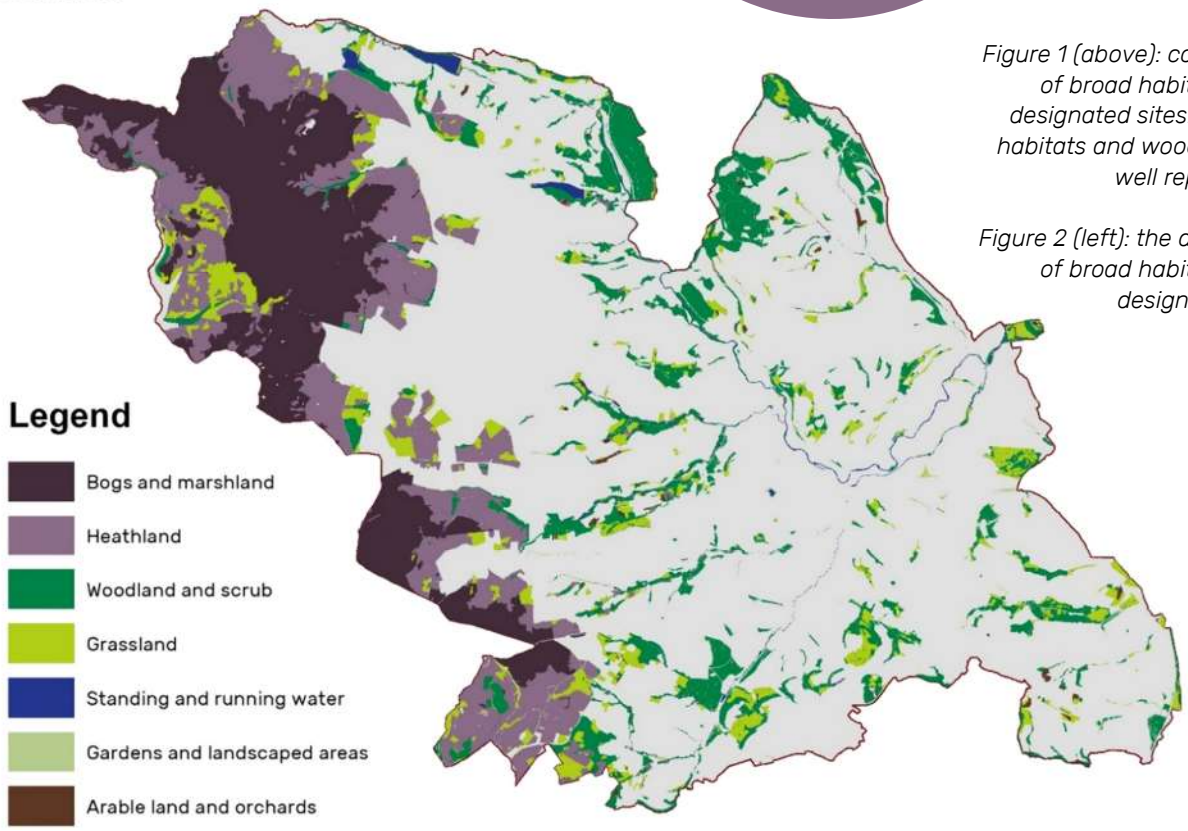


Figure 2 (left): the distribution of broad habitats within designated sites.

Special Protected Areas (SPAs) and Special Areas of Conservation (SACs)

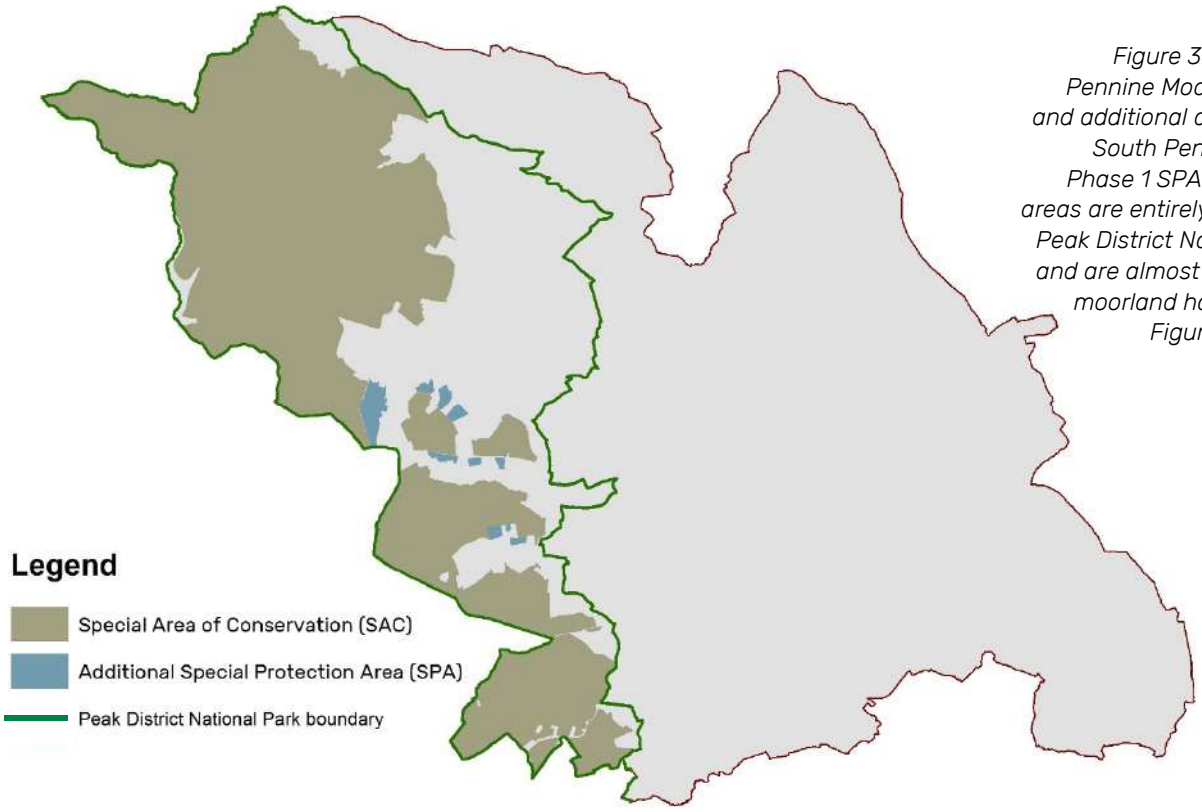


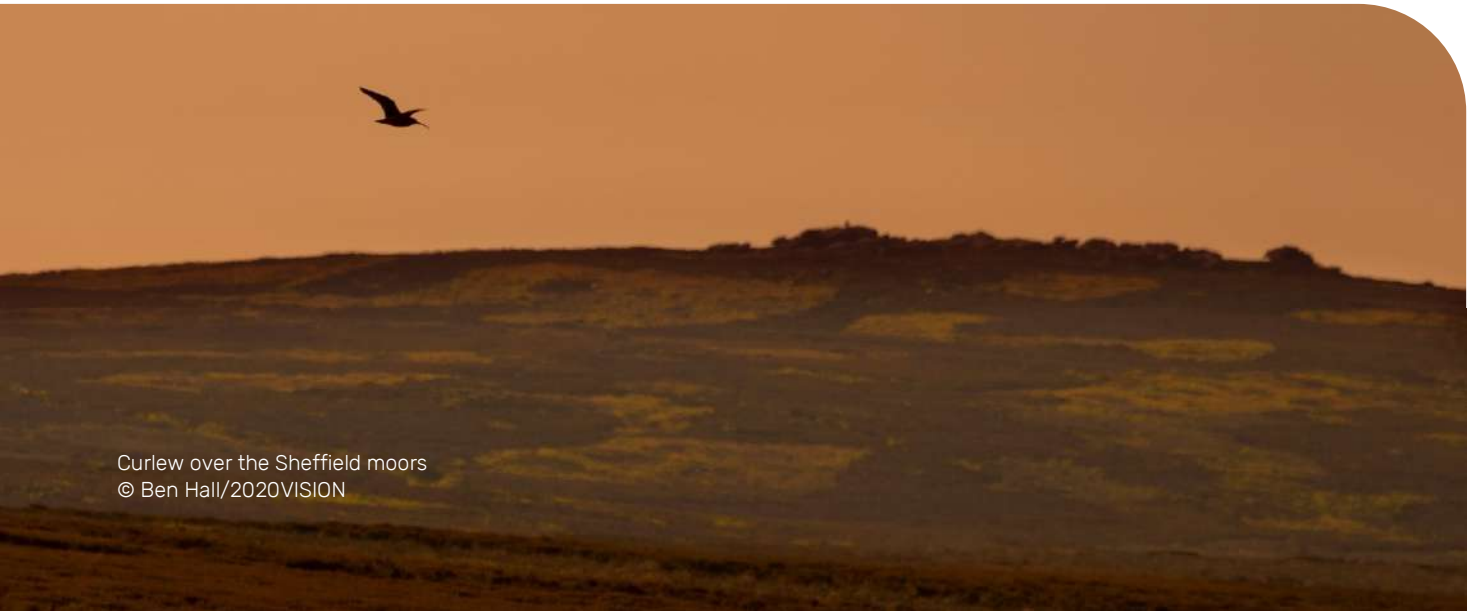
Figure 3: The South Pennine Moors SAC (■) and additional areas of the South Pennine Moors Phase 1 SPA (■). These areas are entirely within the Peak District National Park and are almost exclusively moorland habitats (see Figure 2 above).

SACs and SPAs have been created under the EC Birds Directive and Habitats Directive. In the UK they form part of a larger European network called Natura 2000. SPAs are areas of the most important habitat for rare (listed on Annex I to the Directive) and migratory birds within the European Union. This high level of legal protection prevents damaging activities to both SPAs and SACs. These European-designated sites are all in the Peak District National Park, which in itself offers some degree of protection through its planning and other policies.

The South Pennine Moors SAC in the Pennine area, plus the Eastern Peak District Moors and Dark Peak SSSIs, are all contained within the same area of the Sheffield district. A total of 8,892ha is covered by the South Pennine Moors SAC and the SPA of the Peak District Moors (South Pennine Moors Phase 1) adds an additional 185ha making a total of 9,077ha (Figure 3). A total of 25% of the Sheffield district is covered by these two designations.

Primary habitats of importance in the SAC are European dry heaths, blanket bogs and old sessile oak woods. Habitats of secondary importance are dry heaths and transition mires and quaking bogs.

All of these designations cover extensive tracts of semi-natural moorland habitats including upland heath and blanket bog. The site is of European importance for several upland breeding species, including birds of prey, waders and migratory birds such as merlin, golden plover and dunlin. The recent Peak District State of Nature report goes into more detail on the habitats found within this region and is a valuable management resource.



Curlew over the Sheffield moors

Sites of Special Scientific Interest (SSSIs)

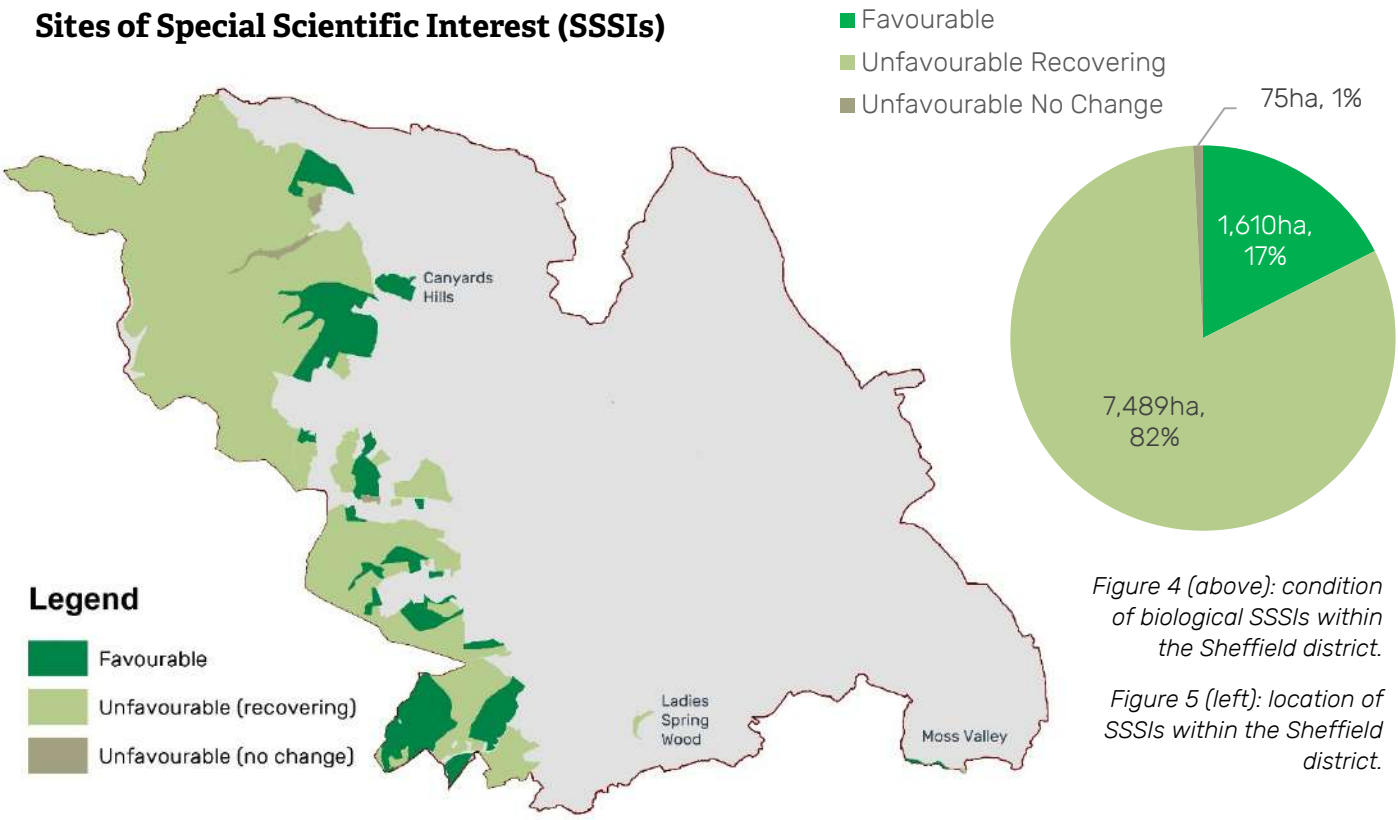


Figure 4 (above): condition of biological SSSIs within the Sheffield district.

Figure 5 (left): location of SSSIs within the Sheffield district.

SSSIs have developed since 1949 as the suite of sites providing statutory protection for the best examples of the UK's flora, fauna, and geological features. They may underpin other designations. Not all outstanding areas are SSSIs as they are designated at the national scale. LWSs are the best examples at a local scale, and are therefore much more numerous, but do not have statutory protection (see opposite).

In Sheffield, there are five biological SSSIs covering 9,174.1ha (Figures 4 and 5). The Dark Peak and the Eastern Peak District Moors are covered in the previous page through their additional higher-level designations as SPAs and SACs. Moss Valley SSSI forms part of the wider Moss Valley Woodlands extending into north-east Derbyshire. Canyards Hills SSSI is a distinctive site designated for both its geology and biology. The distinctive 'ridge-and-trough' topography supports areas of boggy vegetation and ponds which is an unusual feature in the dwarf-shrub moorlands of the north peak. The combination of the aquatic habitats in sheltered troughs with very dry banks of mineral soils provide habitats for aquatic plants, invertebrates and amphibians.

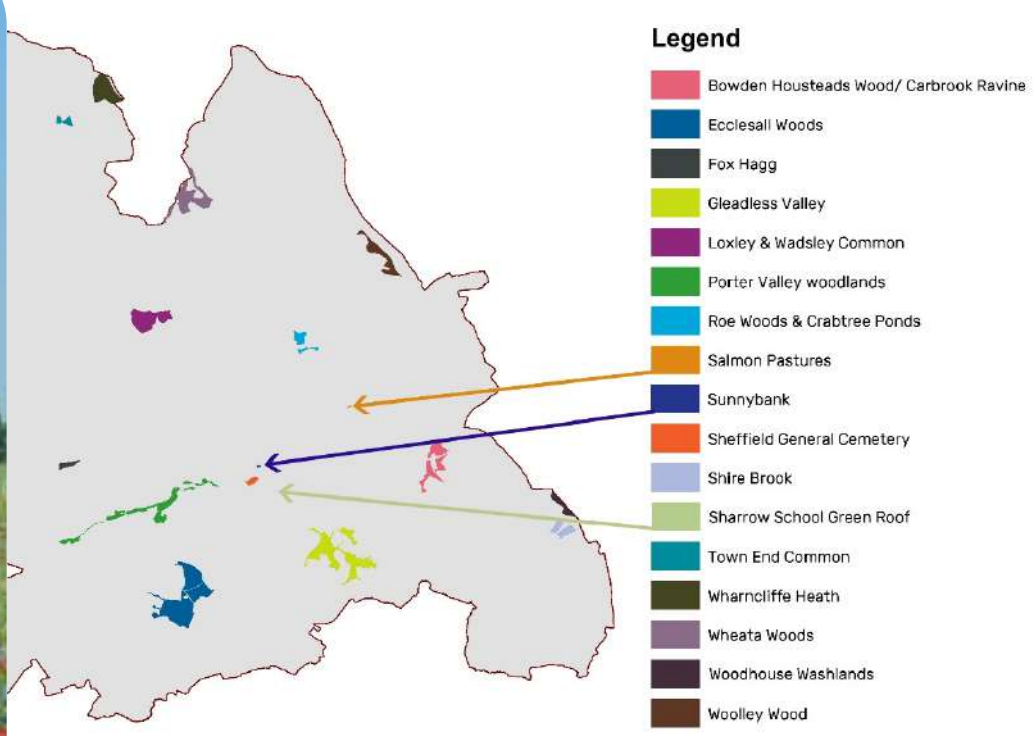
Totley Wood SSSI – also known as Ladies Spring Wood - is a fine example of a Pennine oak-birch wood, occupying steep slopes with thin acid soils, but also including the valley bottom where both ash-wych elm and alder woodland have developed. The well-marked zonation of soil and vegetation, allied with the wood's close proximity to the urban area, makes the SSSI a valuable educational site.

Sheffield's biological SSSIs are performing well with 99% of all sites in 'favourable' or 'unfavourable recovering' condition (Figure 4) compared to 94% for the UK. However, of this, only 17% are 'favourable' compared to the national figure of 39%. Currently none of Sheffield's biological SSSIs are in decline.

Ladies Spring Wood SSSI
© Sheffield City Council

`Local Nature Reserves (LNRs)

Wildflower meadow © Herts & Middlesex Wildlife Trust



A Local Nature Reserve (as defined by NE) is a site that is locally important for wildlife, geology, education or human enjoyment (without affecting wildlife). LNRs are designated by a local authority who will have a legal interest in the land (lease or agreement with the owner or occupier) if they are not the owner and manager. LNRs can be brownfield sites, historic sites (such as cemeteries), orchards, commons or other types of site provided they have recognised wildlife or geological interest. Aims, objectives and a management plan are required for designation and at least part of a LNR should be publicly accessible. A commitment to ongoing management for nature conservation, study and research into nature conservation, or both, is central to LNR designation.

Sheffield's LNRs cover a total of 606ha across 17 sites (see above map) covering 11.4% of the Sheffield district. The majority are woodland sites (82% of LNR area) with associated grasslands including amenity grasslands (13%). Key examples of LNRs within Sheffield include Sheffield General Cemetery LNR which is managed for its ecological, historical and social value by the Sheffield General Cemetery Trust. Sharrow School Green Roof LNR (below left) – Sheffield's smallest LNR – was designated in 2009 as the first green roof LNR in the UK. Ecclesall Woods LNR is the largest LNR within the Sheffield district (135ha) and provides valuable access to ancient woodlands for the people of Sheffield; a short case study is given in the Woodlands & Trees chapter. This is followed in size by Gleadless Valley LNR which also contains important areas of ancient woodland together with wildflower-rich meadows. Several smaller LNRs such as Sunnybank (below right) and Salmon Pastures provide respite for both people and wildlife within Sheffield's urban zone.

Sharrow Green Roof LNR
Local Nature Reserve

Sunny Bank LNR
© Tim Mackey

Local Wildlife Sites (LWSs)

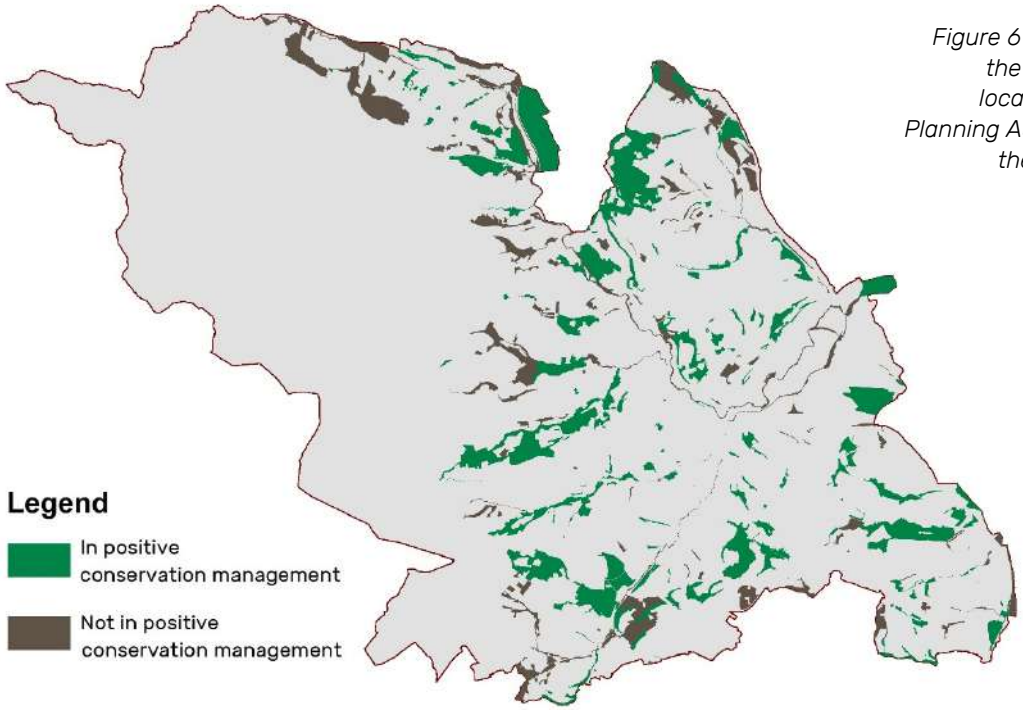
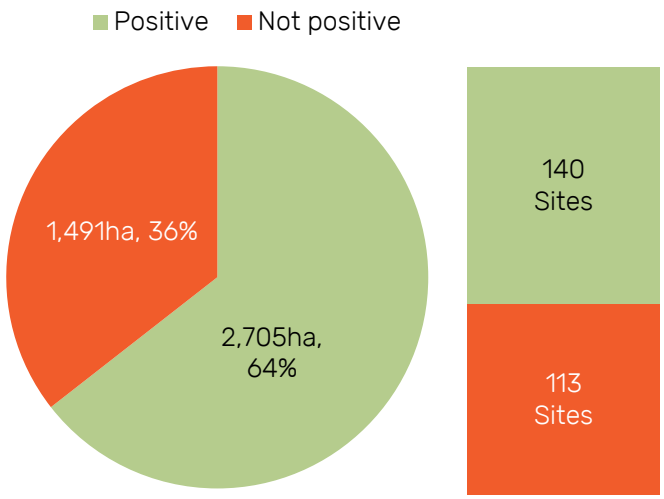


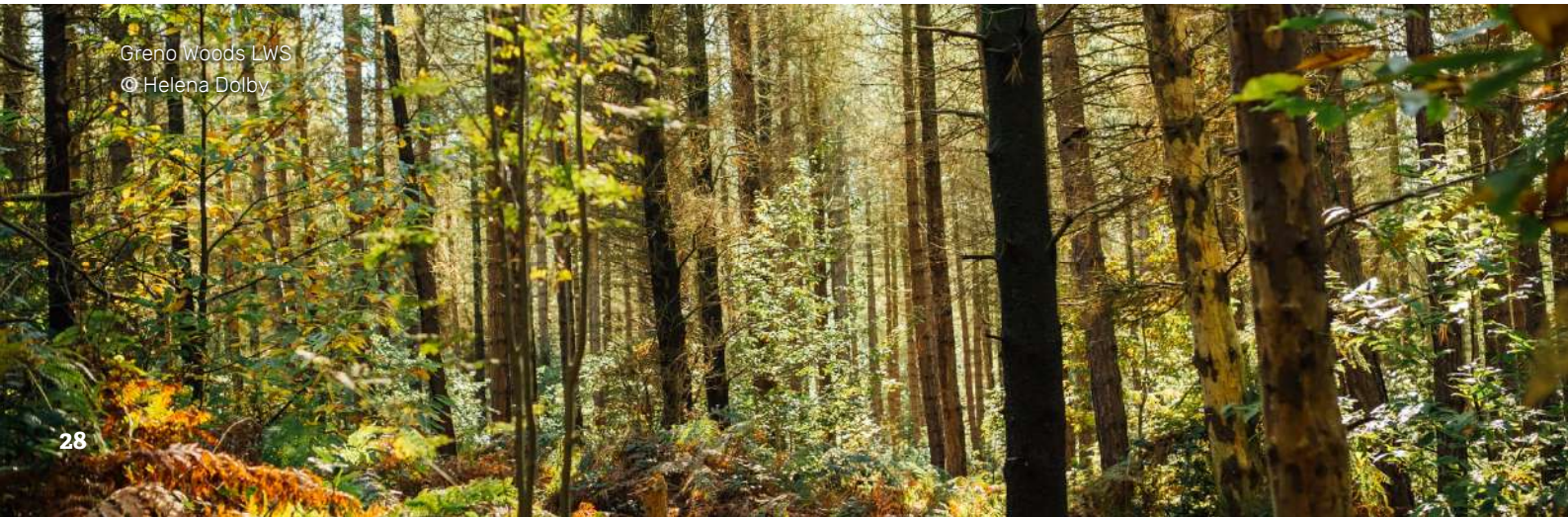
Figure 6 (left): location of LWSs within the Sheffield district. All sites are located within the Sheffield Local Planning Authority Boundary (outside of the Peak District National Park).

Figure 7 (below): conservation management status of all LWSs found within the Sheffield district. Almost two-thirds of land covered by LWSs (2.705.2ha) is in positive conservation management.

Local Wildlife Sites can be privately or publicly owned and in Sheffield a large number are wholly or partly owned by Sheffield City Council (SCC). They have been identified and selected by the Sheffield Local Wildlife Site partnership of local authorities, ecologists and nature experts using robust criteria and ecological surveys. They are not protected by law and for many sites their only protection comes from national and local planning policies. Local authorities report annually on the percentage of sites that are in 'positive conservation management'. Evidence for this includes: a management plan being in place; advice given to landowners; and the site being in a management scheme e.g. environmental stewardship. One of the biggest threats to LWSs is lack of management and resource for management.



Sheffield has 253 LWSs (as of 2017), covering 4,196ha or 11.4% of the district, which are all located within the Sheffield Local Planning Authority Boundary outside the Peak District National Park (Figure 6). Of these sites, 140 – 64% of the area – are in positive conservation management (Figure 7) and 113 are not. Ecclesall Woods is the largest LWS in Sheffield (also a LNR), followed by Wharncliffe Woods and Greno Woods. All three sites are currently in positive conservation management. Indeed, LWSs go a long way to helping protect Sheffield's woodlands – 63% of LWSs habitat is woodland and 49% of all woodlands in Sheffield are covered by this designation.



Greno Woods LWS
© Helena Dolby

Changes in positive conservation management status of LWSs

SCC tracks the conservation management status of LWSs on a yearly basis. Figure 8 shows the number of designated LWSs within the Sheffield district and how their management status has changed over time. The number of sites that have remained in positive conservation management for five years prior to the recording date has continued to increase, and from 2015 onwards, over half of all sites have been positively managed. This figure now stands at 140 sites, or 55%. However, the number of LWSs has slowly decreased over time (from 258 in 2011 to 253 in 2017) due to the loss of sites from irreversible habitat loss and serious degradation.

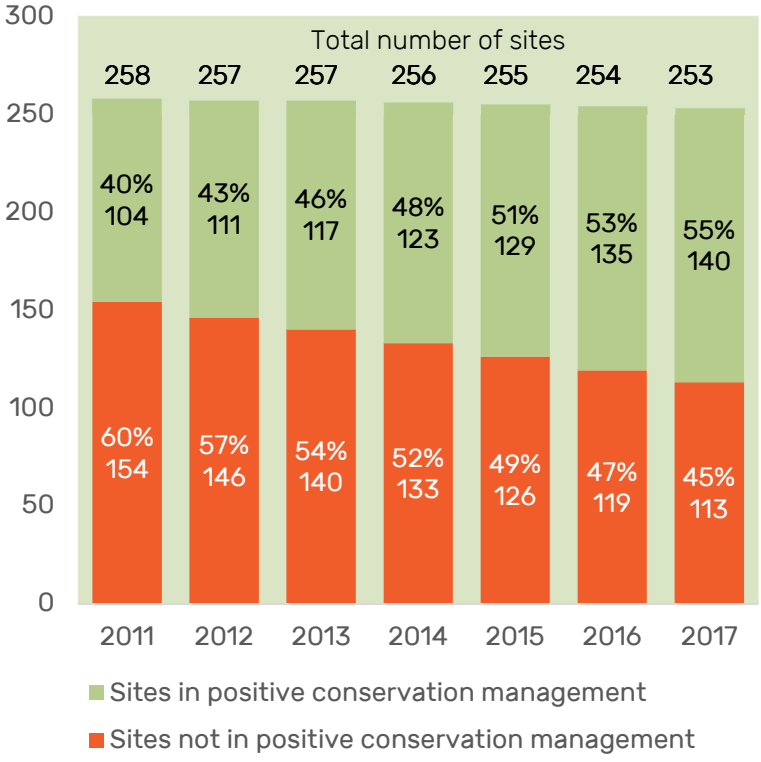


Figure 8 (right): positive conservation management status of LWSs within the Sheffield district between 2011-2017. The total number of sites has decreased but the proportion of existing sites in positive conservation management has increased. Data: SCC

Case study: Improving the management of Local Wildlife Sites in north Sheffield
Tom Newman, Project Manager, Steel Valley Project

Steel Valley Project works with a range of landowners including SCC, Liberty Steel, the Woodland Trust and Bradfield Parish Council to improve the management of LWSs in north Sheffield to safeguard the species and habitats they support. This has involved a range of consultation and practical work with volunteers, helping people from various backgrounds to gain skills, certified training and improve their employability. Work has been carried out on many different habitats, including woodland, heathland, meadows, rivers, ponds and wetlands. In 2016-17, we improved 16 LWSs, improved or created 28.5km of footpath and supported 1,067 hours of volunteering.

Examples of projects that have been undertaken recently include the creation and improvement of habitats in three ancient woodlands for the willow tit, a declining species; creation and management of ponds to enhance existing woodland habitats; control of invasive non-native species which threaten our native flora in areas of ancient woodland; and re-establishment of meadow management on a semi-improved grassland, to prevent it being lost to scrub encroachment, in partnership with the Woodland Trust.

Re-establishing meadow management practices at Bitholmes Wood with the help of volunteers.
© Tom Newman

Wyming Brook nature reserve,
part of the Eastern Moors SSSI
© Sarah Sidgwick

Woodland & Trees

Headlines

- Using our standard methods, 14.8% or 5,454ha of Sheffield is classed as woodland. Data gathered during the recent iTree project suggest even greater coverage of 5,946ha or 16.2%, substantially higher than the national figure of 10%. Total tree cover for the Sheffield district, calculated by iTree, is 18.4%.
- 23.5% of Sheffield's lowland woodland is categorised as ancient semi-natural woodland (ASNW) or plantations on ancient woodland sites (PAWS). This covers 3.5% of the Sheffield district and is higher than the figure of 2.3% for the UK.
- Sheffield's woodlands are a valuable recreational resource. Ninety-four percent of people have access to a large woodland (20ha) within 4km of their residence and nearly half of Sheffield's population has access to a 2ha woodland within 500m.
- Over half of Sheffield's woodlands are covered by designations such as Local Wildlife Sites (LWSs) and 63% of land with LWS designation is woodland. Most sites are improving; over 70% of woodland habitat within LWSs is in positive conservation management. Over 92% of ancient woodland is covered by a site designation.
- Compared to UK trends, bird species considered in the UK Biodiversity Indicator 'C5b: woodland birds' are doing well, particularly woodland generalists, indicating the good health of Sheffield's woodlands.
- Threats to woodlands in Sheffield include habitat fragmentation, damage from recreation and spread of invasive species from gardens. Continued improvements in woodland management, including the input of local groups, can help tackle this.

Broadleaved woodland

Introduction

Sheffield is considered to be the most wooded city in Britain and one of the most wooded cities in Europe with a total tree cover of 18.4%[1,2]. Trees and woodlands provide vital habitat for wildlife as well as a range of benefits to local people including health, recreation and economic benefits. Sheffield has a rich variety of woodland, urban street trees and veteran parkland trees that form an integral part of the city's green heritage, contribute to flood prevention and provide a suite of ecosystem services[3]. Historically, Sheffield's trees and woodlands have played an important part in shaping the city's rich industrial heritage, but today, Sheffield's woodlands serve primarily as sites for recreation with timber production mostly restricted to rural regions. Forty-five percent of local people have access to woodland greater than 2ha within 500m of their home whilst 94% have access to a 20ha wood within 4km of their home[4].

Statistics for woodland cover across the region are varied, both due to changes over time (woodland clearance and habitat succession) and differences in methods used to calculate coverage. For example, figures from the National Forest Inventory in 2002 and 2014 calculate a coverage of 7.4% (11,551ha) and 10.1% (15,727ha) respectively for South Yorkshire[5,6]. Here, the most recent figures calculated from the National Forest Inventory (2014) presented by the Woodland Trust or the most recent figures are used where possible[6]. In some cases additional recent data collected using iTree eco methodology for Sheffield City Council has been presented[3].

What woodland types does Sheffield have?

Figure 1 shows the composition of Sheffield's woodland habitats (as calculated by our standard methods outlined in the appendix, i.e. excluding iTree plot data). How these broad habitat types are distributed across the district is also mapped (Figure 2). Sheffield's diverse spectrum of woodland habitats range from ancient broad-leaved woodland to coniferous woodland and new plantations. Silver birch, sessile oak, sycamore, hawthorn and ash are the five most common species. The majority of Sheffield's woodlands (70%) are composed of native broadleaved species; primarily oak, ash and beech. A more comprehensive description of woodland habitat types found in Sheffield can be found in the Woodland Habitat Action Plan[7].

Recent calculations from iTree plot data, using different methods, suggest an even greater coverage of 5,946ha, which equates to 16.2%.

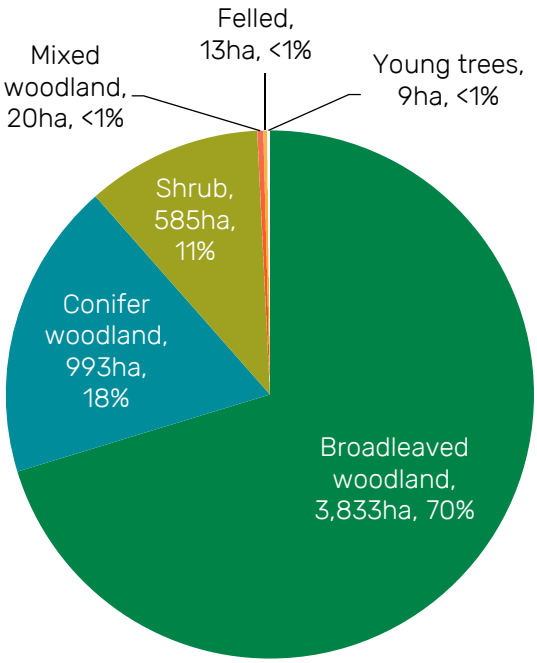


Figure 1 (above): percentage coverage of broad woodland types within the Sheffield district.

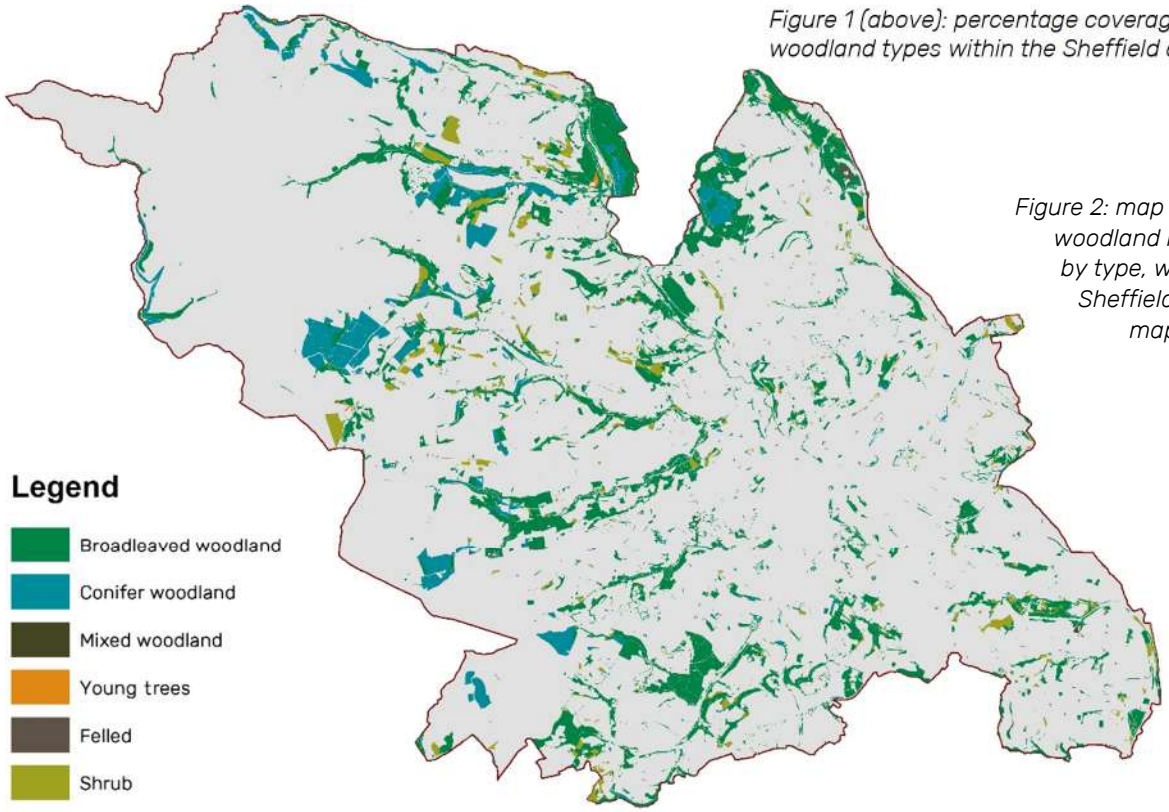


Figure 2: map of broad woodland habitats, by type, within the Sheffield district; map credit 1

Priority Habitat Inventory: woodland habitats

Sheffield features five of the eight woodland habitats, mapped on Natural England's Priority Habitat Inventory (PHI), that fall within the broad habitat type of broadleaved, mixed and yew woodland (Figure 3).

Wood-pasture and parkland – defined as mosaic habitats of grazed grasslands with trees of often considerable age – is scattered across the district with the majority of wood-pasture forming small parcels to the west. Historically, Sheffield supported some of the largest deer parks in South Yorkshire, which typically contained open pasture and mature tree standings. Most notable was Sheffield Park, first documented in 1332. This covered over 1,000ha by the 1600s, radiating from Manor Lodge, and was renowned for containing some of the largest oak and walnut trees in the country. However, by the eighteenth century, many medieval deer parks either changed function to country house landscaping or were lost as parks altogether, either reverting to woodland or converted to farmland. Today, the two largest sections of wood pasture mapped on the PHI fall within the Dark Peak alongside Howden Reservoir and to the west of Wigtwizzle. Both areas support a number of ancient and notable trees as identified by the Ancient Tree Inventory, several of which are highlighted on the next page.

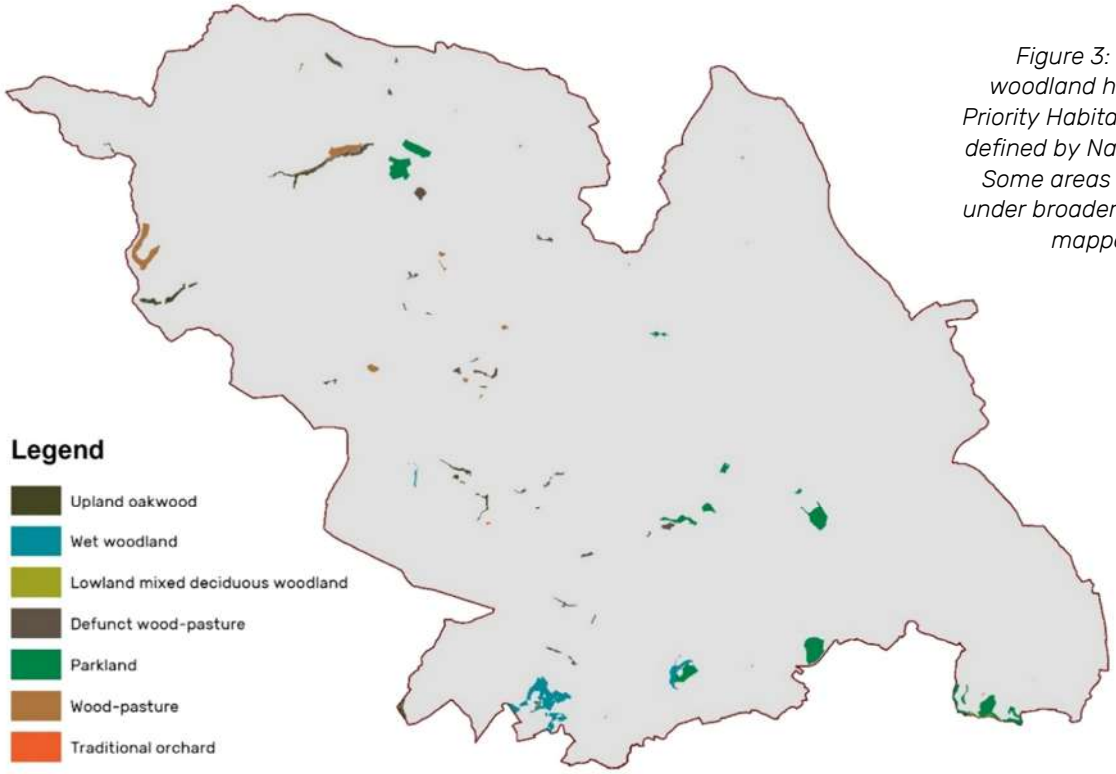


Figure 3: distribution of woodland habitats on the Priority Habitat Inventory as defined by Natural England. Some areas are contained under broader habitat types mapped in Figure 2; map credit 2

Small patches of upland oakwood, consisting of both pendunculate and sessile varieties, are present in Sheffield but are restricted to the Peak District and Pennine areas where they are exclusively concentrated around upland tributaries and associated slopes. Wyming Brook and Fox Hagg feature the largest areas around Rivelin Reservoir. A stretch extends from Howden Dam and a third is clustered around the upland stretches of Ewden Brook.

Some wet woodland also persists in the district. Most notably this is concentrated within Blacka Moor Nature Reserve, but also occurs along the River Sheaf within Beauchief, with a smaller section also noted to border Oaking Clough, off Rivelin Brook, within the Dark Peak boundary. Here wet woodland is more commonly associated with the successional fens and bogs typical of the region. Wet woodlands here are mostly composed of three tree species: alder (*Alnus glutinosa*), birch (*Betula* sp.) and willow (*Salix* sp.).

Traditional orchards feature as a very scarce priority habitat across Sheffield, with only 13 sites identified by Natural England. Several old orchards persist within the urbanised Gleadless Valley, with further examples present at Woodhouse and Beighton, which also support the locally rare wild daffodil[8]. Other small orchards are found to the north-west. Currently, most of these sites are not recognised or managed as traditional orchards and thus are considered to be threatened. However, several projects, such as Grow Wild, have worked to plant a number of new orchards using locally grafted trees, extending the number and geographical spread of orchards.

Finally, two small pockets of PHI lowland mixed deciduous woodland lie to the south-east corner of Sheffield: Birley Wood and Twelve Acre Wood through to Cadman Wood within Moss Valley Woodlands; a designated Site of Special Scientific Interest (SSSI). Typical of the habitat, these small woods have defined boundaries and are low-lying. The site is particularly important for invertebrates such as the declining white-letter hairstreak butterfly.

Hollow Way
© Sheffield Lakeland Partnership

Ancient and notable trees

The Sheffield Nature Conservation Strategy of 1991[1] identified a lack of veteran trees over 200 years of age, and called for increased identification, maintenance and protection of specimens. As of September 2017, the Woodland Trust's Ancient Tree Inventory[9] has now catalogued three ancient trees (●), 13 veteran trees (●) and 17 notable trees (●) within Sheffield, mostly within wood pasture and parkland. In addition, surveys by Yorkshire Water for the Sheffield Lakeland Partnership Project mapped nine veteran trees (▲) and 40 notable trees (▲)[10]. All of these mapped trees are shown below, with highlights, but there are undoubtedly more across the district.

The definition of a tree as an ancient specimen depends on the species, but such trees are recognised for their cultural significance, biodiversity value or notable appearance. These ancient and veteran trees provide essential habitats for hole-nesting birds, particularly ground-feeding green woodpecker due to the availability of surrounding grasslands, as well as for priority bat species. Ancient trees also feature a significant amount of deadwood which in turn supports a range of specialist invertebrates, lichens and fungi. The majority of these trees are concentrated around the south-west of the city around Beauchief, Endcliffe and Bents Green. The Porter Valley supports mostly veteran beech and oak, with the latter also noted in the Gleadless Valley. These ancient and veteran trees are undoubtedly some of the oldest living organisms in Sheffield.

Sweet chestnut
5.5m girth
On open moorland

Ballifield mulberry
97cm girth (national record 102cm)
>400 years old

Pedunculate oak
>600 years old
5.4m girth

Pedunculate oak
4.7m girth
Standing in woodpasture

Ringinglow yew
1,000-2,000 years old
5.5m girth
Recorded in the Doomsday Book of 1086, forming the boundary between ancient Mercia and Northumbria[11]

Data and images: Yorkshire Water, SCC and Woodland Trust: Ancient Tree Inventory. Mulberry image © Catherine Nuttgens; map credit 3

Ancient woodland

Sheffield has a wealth of ancient woodland, defined as woodland existing since 1600 or earlier and cleared only for underwood or timber production[12]. Ancient woodland is a rare and irreplaceable priority habitat which supports more UK biodiversity priority species than any other habitat. At least 37 known and named ancient woods in Sheffield have had their age verified. An additional 20 named ancient semi-natural woodlands (ASNW) or plantations on ancient woodland sites (PAWS) on the Ancient Woodland Inventory are over 2ha in size. This list is clearly not exhaustive; together with smaller parcels and unnamed woods identified by Natural England and Professor Mel Jones, the total is nearer 100[18]. Ascertaining the exact number of ancient woods is difficult; many have changed names over the centuries or have remained unnamed, whilst some have become fragmented into smaller woodland parcels.

	Sheffield	South Yorkshire[F]	UK[9]
Total ancient woodland land cover	3.5%	3.0%	2.3%
ASNW	2.3%	-	1.4%
PAWS	1.1%	-	0.9%

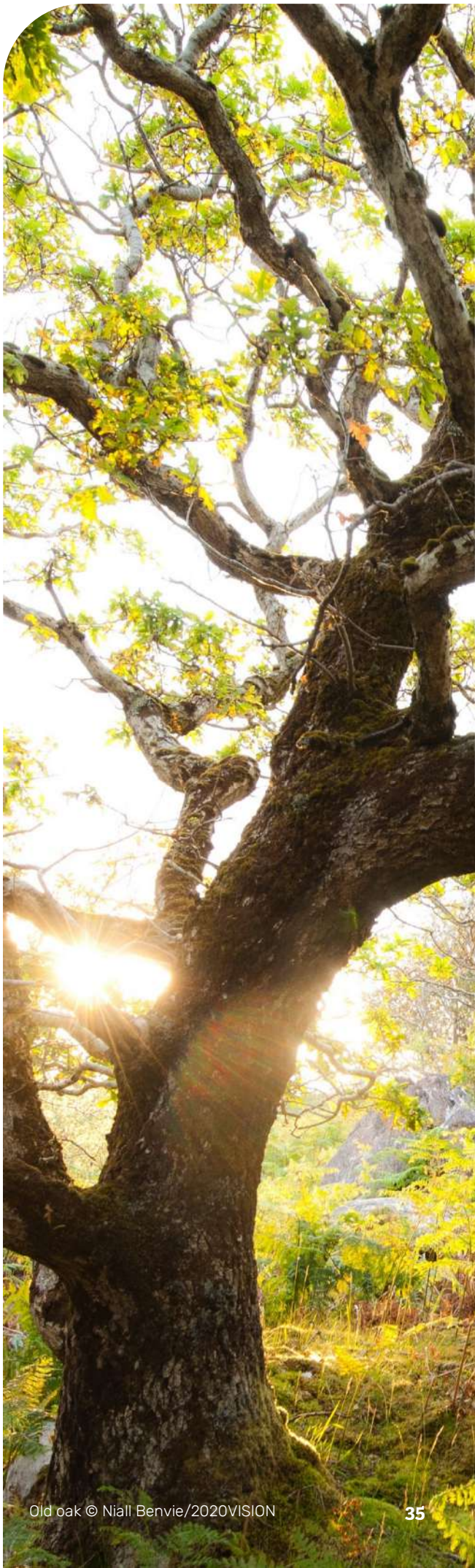
Table 1: percentage coverage (all habitats) of ancient woodland within the Sheffield district, South Yorkshire and UK respectively.

Figures

A significant proportion of Sheffield's lowland woodland – 23.5% – is categorised as ancient woodland. This covers 3.5% of the Sheffield district, substantially higher than a figure of 2.3% for the UK[6]. ASNW sites represent the most valuable habitat with a predominance of native species and semi-natural characteristics, whilst PAWS represent prior areas of ancient woodland that have been felled of native trees and replanted, mostly with non-native coniferous species. A breakdown of figures, both regional and national, are given in Table 1. Sheffield not only has a higher percentage coverage of ancient woodland than the UK, but more of this is represented by ASNW – the most biodiverse and ecologically valuable.

Locations

Two distinct areas of ASNW are prominent within the district (Figure 4). The most extensive lies in the south-western region around Ecclesall and Beauchief and includes Ecclesall Woods – Sheffield's largest connected patch of ancient woodland. A second expanse of ancient woodland is focussed around Wharncliffe, Grenoside and Wheata, although the eastern section of this region is mostly replanted conifer woodland. However, a substantial and relatively well-connected area of ASNW stretches between Oughtibridge and Middlewood. Other notable areas include Chapeltown, Shiregreen and Chancet Wood, although these areas are more fragmented.



Old oak © Niall Benvie/2020VISION

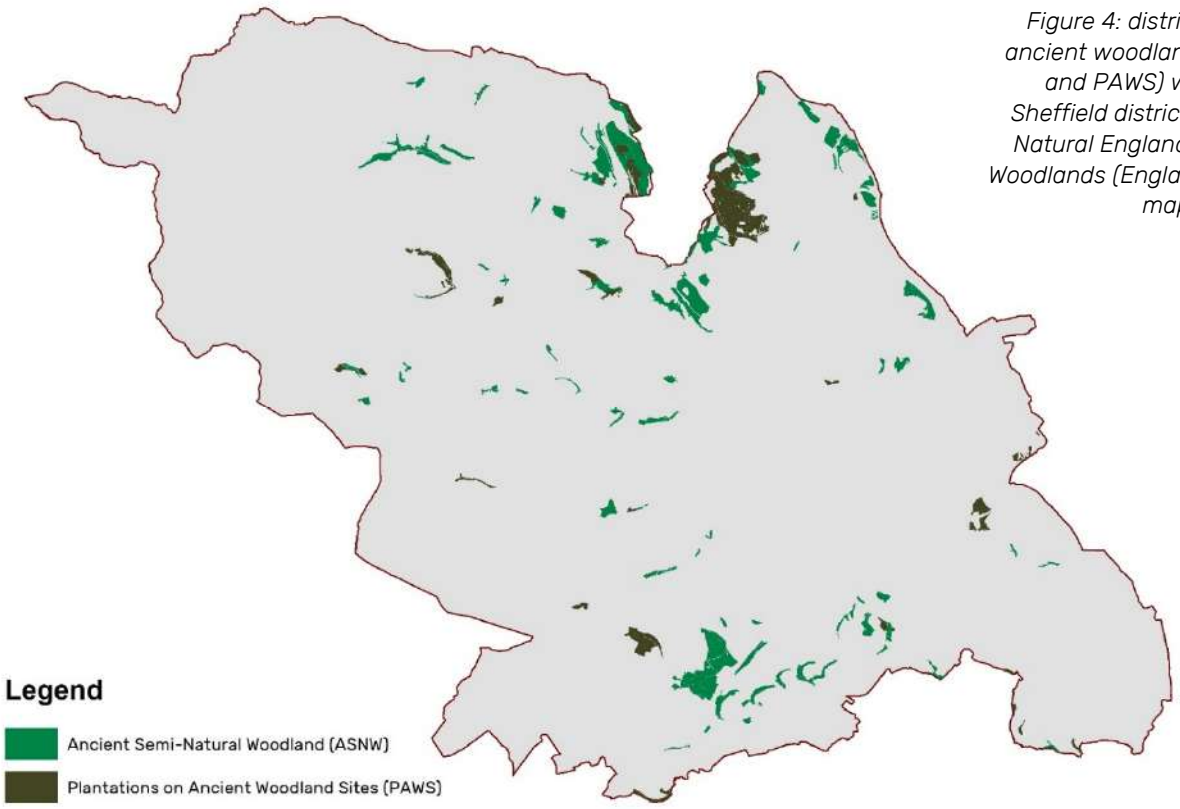


Figure 4: distribution of ancient woodland (ASNW and PAWS) within the Sheffield district. Data © Natural England Ancient Woodlands (England) 2017; map credit 2

Case study: Ecclesall Woods. John Gilpin, Woodlands Officer, SCC

Ecclesall Woods, between Dore and Millhouses, is the jewel in the crown of Sheffield's many ancient woodlands. The largest ancient woodland in South Yorkshire, it has a recorded history going back 700 years. It is also an important archaeological site with over 300 charcoal pits (which provided fuel for the early iron industry in Sheffield) and 100 'Q-pits' dating from the 17th century (large circular depressions which were used to produce fuel for lead smelting)[13]. Some of the archaeology is very old with field systems dating back to Roman times or earlier. Other key historical features include two Grade II listed monuments – the Wood-Collier's Memorial and an arched stone bridge, plus several Neolithic carved cup-and-ring stones, one of which is a Historic England Scheduled Monument. Overall, the woodland is of regional importance for this heritage. In the Middle Ages the woods formed part of a deer park, set up in 1319 by Sir Ralph de Ecclesall[14].

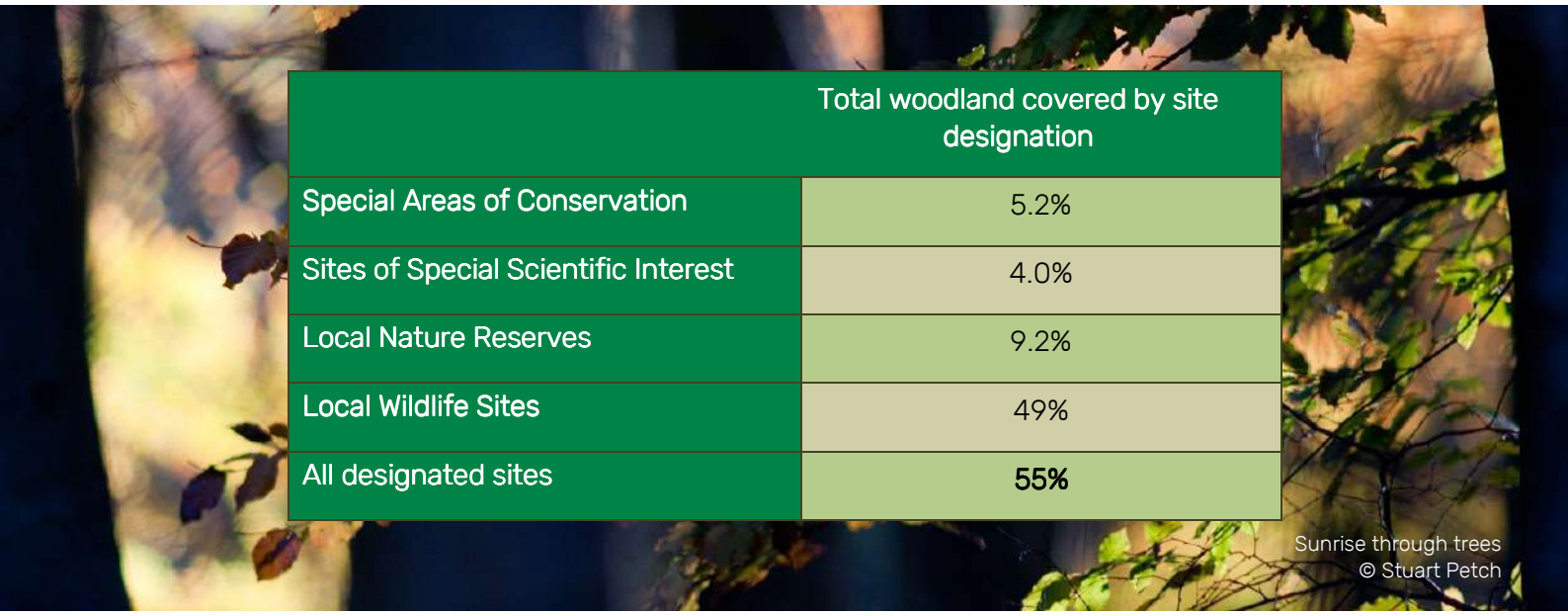
Because it has been woodland for so long, Ecclesall Woods supports in impressive display of spring flowers strongly associated with ancient woodlands, including bluebell and wood anemone, which in turn support a diverse range of insects and birds. These ancient woodland indicator species are not found in other newer woodlands and, once lost, are virtually impossible to recreate. The importance of the site is recognised by several designations including Local Nature Reserve (LNR) and Local Wildlife Site (LWS) and the award of a Green Flag. The wood's heritage and wildlife are very much loved – over 400,000 visits are made to the woodland each year – but can be easily lost. There is a good network of signposted, generally surfaced paths and bridleways across the site – although we recognise some can get muddy in winter.

Ecclesall Woods
© John Gilpin

Status of woodland habitat within protected areas

A total of 3,028ha of Sheffield's woodlands – or 55% of the habitat – falls within designated and locally protected sites (Table 2). Of this, 2,678ha (49%) is covered by LWSs. Other designated sites, particularly Special Protected Areas (SPAs) and Special Areas of Conservation (SACs), are mostly moorland and upland habitats and therefore protect a small proportion of woodland. Even so, small areas of upland oakwood are covered by these sites and are therefore protected at a European level. There is overlap between designated sites and therefore some regions of woodland have multiple designations. Importantly, ancient woodland is well covered by designated areas, with 91% of sites on the Ancient Woodland Inventory, including 92% of Sheffield's ASNW, covered by either LWS or LNR status (see Designated Sites chapter).

LWSs are assessed in terms of their management status, whilst Sites of Special Scientific Interest (SSSIs) are graded by condition. Figure 5 shows the condition and status of woodland habitats within these sites, respectively. Key woodland sites that are in positive management include the three largest LWS woodlands – Greno Woods, Ecclesall Woods and Wharncliffe Woods. These sites alone make up 15% (418ha) of all woodland falling within LWSs. Ladies Spring Wood SSSI is also in positive management. Substantial woodland sites that are not currently in positive management include Parkin Wood and Coumes Vale Wood.



	Total woodland covered by site designation
Special Areas of Conservation	5.2%
Sites of Special Scientific Interest	4.0%
Local Nature Reserves	9.2%
Local Wildlife Sites	49%
All designated sites	**55%**

Table 2 (above): percentage of Sheffield's woodlands that are covered by designated site status. The majority of protected woodland falls within LWSs.

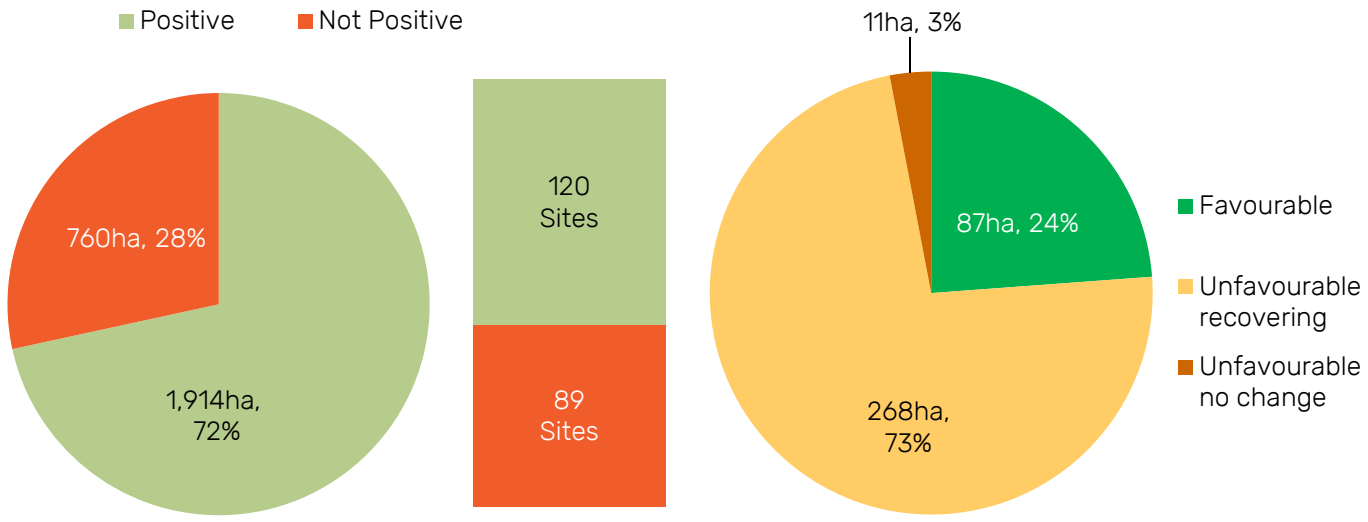


Figure 5: management status of woodland habitat within LWSs by proportion and area size (left) and condition of woodland sites within SSSI units (right). Only sites containing woodland patches larger than 0.5ha were considered to remove sites where woodland is unlikely to significantly inform the management plan.

Wood ants

The northern wood ant *Formica lugubris,* which occurs predominantly in northern England and Wales and throughout Scotland, occurs in a number of the woodlands in Sheffield and can reach high densities in suitable habitat. Although the ants' presence is usually noticed through the distinct nest mounds on the ground, wood ants forage primarily in trees, where they are important predators on many species of invertebrates but also tend and protect aphids, from which they obtain sugary 'honeydew'. Because of the high densities at which the ants can occur, their effects as predators can be considerable, and they can have ecosystem effects (including local nutrient cycling) by moving materials to clear trails and create nests[15]. In addition there are various invertebrate species (myrmecophiles) - such as some beetles - that live in, or are associated with, wood ant nests[16]., The ants' need for suitable trees to forage in, and suitable temperatures for nests, means that habitat management should include the creation or maintenance of sunny areas such as glades or open tracks, and felling should leave sufficient mature trees to provide foraging sites[17]. The longevity of nests, and short dispersal distances of queen ants, means that wood ants may be slow to colonise new habitat, even when it is suitable.

Diverse fungi

Fungi are everywhere and are critical to ecosystem functioning. They are particularly numerous in more undisturbed areas that have low levels of pollution and human inputs: e.g. Longshaw Estate, nearby Sheffield, has over 1,000 recorded species.

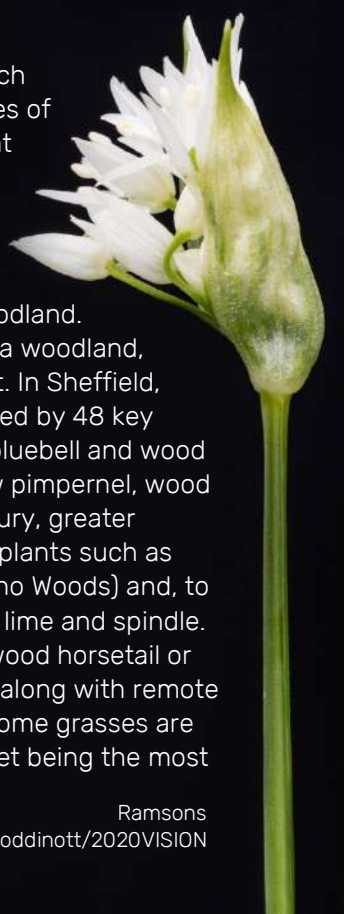
Fungi can be split into three categories, based on their lifestyle. Parasitic fungi derive their food from other living organisms, whether they be plants, other fungi or animals. The scarlet caterpillar fungus (*Cordyceps militaris*) occurs on mossy woodland edges and open grasslands, where it infests the underground pupae of moths and butterflies. Saprophytic fungi, such as the unmistakeable stinkhorn (*Phallus impudicus*) which grows on rotten wood, break down dead organic material and play a vital role in the cycling of nutrients. The third category of fungi live in a symbiotic association on the roots of plants: by enveloping the plant's roots, these so-called mycorrhizal fungi increase the root surface area and thus the ability of the plant to absorb water and nutrients. In exchange, the fungi take sugars from the plant's roots, so both species benefit. Many woodland fungi such as the fly agaric (*Amanita muscaria*) live symbiotically on tree roots, in this case on the roots of birch.

Fly agaric
© Neil Aldridge

Wood ant
© Paul Richards

Plant life

Ancient woodlands often have a rich ground flora due in part to centuries of coppicing activity that allowed light through to the woodland floor. Ancient woodland indicator (AWI) species are slow colonisers that often spread vegetatively and as such are rarely found in newer woodland. if you can count 10 AWI species in a woodland, there is a good chance it is ancient. In Sheffield, ancient woodlands are characterised by 48 key species including vast carpets of bluebell and wood anemone, yellow archangel, yellow pimpernel, wood sorrel, wild strawberry, dog's mercury, greater stitchwort and sanicle[18]. Rarer are plants such as common cow wheat (found in Greno Woods) and, to the east of Sheffield, small-leaved lime and spindle. Wetter areas may have ramsons, wood horsetail or opposite-leaved golden saxifrage, along with remote sedge or pendulous sedge. Even some grasses are AWIs – wood melick and wood millet being the most frequently occurring.



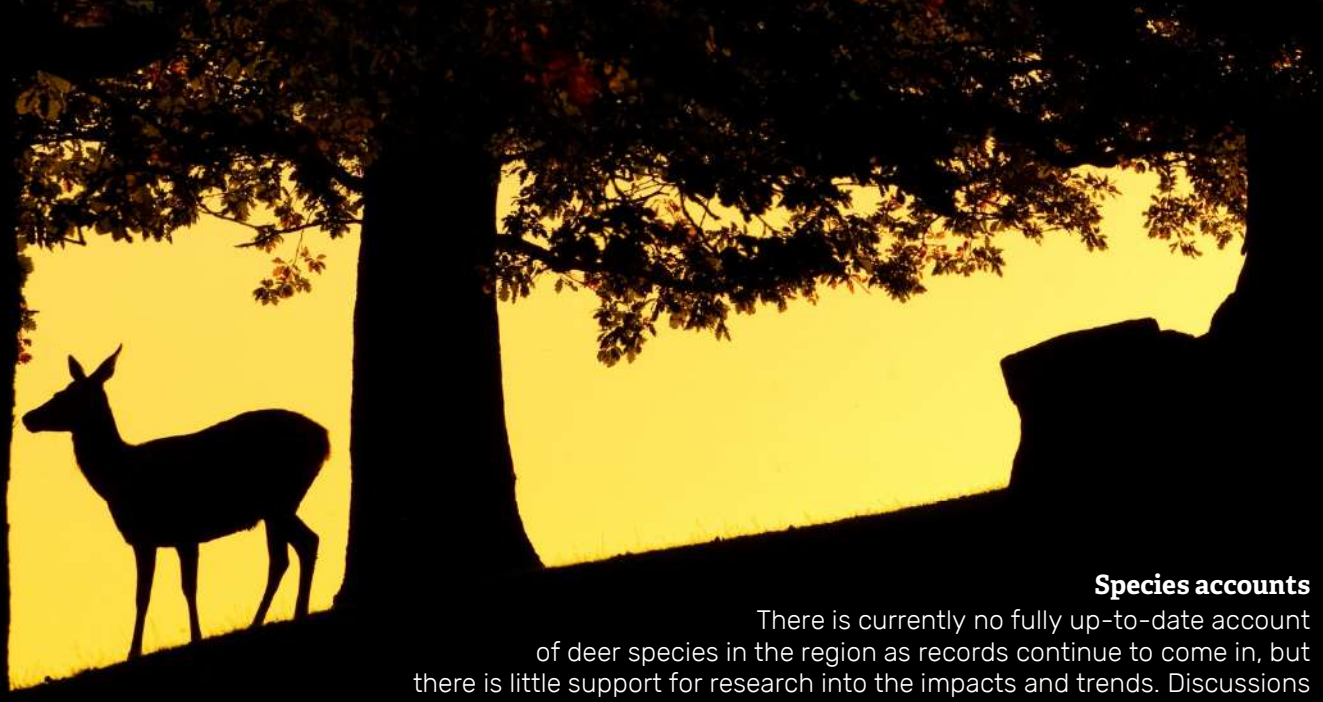
Ramsons
© Ross Hoddinott/2020VISION

Case study: Deer of the Sheffield district
Professor Ian D. Rotherham, Sheffield Hallam University

In terms of deer populations, the Sheffield region has been in a state of dramatic flux since the later 1970s. Prior to this time numbers were very low and restricted to park herds of red and fallow deer plus one major population of feral reds around the former medieval deer park at Wharncliffe.

Prior to this, and since the demise of most regional deer parks around the 1500s, few deer remained locally, but well-established herds of both fallow and red deer were present around Sherwood and the Dukeries. Additionally, a population of black (melanistic) fallow deer existed in the south-east Peak District and around Matlock, originating from a medieval park herd at Stanton-in-the Peak. Occasionally red deer escaped from the park herd at Chatsworth, appearing on the moors or nearby farmland, but were invariably shot. In Sheffield there were no deer except for feral reds from Wharncliffe which wandered down the River Don at least as far as Kelham Island.

By the 1980s, this situation was changing as the feral reds grew in number and were joined by a second population on the Eastern Moors. The area was purchased by the Peak District National Park Authority for public benefit and conservation and so the Chatsworth escapees were able to establish in an area of sanctuary. Numbers were supplemented by deliberate releases from captive stock owned by a landowner in Dore Village. At the same time, there were increasing records of roe deer and occasional muntjac around the district margins. Both these species occurred mostly to the east of the region. However, a process of major colonisation was underway and the feral red herds were expanding dramatically. There is a substantial literature associated with observations of these changes, and the South Yorkshire Biodiversity Research Group has a long-running 'citizen science' project to record and monitor the populations.



Red deer at sunset

Species accounts

There is currently no fully up-to-date account of deer species in the region as records continue to come in, but there is little support for research into the impacts and trends. Discussions with the Deer Initiative confirm that this is a problem across the UK with no support for monitoring or recording. However, there is information on the general locations of key species.

Red deer are now well-established to the west and south-west of Sheffield with a population centred on Big Moor but now ranging in all directions from there. In the west and north-west, the populations are joining with the long-standing feral herds around Wharncliffe and Bitholmes with individuals now recorded from Rivelin and Strines. Roe deer have colonised Sheffield originally from the east and north-east, but now also from the south-west. By the 1980s, records were coming in from rural locations around the city. The population is now well-established into the heart of the urban catchment, with regular sightings for example, in Crookes, Nether Edge, and Sharrow.

Muntjac was first recorded in Sheffield in the early 1990s with individuals holding territories in the Moss Valley fringe. Since then, there has been a progressive movement into the city with records now from urban areas including Woodseats, Heeley, Gleadless, Norton, Nether Edge, Sharrrow, Parkwood Springs and Queen's Road. Fallow deer have continued to expand around Darley Dale and Matlock, and in the Sherwood region. However, fallow is a slow coloniser and has yet to appear in Sheffield. Records and rumours of sika deer have proved to be unfounded, though future colonisation from the north-west Pennines populations remains a possibility.

Case study: True Bluebells
Adele Harrison, Sheffield Hallam University

In spring 2016, Sheffield & Rotherham Wildlife Trust (SRWT) launched their 'True Bluebells' project as part of Nature Counts, which aimed to highlight and tackle the issue of hybridisation of British bluebells (*Hyacinthoides non-scripta*) with non-native Spanish hybrids (*Hyacinthoides hispanica*). A master's project was developed with Sheffield Hallam University to provide a snapshot of the state and distribution of native and non-native varieties across the Sheffield district so that future efforts could be applied to help conserve local British bluebells.

Data were collected by walking transects through 36 woodland sites, stopping every 50 metres to observe the abundance of native or non-native bluebells if present, with similar methods to a previous study in Scotland[19]. Across the 36 woodland sites surveyed, 87% of records were of native bluebells. Of the 36 sites surveyed during primary data collection, 25 included only native bluebells, while three included only non-native bluebells (Figure 6). These three sites – Sunnybank nature reserve, Jaunty Park and Ponderosa – are all centrally located within urban areas. Both species were found in eight (22%) of the sites present, confirming the threat of hybridisation, and subsequent potential loss of the native population, in these sites. Again, all of these sites are located within more urban and suburban areas.

The study also looked at the proximity of bluebells to anthropogenic (human-related) habitats. Away from gardens, British bluebells were the dominant type (Figure 7). However, when proximity to gardens was reduced to 25m, there was no significant difference between the number of native bluebell and non-native bluebell records. This indicates that the gardens are a primary source of non-native bluebells, through spread, garden encroachment and the dumping of garden waste.

It was observed during the site visits that non-native bluebells were often on the outskirts of woodlands but not in the centre. These records were usually found close to obvious patches of dumped garden waste, gardens, or evidence of fly tipping. There were other instances of non-native bluebells away from these sources; these were thought to be a result of deliberate planting.

In addition to threats from hybridisation, local bluebells may also be at threat from lack of woodland management. Sorby Natural History Society member Bob Croxton has been monitoring the decline of ground flora in local woodlands. He has noted that since 2000 bramble has been carpeting many local woods. This is now so serious in some woods that soon plants such as bluebell could become rare. The spread of bramble (which could be due to climate change, lack of management or maturation of a woodland) could be restricting access to the ground for declining woodland birds such as tawny owl and woodcock.

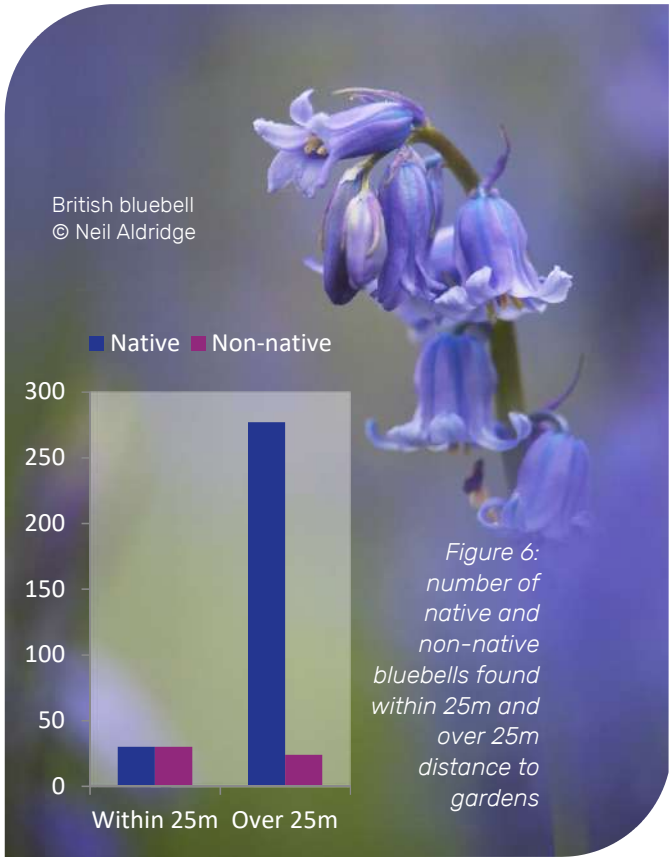


Figure 6: number of native and non-native bluebells found within 25m and over 25m distance to gardens

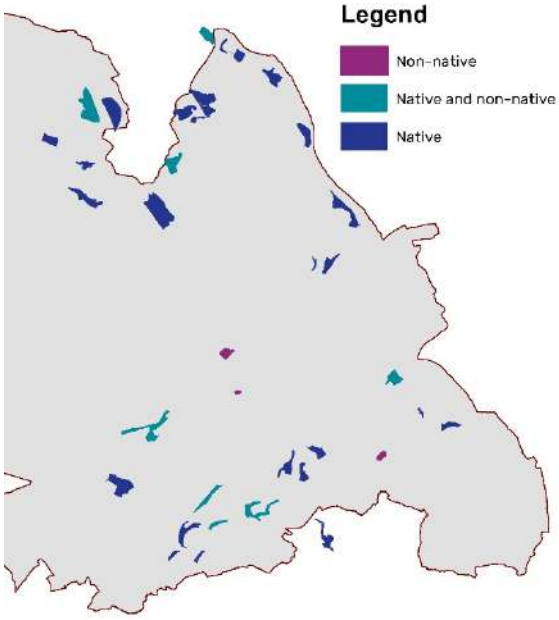


*Figure 7 (above): woodlands with records of only native bluebells (**blue**), non-native bluebells (**purple**) and both species (**turquoise**); map credit 3*

Below: evidence of bramble encroachment on local native bluebell woodlands over time.

Bramble encroachment
© Bob Croxton

Case study: Birch catkin galls: fluctuation in numbers over the years
Margaret Redfern, British Plant Gall Society

Semudobia species are gall midges (Diptera: Cecidomyiidae) that cause galls (an abnormal growth caused by an insect, fungus or bacteria) in the female catkins of birch trees (*Betula pendula* and *Betula pubescens*). The galls are tiny and distort the birch fruits, with individual seeds killed and replaced with a gall midge larva (Figure 8). There are three species in Britain, each causing a distinctive gall that can be recognised with a hand lens. They are generally common in England wherever the birches occur.

Numbers on neighbouring trees vary and they are not found in every catkin on a tree – there may be no galls on some trees, other trees may have just a few of one species only, while yet others have a hundred galls or more in one catkin, perhaps including all three species. The following year the pattern on the same trees may be different. This fluctuating pattern in abundance is common in insects and most likely in other animals too, and in birch catkin galls can be studied by monitoring the same trees over several years. It would be Interesting to try and discover why numbers fluctuate; a complicated question and one that could occupy investigators for years!

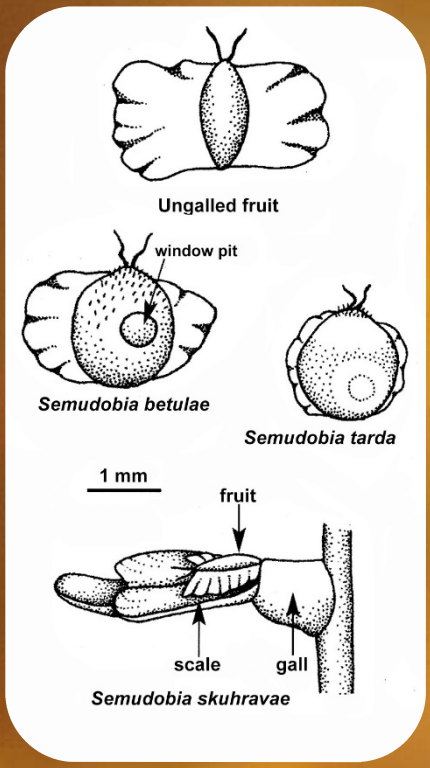
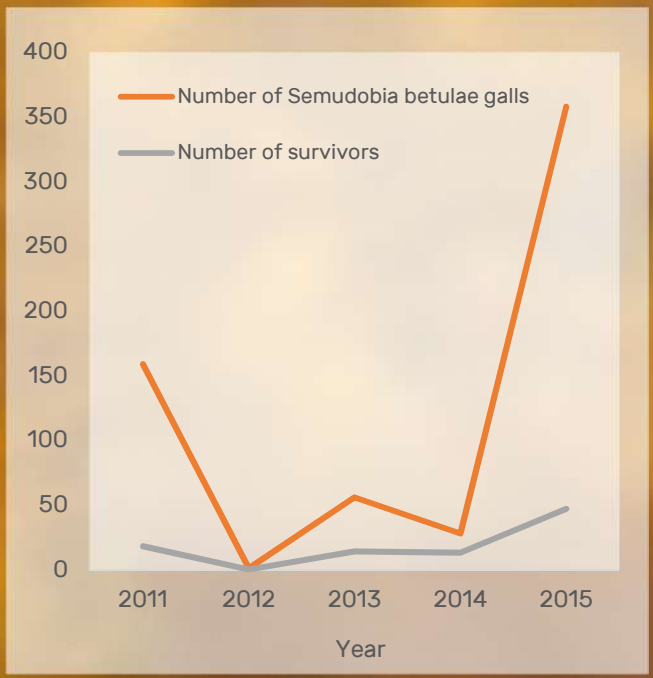


Figure 8 (right): an ungalled fruit, fruits galled by Semudobia betulae *and* S. tarda, *and a catkin stalk galled by* S. skuhravae.

Figure 9 (below): number of Semudobia *galls and number of survivors.*

I have been monitoring these galls for five years (since 2011) from the same five trees of *Betula pendula* in a local wood – although the same exercise could be done anywhere where the trees and the galls are present. Female catkins have been collected when ripe but before they have fallen, i.e. in September each year. Ten catkins were collected from each tree, the catkins were dissected and their galls identified and counted, and each one was put into a gelatine capsule with a label and kept for about six months, partly in the fridge to simulate the cold of winter. In late spring and early summer the following year, parasitoids emerge and can be identified. The number of galls and surivors over time is shown in Figure 9.

There are many unknowns about *Semudobia* galls. In the future it would be interesting to pursue more on the detailed distribution of the three species in long-term studies (10 years+). Worthwhile pursuits would be: studies of fluctuation in the numbers of each species on individual trees and at different sites; investigations into why numbers fluctuate by identifying specific causes of mortality; plus the effects of climate change on the phenology of trees, e.g. whether flowering time influences the egg-laying behaviour of the gall midges. The monitoring of *Semudobia* galls will continue in the future with the aim of discovering the most important mortality factors affecting these populations.



Birch in sunlight
© Paul Hobson

Ownership and management

Sheffield City Council (SCC) owns and manages just over 60% of all woodlands in the district, covering 1,615ha and containing most of the 2.7 million trees in public ownership. Local groups often support this management. Many large woodlands fall within LWSs and LNRs and are managed by conservation organisations and public bodies. LNRs include the SCC-managed Great and Little Roe Wood, Woolley Wood and Wheata Wood, along with SSSI-designated Ladies Spring Wood. Both Ecclesall Woods and Wheata Woods have Green Flag status. Of the 175 sites under SCC management, 70 (650ha) are ASNW and there is 126ha of PAWS. SCC have an aim to restore PAWS at Gillifield Wood, Upper Porter Clough, Rough Standhills, Bowden Housteads and Tinsley Park to traditional broadleaved woodland. Approximately 40% of trees are privately owned and found in a range of environments from large suburban gardens through to small farm woodlands and large coniferous forests.

Management and protection of woodlands has improved since the 1990s. In 2000 a five-year Heritage Lottery Funded project 'Fuelling the Revolution: The Woods that Founded the Steel Country' (managed by the South Yorkshire Forest Partnership) began to restore 35 woodlands across South Yorkshire, including 23 in Sheffield. Improvements included: silvicultural work; access for all including boundary and access controls; and education and interpretation. In addition, both ecological and historical surveys were carried out in all the woodlands listed.

Trees, woodland and forest managed by SCC are covered under the forthcoming Sheffield Trees and Woodland Strategy 2018-2033[3] and the SCC Corporate Tree Risk Management Strategy[20]. SCC and SRWT hold Forest Stewardship Council (FSC) accreditation and manage their woodlands according to certification requirements of the United Kingdom Woodland Assurance Standard (UKWAS). Approximately 700 trees which are dead, decaying or dying are removed by SCC Parks & Countryside Tree Team each year. The Countryside Stewardship provides grants for woodland management and woodland management plans. A single site within Sheffield (in the Rivelin Valley) is managed within a Peak District National Park Authority Conservation Scheme agreement.

Over 100,000 new trees have been planted through the Community Forestry programme on Council owned land, detailed within the Trees in Towns II survey[21] in this programme SCC aims to plant two trees for every one removed and has an annual target of 7,000 new trees[3]. SRWT is working with elm expert Dr David Herling and local tree champion Paul Selby to bring disease-resistant elms back to Sheffield. Eight varieties of resistant elms were be planted in trial plots at Greno Woods (a SRWT nature reserve) in early 2018. This is part of a UK-wide project with the aim of identifying which clones perform best in a range of environments and so informing which varieties become available for restocking the nation's landscapes.

Management of street trees

Sheffield has approximately 36,000 mapped and recorded street trees. Street trees need ongoing management, maintenance and a rolling programme of replacement. Traditionally, Sheffield's street trees were managed by SCC, but in recent years had suffered a period of under-investment. In 2012, Amey took on the management (replacement and maintenance) of street trees as part of the PFI 'Streets Ahead' contract on behalf of SCC. The 25-year contract focused much of the resurfacing work in the first five years (the core investment period) so any required tree works were carried out on these streets at the same time. Streets Ahead (Amey with all decisions approved by SCC) only replace trees when they fall into one of the following categories: 'dead'; 'dying'; 'dangerous'; 'diseased'; 'damaging' (to pavements or roads); or 'discriminatory' (potentially causing issues for people using wheelchairs, mobility scooters or pushchairs)[22]. Approximately 6,000 have been replaced to date. The residents of Sheffield are generally accepting of trees in the first four categories, however some residents and campaigners have argued that significant numbers of mature healthy trees are being felled under the latter two categories, where 'engineering solutions' could have been applied to upgrade pavements and roads whilst retaining trees. The Council counters this by saying that wherever possible trees are retained but there is no funding available for solutions outside the contract so replacement is carried out in these cases. The result is a loss, over the short to medium term, of the benefits that mature street trees provide. The issue continues to prove to be controversial and highlights the importance of trees to people's daily lives.

Montgomery Road street trees
© Mark Taylor

Case study: Transforming the Burbage Valley
Ted Talbot, Countryside Manager, National Trust (NT)

The Burbage Valley (SSSI) lies on the eastern side of the Peak District in Sheffield and is owned by SCC but is now leased to the Eastern Moors Partnership (EMP). It is part of the wider landscape of the Sheffield Moors Partnership (SMP) and was included in the Dark Peak Nature Improvement Area (NIA) to deliver "bigger, better, more and joined up" landscape-scale projects (see Moorlands chapter for more on the EMP and SMP).

An established conifer plantation of 34ha lies within the centre of the Burbage Valley which was planted between 1968 and 1971. At that time there was less emphasis on the conservation of landscape and nature than there is today, and the plantation was laid out to represent a map of Great Britain from the air. The 'Great Britain Plantation' principally contained Lodgepole pine with Scots pine and Japanese larch, none of which had grown well on the poor acidic soils. When the woodland was planted, no consideration was given to access and managing the woodland. Therefore, management had been poor, with little or no thinning leading to trees blowing down. For this reason, despite the trees being mature, the value in the timber was so poor and the cost of extraction and site restoration so high that there was no viable economic solution for taking this site forward without additional funding. Both the valley and woodland are well used recreationally for walking, climbing and geography trips. However, the plantation was also subject to anti-social behaviour, leading to warnings from the Fire Brigade that the risks from fire were becoming too great. It was clear that action had to be taken.

A plan was made by SCC's Woodlands team to fell and remove the existing conifer plantation and restore the site to habitat types that are more consistent and sympathetic to the surroundings, such as native woodland and heathland. A small area of conifers was to remain until the broadleaved woodland was established (in 20-30 years). Clear-felling over 20ha of woodland, and producing 8,000 tonnes of timber, was a significant project for all involved. Following baseline surveys by SCC, funding through the NIA enabled this work to begin in 2015 and involved NT and SCC staff as well as specialist contractors, volunteers and input from Natural England and the Forestry Commission. Helicopters were even required for some of the works to protect vulnerable species. The sensitivity of the area in a much-visited part of the National Park also required good communication with site users and the public. Thankfully the public response to the work was positive, which demonstrated the effectiveness of the NIA partnership and its broad stakeholder base.

Above: the plantation was still known by many as the 'Great Britain plantation', although the 'West Country' spur was never planted because of unexploded WWII ordnance left from previous use of the valley by the Ministry of Defence. Bullet marks can also be seen on many tank-sized boulders that are enjoyed by climbers.

On reflection, it is with a sense of relief and pride that this complex, landscape-scale conservation project went so well. Watching the wildlife return to the site and nature respond to the changes delivered will be fascinating, and by benchmarking against the baseline ecological surveys should, in time, demonstrate that this sort of carefully planned intervention really does work.

Below: the Burbage Plantation from the south looking north. Forest access work just starting: 20 August 2014.

UK Biodiversity Indicator Focus:

Birds of the wider countryside: C5b. Woodland birds

Sheffield's woodland birds generally appear to be relatively stable, or in a favourable state. Of the twelve species included in the woodland generalist indicator (Figure 10; left), a third (n=8) show no change in occupancy, with a fifth of species (n=3) showing an increase[23,24]. Of the 23 species included in the specialist group (Figure 10; right), 15 (65%) had increased in occupancy between 1975-80 and 2003-08, one species showed no change and seven species (30%) showed a decline. The major winners and losers are given in more detail below.

Comparing these figures to national trends (although it is important to note that national analyses consider abundance, and a total of 37 species are included), the picture appears optimistic for Sheffield, with a higher proportion showing local improvements.

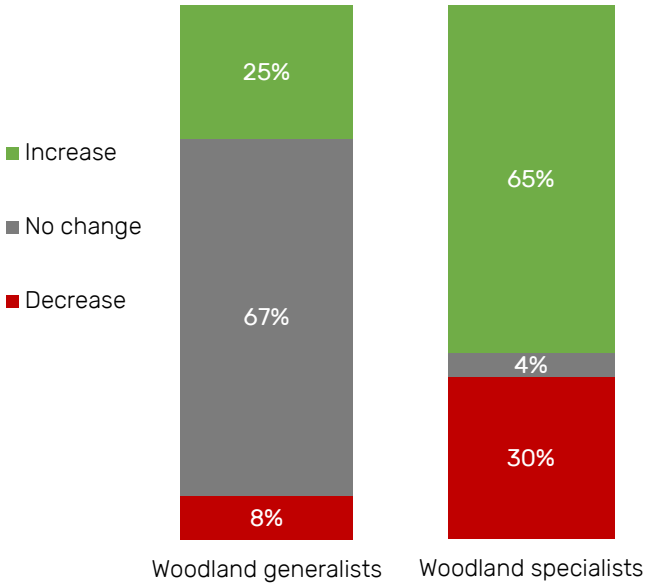


Figure 10: trends of woodland bird specialists (left) and generalists (right) included as part of the UK biodiversity indicator C5: birds of the wider countryside, measured as a change in the number of tetrads occupied between 1975-80 and 2003-07[23,24].

Which species are doing well?

Sparrowhawk
221% increase
129-140 sightings per year
Stable; mirrors national trend

Nuthatch
238% increase
Yearly site 'firsts'.
Expanding north and south-west

Lesser spotted woodpecker
Red-listed species
264% (but only two sightings in 2015)

Chiffchaff
73% increase
79% occupancy

Siskin
327% increase

Pied flycatcher
335% increase

Willow warbler
Widespread, 94% occupancy

Blackcap
20% increase
259 total tetrads
86% occupancy

What are the reasons?

Climate change
Sheffield formed the northern boundary of some species' distributions in the 1970s, such as the nuthatch. Shifts in seasons has brought them further north.

Habitat restoration
Reclamation of woodland habitat, natural succession and replanting of native species has improved habitat availability for species such as blackcap.

Management
Increasing standing dead wood and woodland thinning has increased food sources and breeding sites for species such as pied flycatcher.

Which species are not doing well?

Lesser redpoll
64% decrease
Large declines to the east


© Bob Coyle

Willow tit
47% decrease
Lost from central Sheffield region


© Harry Hogg

Spotted flycatcher
40% decrease


© Richard Steel/2020VISION

What are the reasons?

Climate change
Climate change has negatively affected spotted flycatcher which struggles to adapt to changing seasons.

Habitat modification
Fragmentation and loss of habitat. Maturation of conifer and birch woodlands, coupled with removal of scrubland through residential development, has impacted lesser redpoll and willow tit.

Management
Browsing of woodland by deer has impacted willow tit by removing the shrub layer.

Case study: Greno Woods fungi survey
Steve Clements, Brian Mitchell, Sally Chadwick & John Leach

Greno Woods is one of the most significant recent acquisitions by Sheffield & Rotherham Wildlife Trust and is notably lacking in useful data about its fungi. Our aim was to carry out a highly detailed and comprehensive team survey for all kinds of fungi and to look at habitat and management factors which seemed relevant to fungi.

We used the same 10m circle unit of recording as in our grassland surveys, following the British Mycological Society's guidelines for responsible scientific collection. An evidence base of 5,340 field, studio and microscope photographs was assembled. From 26 full-day surveys from March–November 2017 we accrued 3,389 records of fungi of which 2,692 fell within the area of woodland prioritised by the Wildlife Trust. Data on fungal abundance were also recorded.

A total of 456 species were identified in the locality, of which 405 were in the priority area. Thirty-three nationally or locally rare species, including five Red Data species, were noted. We analysed 502 10m circles for correlation of fungal diversity with habitat factors. The three most significant factors, in order of importance, were: unspoiled path edges; dead wood such as 'habitat heaps', logs and stumps; and tree species. Oak is prioritised by the SRWT but our survey showed the additional importance of beech, sweet chestnut and conifer for fungal diversity.

In general, fungi are not present in great abundance at Greno Woods, and colonies tend to be small. This reflects our feeling that the woods have not been managed in a wildlife-friendly manner in the past. We determined that the care of path edges by discouraging trampling by dogs, plus provision of much greater volumes of dead wood and tolerance of a wide variety of tree species, would enhance the mycota of Greno Woods.

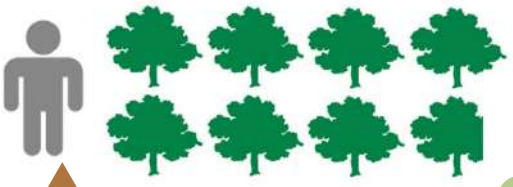

Slime mould at Greno Woods © Brian Mitchell

Key facts & figures

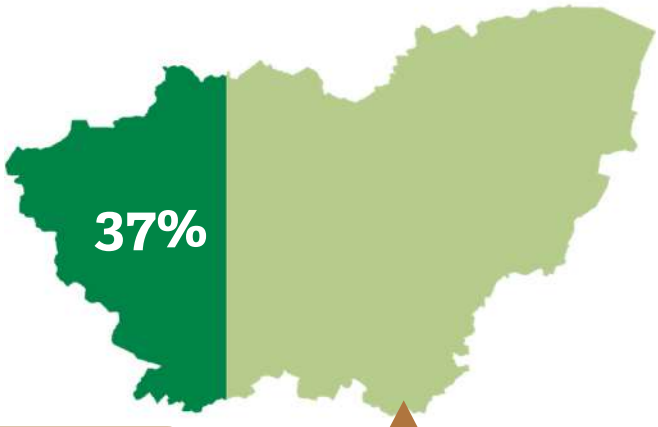
Sheffield boasts a higher proportion of woodland than both England and South Yorkshire[6]

*Figure taken from iTree 2017 plot data

Over two-thirds of Sheffield's woodland is broadleaved. This beats both national and county figures[25]



An estimated 4.5 million trees are located within woodlands, streets and parks[2]. That's nearly eight trees per person.



Over a third of South Yorkshire's woodland is found within Sheffield, despite Sheffield only covering 24% of the county. Current data taken during iTree survey suggests 5,946ha or 37% of a total 15,737ha[6].

18.4%

Mean tree cover within Sheffield, calculated by iTree, is 18.4%.

Sheffield has better access to woodland than the national average. 45% of residents have access to a 2ha area of woodland within 500m of their home whilst 94% have access to a 20ha wood within 4km[4].

21,800 tonnes of carbon are absorbed by the city's trees each year. That's 84 million car miles[2].

Sheffield has 1,256ha of ancient woodland, of which 866ha (67%) is ancient semi-natural woodland (ASNW). The remaining sites are replanted (PAWS).

Threats to woodlands and trees

What is the threat?	What does it cause?
Lack of, or changes in, woodland and tree management	Lack of resources for on-going management. Neglect of veteran trees leads to less standing deadwood and a reduced age structure of trees.
Habitat fragmentation	Reduced habitat connectivity results in isolated populations of woodland species.
Development of buildings and infrastructure	Loss of urban trees and large suburban gardens leads to reduced canopy cover in urban areas and reduced habitat connectivity for tree-dependent species.
Invasive species	Rhododendron and Himalayan balsam over-shade the woodland floor leading to a reduction in diversity of woodland flora.
Nutrient enrichment	Leads to an increase in brambles and pioneer species which reduces woodland flora diversity.
Recreational demands and illegal motorcycling and off-road activity	Erosion of tracks and paths, endangerment to recreational users, noise pollution and disturbance to sensitive woodland species.
Fly tipping, including waste from gardens	Introduction of invasive species into ancient woodlands (see bluebell case study), loss of boundary habitats, introduction of harmful litter for woodland species.
Uncontrolled firewood collection; 'tidy' woods	Reduction of natural age structure of woodlands and resulting reduction in availability of deadwood microhabitats and related biodiversity in lichens, bryophytes and invertebrates.
Plant pathogens including Chalara (ash) and *Phytophythora* (larch and oak)	Significant loss to affected tree species and a resulting reduction in biodiversity through the loss of large standing trees.
Flood alleviation methods	Reduction in riparian vegetation and potential loss of habitat to hard defences.

Woodland at dusk

Recommendations

1. Develop targeted conservation plans for key indicator species or local species facing threats or in severe decline including butterflies and woodland birds such as tawny owl and woodcock.
2. Continue to deliver conservation actions that support the return and expansion of willow tit and pied flycatcher, including more standing deadwood and tree thinning.
3. Develop a strategic plan for tackling invasive species in ancient woodlands such as rhododendron and Himalayan balsam.
4. Promote the value of LWSs associated with woodland habitats and the importance of their protection and ongoing management for wildlife to land managers, land owners, planners and developers.
5. Focus efforts on improving the overall condition of key woodland LWSs currently in poor condition or not in positive management for wildlife.
6. Seek opportunities to improve connectivity between woodland blocks.
7. Increase diversity in tree planting to promote greater woodland resilience against destructive pathogens and fungi.
8. Continue to work in partnership with the local community and police to reduce motorcycling and off-road activity in key woodlands in the north of Sheffield and ensure that wildlife is not detrimentally affected by increased recreation and disturbance at these woodland sites.
9. Undertake effective prosecution of fly-tippers and promote successful cases.
10. Further improve our knowledge of woodland fungi and promote the use of habitat piles and lying deadwood.
11. Further improve our knowledge of woodland butterflies by promoting and enabling local groups in monitoring butterfly populations, to better inform future conservation activities through the use of the woodland butterfly indicator.
12. Develop, through open partnership, a long-term citywide strategic plan that considers how Sheffield's urban street trees can be valued and managed appropriately to better contribute to improving people's health and wellbeing, reducing noise and air pollution, improving flood risk management, helping to mitigate for climate change, supporting biodiversity and encouraging community engagement and cohesion.

Lone tree at dusk

Waterways & Standing Water

Headlines

- Sheffield's rivers and the quality of their waters have undergone vast improvements in recent decades, resulting in a substantial increase in biodiversity.
- The current ecological status of Sheffield's rivers is variable; assessments conducted by the Environment Agency show that most stretches are of an overall moderate status. Quality improves with increasing distance from central industrialised areas.
- Otter and several fish species have now returned to the Don as a result of improving water quality and the installation of fish passes. Twenty-six out of 31 species of fish historically found on the Don have now recolonised the river.
- Reservoirs, such as Redmires, have proved hugely important for many species of breeding birds including curlew, golden plover and snipe.
- Local ponds provide important habitats for species such as great crested newts and dragonflies and many have benefitted from recent restoration work. Dragonfly diversity has significantly increased, partly due to improvements in water quality and associated emergent waterside vegetation.
- Threats to Sheffield's waterways and wetlands include pollution, physical modification of the river and invasive species. Non-native invasive species which have a stronghold on Sheffield's river systems include Japanese knotweed, Himalayan balsam, signal crayfish and American mink.
- Several organisations are involved in the ownership and management of the waterways and there are successful examples of partnership working. Key non-native invasive plants are the focus of ongoing conservation management aimed to control their spread.

European otter © Andy Rouse/2020VISION

Introduction

As a historically industrial city, Sheffield has always been known as a City of Rivers[1]. Sheffield's diverse rivers and waterways have helped shape its rich industrial history, which in turn has influenced their suitability for wildlife and their role in healthy ecosystem functioning. Clearly, Sheffield's rivers are places of transition and ongoing change. Despite being heavily industrialised in the past, waterways within densely populated areas still provide valuable green corridors for wildlife, and following the improvement of Sheffield's river systems, now support a plethora of species including breeding birds, fish and top predator mammals. Five main rivers: the Don; Sheaf; Rivelin; Loxley and Porter, plus the Sheffield and Tinsley Canal, pass through parts of urban Sheffield. The riparian areas surrounding the main rivers also support a network of streams. Naturally occurring standing waters are rarer, but there are many man-made notable standing water habitats, including many reservoirs, particularly to the west of the city. These large reservoirs (see case study) are host to several bird species both in the spring and summer – such as common sandpiper and little ringed plover – and over winter – such as lapwing and golden plover. Sheffield is part of the larger Don and Rother catchment which in its entirety extends over 1,800km^2. Several documents and reports detail the past and present state of Sheffield's rivers and standing waters. Of note is the Don Catchment Flood Management Plan[2], The Sheffield Wetland Habitat Action Plan[3], and the Sheffield Waterways Strategy[4].

What running and standing water does Sheffield have?

Figure 1 shows the composition of Sheffield's running and standing water habitats. There are a number of open waters and canals including several reservoirs, but no large, naturally occurring waterbodies or any priority standing water habitats besides ponds; see case study. Rivers range from upland tributaries to fast flowing main waterbodies, and Ordnance Survey data identifies 258km of linear waterways (including distances from inflow to outflows in lakes and reservoirs). However, this figure does not include many small, incompletely mapped watercourses. Figure 2 shows how these broad habitat types are distributed across the district.

Not all 'wet' habitats are included here: wetland areas such as bogs and fens are considered in the Moorland, Upland & Heathland chapter reflecting the landscapes in which they are mostly found. Wet woodland is considered in the Woodland & Trees chapter.

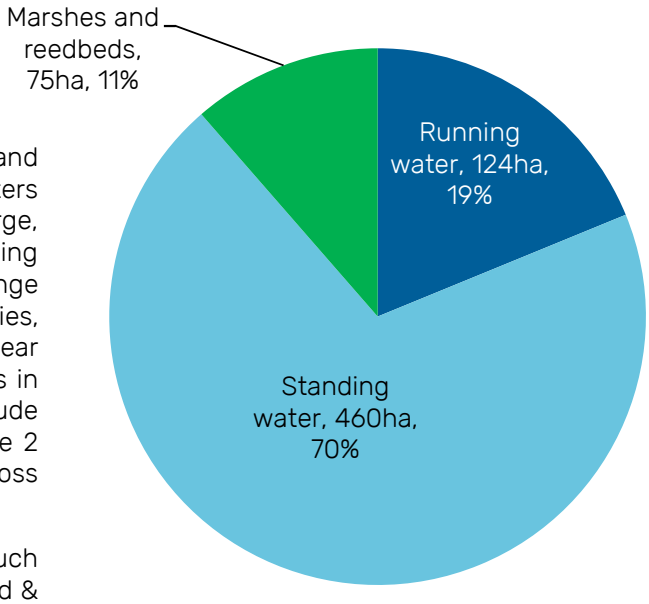


Figure 1 (above): percentage coverage and area (hectares) of broad water habitats within the Sheffield district.

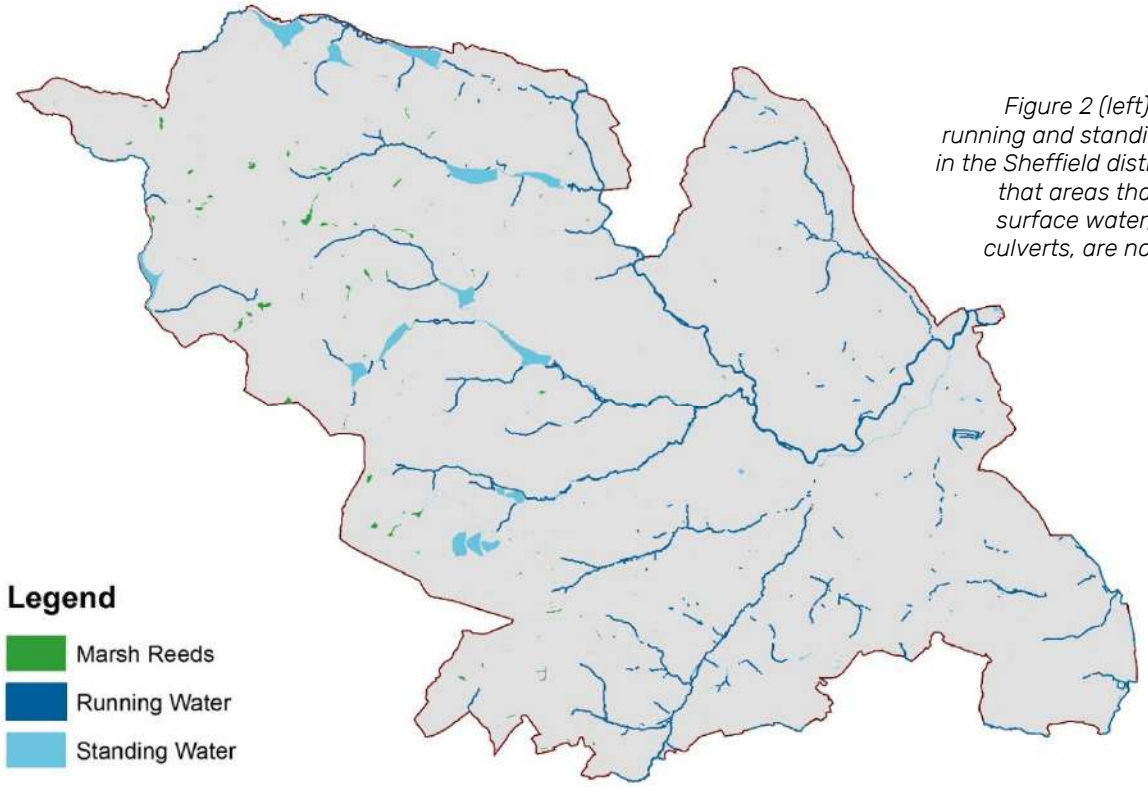
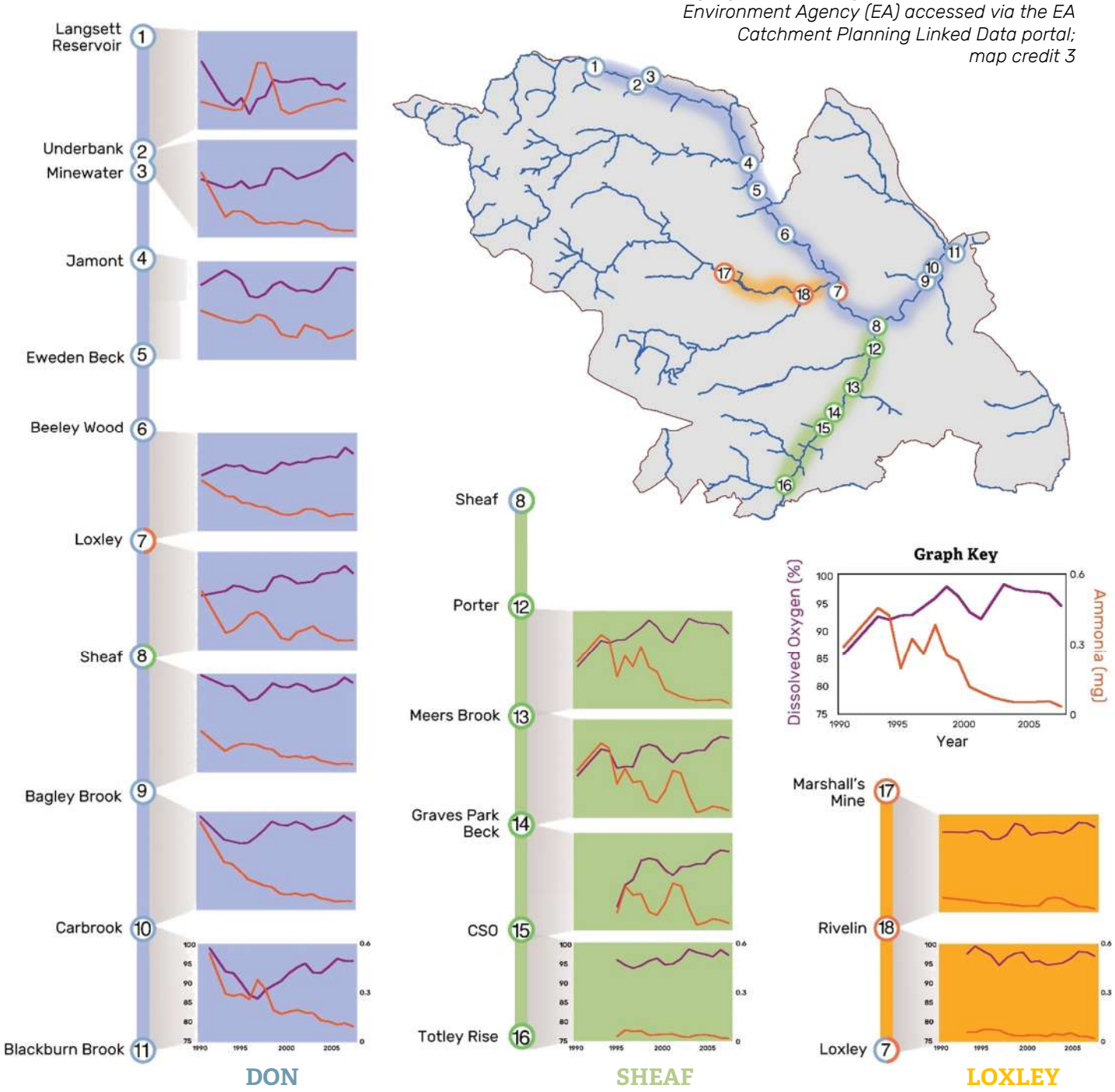


Figure 2 (left): surface running and standing water in the Sheffield district. Note that areas that are not surface water, such as culverts, are not shown.

UK Biodiversity Indicator Focus

B7: Water Quality

Figure 3: levels of dissolved oxygen levels (purple; left axis) and ammonia (orange; right axis – see graph key below) as recorded along the Don (blue), Sheaf (green) and Loxley (yellow) rivers between 1990 and 2009. Explanation of ammonia and dissolved oxygen levels are given below. Each river is divided between set monitoring points with single graphs showing data for each. Data from Environment Agency (EA) accessed via the EA Catchment Planning Linked Data portal; map credit 3

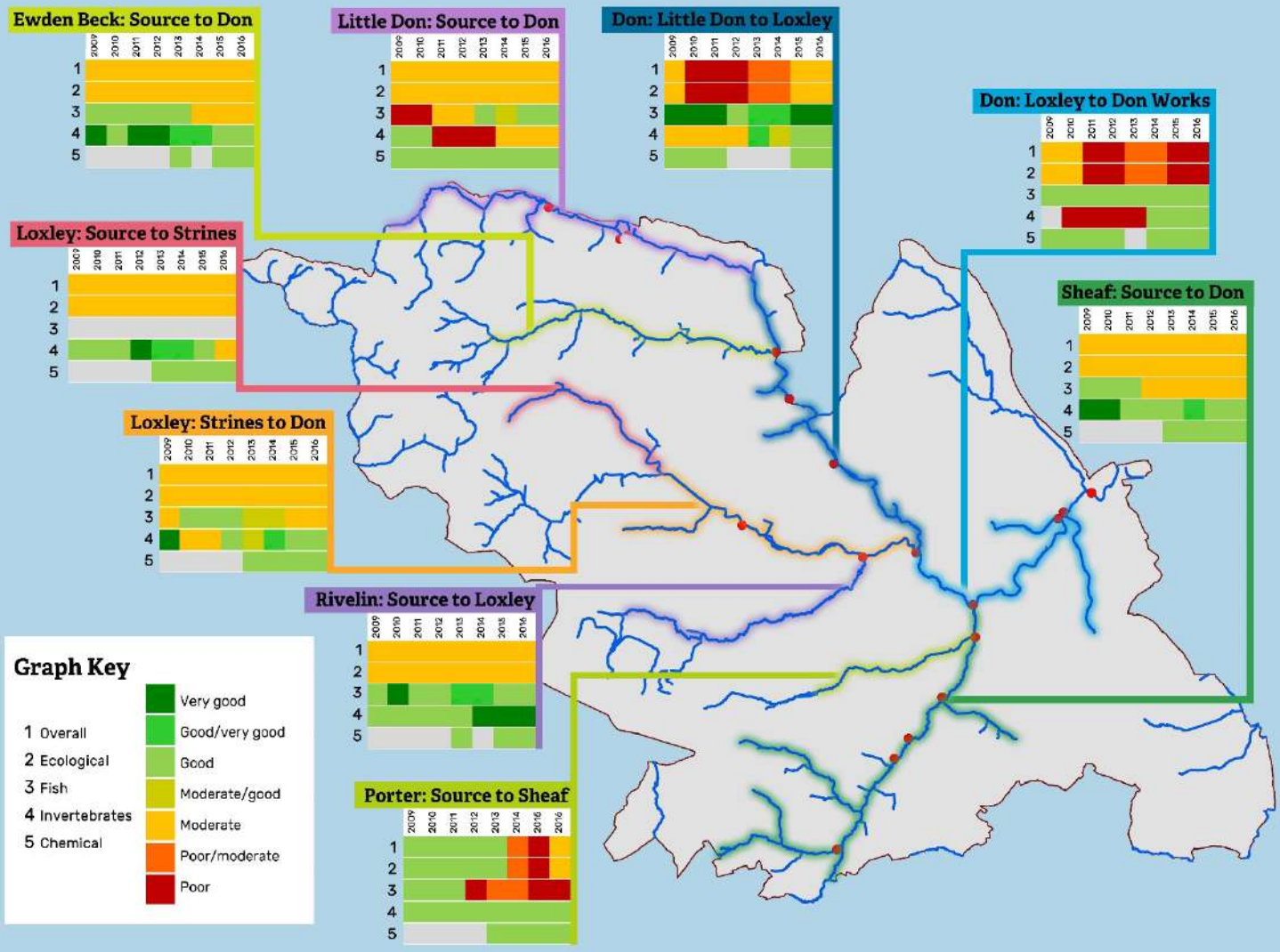


Water quality 1990-2009

Tests carried out by the Environment Agency (EA) show that water quality has improved in recent decades. Figure 3 details changes in ammonia (orange line; right axis) and dissolved oxygen (purple line; left axis) between 1990 and 2009 along key stretches of the River Don, Sheaf and Loxley as indicated on the map. High levels of ammonia are indicative of pollution from industrial waste and sewage, whilst dissolved oxygen levels that are too low can harm aquatic life. Following efforts from industries to control the release of waste into rivers, ammonia levels had significantly reduced along all monitored waterways by 2009. Coupled with higher levels of dissolved oxygen, this indicates that the ecological state of these water bodies has shown important improvements over the last 25 years.

Tinsley Sewage Farm Lagoon
© Sorby Natural History Society

Figure 4 (below): status of river systems across the Sheffield District, recorded by the EA from 2009-2016 between key points (red dots). Data © Environment Agency accessed via the EA Catchment Planning Linked Data portal.



River quality 2009-2016

Figure 4 (above) details several measures of the health of water bodies between 2009 and 2016: overall status; ecology; fish; invertebrates; and chemical status. Most tributaries are in overall moderate status, apart from the Porter, which at least in its lowest reaches, has fluctuated over the past eight years. However, the Don has shown poor to poor/moderate overall condition over the monitored period, indicating that there is still work to be done to improve this river system particularly within industrial stretches. Elsewhere on the Don, fish populations are improving, most likely driven by similar improving trends in the status of invertebrate communities. However, the Porter shows a worrying decline in overall quality, particularly reflecting the status of the river for fish. Further details on the surveys can be found in the relevant river basin management plan for the Humber accessed via:

www.environment.data.gov.uk/catchment-planning
www.catchmentbasedapproach.org/deliver/use-data

Redmires Reservoirs – A body of water with more depth than you may think...
Richard Hill, Honorary Secretary – Sheffield Bird Study Group

I can still vividly recall my first visit to Redmires in the somewhat vain attempt to look for birds in the winter of 1981, where I withstood the gales long enough to identify my first ever goldeneye – a winter-visiting duck which in those days was often the only species found on the upland reservoirs west of Sheffield at that time of year.

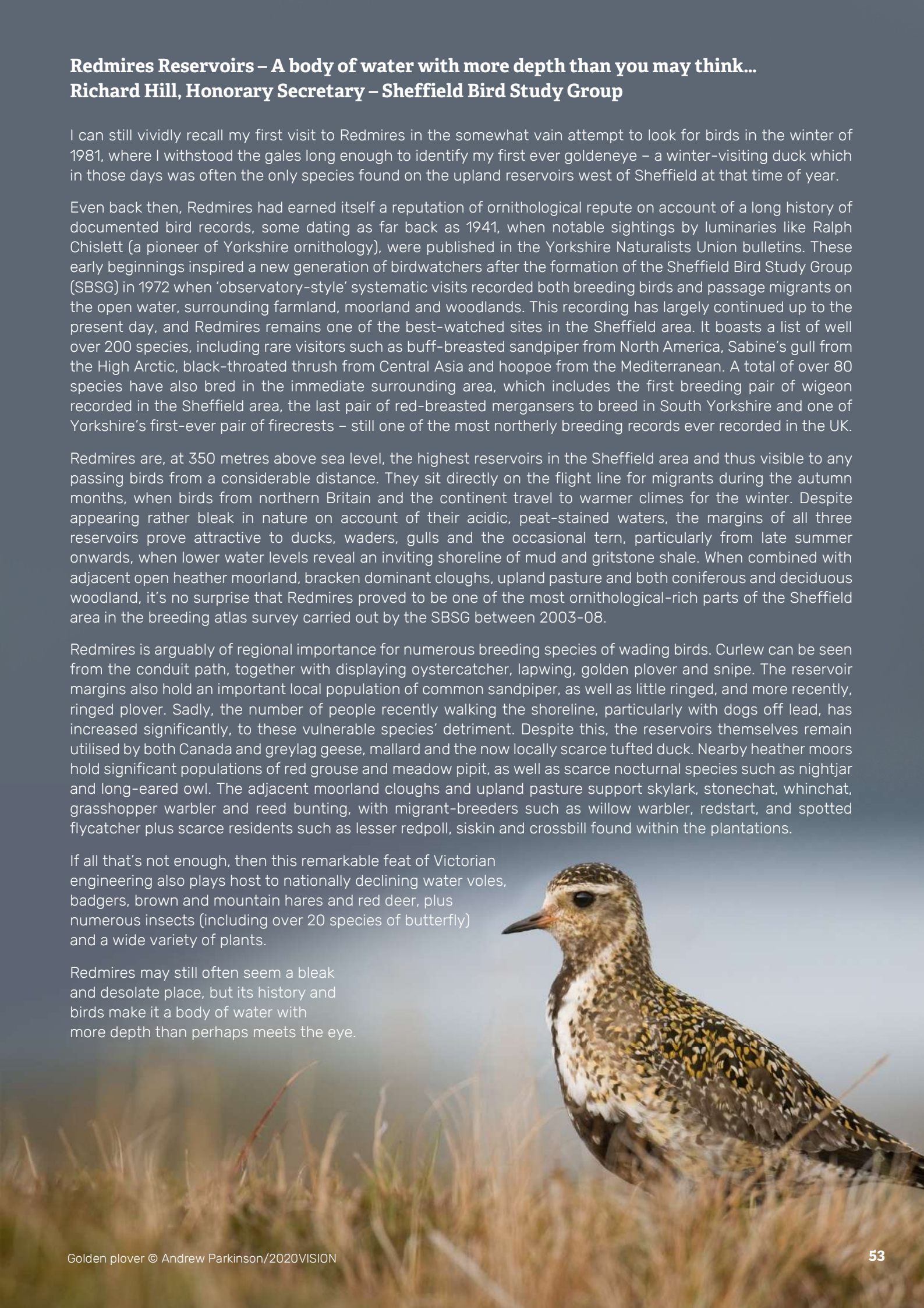
Even back then, Redmires had earned itself a reputation of ornithological repute on account of a long history of documented bird records, some dating as far back as 1941, when notable sightings by luminaries like Ralph Chislett (a pioneer of Yorkshire ornithology), were published in the Yorkshire Naturalists Union bulletins. These early beginnings inspired a new generation of birdwatchers after the formation of the Sheffield Bird Study Group (SBSG) in 1972 when 'observatory-style' systematic visits recorded both breeding birds and passage migrants on the open water, surrounding farmland, moorland and woodlands. This recording has largely continued up to the present day, and Redmires remains one of the best-watched sites in the Sheffield area. It boasts a list of well over 200 species, including rare visitors such as buff-breasted sandpiper from North America, Sabine's gull from the High Arctic, black-throated thrush from Central Asia and hoopoe from the Mediterranean. A total of over 80 species have also bred in the immediate surrounding area, which includes the first breeding pair of wigeon recorded in the Sheffield area, the last pair of red-breasted mergansers to breed in South Yorkshire and one of Yorkshire's first-ever pair of firecrests – still one of the most northerly breeding records ever recorded in the UK.

Redmires are, at 350 metres above sea level, the highest reservoirs in the Sheffield area and thus visible to any passing birds from a considerable distance. They sit directly on the flight line for migrants during the autumn months, when birds from northern Britain and the continent travel to warmer climes for the winter. Despite appearing rather bleak in nature on account of their acidic, peat-stained waters, the margins of all three reservoirs prove attractive to ducks, waders, gulls and the occasional tern, particularly from late summer onwards, when lower water levels reveal an inviting shoreline of mud and gritstone shale. When combined with adjacent open heather moorland, bracken dominant cloughs, upland pasture and both coniferous and deciduous woodland, it's no surprise that Redmires proved to be one of the most ornithological-rich parts of the Sheffield area in the breeding atlas survey carried out by the SBSG between 2003-08.

Redmires is arguably of regional importance for numerous breeding species of wading birds. Curlew can be seen from the conduit path, together with displaying oystercatcher, lapwing, golden plover and snipe. The reservoir margins also hold an important local population of common sandpiper, as well as little ringed, and more recently, ringed plover. Sadly, the number of people recently walking the shoreline, particularly with dogs off lead, has increased significantly, to these vulnerable species' detriment. Despite this, the reservoirs themselves remain utilised by both Canada and greylag geese, mallard and the now locally scarce tufted duck. Nearby heather moors hold significant populations of red grouse and meadow pipit, as well as scarce nocturnal species such as nightjar and long-eared owl. The adjacent moorland cloughs and upland pasture support skylark, stonechat, whinchat, grasshopper warbler and reed bunting, with migrant-breeders such as willow warbler, redstart, and spotted flycatcher plus scarce residents such as lesser redpoll, siskin and crossbill found within the plantations.

If all that's not enough, then this remarkable feat of Victorian engineering also plays host to nationally declining water voles, badgers, brown and mountain hares and red deer, plus numerous insects (including over 20 species of butterfly) and a wide variety of plants.

Redmires may still often seem a bleak and desolate place, but its history and birds make it a body of water with more depth than perhaps meets the eye.



Golden plover © Andrew Parkinson/2020VISION

Case study: Otters return to the River Don
Sara Blackburn, Sheffield & Rotherham Wildlife Trust (SRWT) & Dr Deborah Dawson, the University of Sheffield

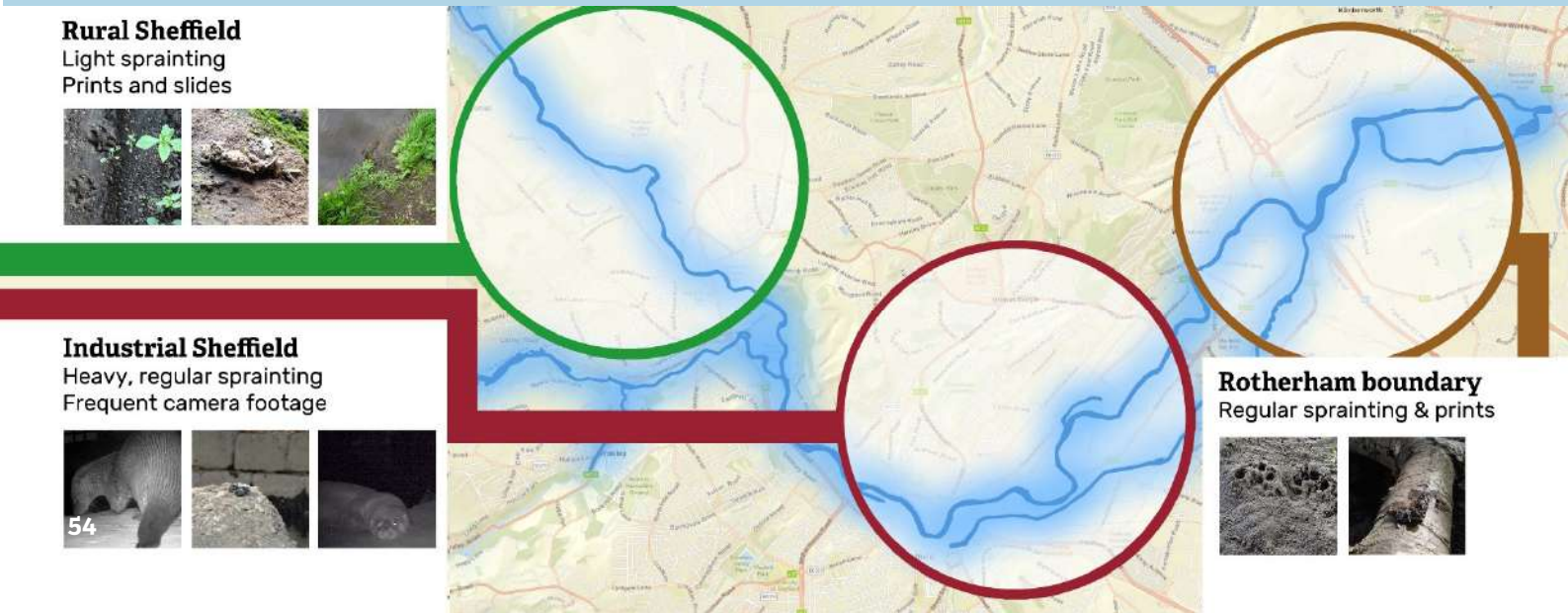
In May 2016 SRWT initiated the Otterly Amazing project as part of Nature Counts which sought to identify the current presence of otters along the River Don using citizen scientists, professional surveys and a network of infra-red triggered remote cameras. A total of 120 field signs of otter, comprising of droppings (spraints), footprints and feeding signs, were found across 24km of the Don within the Sheffield district (Figure 5). Additionally, over 40 video shots were captured from five distinct locations – the first time that otters have been filmed locally. Field signs and videos were recorded year-round. The most active camera sites were in central urban areas and captured early evening footage, indicating that Sheffield's urban otters can adapt to some human disturbance. All of the video captures showed individual adults. Evidence of potential resting sites and possible breeding was recorded within developed locations, although no urban holts were confirmed.

As the only way to reliably identify the number and sex of otters in an area, DNA analysis of spraints mostly collected through the Otterly Amazing project (summer 2016 and spring 2017) plus some additional spraints, was performed at the University of Sheffield by a team led by Dr Deborah Dawson, in the Department of Animal and Plant Sciences. Amy Withers, an MSc student at the University of Leeds co-supervised by Dr Hannah Dugdale, completed the lab work in Sheffield from May-September 2017. There are well documented difficulties of using spraints for DNA analysis, and the team developed new methods to increase the amount of data obtained. DNA was extracted and samples were genetically sexed and genotyped to identify individuals. The team found the presence of at least three individuals, and possibly up to seven. At least one of the 2017 spraints was from a male. Additionally, a female was detected at a more rural location, from a spraint collected in 2016.

As males do not rear cubs and otters' territories (typically 20-30km in freshwater systems[5]) do not overlap, it is unlikely that more than one male or a single mother and offspring are present within urban-suburban Sheffield, with other otters likely to be passing through. Further work is being performed at the University of Sheffield to obtain fuller genetic profiles which may be used to estimate territory size for some individuals. This may also help to confirm whether otters are truly resident and breeding on the Don or if they are simply transient.

The banks of the River Don are active sites for development. Current, local information on otter presence is critical to the protection of this European protected species which is fully protected under Schedule 5 of the Wildlife and Countryside Act 1981. These data are now available through the Sheffield Biological Records Centre to be considered alongside future planning within the Don catchment area to help protect this charismatic species.

Figure 5 (below): rough locations of otter evidence recorded (exact locations are protected). Above: camera trap footage from various urban locations in Sheffield.



Waterways within designated sites and protected areas

The linear nature of streams and rivers means that their condition at a particular location is dependent on the upstream environment as well as the environment at that location. This also means that protection of one stretch of a waterway can also have benefits far downstream. Several large waterway stretches are covered by SSSIs, Local Wildlife Sites (LWSs), Local Nature Reserves (LNRs), and Special Protected Areas (SPAs). Figure 6 highlights key LWSs that were selected and managed based largely on their water and wetland habitats.

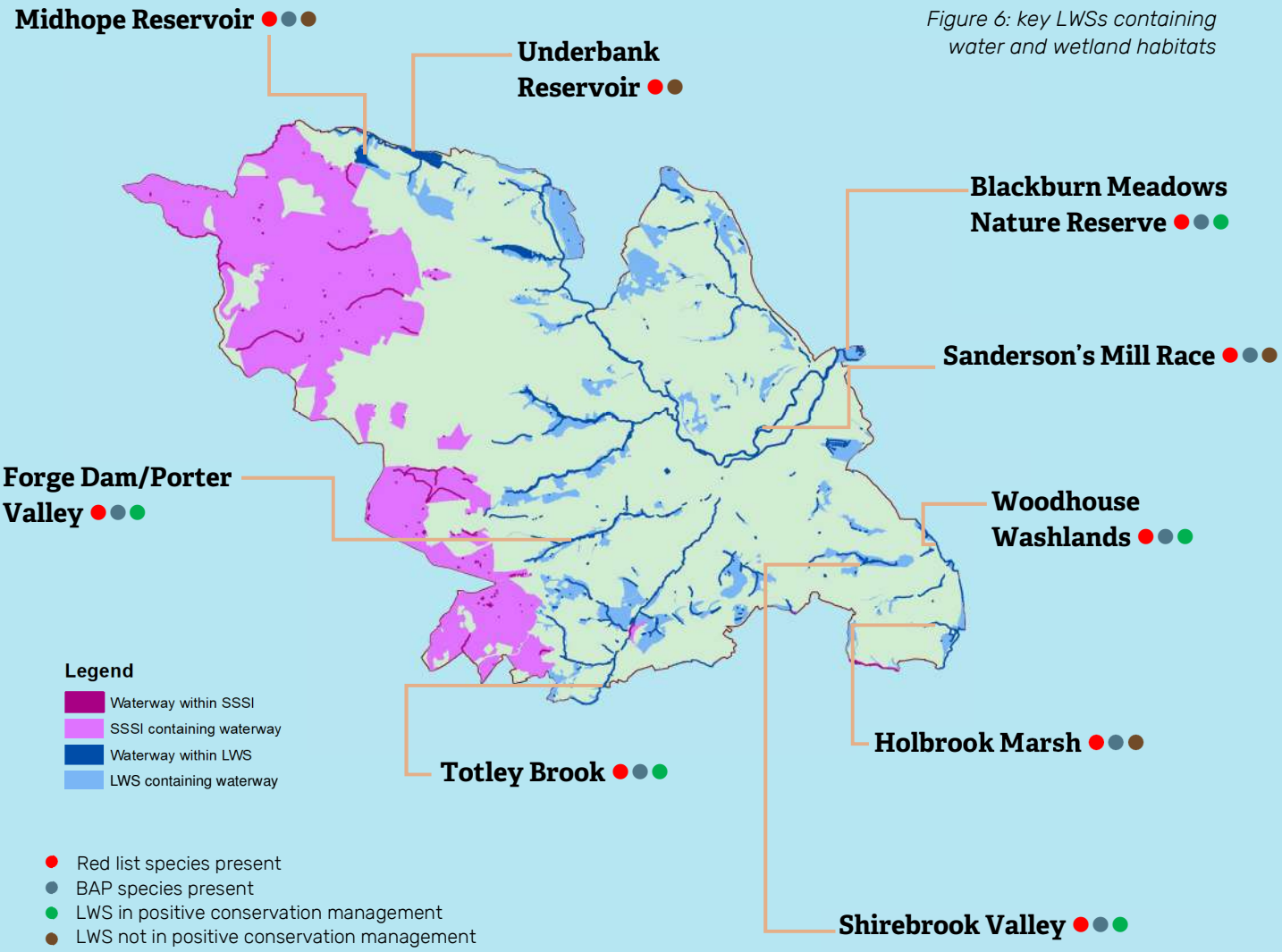


Figure 6: key LWSs containing water and wetland habitats

	Running water	Standing water	Reed beds	Total
Special Areas of Conservation	-	-	-	11%
Sites of Special Scientific Interest	-	-	-	12%
Local Nature Reserves	-	-	-	<1%
Local Wildlife Sites	-	-	-	35%
All designated sites	**46%**	**28%**	**87%**	**47%**

Table 1: Percentage of waterways and wetland habitats found within designated sites (47% of all running water, standing water and reed beds are covered by a site designation).

Autumn river
© Steve Waterhouse

Due to their mostly linear nature, waterways cover a relatively small area within designated sites – the habitat amounts to only 2.3% of all habitats within designated areas. However, the habitat itself is relatively well protected, with 47% of this habitat – or 306ha – covered by designated or protected site status. LWSs protect the largest area of waterways with a total of 24ha (35%) falling under this designation. A further 11% falls under Special Area of Conservation (SAC) or Site of Special Scientific Interest (SSSI) designation. These are mostly upland streams and tributaries that serve as important fish spawning grounds for salmonid species which have recently returned to the River Don[6]. LNRs protect less than 1% of the district's standing and running water.

LWSs are assessed on their positive conservation management status whilst SSSI sites are graded by condition. Figure 7 (below) shows the condition and status of these designated waterways and standing water habitats.

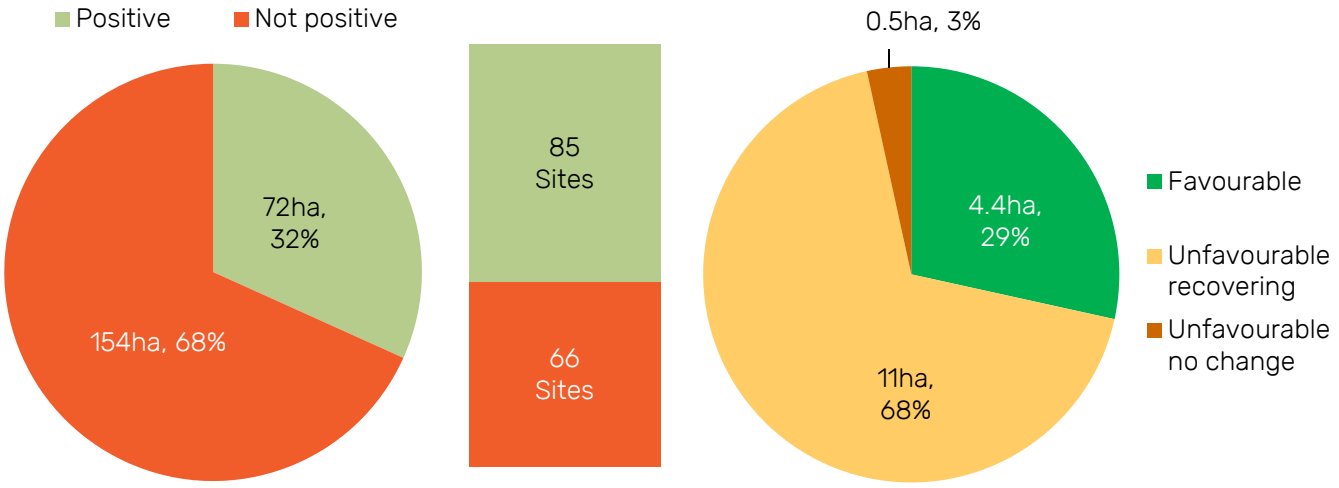


Figure 7: management status of all LWSs containing water and wetland habitats by area (left) and number of sites (middle), plus condition of SSSI units containing water and wetland patches (right). Unlike other chapters, all sites were considered (including those larger than 0.5ha) so as not to exclude sites containing small ponds and reed bed areas.

Case study: Fish return to the Don. Chris Firth, Don Catchment Rivers Trust

Sheffield's industrial history has had a profound impact on the River Don's fish populations. By 1760 there were 161 weirs, serving multiple booming industries, blocking the flow and isolating fish populations. By 1860 industries had expanded significantly and further modifications such as canalisation caused fish populations to completely collapse; only small, isolated populations of brown trout, bullhead and brook lamprey persisted within upland tributaries. The Don remained grossly polluted until the mid-1980s, by which point industries had declined and waste regulations were enforced.

It was not until 1990, following huge investments by water companies to improve water quality, that conditions were thought suitable for fish to be reintroduced. Since the year 2000, another driver for water quality and fish passage improvements has been the Water Framework Directive[7]. Out of the 31 species of fish identified as frequenting the Don prior to its decline, 26 recolonised through natural spread or reintroductions. Species of interest include bullhead – a Habitats Directive Annex II species. Only sturgeon, smelt, river lamprey, spined loach and burbot failed to return. Rainbow trout were also a new species to the river.

Conservation and restoration work has been carried out by the EA, the Canal and Rivers Trust and Yorkshire Water (YW), together with local authorities and many local groups. The Don Catchment Rivers Trust (DCRT) has supported the construction of fish passes on weirs to restore connectivity; salmon are now found in the lower stretches of the river on the eastern side of Rotherham for the first time in 200 years[6]. Pending work being completed on a weir in Rotherham, it is expected that salmon will be able to reach Sheffield as far as the outskirts of Oughtibridge by 2019 and suitable spawning and nursery conditions have been identified.

The next project aims to address the six weirs further upstream of Oughtibridge to allow access to the headwaters. Brown trout and grayling are also present from the headwaters to the lower outskirts of Sheffield.

Pike © Linda Pitkin/2020VISION

Waterways species highlights

Water vole © Terry Whittaker 2020VISION

Kingfisher © James Rogerson

Water vole
Strong declines but isolated populations still present

Kingfisher
New breeding locations along the Don recorded between 2005-08[8]

Sand martin
Severe local declines seen but new observations at Attercliffe

Why are these species important?

Along with other case study species, the presence of these species highlights key issues surrounding conservation of our river systems. Breeding pairs of kingfisher – a key apex predator – are thriving on the Don thanks to improving water quality and fish populations[8]. Small populations of water vole are still prevailing within the Sheffield district, notably within upland streams and tributaries where American mink, first recorded in 2005[9] and a known predator of water voles, have not yet gained a hold. Sand martin have significantly declined within the larger local area, but have established new breeding sites along the Don, possibly due to improvements in water quality[8].

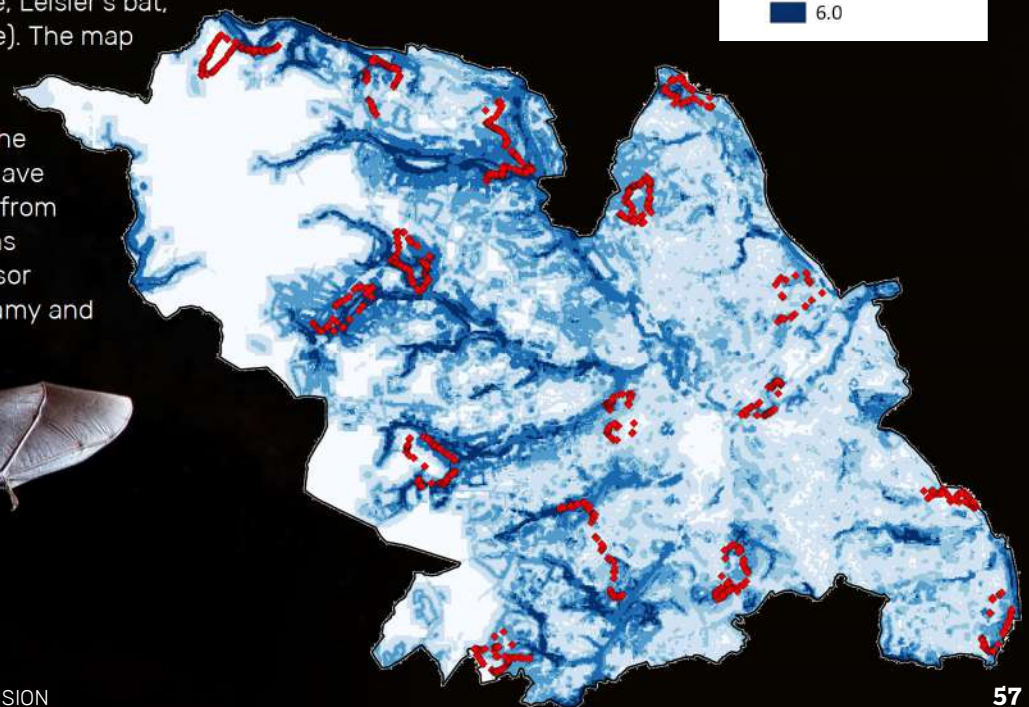
UK Biodiversity Indicator Focus

C8. Mammals of the wider countryside (bats)

Case study: Bat species distribution modelling within Sheffield

Robert Bell, South Yorkshire Bat Group; Paul Liptrot & Andy Geiger, Wildscapes

South Yorkshire Bat Group (SYBG) have been working with Wildscapes CIC and the Sheffield Lakeland Landscape Partnership to develop distribution maps for foraging bat species within the Sheffield area. These maps are being produced using a Habitat Suitability Modelling (HSM) approach, with HSM comprising a statistical technique that predicts the distribution of a species from environmental data and occurrence records[10]. Using 1612 presence records collected across 16 transect routes by SYBG volunteers during the summers of 2014 and 2015, the team are currently refining the models for six bat species (Daubenton's bat, whiskered/Brandt's bat, noctule, Leisler's bat, common and soprano pipistrelle). The map comprising a working draft shows the type of output that will be produced at the end of the project. This project could not have taken place without assistance from several people and organisations including Dr Ebru Ersoy, Professor John Altringham, Dr Chloe Bellamy and Pettersson Electronics.



Daubenton's bat © Dave Sutton/2020VISION

Case study: Crayfish on the brink. Sheffield Crayfish Action Group

The white-clawed crayfish (*Austropotamobius pallipes*) is the UK's largest native freshwater invertebrate and the only native crayfish species. Once widespread and common in English and Welsh rivers, they have declined significantly since the 1970s due to the introduction of non-native crayfish, pollution, habitat degradation and a disease known as 'crayfish plague'. White-clawed crayfish are classified as 'endangered' on the IUCN red list of threatened species and are at risk of global extinction[11]. Sheffield is one of only four locations in the Yorkshire and Humber region that supports populations of white-clawed crayfish[12]. The Sheffield Crayfish Action Group (Sheffield City Council (SCC) Ecology Unit; Sheffield & Rotherham Wildlife Trust (SRWT); the University of Sheffield; EA; local crayfish expert consultants) worked together with other local organisations, from 2008-2014 and again from 2017, to address local crayfish declines. The partners have compiled existing data on crayfish distributions, raised awareness of current threats, shared good practice on reducing spread of crayfish plague, produced a Crayfish Species Action Plan[13] and translocated threatened white-clawed crayfish populations[12]. Data show that the number of local flowing water bodies with white-clawed crayfish has recently decreased, while those supporting non-native American signal crayfish (*Pacifastacus leniusculus*) has increased.

Although undoubtedly affected historically by industrial pollution, the recent local decrease in range of white-clawed crayfish seems most likely to be due to the spread of signal crayfish through the River Don catchment area[12]. The signal crayfish grows faster and to a larger size, produces more offspring and can live at higher densities than the white-clawed crayfish[14]. It also often acts as a vector for the virulent crayfish plague to which it is immune. Consequently, although mixed populations of both species are found, the white-clawed crayfish is usually eliminated within a few years of the arrival of signal crayfish, or after only a few weeks if crayfish plague is introduced[14]. Currently signal crayfish cannot be controlled once they are established[14]. Even so, populations can go extinct even when not in direct contact with signal crayfish. One of the last white-clawed crayfish populations in Sheffield provides a salutary example. The Porter brook had a well-established native population over a roughly 3.5km stretch between Forge Dam and Hunter's Bar. The river flows through woodland and park and is a valued recreational resource. Despite this relatively benign environment, the crayfish population appears to have gone extinct over a period of 5-6 years (see Figure 8).

The evidence, both from analysis of dead crayfish and the lack of other known environmental impacts, points to crayfish plague causing the extinction in two apparent phases – possibly indicating two separate disease introductions. Interestingly, no signal crayfish have yet been recorded in the Porter and how the plague arrived in the river is unknown, although boots and fishing tackle can aid its spread. The apparent loss of this long-standing population indicates the fragility of extant local white-clawed crayfish populations. In the face of such threats, the action group is considering best actions to protect the species. Presently one population has survived a translocation to an 'Ark site' where it is the subject of monitoring. Only one original population survives on a tributary. The group was considering whether this population could be protected by a barrier, however recent unverified reports of suspected plague may mean it is already too late to save this population from extinction.

Figure 8: native crayfish were present in the Porter Brook prior to 2009, at which point many were found dead from plague. Extinction below the weir at Bingham Park occurred from 2010-2012. In 2013, crayfish were only recorded below Forge Dam and in low numbers near Wiremill Dam with the latter eliminated in 2014. In 2015-16 none were found at Forge Dam and the entire population appears to be extinct.

Data from engineering works, Sheffield Biological Records Centre, and surveys carried out by the University of Sheffield field courses.

White-clawed crayfish © LindaPitkin/ 2020VISION

Ownership and management

Ownership of Sheffield's rivers is complicated. Bank owners also own the riverbeds; if landowners are different on each side then the boundary falls in the channel centre. Whilst the EA owns very little waterway in Sheffield, it regulates licences and permissions for various river works or undertakings affecting the river (e.g. abstraction). It also works with others to tackle issues surrounding water quality (including pollution incidents). SCC are a major landowner and work with the EA and YW on strategic flood prevention projects and flood incidents, and with others on fish passage and habitat improvements. Sheffield has recently constructed numerous good examples of multi-functional flood defences which also incorporate enhanced habitat, public access, deculverting and renaturalisation (e.g. Matilda Street Pocket Parks and Porter Head).

Many river sections and their banks are owned by private individuals, farmers and businesses. Although the EA holds some information on land ownership, identifying landowners is complex, especially as urban land often changes hands. In the urban area, riverside businesses range from large and long-established (e.g. Meadowhall and Forgemasters) to smaller businesses who may not be well informed regarding riparian ownership. SRWT engaged businesses through its Waterways Development, Business & Biodiversity project – an Esmee Fairburn-funded project (2006-08) and the 2012-13 Catchment Walkover Project, run jointly with the River Stewardship Company (RSC) for the EA. RSC offers habitat management services to businesses, and several in the Business Improvement District in the Lower Don have recently signed up to long-term river maintenance, with RSC, through the Sheffield Lower Don Valley Flood Defence Project[15]. Don Catchment Rivers Trust does not own land but works with many partners to improve fish passage and on community engagement projects. Other community engagement work is carried out by RSC (e.g. Blue Loop[16] and Riverlution Projects) and other local organisations. The complex nature of ownership and management of Sheffield's rivers has led to the development of the Sheffield Waterways Partnership and Living Don Partnership, the latter being part of the larger catchment-wide Don Network. These partnerships and networks allow sharing of information and strategic project development.

The Sheffield & Tinsley Canal (the Sheffield stretch is from Victoria Quays to Meadowhall) is owned and managed by the Canal and Rivers Trust (formerly British Waterways). It carries out maintenance and improvement projects and engages volunteers from the community. The canal forms one side of the 'Blue Loop' between the city centre and Meadowhall, with the Don's Five Weirs Walk forming the other[16,17]. This 8-mile walk is a shining example of partnership working with local landowners resulting in a long-term gain for the residents of Sheffield.

The angling community and supporting organisations also play a vital role. The Wild Trout Trust (WTT) supported the formation of Sheffield Partnership for Rivers in Town Environments (SPRITE) in 2009 as a local branch of its 'Trout in the Town project'. SPRITE has been voluntarily collecting riverfly records since 2010, adding more sites in 2014. As a partner organisation for the Riverfly Monitoring Initiative[18] it undertakes a standardised sampling methodology to check water quality. SPRITE acts as the contact point for the EA for any potential pollution incidents, should an alarm level be breached, ensuring that early action can be taken. Data are collected by 12 SPRITE members, 14 trained volunteers and two RSC volunteers. The data feed into EA's data shown in Figure 4.

Case study: Porter Brook - channel habitat improvement in a deculverted city centre stream. Dr Paul Gaskell, Wild Trout Trust

In 2015, SCC undertook a bold project to uncover a section of stream that used to live beneath a factory floor. The aim was to create a 'pocket park' to provide new flood-water storage (when the rivers are in spate) and an improved public park amenity (when the rivers are calm). WTT's role was to design in-channel features and riverbed morphology that would maximise improvements for the ecology of the stream - including for the small and fragmented native population of wild brown trout. A number of features were introduced including boulder clusters and pre-planted coir rolls on new berms. The interventions have created much more physical structural variety plus variation in flow speed and depth, which will benefit fish and their supporting food chains[19].

During deculverting (top) and post-establishment (bottom) © Paul Gaskell

Case study: Recent conservation efforts for ponds

Angus Hunter, Sheffield City Council Ecology Unit &
Dr Nicky Rivers, Sheffield & Rotherham Wildlife Trust

The restoration of ponds – identified as a national priority habitat – has been a key focus in Sheffield. The South Yorkshire Ponds Project ran for three years from May 2008 as a joint initiative between Pond Conservation and the South Yorkshire Biodiversity Forum, with funding from the Heritage Lottery Fund, SITA Trust (now the SUEZ Communities Trust), Biffa Award and the EA. The project created a pond inventory map, contributing to the identification of Important Areas for Ponds (IAPs). Surveys underpinning practical pond restoration and management work were also undertaken at 20 ponds, resulting in work to restore existing ponds and create new ponds at 16 sites. The project team was managed by SRWT and worked with volunteers and local community groups.

More recent work has focussed on Froglife's Living Waters Project developed in partnership with the SCC Ecology Unit. During part one, run from 2013 to 2015, 30 new ponds were built with an additional five restored at key sites including Shire Brook Valley and Perrywood Lane (Figure 9). The project is currently in part one, with 16 new ponds being created together with extensive heathland restoration work for reptiles within seven LWSs including Holbrook marsh and heath. There is an ambition to develop a part three to further benefit Sheffield's great crested newt populations in the south east of the city. Ponds require regular resources for management to maintain their open water component.

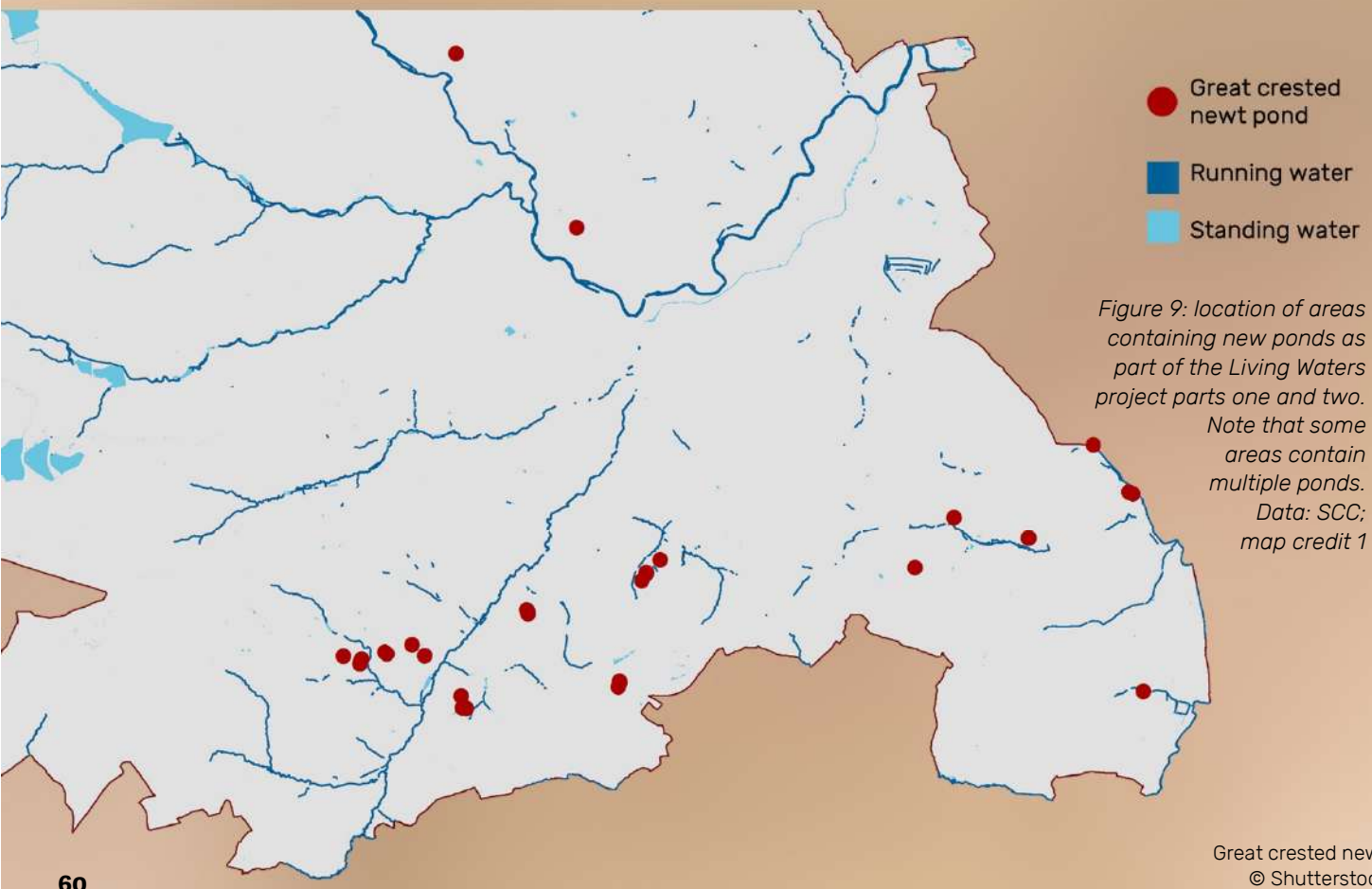


Figure 9: location of areas containing new ponds as part of the Living Waters project parts one and two. Note that some areas contain multiple ponds. Data: SCC; map credit 1

Great crested newt
© Shutterstock

UK Biodiversity Indicator Focus

Birds of the wider countryside: C5c. Wetland Birds

A wide range of birds are supported during at least part of the year by rivers and wetlands in Sheffield which provide either breeding habitats, feeding grounds, or both. However, overall, the picture is not encouraging for Sheffield's breeding wetland birds. Of the 24 species included in the wetland bird indicator (Figure 10; right), 15 (63%) had decreased in occupancy between 1975-80 and 2003-08 with only nine species (37%) showing an increase in occupancy[8]. Of these decreases, the most significant are seen in wet grassland and reed bed areas (Figure 10; c and d). The only habitat in which the balance was tipped in favour of increasing species is fast flowing rivers, adding to the evidence of the increasing health of our waterways.

Comparing these figures to national trends (although it is important to note that national analyses consider abundance as opposed to occupancy), the picture appears less optimistic for Sheffield, with a higher proportion showing a local decline (63% as opposed to a national figure of 27%).[20]

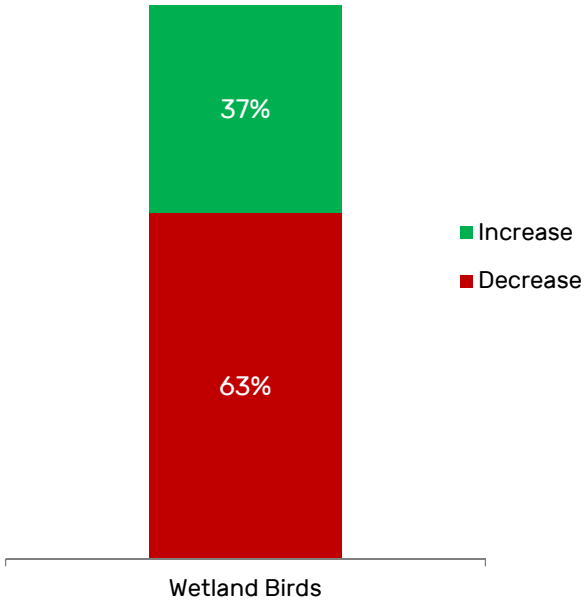
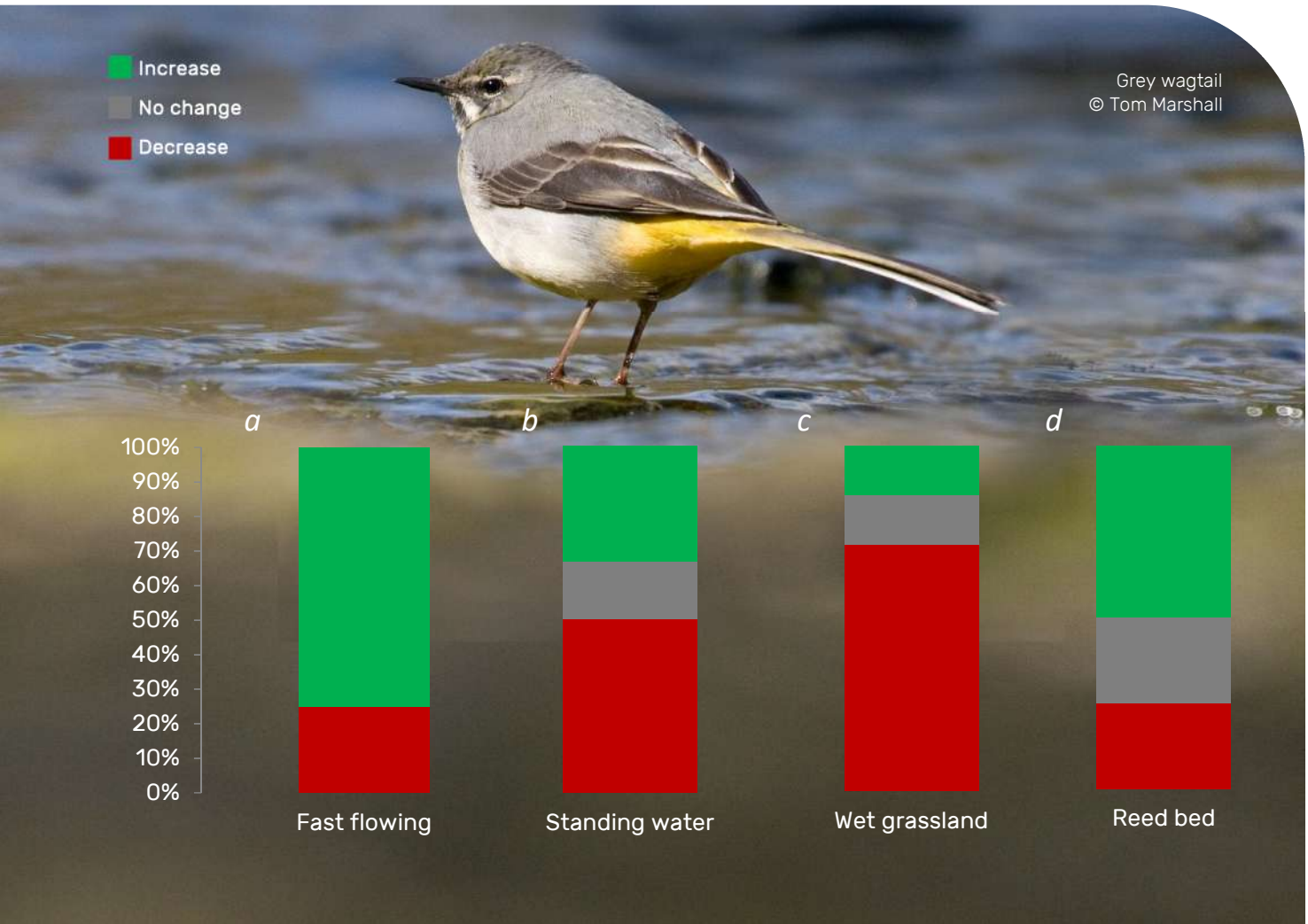


Figure 10: trends of wetland birds (above) included as part of the UK biodiversity indicator C5: birds of the wider countryside, measured as a change in the number of tetrads (2km x 2km) (locations) occupied between 1975-80 and 2003-08. Also shown (below) are the same species divided by their specialist habitats: fast flowing rivers (a); standing water (b); wet grassland (c) and reed beds (d).



Which species are doing well?

Goosander
© Richard Steel/2020VISION

Dipper
© Tom Marshall

Goosander
New to the area in 2003-08 with breeding confirmed.

Grey heron
Breeding population is increasing.

Oystercatcher
6% occupancy. New to the area in 2003-08.

Mallard
Widespread indicator species 72% occupancy.

Grey wagtail
51% increase. Expanding to the north-east.

Curlew
Stronghold to the west with lowland breeding.

Mute swan
100% increase in occupancy.

Dipper
18% increase Expanding to the east.

What are the reasons?

Climate change
Changing climate has helped to bring new species to the Sheffield area.

Habitat restoration
The improvement of our rivers, both in terms of habitat and water quality, has most likely benefited species that favour fast flowing waters such as grey wagtail and dipper, despite these species declining nationally.

Management
Improved management of moorland and unimproved farmland areas (habitats on which some wetland birds depend on for breeding grounds) has helped stem local declines of species such as curlew.

Which species are not doing well?

Sand martin
© Bob Coyle

Reed bunting
© Chris Gomersall /2020VISION

Common sandpiper
37% decrease.

Reed bunting
15% decrease. Declines seen to the east.

Lapwing
22% decrease.

Teal
57% decrease. Declines seen in the north-west.

Redshank
43% decrease. Mostly restricted to the east.

Yellow wagtail
83% decrease. Now absent from Sheffield district.

Snipe
44% decrease, No breeding in the east in 2007-08.

Sand martin
72% decrease. Restricted to the north-east.

What are the reasons?

Climate change
Climate change has affected species such as sand martin possibly due to unpredictable rainfall affecting availability of the flying insects on which they feed[21]

Habitat modification
Drainage and 'improvement' of local pastures, together with the intensification of farming, has negatively impacted breeding birds such as lapwing, redshank and yellow wagtail.

Management
Increased disturbance from recreational activities has impacted species such as common sandpiper. Higher livestock densities on breeding grounds can also affect these wetland birds.

UK Biodiversity Indicator Focus

B6a. Freshwater Invasive Species

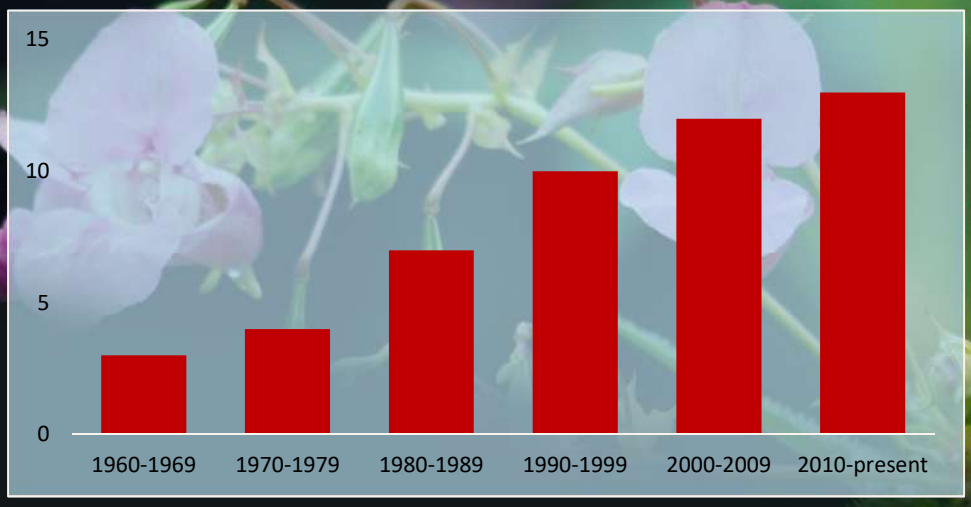


Figure 11: cumulative number of novel freshwater species recorded, in Sheffield, per decade as categorised in 'Non-Native Species in Great Britain: establishment, detection and reporting to inform effective decision making'. Data: NBN Gateway.

Himalayan balsam © Amy Lewis

Invasive Non-Native Species (INNS)

A number of INNS plant species are particularly associated with freshwater and riparian habitats. These species have been extensively mapped by SRWT from 2012 as part of the Yorkshire Invasive Non-Native Species Project[22] using the citizen science mobile phone app 'PlantTracker' (Figure 12a).

Japanese knotweed

This species has had a significant hold across Sheffield's river system, particularly the Don and lower stretches of the Sheaf and Porter, where it continues to spread and cause challenges for riverside developments.

Giant hogweed

As a result of more stringent methods for removal of giant hogweed employed by the RSC and other volunteer organisations, the density and distribution of giant hogweed has significantly reduced since 2013[23] (Figure 12b).

Himalayan balsam

This species is evidently rife across the larger water networks, particularly the Don and Rivelin (Figure 12c). Organisations and volunteers groups frequently 'balsam bash' to remove it.

Other species

The project has also revealed the presence of floating pennywort, American skunk cabbage and New Zealand pigmyweed along Sheffield's waterways.

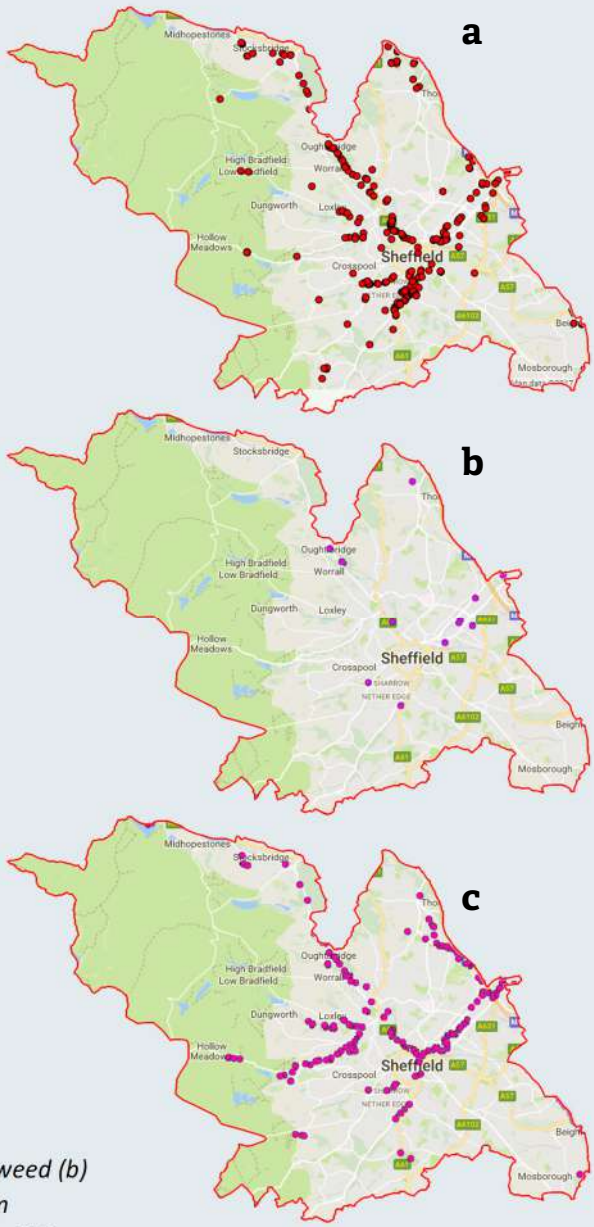


Figure 12 (right): distribution maps of Japanese knotweed (a), giant hogweed (b) and Himalayan balsam (c) across main waterways in Sheffield. Data from PlantTracker: accessed via naturelocator.org and NBN Gateway. Map credit 3

Case study: Dragonflies and damselflies on the up
Alistair McLean, Curator of Natural Science, Museums Sheffield and Sorby Natural History Society Odonata Recorder

In 1981, the Odonata of Sheffield were "relatively poor compared with areas of Southern and Western England" with a likely nine or 10 species present[24]. Within the last 30 years, the situation has clearly improved. There are now 20 regularly occurring species with an extra four occasional migrants. Whilst there are still fewer species recorded within the Sheffield boundary than can be found in southern and western Britain and indeed within the wider Yorkshire area, much of this can be explained by our northern climate and distance from the coast and dragonfly migration routes, rather than human causes. However, previous pollution, loss of habitat and poor water management had contributed to a reduction in species numbers[25], and recent increases in group biodiversity have likely been helped by improvements in these areas. As dragonflies are reliant on periods of warm, settled weather and mild winters, it is possible that climate change may also be having an effect on biodiversity in this area (Figure 13).

Red-eyed damselfly *Erythromma najas*

This distinctive damselfly would appear to have been present near Sheffield since 1978 with records from sites in Rotherham (recorder unknown) and Renishaw Hall in north-east Derbyshire (Dunn, R). There is little in the local literature of the time, presumably as a result of the deficiency of data. It was not until the 1990s that its range expanded to other sites in Rotherham (including Tinsley Dyke) and eventually Sheffield in 2010, colonising multiple spots along the Sheffield & Tinsley Canal - a significant leap from its previous residence. This may show that areas such as Treeton Dyke had a healthy enough population to require dispersal but could equally have been a result of prevailing winds.

Banded demoiselle *Calopteryx splendens*

C. splendens was, until recently, locally scarce. The first records, from the Nottinghamshire side of the Sheffield area, were reported in 1973[26] with other sporadic sightings in the late 1970s and 1980s. Since the mid-1990s, Sheffield appears to have played host to a meeting of two populations of this damsel. Recording in the area throughout the 1990s shows a gradual increase in distribution from the Doncaster area, travelling south west. Meanwhile, recording in Derbyshire has shown a spread of distribution heading north through that county[27]. The result has been a pincer movement of two presumably distinct populations and a dramatic increase in numbers and geographic spread. The species is now seen in good numbers into the heart of Sheffield along both the canal and River Don, as well as occasional random ponds and reservoirs, as high up as Burbage (personal communication; Whiteley, 2015). This species is known for its intolerance of pollution[28] and has almost certainly dispersed in relation to cleaner waters and improvements to emergent waterside vegetation.

Red-eyed damselfly
© Mark Hamblin/2020VISION

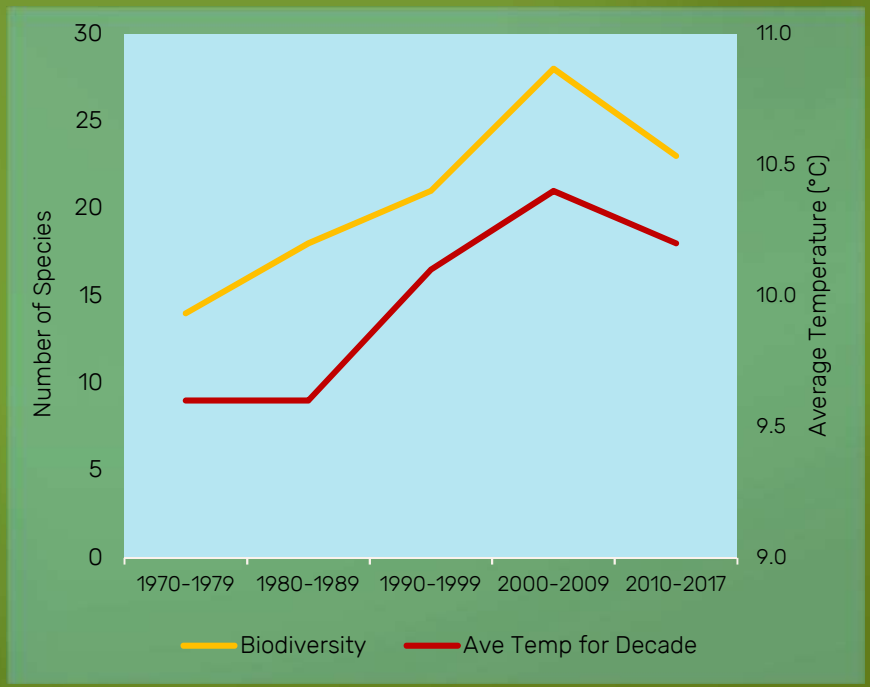


Figure 13: number of dragonfly species recorded in Sheffield since 1970 and correlated changes in average temperature per decade. Temperature measurements from Weston Park Weather Station, Museums Sheffield.

Threats to waterways and standing water habitats

What is the threat?	What does it cause?
Pollution such as industrial waste, sewage and agricultural runoff, especially in storms; atmospheric pollution and release of iron-rich colliery water	Effects can include deoxygenation, nutrient enrichment, direct toxicity, and spread of pathogens, with effects on fish and invertebrate populations with knock-on effects further up the food chain. Nutrient enrichment can cause excessive algal growth with detrimental effects on other aquatic plants.
Alterations of waterflow through construction of weirs, dams, ground and surface water abstraction and water transfer schemes	Periods of low water flow can restrict habitat area and result in low oxygen levels. Both low flow and physical barriers (dams, weirs) can restrict movement of migratory species such as fish. Sensitive river invertebrate communities are also negatively affected by low oxygen levels.
Physical modification of the river for flood defence, drainage, fisheries, management and waterpower. Includes: channelling; culverting; dredging; filling; creation of artificial banks	Removal of banks and reduced stability of retained banks affects breeding birds and other wildlife that require undisturbed bankside vegetation for food or shelter. Also reduces habitat availability and connectivity for riparian species.
Residential and industrial development, agricultural intensification	Loss of riparian habitat leads to a reduction in biodiversity within river sections and a reduction of riverside buffer zones, increasing the risk of pollution and sediments entering the river.
Fisheries management including artificial stocking and vegetation removal	Stocking can spread disease and can also cause conflict between people and wildlife. Potential genetic threat to wild stock.
Invasive plants and animals	Invasive plants outcompete native species leading to a reduction of diversity of bankside vegetation. Species, such as floating pennywort, can clog waterways, reduce light penetration and affect oxygen levels with knock-on effects for invertebrate and fish communities. Also leads to direct or indirect eradication and restriction of native species such as white-clawed crayfish and water vole by predation or disease introduction.
Recreational use of the river	Unsustainable or uncontrolled recreational use can cause bank erosion, trampling as well as disturbance to wildlife.
Lack of management, particularly for small ponds	Progressive loss of open water and depth can occur if vegetation growth and sediment input are not managed[29]. Changes to bank habitat can change water inflow and shading, affecting temperature, turbidity and water quality.

River Don © Paul Richards

Recommendations

1. Develop targeted conservation plans for water vole, white-clawed crayfish, sand martin, kingfisher and otter as key indicator species or local species in severe decline.
2. Continue to deliver conservation actions that support the return and expansion of fish species including salmon.
3. Promote the value of LWSs associated with freshwater habitats and the importance of their protection and ongoing management for wildlife to organisations, private owners, planners and developers.
4. Focus efforts on improving the overall condition of key water and wetland LWSs currently in poor condition or not in positive management for wildlife, for example, Blackburn Meadows.
5. Continue to monitor and improve our knowledge of otters on our waterways and ensure that planners, developers and construction companies are aware of the importance of this protected species and the habitats they rely on along the Don and elsewhere.
6. Continue efforts on improving the overall condition of rivers, particularly parts of the Porter and urban sections of the River Don. This includes: removing restrictions and barriers for wildlife whilst maintaining biosecurity; managing water extraction sensitively; renaturalising rivers by removing modifications; and tackling diffuse pollution from agriculture, industry and other sources.
7. Continue to strategically tackle non-native invasive plant species such as Japanese knotweed and Himalayan balsam.
8. Work with landowners, managers and farmers to provide more habitat for wetland birds such as yellow wagtail and breeding waders such as lapwing, for example, by rewetting grassland areas and by increasing and managing reedbeds.
9. Promote the importance of Redmires (within the PDNP and therefore not designated as a LWS) as a bird breeding and wildlife site and develop coordinated habitat management plans amongst relevant landowners and other stakeholders.
10. Work with Natural England and other stakeholders to support and promote the improvement of water and wetland SSSIs to favourable condition.
11. Promote the importance of ponds for wildlife, encouraging public bodies, developers, landowners and farmers to incorporate ponds in to new schemes. Provide advice to enable the public to include ponds in private gardens or improve the wildlife value of existing garden ponds.
12. Carefully balance recreational demand with undisturbed areas for wildlife.

Kingfisher
© Dawn Monrose

Moorland, Upland & Heathland

Headlines

- Several key priority moorland habitats are present, including lowland and upland heathlands, blanket bogs and upland flushes, fens and swamps, with the majority lying within designated sites. 12% of the Sheffield district is covered by heathland with an additional 12% of blanket bog.
- Most of Sheffield's moorland habitats lie within the Peak District National Park. However, some important heathland lies outside of the National Park. These lowland heathlands are mostly contained within Local Wildlife Sites (LWSs).
- Over 95% of moorland habitats are covered by designated sites, mostly with the highest level of European protection.
- 99% of Sheffield's moorland within Sites of Special Scientific Interest (SSSIs) is in either 'favourable' or 'unfavourable recovering' condition, compared to a UK figure of 94%.
- Lowland heathlands require regular ongoing management to maintain the habitat.
- Characteristic moorland species include red grouse, sphagnum mosses, ling heather and bilberry bumblebee. Key species such as cuckoo, ring ouzel, nightjar, peregrine falcon and mountain hare may be at risk from disturbance and, in some cases, persecution.
- The UK Biodiversity Indicator 'C5e: wintering waterbirds' highlights further species in trouble including dunlin, redshank and lapwing, with declines attributed to land management practices and habitat loss.

Derwent moors at sunset

Introduction

Sheffield's uplands are largely composed of moorland habitats and lie predominantly to the west within the upland areas of the Peak District National Park (PDNP). However, the Sheffield district also features a number of scattered lowland heathland areas (sometimes referred to as the Coalfield Heathlands), which are more centrally distributed. In addition there are a number of intermediate sites where heathland forms a mosaic with woodland. These include the steep, wooded river valleys – such as Porter Clough and the Limb Valley – draining the higher moors. The management of these mosaic heathland areas including woodland is normally covered by relevant woodland management plans (see woodland chapter).

The vast majority of Sheffield's moors are open access and are of significant value to the people of Sheffield in regard to access to nature, recreation, health and well-being and cultural heritage. Moorlands and heathlands also have a significant part to play in climate change mitigation, flood control and water quality management.

What moorland habitat types does Sheffield have?

Figure 1 shows the composition of Sheffield's moorland, upland and heathland habitats. How these broad habitat types are distributed across the district is also mapped (Figure 2). In this report, moorland habitat – mostly upland heath – has been divided into four distinct types related to coverage of ling and bell heather (*Calluna vulgaris* and *Erica cinerea*, respectively) and bog. These habitats are further defined in the Appendix. Heather-dominated habitats make up nearly 50% of Sheffield's moorland with the other half being bogs that are either heath-dominated or grass-dominated (33% and 14%, respectively). Within the upland region of the PDNP there is also a quantity of unimproved acid grassland, constituting the moorland fringe, which is also considered in this chapter as an upland habitat. Sheffield's moorlands are covered by the Sheffield Heathland Habitat Action Plan (HAP)[1] and the Peak District's Biodiversity Action Plan[2]. The recent 'State of Nature in the Peak District' report also goes into further detail regarding the habitats and wildlife of Sheffield's moorlands, and is a valuable resource for their ongoing protection.

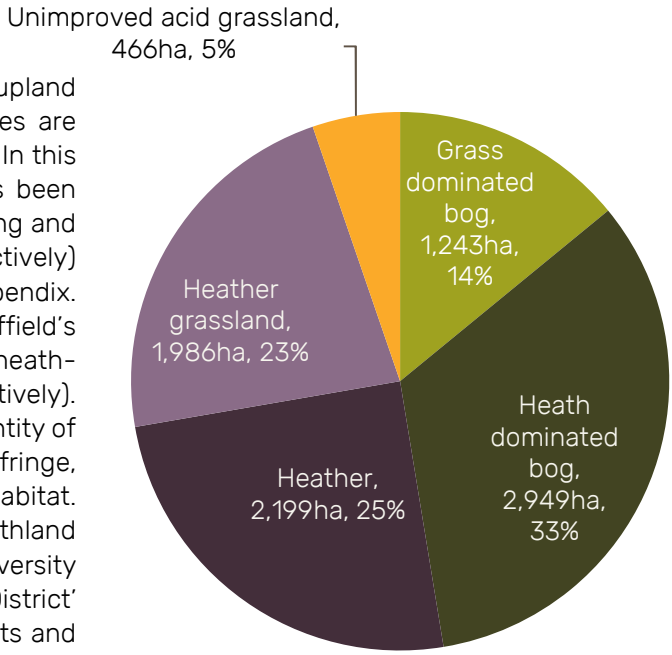


Figure 1 (above): area (hectares) and percentage coverage of moorland habitat types within the Sheffield district.

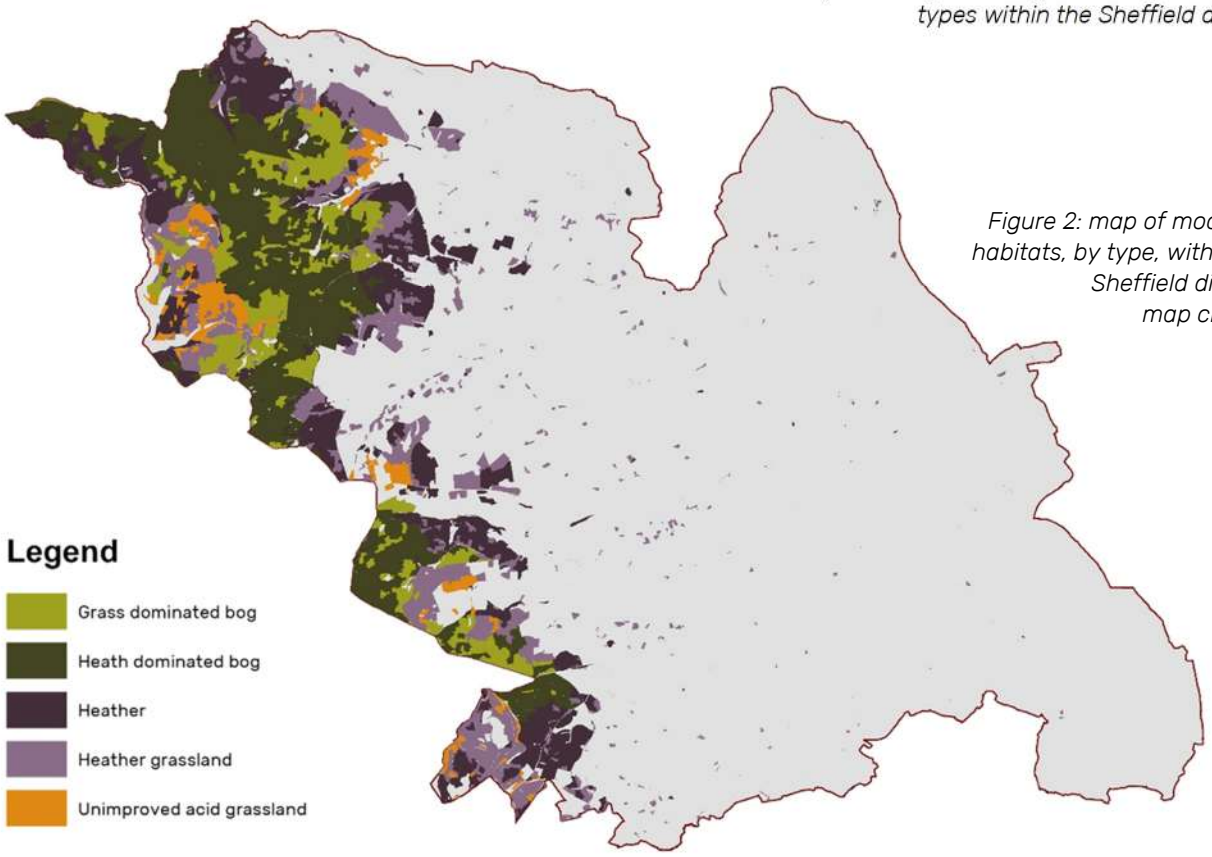


Figure 2: map of moorland habitats, by type, within the Sheffield district; map credit 1

Priority Habitat Inventory: Moorland, upland and heathland habitats

Many of the constituent habitats of moorlands - upland heathlands, blanket bogs and upland flushes, fens and swamps – plus lowland heathlands, are mapped on Natural England's (NE) Priority Habitat Inventory (PHI) as designated UK Priority Habitats. They are recognised for their scarcity and importance for the natural environment, susceptibility to habitat modification and for their support of associated priority species[3]. These habitats support a range of more unusual higher plants typical of the Peak District, including species such as cloudberry, chickweed wintergreen and bearberry (at the southern edge of their range on Hallam, Houndkirk and Derwent Moors respectively); bog rosemary, common cow-wheat and bog pimpernel.

The majority of the areas of priority habitat fall within two Sites of Special Scientific Interest (SSSIs) – the Dark Peak and the Eastern Peak District Moors - which are incorporated into the South Pennine Moors Special Areas of Conservation (SAC) and Special Protection Areas (SPA), both European designations. Only a few sites fall outside the designated area, including Whitwell Moor, areas on Agden Side, White Lee Moor, Swan Height and Kirk Edge. These sites, together with the Ughill and Rod moors (within the EPDM SSSI), are distinctive outliers to the main moorland block to the west. They are of particular importance to the local Sheffield landscape, increasing the area of transitional habitats which are often of particular wildlife value. Agden bog, a SRWT nature reserve (see case study), is one of a small group of undesignated upland wetlands in the Bradfield area.

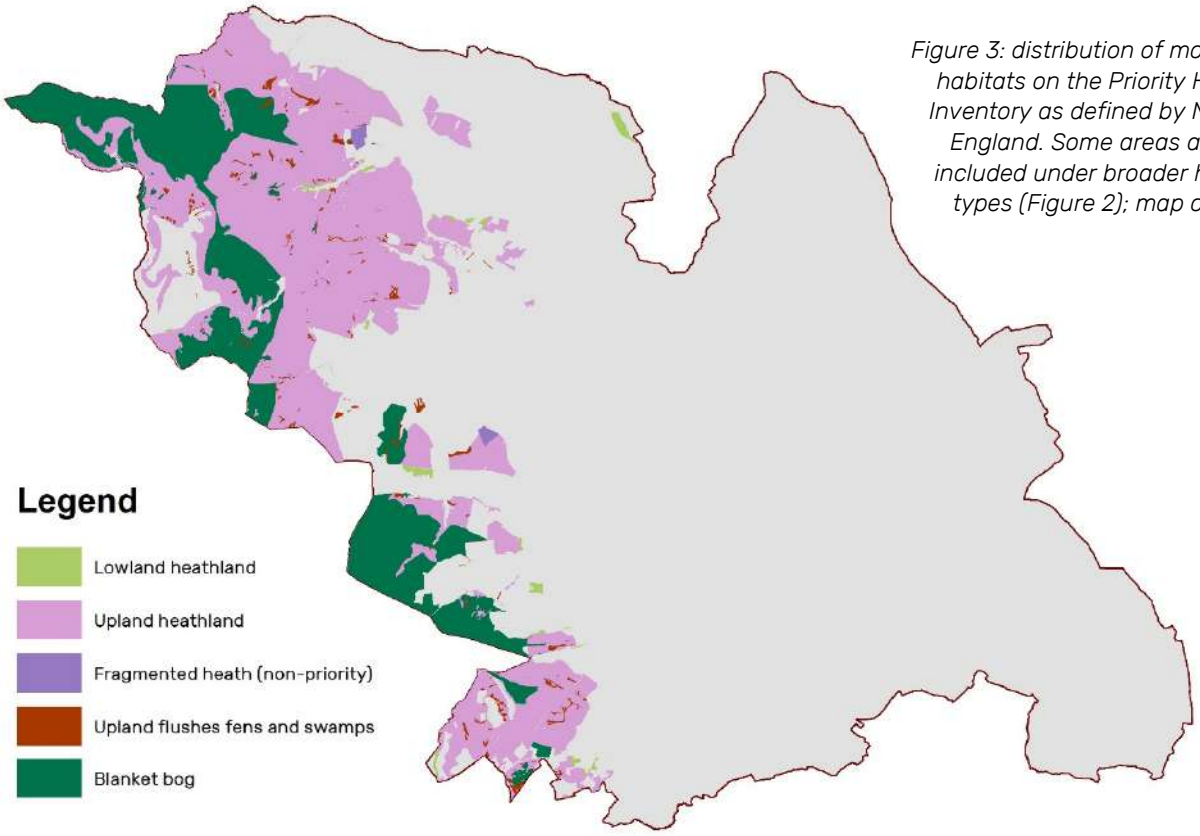


Figure 3: distribution of moorland habitats on the Priority Habitat Inventory as defined by Natural England. Some areas are also included under broader habitat types (Figure 2); map credit 2

Upland heathland is found on the lower moors and slopes below the plateau and is dominated by ling heather. A variable proportion of other dwarf shrubs, commonly bilberry and crowberry, may be found beneath the heather with cowberry locally abundant north of the A57 in a nationally unusual species assemblage. A combination of burning and over-grazing particularly around the moorland fringes has resulted in some areas losing diversity and being dominated by acid grasses; commonly matt grass and wavy hair grass with purple moor grass on the wetter slopes. In these areas bracken can be locally abundant.

Blanket bog is found on the high plateau where it contains variable quantities of cotton-grasses and dwarf shrubs over deep peat. The peat-forming bog-mosses (sphagnum) are limited in extent largely as a result of historic atmospheric pollution. However, the Hallam and Ringinglow Bogs are recognised as one of the few Peak District locations where sphagnum still survives in large quantities and the peat is actively growing. Elsewhere the blanket peats exhibit erosional features caused by complex issues including pollution, fires and climate change.

Upland flushes, fens and swamps are the most botanically rich communities in the area dominated by rushes or common cotton grass with a wide range of associates including star sedge, sphagnum, bog asphodel and marsh pennywort. Bog pondweed and round-leaved crowfoot can be found along seepage lines.

Round leaved sundew
© Nabil Abbas

Key heathland sites within the Sheffield Local Planning Authority Boundary

As described on the previous page, most of Sheffield's moorlands fall within the Dark Peak area of the Peak District National Park. The majority of the small pockets that are outside this area are lowland heathland, with the exception of Whitwell Moor which is wetter and more upland in character (Figure 4). This resource is very small and fragmented and represents a formerly more widespread habitat type which has been largely lost historically to agricultural intensification and coal mining.

Figure 4: moorland habitat lying outside of the PDNP (PDNP defined as white) and moorland covered by LWS status; map credit 1

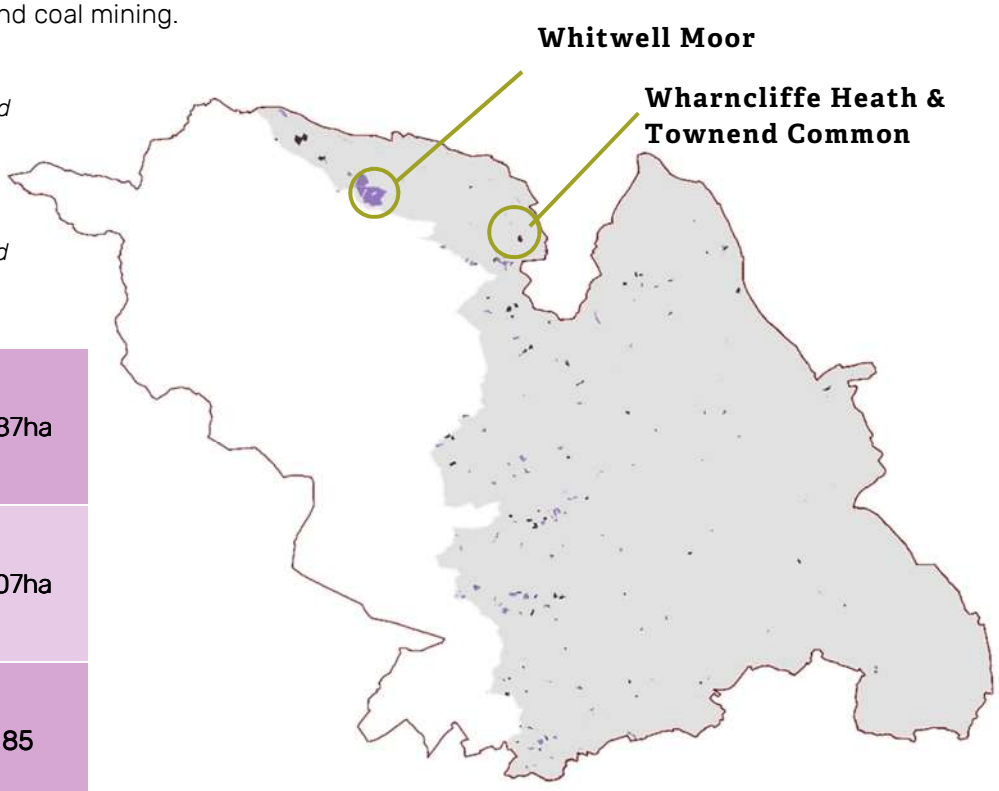


Table 1 (below): details of moorland and heathland habitat and LWSs outside of the PDNP

Area of moorland & heathland outside of PDNP	187ha
Area of LWSs containing moorland or heathland	107ha
Number of LWSs containing moorland or heathland	85

Sheffield's Heathland HAP highlights 25 of the most important lowland heathland sites[1]. The majority are small; only two are over 10 hectares (Wharncliffe Heath and Townend Common, Figure 4) and a further four support between five and 10 hectares of heath including Loxley and Wadsley Common. Wharncliffe Heath is shown as a priority Lowland Heathland habitat by Natural England (NE). This site includes approximately 170 hectares of heathland habitat, most of it lowland in character or intermediate to a more upland type. These sites all lie within the Yorkshire South Pennine Fringe Natural Character Area in elevated locations, and, as with the Peak District moorlands, are associated with gritstone outcrops and escarpments. The majority are contained to some extent within Local Wildlife Sites (LWS; Table 1). Eight of the larger sites are on, or form part of, Local Nature Reserves (LNRs). Eleven local groups are actively involved in the management of 16 out of the 25 most important sites, and 13 management plans are in place[1]. Few of these areas are grazed and all are open to public access.

These lowland heathland habitats are commonly dominated by ling heather and are often found in a mosaic with areas of scrub, grassland and wetlands; it is this variability and diversity that imparts much of the wildlife value. Important species widely distributed amongst these LWSs include: grass snake and common/viviparous lizard; a range of birds typical of the moorland and woodland fringe including whinchat, nightjar, tree pipit, spotted flycatcher, redpoll and cuckoo; green hairstreak butterflies; and brown hare.

Case study - Coalfield Heathlands Project 2005 – 2010
Roy Mosley, Former Coalfield Heathlands Project Manager
Sheffield & Rotherham Wildlife Trust

This partnership project, located across 25 sites in South and West Yorkshire, was set up to address the issues surrounding the conservation of Coalfield (lowland) heathlands including their management and fragmentation and to encourage greater understanding, enjoyment and involvement of the area by local people. A total of £1-million was invested in the project with lasting impacts for heathland condition, extent, associated species and local communities. The project included four sites in Sheffield: Back Edge; Parkwood Springs; Townend Common; and Wharncliffe Heath. Habitat, access and interpretation management plans were implemented for all sites.

Over the whole larger project area, 300ha of heathland on 25 sites were restored or created. Over 2,000 people were involved in heathland events across 4,000+ volunteer days, including educational sessions, which were delivered to 53 groups of school children. Additionally more than 50 NVQ or other local accreditations were achieved through the project's training, securing further investment and involvement in the conservation of this unique area[4].

Townend Common © Steel Valley Project

Case study: Nightjar[5-9]
Michael Senkans, Biodiversity Monitoring Officer, Sheffield City Council

Nightjar are an amber-listed species (Bird of Conservation Concern) associated with lowland heath and, more recently, felled or newly planted conifer plantations. Historically the species underwent a significant range contraction of 51% in Britain prior to 1981. Between 1981 and 2002, the number of 'churring' males has increased from 2,100 to 4,600. Despite this doubling in numbers, there has been little range expansion. This countrywide increase is likely to be due to both habitat protection and restoration since the 1980-90s.

Locally, prior to the early 1970s, the nightjar's breeding range was limited to areas below the gritstone edges. Since then it has followed recent national trends with a moderate population increase, despite declining between 1975–1980, with declines likely to be due to wetter, cooler springs. Though suitable nightjar habitat has remained stable locally since the 1970s, weather conditions may be crucial to the nightjar's success. A slight increase in the mean minimum and maximum temperature during May and June will influence the availability of insect prey, whilst excessive rain during the same period could push this species in the opposite direction. The implications of climate change are uncertain.

Local populations of this transient species may also be threatened from increased recreational pressure. Care should be taken to ensure that they are not detrimentally impacted from new recreational projects.

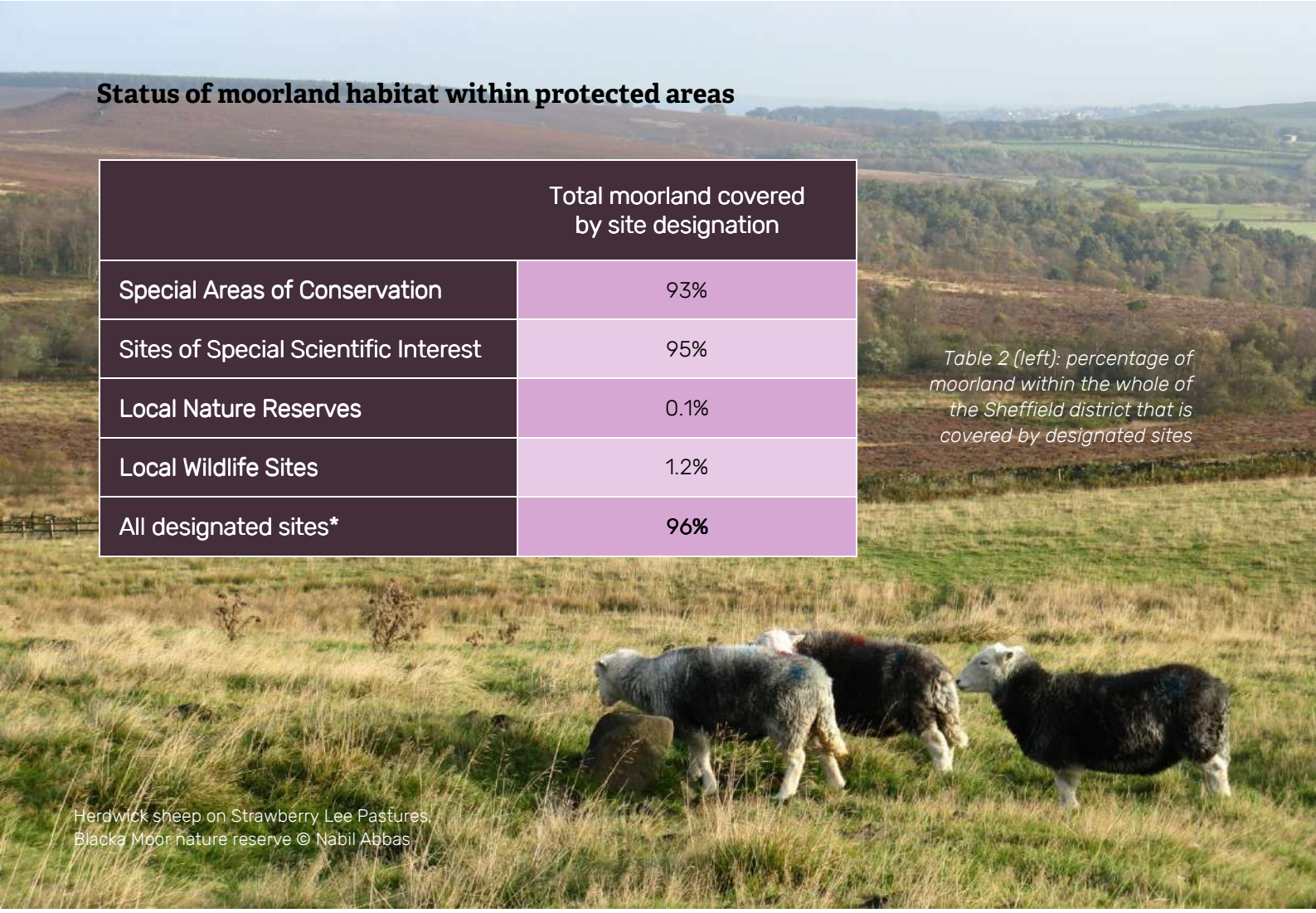
As nightjar are nocturnal, it is difficult to confirm breeding with data often based on churring or displaying males only. Fledgling surveys are needed to get a true picture of breeding success. The local breeding popualtion is thought to be 10-20 pairs. Between 1968-2017 there were 168 total records for nightjar in the Sheffield area, plus an additional 320 records from 2005-2015 from the Sheffield Bird Study Group. Popular sites are Wharncliffe, Ewden Valley, Strines Moor, Bradfield Moor plus recently and partly-felled plantations including Burbage, Redmires and Agden Side.

Nightjar
© David Tipling/2020VISION

Status of moorland habitat within protected areas

	Total moorland covered by site designation
Special Areas of Conservation	93%
Sites of Special Scientific Interest	95%
Local Nature Reserves	0.1%
Local Wildlife Sites	1.2%
All designated sites*	**96%**

Table 2 (left): percentage of moorland within the whole of the Sheffield district that is covered by designated sites



Herdwick sheep on Strawberry Lee Pastures, Blacka Moor nature reserve © Nabil Abbas

A large portion of moorland habitat (96%) is covered by designated and protected sites, most substantially as SSSIs across the eastern Peak District. Most of the habitat also has additional SAC and SPA status (Table 2). Over 99% of Sheffield's SSSI moorland is in either 'favourable' or 'unfavourable recovering' condition (Figure 5). In contrast, very few LWSs feature heathlands or bog and therefore these sites protect a very small proportion of the total habitat. This is partly because LWSs are not created in areas that have existing European status such as the PDNP. Of the LWSs that do feature grass or heather heath (Figure 4), nearly three-quarters (74%; 76ha) are not in positive conservation management. Indeed, heathland habitat requires on-going management. This can be a challenge for all landowners and remains a threat to moorland habitats outside of the PDNP. LNRs cover only a tiny fraction of moorland habitat.

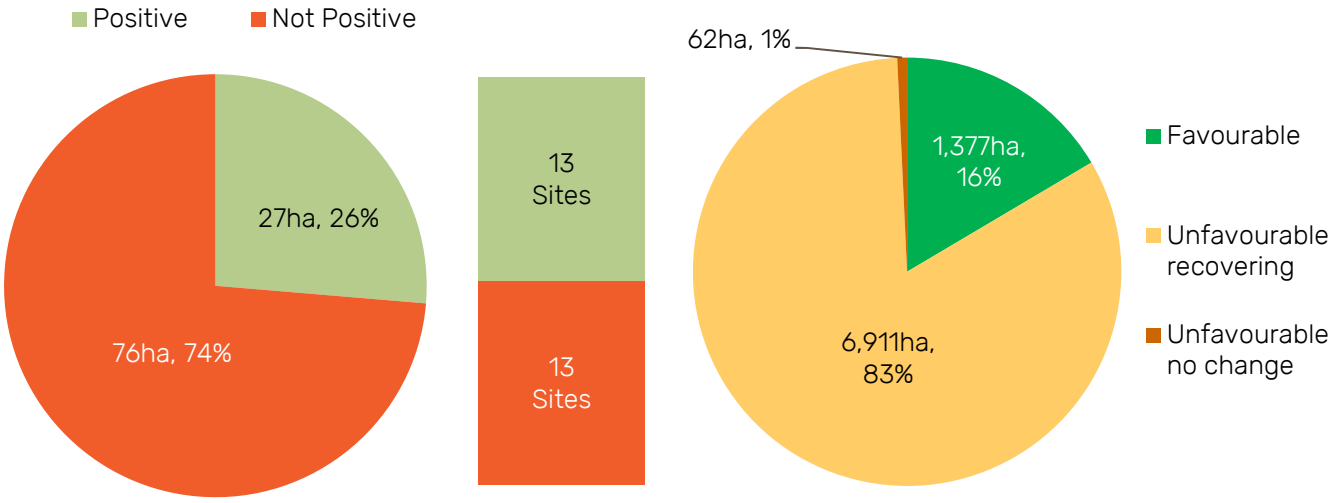


Figure 5: management status of moorland habitat within LWSs by proportion and area size (left) and condition of moorland sites within SSSI units (right). Only sites containing moorland patches larger than 0.5ha were considered to ensure that positive management included reference to the moorland habitat as a significant component.

Case study: Agden Bog
Rachel Stevenson, Community Wildlife Ranger, Sheffield & Rotherham Wildlife Trust

Agden Bog is a small but important wildlife site in north-west Sheffield. The site is owned by Yorkshire Water and has been managed since 2017 by Sheffield & Rotherham Wildlife Trust (SRWT). The site falls on the corner of Agden Reservoir with the bog land mainly formed from a series of converging seepages which emerge from a steep hill. Water from the bog then travels further downstream through the site in a series of runnels to form a mosaic habitat of tussocks and small hollows of open water, finally leaving the site as two small water trackways heading towards Adgen Dyke which runs into the reservoir. The site is a good example of bog land that has been mostly lost due to draining of land for agricultural purposes. The area is home to some important and locally rare plant species such as the insectiverous sundew, common spotted orchid, heath spotted orchid and bog asphodel. The majority of vegetation in the bog is low-growing with sedges, mosses and sphagnum cushions, as well as reeds and rushes that prefer acidic conditions. The reserve is good for reptiles and invertebrates including a recent sighting of a purple hairstreak butterfly. Nightjar, spotted flycatcher, siskin, lesser redpoll and common sandpiper have all been recorded nesting in nearby areas.

The site is currently being grazed by cattle in the summer months as part of the management regime started by Yorkshire Wildlife Trust (YWT) in 2012 and being continued by SRWT. This is helping to reduce scrub encroachment and promote conditions for the low growing vegetation on site, hopefully encouraging specialist species to return such as common butterwort. The site can be visited at any time of year; however, June is an excellent time to catch many of the wildflowers in bloom.

Case study: Flies (Diptera)[10,11]
Rhodri Thomas, Cranefly Recorder, Sorby Natural History Society

Craneflies are a key component of the Peak District's peatland fauna and are a major prey item for breeding birds, particularly the small dark grey cranefly *Tipula subnodicornis*. However, the eggs and young larvae are highly susceptible to drought and so are at significant risk from climate change.

Although several groups of flies such as hoverflies and craneflies have been studied reasonably well in Sheffield by members of the Sorby Invertebrate Group, there is little quantifiable information to enable detection of changes over time, or to identify whether any changes are the result of real change rather than the intensity of recording. However, anecdotal observations of 'vehicle windscreen casualties' over the last few decades suggest large declines in the number of aerial insects, and likely changes may be inferred from habitat change.

Nectar-feeding species, including many hoverflies, have probably declined substantially, along with other pollinators, with the widespread loss of flower-rich grasslands. Brownfield sites are likely to have provided important refugia, but require imaginative planning policies if those benefits are to be anything more than temporary. Species whose larvae are associated with dung are also likely to have been significantly reduced with the use of persistent vermicides to treat livestock. Wetland and aquatic species such as snail-killing flies and many craneflies have probably also suffered from habitat loss, but wetland creation and water quality improvements may have compensated for some of these losses.

Looking to the future, deadwood species, which include many uncommon specialists, are likely to be in for a good time as ash dieback spreads. Warmth-loving species such as some of the predatory robber-flies may benefit from climate change, and aquatic species will probably continue to benefit from improving water quality. Continuing extensive moorland restoration results in an increase in soil moisture and an associated significant increase in cranefly abundance. The future of the insect fauna and associated birdlife of the moors may therefore be much brighter than it might have otherwise been.

Helophilus
© Paul Richards

Characteristic moorland species

Ling heather © Kerry Long

Red grouse © Rob Miller

Chartley sphagnum © Vicky Nall

Ling heather
Ling heather is the dominant species of Sheffield's heathlands. This is not typical of upland heaths but is believed to be a result of local historic management and pollution. Proactive conservation management in recent years has sought to increase the extent of heather and other dwarf shrubs in upland acid grassland areas and to increase the age range of the heather plants.

Red grouse
This charismatic bird is endemic to the British Isles. It is a characteristic species of the moorlands of the Peak District. Many of the privately owned moorlands are managed for seasonal gamebird shooting. The territorial and monogamous behaviour of this species means all available habitat is filled with territories[12].

Sphagnum
These mosses are the major peat forming species of the blanket bogs. It is very susceptible to atmospheric pollution, erosion and fire damage and as a result many of the Peak District's blanket bogs are in a poor condition, although positive action and management agreements are seeking to reverse this trend. Only a few species are now widespread in comparison to several prior to the industrial revolution. The Moors for the Future (MFF) Community Science project is encouraging members of the public to become involved in recording sphagnum.

Bilberry bumblebees
© Tom Aspinall

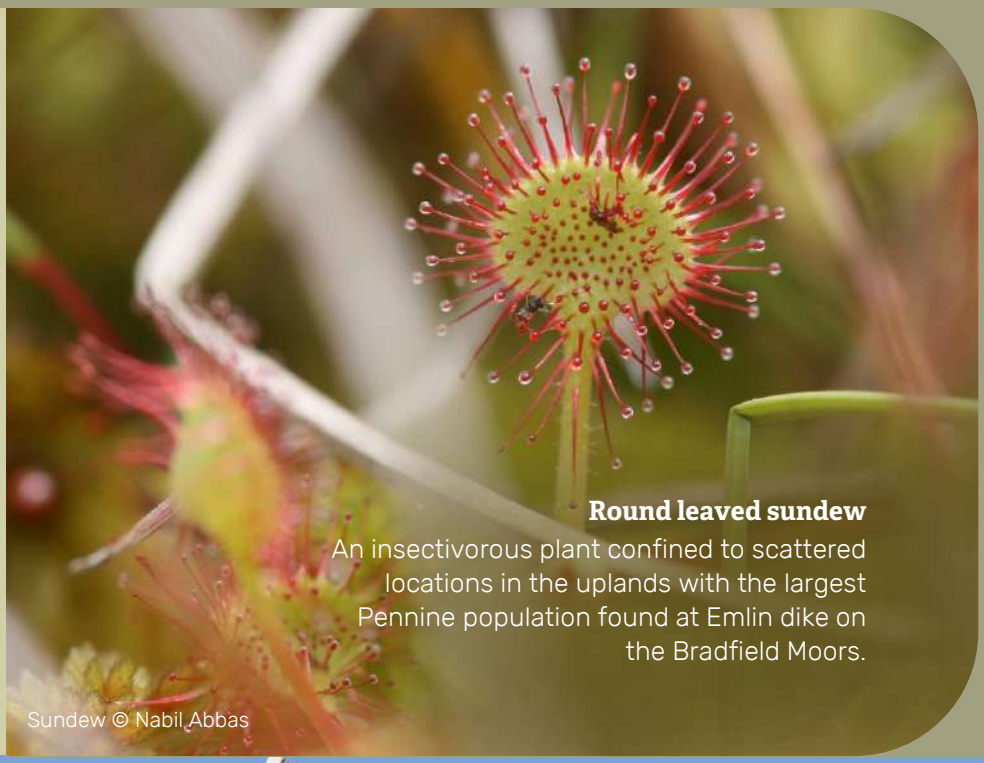
Bilberry bumblebee
The bilberry bumblebee is a cold-loving species of uplands, moorlands and moorland edges and typically feeds on bilberry and willow, bird's-foot trefoil, clover and bramble. Queens emerge from hibernation in April and workers are present from May onwards. They tend to nest at the base of bilberry or heather plants. In the past the bilberry bumblebee was widely found in northern and western Britain but now appears to be in decline. As a cold-loving species it is likely to be vulnerable to climate change. In the UK it reaches the south-eastern edge of its distribution in the Peak District and is usually only found above 300m. The Peak District is, therefore, likely to be one of the first places that its decline will be observed.

Bilberry bumblebees have been recorded at Totley Moss, Blacka Moor and Longshaw. The Moors for the Future (MFF) Community Science project is encouraging members of the public to share their records for this species both with the aim of encouraging site-specific conservation measures and to facilitate climate change impact monitoring.

www.moorsforthefuture.org.uk/community-science

Peregrine falcon

Within moorland areas peregrines have suffered declines during the 21st century. Between two and four breeding pairs were recorded annually in the Derwentdale area between 2000-2011, but no breeding pairs were recorded in 2017. This picture is mirrored across the whole of the Dark Peak within the PDNP and contrasts with an increase from 6–32 breeding pairs within the White Peak between 2000 and 2011 and an increase in urban Sheffield and Rotherham[7].

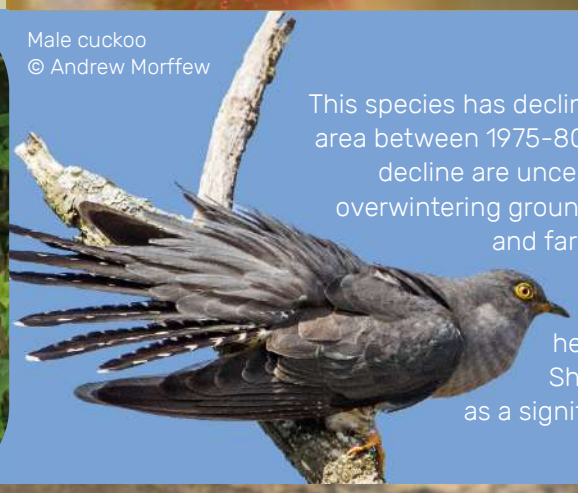


Round leaved sundew

An insectivorous plant confined to scattered locations in the uplands with the largest Pennine population found at Emlin dike on the Bradfield Moors.

Sundew © Nabil Abbas

Peregrine
© Jon Hawkins



Male cuckoo
© Andrew Morffew

Cuckoo

This species has declined by 50% in the wider Sheffield area between 1975-80 and 2003-08[6]. Reasons for this decline are uncertain but thought to be related to overwintering grounds. These are birds of the upland and farmland woodland fringe and have Blacka Moor as a stronghold, but are also present on the lowland heathlands of central and northern Sheffield. Here they are recognised as a significant species on many key sites.

Common lizard © Graham Thorpe

Lizards

The common or viviparous lizard (*Lacerta/Zootoca vivipara*) is the UK's most common and widespread reptile. Slow worm (*Anguis fragilis*) have been recorded in the neighbouring White Peak, although they have also been recorded in Nether Edge, the likely result of an introduction (pers comms J Newton, SNHS Amphibian and Reptile Secretary). The sand lizard (*Lacerta agilis*) is not found in the Sheffield area. The common lizard is a UK BAP priority species and listed in (NERC Act Section 41) Species of Principal Importance in England and is protected under the Wildlife and Countryside Act (1981).

The Sheffield Biolological Records Centre only holds 150 records for the common lizard, ranging in date from 1950-2017. In Sheffield, its main distribution is in the west and is commonly seen in the gritstone/heather-dominated moorland habitats. There are also a few central and eastern Sheffield records: Wickfield Heath (1986, 2006 and 2013), Beighton Railways Sidings (2006, 2010) and Wardsend Cemetery[13]. Lizards are under-recorded. They are most often seen fleetingly, a tail disappearing into the undergrowth, but occasionally they may be viewed when basking, especially earlier in the day. Dry stone walls, for example the one at Strawberry Lee Pastures at Blacka Moor, are worth checking.

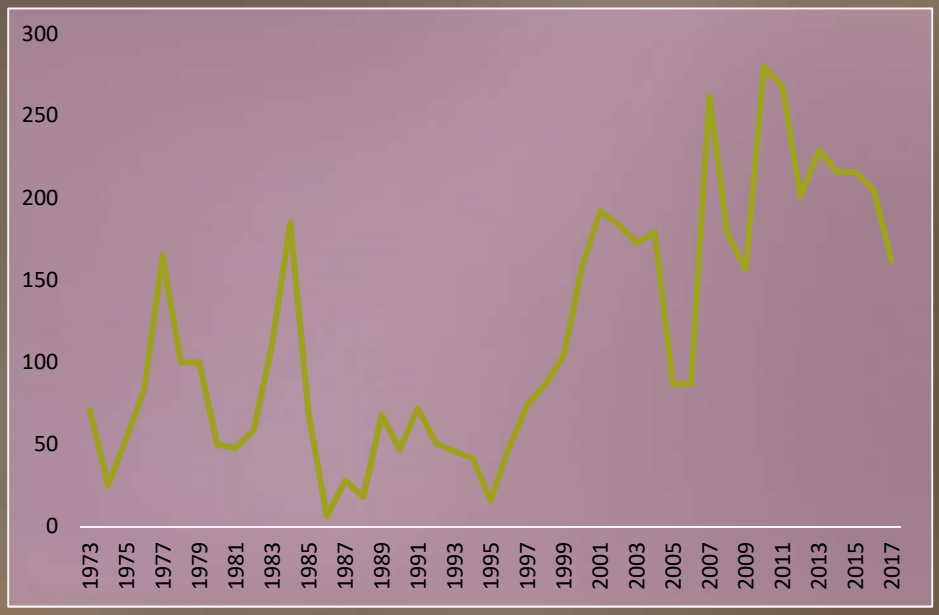
Case study: Over 40 years of the Colin Marsden mountain hare walk
Val Clinging, Mammal Recorder, Sorby Natural History Society

The Sorby Natural History Society (SNHS) has been monitoring the population of mountain hares (*Lepus timidus*) on the Sheffield side of the PDNP for many years via the annual 'mountain hare walk'. This annual event normally takes place each year in March. It was inaugurated by the late Colin Marsden in 1973 and has continued every year since, no matter what the weather (except for 2001 when the foot and mouth epidemic prevented access).

The walk route of between 15 to 18 miles encompasses both Sheffield and Derbyshire moorland from Cutthroat Bridge to Smallfield, Back Tor, Featherbed Moss and Margery Hill. Detailed reports from the walks have been published in the Sorby Record[14,15]. The hares in this area were introduced in the 19th century from Scotland and spread to become well-established as part of the fauna on the Peak District moors. The walks also generate records of other species such as golden plover, red grouse, ring ouzel, wheatear, curlew, hen harrier, lizards and the scarce ground beetle *Carabus nitens*. After 44 years the walk has now become an institution.

Over the years the starting location, number of participants and weather conditions have varied greatly and so have the number of hares seen. From an all-time low of five recorded in 1986, numbers have steadily risen to a record 280 in 2010, and since 1995, the population has appeared to be thriving (Figure 6). Weather conditions are also recorded and analysed throughout the year against which hare numbers can be compared. For example, it appears that good summer weather allows more leverets to survive, high rainfall through autumn allows vegetation to continue to grow and therefore the hares to feed well for longer, and less harsh winters help survival rates[16]. Although they can cope with the cold weather, prolonged periods of snow cover make it difficult for the hares to find food and many die of starvation.

Figure 6: number of mountain hares observed during yearly walks from 1973-2017. Data thanks to Val Clinging, SNHS. Years where the walk was shortened due to inclement weather have been omitted and repeat surveys (within one year) have been averaged.



Sadly though, recent unpublished comments have suggested that groups of men with guns have been observed shooting hares on the moors. This may be contributing to the decline in numbers seen since 2011. A big shock in 2017 was only two hares counted east of grid line 21 (Broomhead Moors, Hobson Moss and along Dukes Drive). In past years we have seen dozens here. Our observations correlate with accounts of systematic shooting last winter.

It also remains to be seen whether predicted changes to our weather will affect their numbers in the future. Whatever happens, the SNHS will continue to monitor their numbers in the same fashion.

Mountain hare
© Luke Massey

Access

There is a long history of access to the moorlands and heathlands in the Sheffield area with open access on the majority of the sites now formalised by the Countryside and Rights of Way Act (2000), through individual site arrangements or as a result of status as a 'common'. In addition there are footpaths, bridleways, tracks and small lanes which facilitate access to these habitats.

Together with the adjacent Derbyshire areas the moorlands are often described as Sheffield's 'Golden Frame' acting as a semi-natural backdrop to the city. Along with the wooded valleys, which connect the moorlands to the city and extend through it to its core, they impart much of what makes Sheffield's landscape distinctive amongst the cities of the UK. Together they have led to a recent Sheffield City Council (SCC) initiative to brand Sheffield as 'The Outdoor City'[17]. The lowland heathland areas act similarly in the immediate north of the city.

Many people who visit the moorlands and heathlands do so to experience and appreciate their wildlife, landscapes and cultural heritage. Some also use them for recreation and sport. These areas are increasingly being used for organised events (for example, charity walks), and, in some locations, commercial sporting activities such as rock climbing and horse riding, particularly in the Peak District moorlands. Both of these market their experience on the opportunities the site has for bringing people closer to nature, although this has to be managed to reduce the risk of damage and disturbance to sensitive species and habitats.

Ownership and Management

Of the moorland areas within the National Park, ownership is divided between public bodies (Peak District National Park Authority: PDNPA; SCC; Forestry Commission), conservation organisations (e.g. National Trust; NT), utility companies (Yorkshire Water) and private owners. Within the lowland heathlands, SCC own a larger proportion of sites. Ownership details of 27 target sites covered by the heathland HAP, and more, are shown in Figure 7.

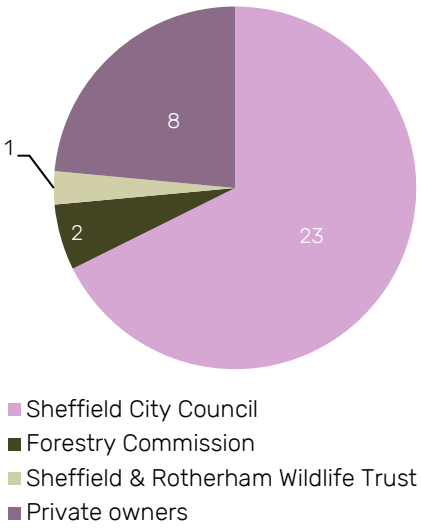


Figure 7: ownership of target moorland sites within the lowland heathlands

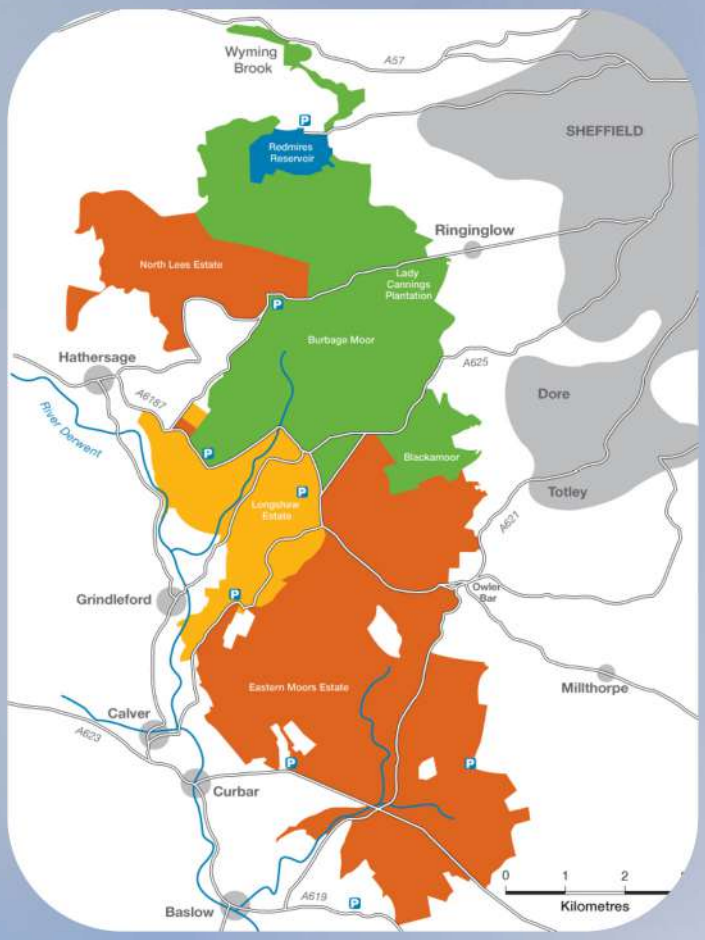
The Peak District National Park Management Plan is recognised as the single most important strategic document for the PDNP. This, together with the SSSI legislation and NE's strategic vision for the uplands, largely determines management of the moorlands alongside the landowners' and managers' business operations and aspirations. Local people are involved in the management of Burbage, Houndkirk and Hathersage Moors through the Eastern Moors Stakeholder group, and in the management of Blacka Moor nature reserve through the Blacka Moor User Forum.

Most moorland sites are managed for sheep or cattle grazing and, on many private sites, grouse shooting. Following huge efforts by NE the majority of sites are now managed within a positive agri-environment scheme. This has resulted in a vast increase in the proportion of SSSIs in 'favourable' or 'unfavourable recovering' condition with a current figure of 99% (Figure 5). This compares with just 49% of upland heathland nationally in favourable or unfavourable recovering in 2006 and 73% of blanket bogs[18]. Bradfield, Broomhead and Midhope Estates have had significant moorland restoration plans, funded through the first four to five years of their Higher Level Stewardship (HLS) agreements, including gully blocking/reprofiling and bare peat revegetation work. Whilst HLS capital funding is winding down it is hoped that work can carry on with the help of ML2020 and future Yorkshire Water projects.

Liz Ballard, Chief Executive of SRWT, comments: "*With Brexit on the horizon, the future management and protection of moorlands is uncertain. Many sites have benefitted from significant funding to landowners and managers who have applied for EU agri-environment scheme payments (translated into the UK as Countryside Stewardship HLS). Although the Government has committed to supporting Countryside Stewarship agreements until 2022, as estates come out of current schemes or look further ahead, the future is far from clear. Current proposals outlined in the DEFRA 25-year Environment Plan suggest a new environmental land management scheme may be made available post-Brexit. But details as to how this will operate and the level of funding available have not been confirmed. In addition, there is also great uncertainty as to how EU directives (currently translated through EIA regulations and SAC and SPA designations) will continue in UK law after Brexit. Will these sites be at least as strongly protected as they are now? Where will issues of legal contention and complaint go if not to the European Court of Justice? Whatever the outcome, this will have the most profound effect on the future of our local moorlands and the wildlife they support.*"

Case study: the Sheffield Moors Partnership

The Sheffield Moors Partnership (SMP) covers 56 square kilometres of upland landscape in public sector or charitable ownership straddling the Sheffield/Derbyshire border within the Peak District National Park (see map). The partnership developed in 2010 out of the recognition of the benefits of increased collaborative working for both people and the landscape. The core partners are both local and national, due to the site designations covering much of the area, and include: the PDNPA; NT; SCC; SRWT; Royal Society for the Protection of Birds (RSPB); and NE.



The SMP's aims are to steer delivery across the sites through integrated and holistic planning and thinking, and to develop and deliver a strategic landscape scale masterplan[19] through robust stakeholder and community engagement and consultation. The masterplan (2013-28) has four main themes: access & recreation; being involved; sustainable land management; and recognising the wider value of the moors.

The Eastern Moors Partnership (EMP; between NT and RSPB) looks after the SCC-owned property centred on Burbage, Houndkirk and Hathersage Moors, plus the Eastern Moors from Birchen Edge to Totley Moor on behalf of the PDNPA. This constitutes part of the SMP. A 25-year vision for the EMP sets an ambition for the EMP to be a guiding model of future managment and a new management plan is being published.

SMP was at the centre of the nationally funded Dark Peak Nature Improvement Area project[20]. One of the outputs of this project, which demonstrates the benefits of the SMP approach, was the upgrading of the bridleway network across the area, within and between different landholdings. This work has facilitated access for the people of Sheffield and beyond to the wildlife, landscape and cultural heritage of the Sheffield Moors.

Blacka Moor is a nature reserve in the SMP area and is a rich mosaic of upland habitats on the southwest edge of Sheffield, managed by SRWT. Unlike some of the more intensively managed moorlands elsewhere in the Peak District, the site hosts a ranfge of habitats including open heathland; scrub; woodland; bog; and pasture, making it one of the city's most biodiverse.

www.sheffieldmoors.co.uk

www.visit-eastern-moors.org.uk

View to the Dark Peak © Chris Maguire

Case study: Bradfield Moorland Restoration Project
Anthony Barber-Lomax, agent for the Fitzwilliam Wentworth Estate

Between 2008 and 2010, 70ha of coniferous forest were felled on the Fitzwilliam Wentworth Estate, to the north-west of Strines Reservoir, with the objective of restoration to a heather-dominated moorland. The project delivered 1% of the UK's and 69% of the Peak District's Biodiversity Action Plan target for upland heathland restoration.

Heather seed, collected from the adjacent moorland, was spread on the majority of the cleared areas with broadleaved trees retained and planted along the streams and gullies to reduce run-off, create small areas of clough woodland and produce a natural looking landscape. Throughout the project the conservation and enhancement of moorland and woodland birds were key priorities. The remainder of the woodland (approximately two-thirds of the original area) is under a long-term management plan which includes enhancement of the ground flora and diversification of the conifers with native broadleaved species.

By 2017, in terms of habitat, roughly a third of the site was considered to have achieved the desired outcome. A further third and the remainder will have achieved the desired outcome within the next three and five years respectively. The site is incorporated into the grazing and heather burning and cutting regime on the rest of the Estate and contributes to the area of value to the grouse management business.

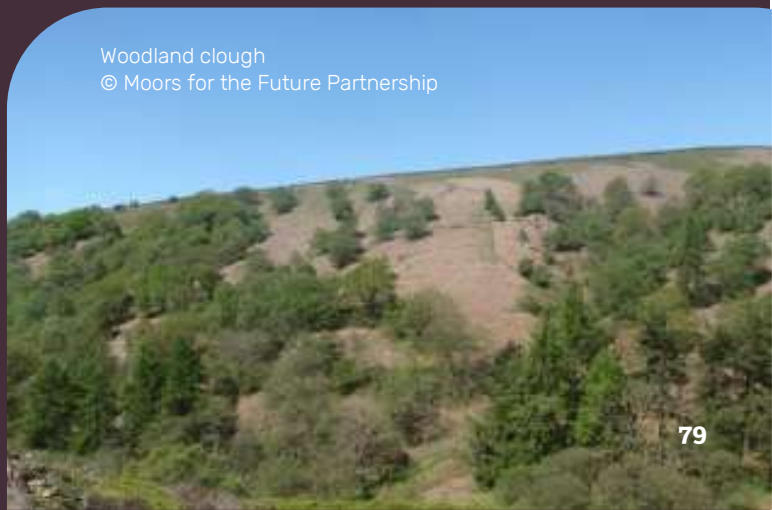
In the years succeeding the felling, golden plover were sighted closer to the old boundary of the woodland than previously. For the past two years – six years after felling ceased – golden plover have been using part of the restoration area. The biodiversity benefits are clear, the restoration of a priority upland habitat with the potential for supporting a wide range of species including birds of national and international conservation concern. In addition, a greatly enhanced visual transition between the moorland and the woodland has resulted in an improved landscape.

Case study: Dark Peak Clough Woodland Project
Jon Stewart, National Trust Peak District General Manager

The NT, working with the Forestry Commission and the MFF Clough Woodland Project[21], has restored and created around 250ha of clough woodland as part of our High Peak Moors Vision. Within the Sheffield area, new woodlands have been delivered in three principal locations in the Upper Derwent Valley: Coldside & Cranberry Clough (25ha), Bosenholes & Howden Clough (11ha) and the Abbey Brook (12ha).

The Clough Woodland Project and MFF wider work is designed to deliver benefits for wildlife within moorland and moorland fringe environments alongside numerous ecosystem services including flood and erosion control, enhanced water quality, carbon storage, climate change mitigation and landscape enhancement.

Woodland planting in the upland valleys and cloughs is one of the five key outcomes identified in the NT's High Peak Moors Vision[22], which covers the Trust's High Peak moorlands stretching from the Sheffield area, across Derbyshire to the western fringe of the Peak District close to Hayfield. Developed in consultation with tenants, partner organisations, experts and local communities, the vision is designed to steer the management of moors over the next 50 years. The other four outcomes are: people being inspired; people looking after the land; vibrant wildlife including birds of prey; and secure and healthy peat bogs.



Woodland clough
© Moors for the Future Partnership

UK Biodiversity Indicator Focus:

Birds of the wider countryside: C5e. Wintering wading birds

Sheffield's moorlands support a number of wading birds over the winter period. Unfortunately, data from the Sheffield Bird Study Group's Breeding Birds of the Sheffield Area 2005-08[6] indicates that three out of seven of these are in decline.

Of the seven local species included in the UK biodiversitry indicator C5e: wintering wading birds (Figure 8), three (43%) had declined in occupancy between 1975-80 and 2003-08 whilst only two species (29%) showed an increase. The major winners and losers of moorland are highlighted below. Oystercatcher and ringed plover are also included in this indicator but, as they are associated more with other habitats, they are not highlighted here. Oystercatcher have shown a vast increase in Sheffield despite declining nationally.

Comparing these figures to national trends for the same species (although it is important to note that these analyses consider abundance) the picture appears less optimistic for Sheffield.

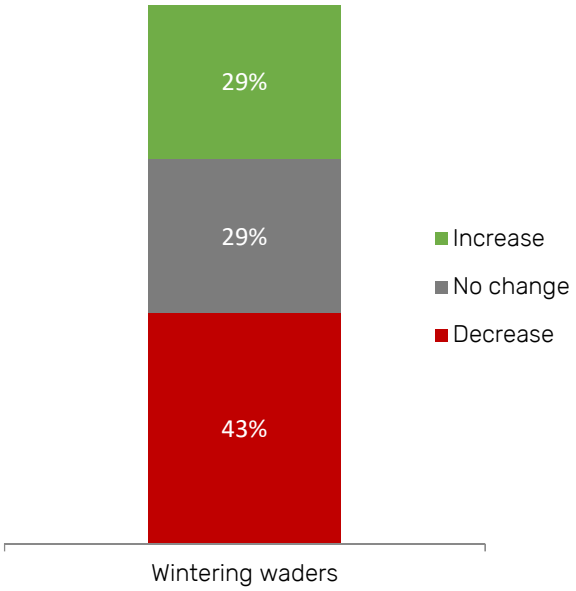


Figure 8: trends of wintering waders included as part of the UK biodiversity indicator C5: birds of the wider countryside, measured as a change in the number of tetrads occupied between 1975-80 and 2003-08[6].

Which species are doing well?

Curlew over the Dark Peak
© Ben Hall/2020VISION

Curlew

Despite not showing an increase in occupancy, curlew have continued to have strong presence within Sheffield's moorlands, with large areas having 'confirmed' breeding in 2003-08 as opposed to 'probable' in 1975-80. They have also slightly increased their range towards the centre of the district.

Golden plover
© Andrew Parkinson/2020VISION

Golden plover

This species has shown notable gains towards the south and east of its local range. They continue to have a stronghold within the Dark Peak region.

What are the reasons?

Habitat restoration

Moorland and heathland management and restoration plans are driving the improvement of sites with funding from Higher Level Stewardship schemes (see Grassland & Farmland chapter). These include substantial capital works projects, such as gully blocking reprofiling and the revegetation of bare peat. Examples include Bradfield, Broomhead and the Midhope Estates. In addition, MFF is restoring areas at Moscar damaged by high levels of recreational pressure. These works are all designed to enhance habitat condition, which in turn will benefit associated species including golden plover.

Which species are not doing well?

Dunlin © Scott Petrek

Dunlin

Dunlin are largely restricted to the blanket bog where they feed on the rich invertebrate fauna. In the wider Sheffield area there has been a 59% decline between 1975-80 and 2003-08[6] with this rate of decline even higher in the Sheffield area, for example, on Ringinglow Bog. Within the district, in 2005-08, only three locations showed possible or probable breeding, with no confirmed sites. Reasons for this are poorly understood, although climate change may well be a significant factor.

Redshank

Redshank have been mostly lost in Sheffield's moorlands. A decline of 44% has resulted in no breeding in the eastern moorlands. Only one location showed probable breeding to the south of the district with breeding confirmed only at Tinsley to the east.

What are the reasons?

Habitat modification

Drainage and improvement of moorland fringe pastures is likely to have had a significant impact on species such as redshank. Development of other habitats such as reclamation of derelict industrial sites has also had a negative impact.

Management

Intensification of farming in moorland fringe areas, including silage production and heavy grazing pressure, has contributed to the loss of suitable breeding and feeding habitat for wintering waders.

Case study: Upland birds of prey
Liz Ballard, CEO, Sheffield & Rotherham Wildlife Trust

Birds of prey, including hen harriers, goshawks and peregrines, are sadly disappearing from Sheffield's Peak District moorlands (and nationally in the uplands) whilst species such as buzzard, which have been rapidly spreading into adjacent areas, appear to be incapable of establishing populations here. Whilst not neccessarily the sole cause of these declines, there have been several cases of suspected and confirmed illegal birds of prey persecution. At least some of these have been associated with intensively managed grouse moors[23].

SRWT, together with the Wildlife Trusts nationally, believe that a new approach away from increasingly intensive grouse moor management is needed - and soon.

Licensing legitimate law-abiding grouse shoots is an option put forward by the RSPB, or, alternatively, vicarious responsibility making the landowner liable (as in Scotland) is another suggestion. However, their success will depend on adequate policing, sentencing and resourcing to administer and monitor each scheme.

We are working on a range of actions designed to work with moorland owners and managers but also put pressure on those demonstrating bad practices. We are also campaigning to ask the Government to implement changes that ensures that birds of prey have a future on our Sheffield moors.

Hen harrier
© Amy Lewis

wildsheffield.com/ourmoors

Case study: Ring ouzels at Burbage
Kim Leyland, Eastern Moors Partnership
Henry Folkard, British Mountaineering Council

Ring ouzel - commonly known as the mountain blackbird - breed in upland locations in the UK. In the Peak District they favour locations in amongst boulders or cliffs or within associated bracken beds. On the eastern Peak District edges, which includes Burbage within the Sheffield area, these are also prime locations for climbing and more general outdoor recreational activities. Hence, since 2003, a unique partnership approach between the PDNPA and the British Mountaineering Council (BMC) has been struck up to help monitor the breeding populations of ring ouzel.

This important partinership has resulted in the maintenance of the breeding population at Stanage Edge despite continued national declines and the loss of the birds from the south-west Peak District. The approach of intensive monitoring, now including BMC volunteers, coupled with very site and time-specific mutually agreed access restrictions, has recently been extended to the Burbage area by the EMP. Nest sites are known from the Burbage crags; Higger Tor; Carl Wark; Houndkirk and Millstone within the order of 11-12 pairs in 2017. Eight of these are confirmed to have bred and six of these successfully fledged at least one brood (Figures 9 and 10). Five of the nest sites were also signed on site to discourage access close to the birds to minimise disturbance. In addition, the BMC holds information on its webpages regarding disturbance to birds and school groups were contacted directly. As a result only a single nest attempt was considered abandoned because of disturbance. Data on nests and breeding success is also recorded from White Edge and Curbar just to the south of Burbage – these areas are also managed by EMP. As at Stanage, the monitoring and signing efforts in these areas also appear to be successfully maintaining the population of these charismatic birds.

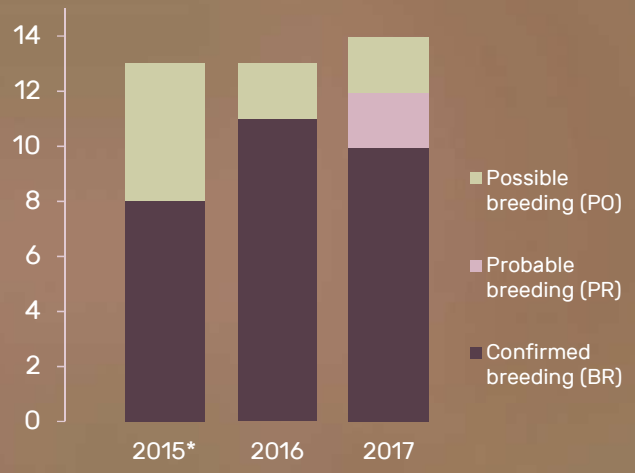


*Figure 9: number of confirmed, probably and possible breeding pairs of ring ouzel recorded. *Note that there was less intensive monitoring in 2015 and that these are numbers found and may not be definitive numbers.*

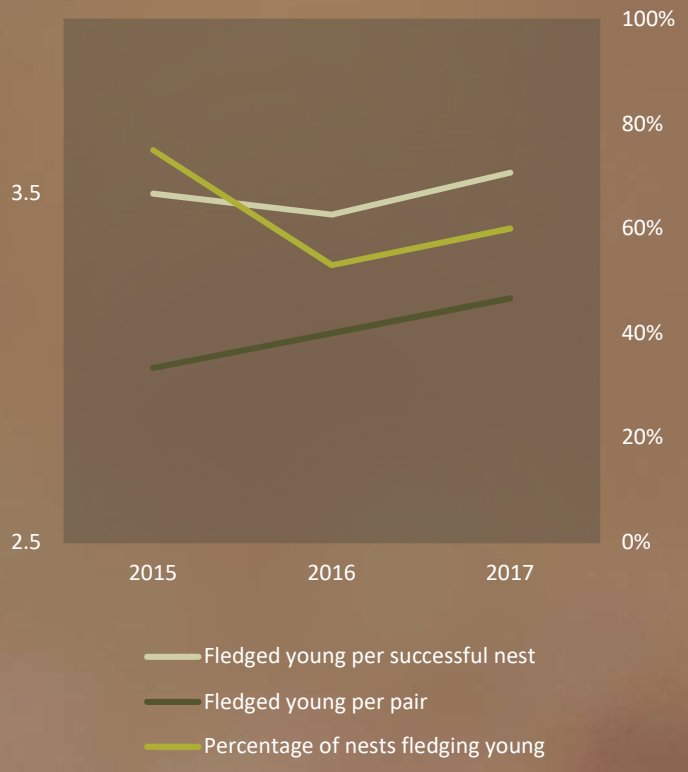


Figure 10: numbers of fledged young per successful nest and per pair (left axis), plus the total percentage of nests fledging young (right axis). These data show that numbers are stable and comparable to other areas of the country without the level of recreational use seen in the Peak District.

Ring ouzel
© Kari Eischer

Threats to moorland, upland and heathland habitats

What is the threat?	What does it cause?	What solutions are being applied?
Overgrazing	Reduction in habitat diversity, particularly the cover and condition of dwarf shrubs, with associated declines in invertebrates and birds	Agri-environment schemes are reducing sheep numbers and encouraging an increase in the number of cattle
Scrub encroachment and colonisation by trees, primarily outside the PDNP	Reduction in the area of upland and lowland heathland habitat	Manual scrub control; introduction of grazing to the lowland heathland sites where this is a particular problem
Burning of blanket bogs	Permanent removal of peat when fires burn not only the vegetation but also the peatland substrate. This is increasingly being recognised as a significant threat	The government is considering a change to the law; NE is encouraging landowners to refrain from burning on blanket bog through the SSSI consent process and agri-environment scheme negotiations
Erosion, primarily of the blanket peat, plus over-grazing, burning and pollution	Removal of the peat and associated vegetation; water quality issues; increase in run-off	Revegetation of the blanket peat has been achieved through restoration projects including gully blocking, seeding, and plug planting sphagnum and cotton grass. This work has been carried out within the Peak District by individual landowners within moorland management plans agreed with NE but also through a succession of nationally and internationally funded projects managed by MFF.
Intensive grouse moor management	Results in poor quality habitat on some moorlands; reduces biodiversity[24]; moorland birds of prey not present or in very low numbers, suspected and confirmed illegal persecution[25]	The SSSI consenting process and agri-environment scheme negotiations are encouraging less intensive moorland management including the retention of areas of older heather
Recreation, notably people and uncontrolled dogs off leads	Disturbance to wildlife (and to farm livestock); erosion	Paving heavily used routes has been shown to increase the area of moorland used by upland birds as people are concentrated onto pathways; 'Take the Lead' (SMP) and other conservation organisation led initiatives to encourage responsible dog walking; Partnership working with recreational groups to encourage responsible use (e.g. Ring Ouzel case study)
Climate Change – see section on Ecosystem Services	Changes to species distributions	-
Changes to agri-environment schemes and funding	Reduction in area of habitat managed within a higher tier agri-environment scheme	PDNPA and NE providing support to farmers/landowners to help them access the mid-tier of the new Countryside Stewardship scheme
Change of land use	Fragmentation or total loss of smaller heathland areas, particularly in the Sheffield Lakeland Partnership area	Sheffield Lakeland Landscape Partnership project will help address this, but on-going wider efforts are needed

Recommendations

1. Develop targeted species conservation plans for key indicator species or local species facing threats or in severe decline such as mountain hare and breeding waders.
2. Tackle declines in local birds of prey by improving habitat, raising awareness and challenging wildlife crime, as well as challenging overly intensive management for grouse shooting applied by some landowners and managers.
3. Actively promote and practically support farmers, land managers and landowners in applying for, and managing, agri-environment schemes, especially as current schemes are replaced following Brexit.
4. Continue to deliver conservation actions that support the return and expansion of nightjar. This includes habitat improvements and ensuring that they are not detrimentally affected by increased recreation and disturbance at key locations.
5. Work with NE and other stakeholders to support and promote the improvement of moorland SSSIs to favourable condition.
6. Focus efforts on improving the overall condition of the two-thirds of key lowland heathland LWSs that are currently in poor condition or not in positive conservation management for wildlife.

Common blue butterfly on heather
© Ross Hoddinott

Grassland & Farmland

Headlines

- Sheffield has over 7,528ha of grassland and arable land, over half of which is improved grassland. Unimproved grasslands – the most beneficial for wildlife – cover less than 10% of all grasslands and farmland.
- Less than 10% of grassland is covered by designated sites. A total of 46 Local Wildilfe Sites (LWSs) featuring grassland habitats – covering 138ha – are in positive conservation management but these make up only 39% of LWS grassland. Most grassland within LWSs is amenity grassland, covered in the Urban chapter.
- Over 9,350ha of farmland is under agri-environment schemes which are working to improve grassland, field boundaries and arable land for a variety of outcomes such as increasing wildlife habitat and reducing the declines of farmland birds.
- Priority grassland sites are likely to be under represented and mapping is incomplete. More action is required to fully understand how much priority grassland lies within the district.
- The UK Biodiversity Indicator 'Birds of the wider countryside: Ca. farmland birds' shows that most specialist farmland birds are declining due to changes in agricultural practices. Four of the five most severe declines of breeding birds are farmland specialists.
- National and local conservation projects are working to better understand the flora and fauna of local grasslands in order to improve their protection.
- Current threats to farmland and grassland habitats include agricultural intensification, lack of protection, neglect and pressure from development and urbanisation.

Barn owl

Introduction

This chapter covers the grasslands and farmlands that make up the rural landscape of Sheffield with the exception of woodlands and moorlands. Wildlife-rich, unimproved grasslands provide resources for a range of wildlife, store carbon in the soil, filter pollutants, retain water to reduce flooding, help reduce soil erosion, store native plant seeds and are hotspots for pollinators[1]. They also help produce quality pastoral produce such as beef and lamb[1]. Sheffield's grassland sites are often the result of an interaction between human activity and the environment and are managed through activities such as mowing, burning or feeding livestock. The most botanically rich sites are often relicts of long-established grasslands from the historic rural landscape[2]. Good quality grasslands contain diverse plant species, which support invertebrates, birds, fungi and lower plant communities and provide further conservation interest as part of a mosaic of habitats.

In the UK 75% of the landscape is classed as agricultural, with enclosed farmland (40%) incorporating grasslands, hedgerows, field margins, arable land, fallow land and other uncropped areas. These all have value for wildlife with appropriate management. Here, farmland is defined as arable land which is managed and modified for crop production and grazing. Arable land and field boundaries are important habitats for farmland birds and provide linkages to connect natural habitats. Uncropped, cultivated land provides key nesting habitats for ground nesting birds such as lapwing as well as open ground foraging opportunities for priority species including skylark, turtle dove and brown hare.

What grassland and farmland habitat types does Sheffield have?

Figure 1 shows the composition of Sheffield's grassland habitats. How these broad habitat types are distributed across the district is also mapped (Figure 2, opposite page). Amenity grasslands, such as parks, are primarily in developed areas and are covered in the Urban chapter.

Sheffield has a mosaic of grassland types that appear in distinct bands across the district (described below). These include improved grasslands – mostly managed for agricultural purposes and composed of fast-growing grasses – plus rough grasslands with low productivity. Unimproved neutral and unimproved acid grasslands are also present (see Appendix for definitions). These are primarily composed of vegetation on a range of lime-deficient soils. In addition, there are very small patches of calcareous grassland, and the flora that it supports, found on man-made substrate such as limestone chippings on railway sidings and road verges.

Sheffield's priority grasslands outside of the Peak District National Park (PDNP) are covered by the Sheffield Grassland Habitat Action Plan (HAP)[2].

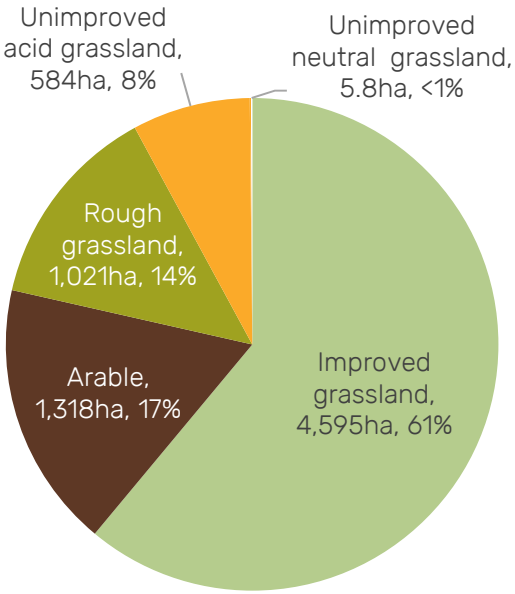


Figure 1: percentage and area coverage (hectares) of grassland and farmland habitats, including boundaries, e.g. hedgerows, within the Sheffield district

Whilst much of Sheffield's agricultural land is pasture or grassland, there is a substantial area of arable land (1,318ha). This is defined by regular ploughing and is managed for crop production and horticulture. Some re-seeded ley grassland is also managed for silage production. This arable land mostly buffers pastoral lands within the central region but also forms a distinct pocket to the south-east.

Sites within the PDNP include both species-rich grasslands and semi-improved sites. An example of the former are sites adjacent to Burbage, owned by Sheffield City Council (SCC), which include a range of plants uncommon in Sheffield such as autumn gentian. The latter includes Hammonds Field, under the management of Sheffield & Rotherham Wildlife Trust (SRWT). Other sites are key sites for upland birds such as golden plover. The importance of these sites is recognised through their designations of Special Protection Area (SPA) and Site of Special Scientific Interest (SSSIs).

Ewden Valley
© Rob Miller

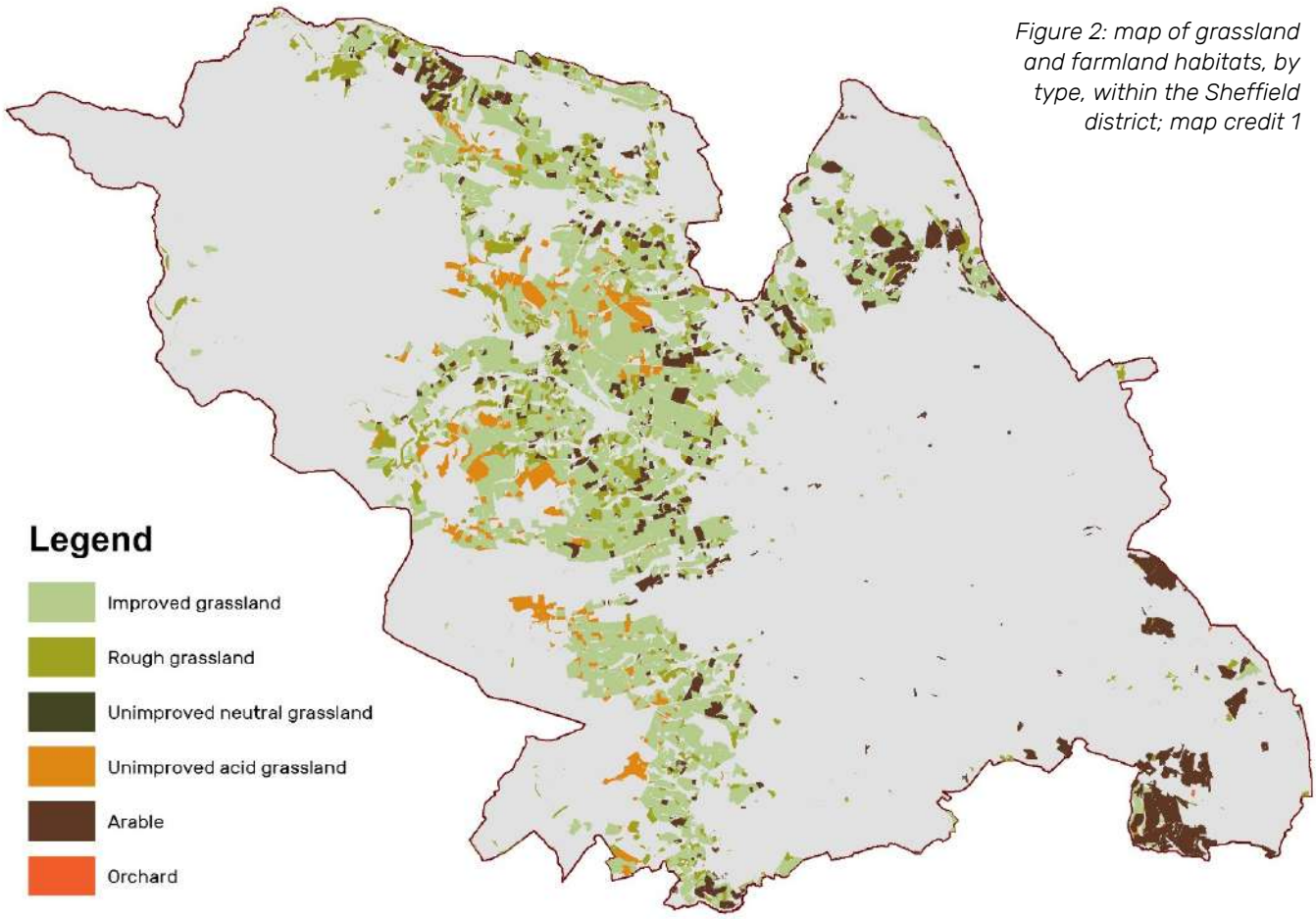


Figure 2: map of grassland and farmland habitats, by type, within the Sheffield district; map credit 1

National Character Areas (NCAs) relating to farmland and grassland

National Character Areas (NCAs: see Sheffield Overview chapter for map) have a key relevance to grasslands and arable land across the district, and their importance for wildlife, as they relate significantly to land use and how this has changed over time. Within the Dark Peak NCA, farmlands and associated grasslands are isolated at the moorland fringe and are dominated by acid and rough grasslands bounded by dry stone walls. Scattered enclosed fields on flatter land are commonly semi-improved or rarely support unimproved neutral grasslands.

The Yorkshire Southern Pennine Fringe (YSPF) NCA is characterised by small family farms dominated by livestock farming including dairy farming, for example, around Bradfield. Farming here has remained relatively constant with most changes being a shift in livestock grazing from lowland areas to less favourable areas[3]. Topography is varied with steep grassland slopes above wooded cloughs and reservoirs. Wildlife-rich habitats in these areas include acid grasslands on the steepest slopes with scattered dwarf shrubs and areas of heathland on the highest ground, wet grasslands and marshes where springs emerge between the gritstone and shales, and rare areas of species-rich or semi-improved hay meadows. Closer to farmsteads, grasslands are commonly (and extensively) improved, supporting productive agriculture including intensive grazing land and silage fields. Fields may be regularly ploughed and reseeded. Dry stone walls are the most prevalent field boundary with hedges localised on the lower ground.

The Nottinghamshire, Derbyshire and Yorkshire Coalfield (NDYC) NCA supports a more mixed farmland including significant areas of arable land. Over half of this area (64%) is designated as Green Belt[4]. Farming here tends to be more intensive than in the YSPF NCA as a result of more productive soils and lower altitudes. Livestock farming has slowed since 2000 with lower stocking rates and a shift towards horse and pony grazing[4]. Grasslands here are mainly improved for agriculture, or at best, semi-improved. The rolling topography – particularly in the west – is characterised by the pattern of field boundary hedgerows. The size and pattern of fields and enclosed grasslands is varied, reflecting both how woodland was cleared in medieval times and how piecemeal medieval strip fields were enclosed. Further east many traditional boundaries have been lost as a result of agricultural intensification but this has improved slowly with agri-environment schemes focussed on hedgerow and dry stone wall management. In several areas farming now occupies the sites of former coal workings and wildlife-rich habitats are very rare. The conservation emphasis, through agri-environment support, is often on the maintainance of priority habitats plus the creation of field headlands (including those alongside ditches and remnant hedgerows) to benefit farmland birds and invertebrates.

Rural verges, hedgerows and field boundaries

Whilst the majority of grasslands are found within a farmland context as described above, the Sheffield area also includes many kilometres of rural road verges which are managed by cutting at least once a year. Very little data exists for these sites, and whilst it is expected that few are of high species diversity, they are likely to play a significant role as refuges for wildflowers and associated invertebrates. Many of these species are now unusual on the improved grasslands and arable fields which make up the majority of Sheffield's farmland, and thus these verges are a valuable habitat. They are also likely to perform a useful function in linking other grassland and semi-natural sites, acting as wildlife corridors. Figure 3 shows 48.3km of rural verges mapped across the district.

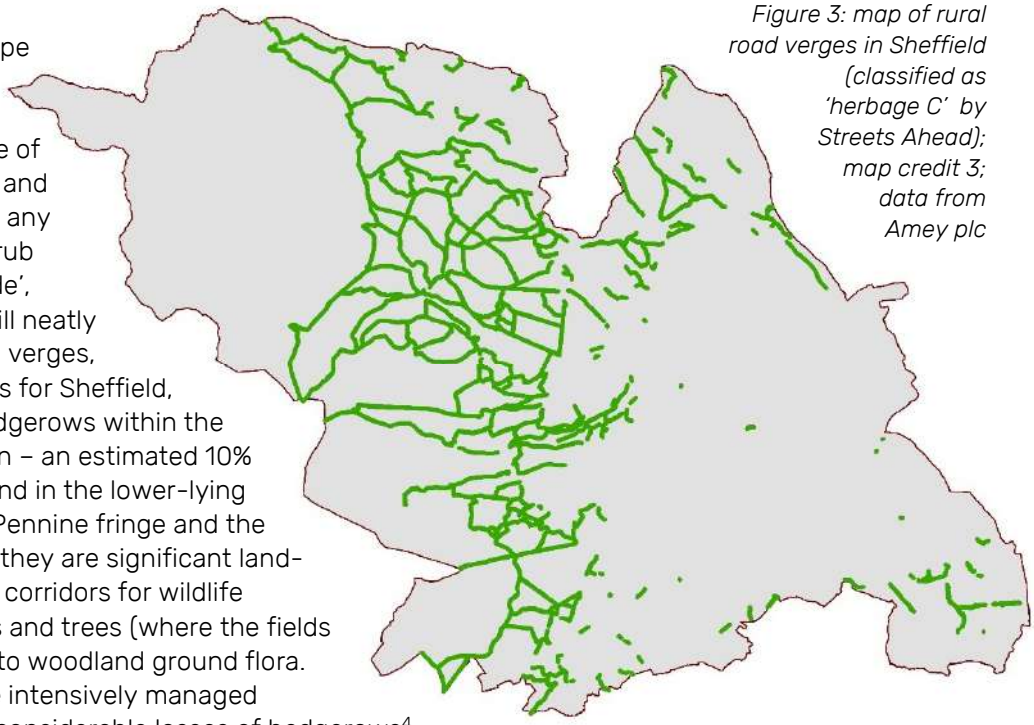


Figure 3: map of rural road verges in Sheffield (classified as 'herbage C' by Streets Ahead); map credit 3; data from Amey plc

Hedgerows are an important feature of the farmed landscape in the Sheffield area. The UKBAP definition of a hedgerowis 'any boundary line of trees orshrubs over 20m long and less than 5m wide, and where any gaps between the trees or shrub species are less than 20m wide', although not all hedgerows will neatly fit this definition. As with road verges, little data for hedgerows exists for Sheffield, but there are 37,400km of hedgerows within the Yorkshire & the Humber region – an estimated 10% of the national resource[5]. Found in the lower-lying areas of the Yorkshire South Pennine fringe and the western parts of the coalfield they are significant landscape features and important corridors for wildlife supporting a variety of shrubs and trees (where the fields are lightly grazed) in addition to woodland ground flora. Locally, especially in the more intensively managed landscapes, there have been considerable losses of hedgerows[4]. In other areas, for example close to Totley, most hedgerows survive with only 16% of the network having been lost since 1876.

Dry stone walls are the predominant field boundaries in the more upland moorland fringes of the western areas of Sheffield within the Peak District and the South Yorkshire Pennine fringe. Local wildlife associated with dry stone walls include wheatear, little owl, various reptile and amphibian species, lichens and plants including ivy-leaved toadflax and crane's bills[6]. In addition the field edges often support plant species which have been lost from the core field areas as a result of intensive farming practices.

Rainbow over Strines
© Paul Richards

Priority Habitat Inventory: Grassland habitats

Sheffield has a number of Priority Habitat Inventory (PHI: Figure 4) grasslands as classified and mapped by Natural England (NE). These mapped areas are small (736.2ha) and lie mostly between the urbanised centre of Sheffield and the moorland fringe to the west with small areas also found to the east of the city.

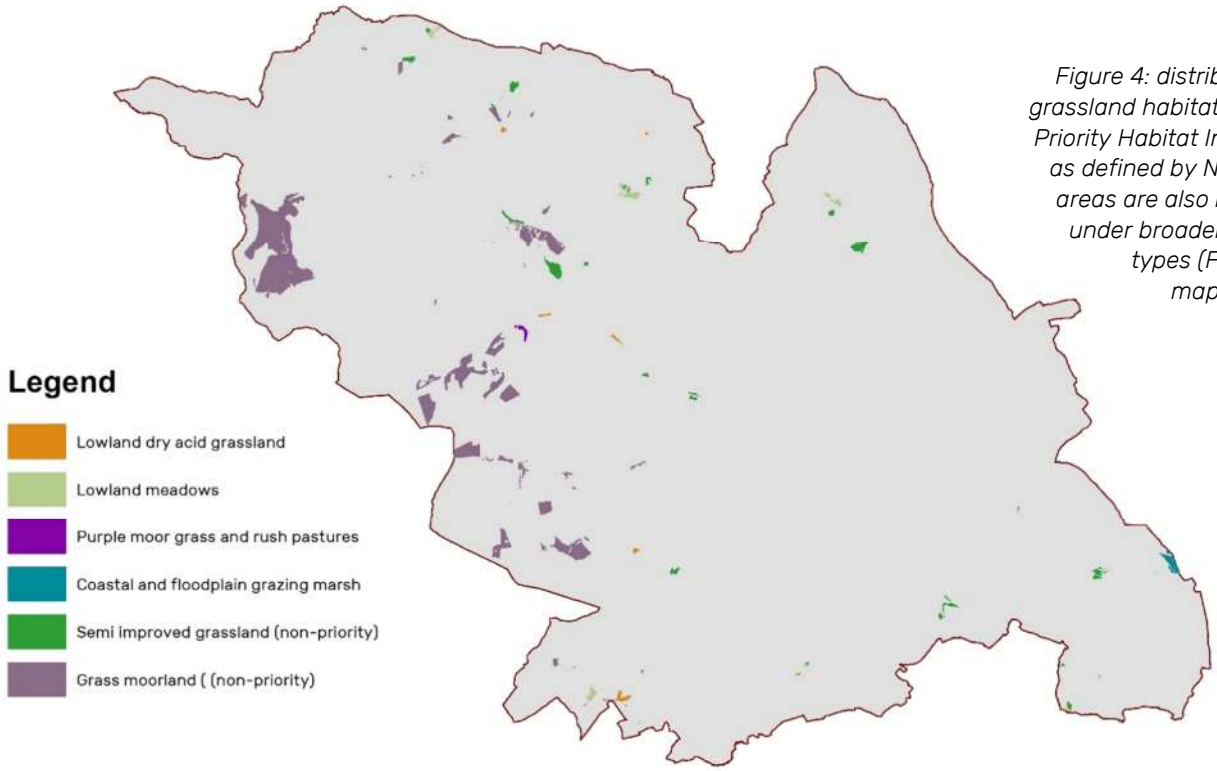


Figure 4: distribution of grassland habitats on the Priority Habitat Inventory as defined by NE. Some areas are also included under broader habitat types (Figure 2); map credit 2

Coastal and floodplain grazing marsh is pasture or grazed/cut meadow which is periodically flooded or has high water levels sustained by ponds or ditches. Species found include creeping buttercup, tufted hair grass, hard rush and common spike rush. Sheffield has only 12.9ha of this habitat, across the River Rother on the Sheffield-Rotherham boundary, mostly within the Woodhouse Washlands Nature Reserve managed by SRWT. This rare habitat covers only 215ha (<1%) of the NDYC NCA[4].

Lowland dry acid grassland covers just 15.6ha of Sheffield. Nutrient-poor, free-draining soils are characterised by a range of plant species such as heath bedstraw, devil's bit scabious and sheep's sorrel plus grasses such as wavy hair grass and mat grass. It is often found in enclosed fields managed as pasture close to the moorland edge. Yorkshire and Humber has 17,704ha of lowland dry acid grassland - 34.3% of the national resource[5]. Within the NDYC and YSPF NCAs, lowland dry acid grassland covers a total of 490ha (<1%)[3,4].

Lowland hay meadows cover 29.7ha of the Sheffield district. This neutral grassland type includes enclosed unimproved neutral grasslands with species such as common knapweed and grasses such as crested dog's tail, yorkshire fog, false oat grass and meadow foxtail. Many sites are managed as hay meadows whilst others are managed as pasture. Good examples of lowland hay meadows exist in fields near Burbage, Midhope Reservoir and Ecclesfield. Yorkshire and Humberside has 2,217ha of lowland meadow - 7.3% of the national resource[5]. Within the NDYC NCA and YSPF NCAs, lowland hay meadows cover a total of 539ha (<1%)[3,4].

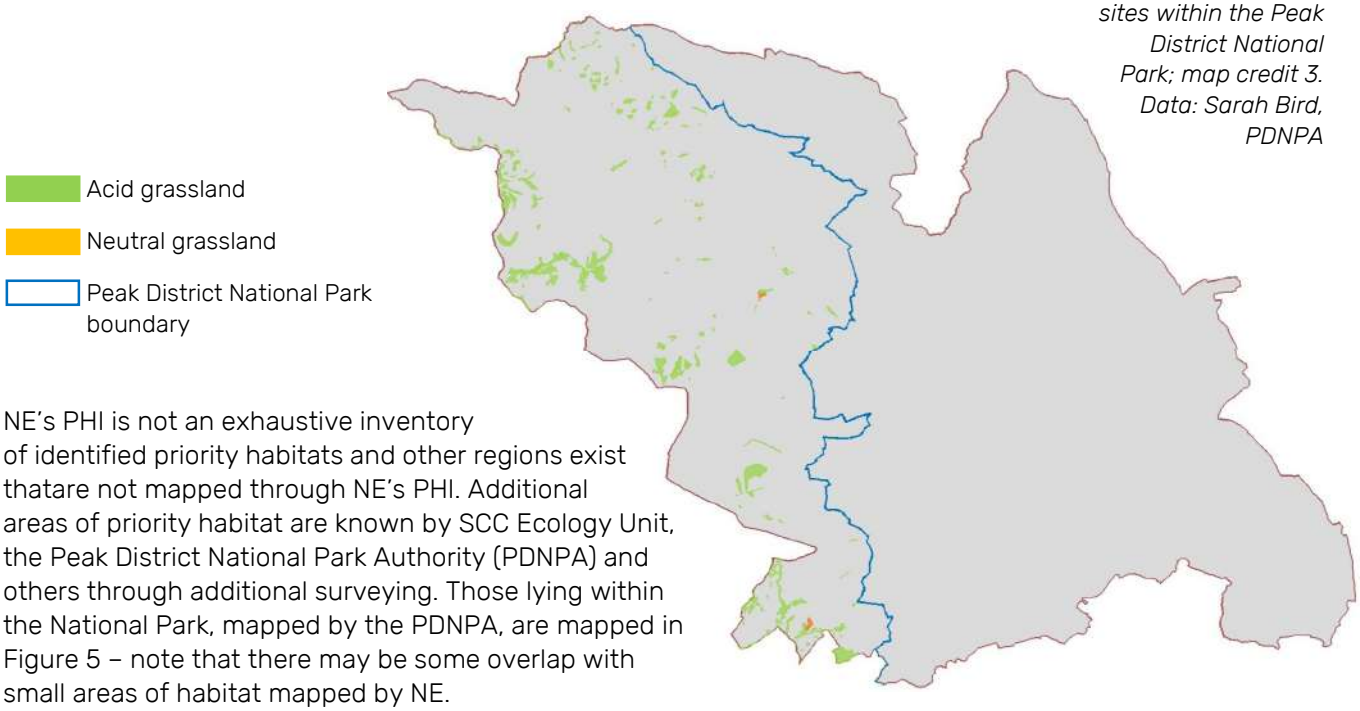
Purple moor grass and rush pasture are wet grasslands with various rushes and grasses are found in the moorland fringe north of Sheffield. These grasslands, including species such as devil's bit scabious, lousewort and various sedges, are also of considerable value for invertebrates and wading birds including snipe and curlew.

Semi-improved grassland is not a priority habitat but is on the PHI. These are species-rich grasslands with conservation value. Approximately 75ha are scattered and fragmented around the district including Stocksbridge and High Bradfield. On the moorland fringe these sites provide key feeding sites for upland birds; their importance is recognised in the designation of the South Pennine Moors SPA. Together with a proportion of acid and neutral grasslands these sites are also important for grassland fungi.

Grass moorland is also not a priority habitat but is included on the PHI as it usually forms a rough mosaic of other priority habitats with both grassland and moorland characteristics. Such open mosiac habitats may be important for invertebrates and serve as important bird feeding grounds.

Additional priority and quality grassland habitats

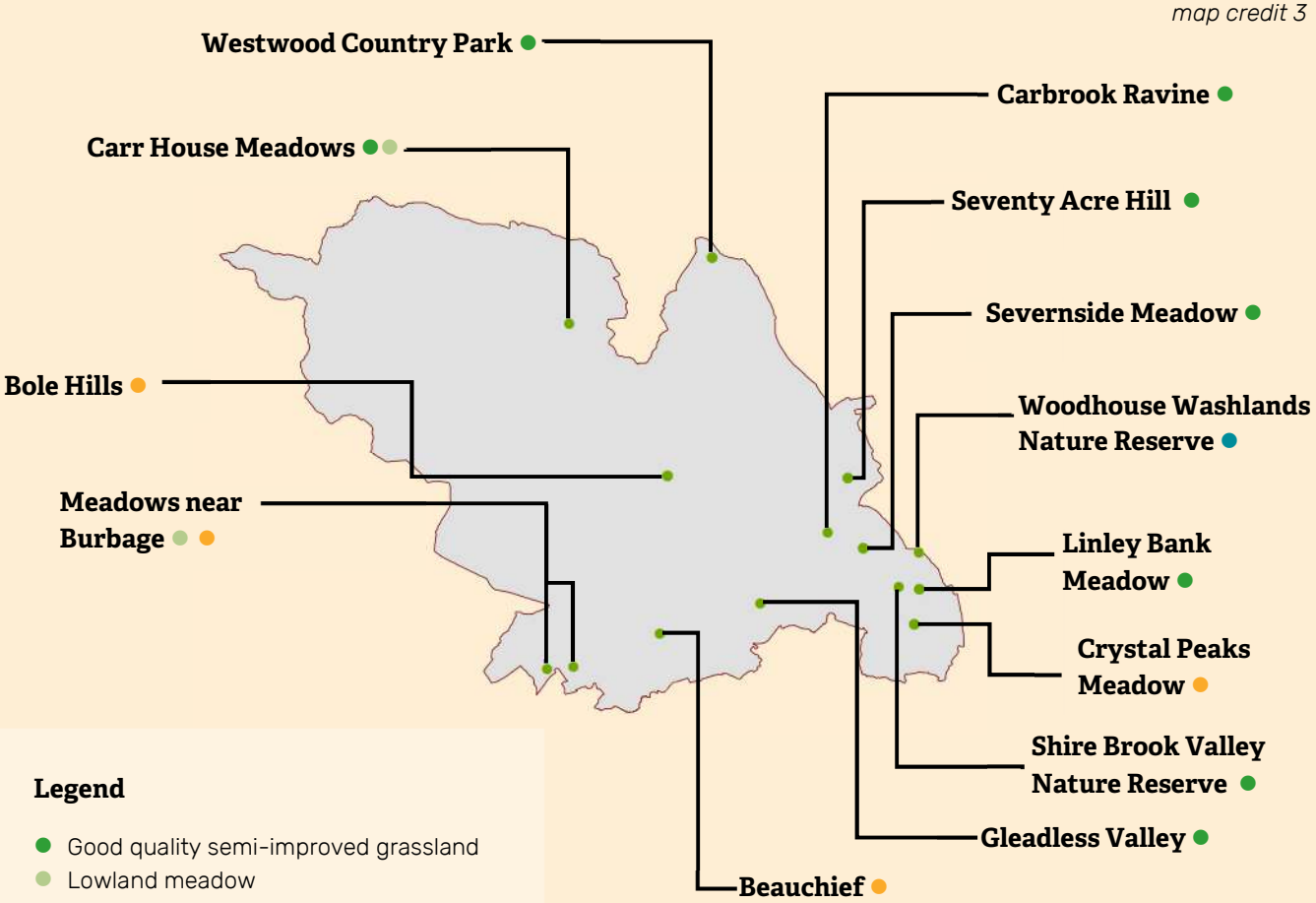
Figure 5: additional priority grassland sites within the Peak District National Park; map credit 3. Data: Sarah Bird, PDNPA



NE's PHI is not an exhaustive inventory of identified priority habitats and other regions exist thatare not mapped through NE's PHI. Additional areas of priority habitat are known by SCC Ecology Unit, the Peak District National Park Authority (PDNPA) and others through additional surveying. Those lying within the National Park, mapped by the PDNPA, are mapped in Figure 5 – note that there may be some overlap with small areas of habitat mapped by NE.

Important grassland sites

Figure 6: sites that feature key areas of important grassland habitat. Note that this map does not includes privately owned important grassland sites; map credit 3



Case study: Cowslips and the hay meadows at Burbage
Julie Riley and Dr Rebekah Newman, Sheffield & Rotherham Wildlife Trust

Cowslip *Primula veris* used to be a common plant of traditional meadows and is closely associated with much English folklore and tradition including adorning garlands for May Day. An early flowering plant, it provides nectar to a variety of invertebrates. The loss of its habitat to the advancement of agriculture caused a serious decline in cowslip populations and now fields coloured bright yellow with the nodding heads of cowslip are a rare sight.

Cowslip is an unusual find in the Sheffield area. It occurs in well-drained calcareous and neutral grasslands, occurring in a generally herb-rich community in pastures and meadows. It was recorded as being common in pastures in 1889, and present around Crookesmoor, Fulwood, Hallam and Upperthorpe in 1911, but unrecorded in the years between 1918-1988, although present in adjoining Derbyshire[7]. Between 2001 and 2010 the South Yorkshire Plant Atlas lists it as present in 165 of 1665 km squares in South Yorkshire; within the Sheffield area it has been recorded in eleven 1km squares[8].

One of the locations cowslip is present is in the flower-rich hay meadows near Burbage, part of the Eastern Peak District Moors SSSI. Here, cowslip is locally abundant within a low productivity grassland with a thin scatter of other species of interest including birdsfoot trefoil, oxeye daisy, meadow vetchling, eyebright, common spotted orchid, tormentil and yellow rattle. The meadows are secured into positive management with a late July/August cutting date, through a Higher Level Stewardship Scheme agreement. The meadows are owned by SCC and managed by the Eastern Moors Partnership. In 2017 seed from these meadows was hand harvested for use in a grassland restoration project within the Peak District.

Cowslips can also turn up on road verges and embankments where the grassland strip has withstood development and is well-drained – for example on a tiny verge along Abbeydale Road in the southwest part of the city. Cowslip can also be planted into urban meadow developments as plug planting – such as in the 'Grey to Green' development at West Bar in Sheffield city centre (see Urban chapter case study) - and appears in parks, for example in Meersbrook Park and Millhouses Park.

Cowslips © Guy Edwardes/2020VISION

Case study: Hedgerows in Totley. Friends of Gillfield Wood

The Friends of Gillfield Wood (FoGW) are carrying out a study of hedgerows in a small area just to the west of Totley. The survey began in late spring 2017 as part of a wider project funded by the Heritage Lottery Fund and facilitated and supported by the South Yorkshire Biodiversity Research Group. The aim is to map the distribution of ancient woodland indicator species within the hedgerows and the distribution and age class of the hedgerow trees (Figure 7). The work is being carried out solely by local volunteers who started with very little knowledge but have now acquired skills in fieldwork, data recording and mapping. The evidence collected, together with research into old field names, suggests that the hedgerows could be relicts of a formerly more widespread woodland. Now, they provide corridors through intensively managed farmland for many woodland species.

The project shows that only 16% of the total length of hedgerow in the area has been lost from this landscape since 1876. Surveys will continue in 2018 and the FoGW have produced a training package that could be used by other local people and groups to get involved in hedgerow recording.

Figure 7: Surveyed hedgerows close to Gillfield Wood. 'Significant' trees are shown as a red dot. Imagery and map data ©2018 Google.

Case study: Carr House Meadows waxcap grassland: Quadrat recording of abundance and diversity of fungi

Steve Clements & Brian Mitchell, National Trust Longshaw Fungi & Lichen Survey Team

Waxcap grasslands are highly endangered in Europe, with the UK representing an important stronghold. Climate change means that grass grows longer, for a longer period, and poses a potential threat to these rare ecosystems. We suspect that waxcaps are decreasing but insufficient data has been collected to confirm this – fungi are generally under-recorded. Following Shelley Evans' English Nature study of UK grasslands in 2003[9], much work has been done to locate important waxcap grasslands across the UK.

Typical grassland fungi surveys produce a species list and comments about the habitats, but offer little objective assessment of abundance. In this single visit study in 2015, we used 10m circular quadrats (quadrats may be any shape!) to carry out a very detailed and systematic study of the grassland fungi of the site. Fungi generally fruit in a circular pattern, and research by Dahlberg & Mueller in 2011 demonstrated that terrestrial fungi mycelia are generally separated by less than 10 metres[10]. Thirty-eight specimens were examined microscopically and peer review on social media confirmed difficult identifications.

The 246 quadrats produced 699 individual records of well over 100 species. We were able to count over 2,600 fruiting bodies of mushroom and toadstools, of which 590 were in a single field. In addition we recorded 11 'numerous', two 'abundant', two 'large troops' and two 'small clusters' of mushrooms or toadstools. Over 1,120 waxcaps comprising at least 14 species on a single visit establishes Carr House Farm as a waxcap grassland site of national importance. Seventeen finds of pink waxcaps produced 67 specimens.

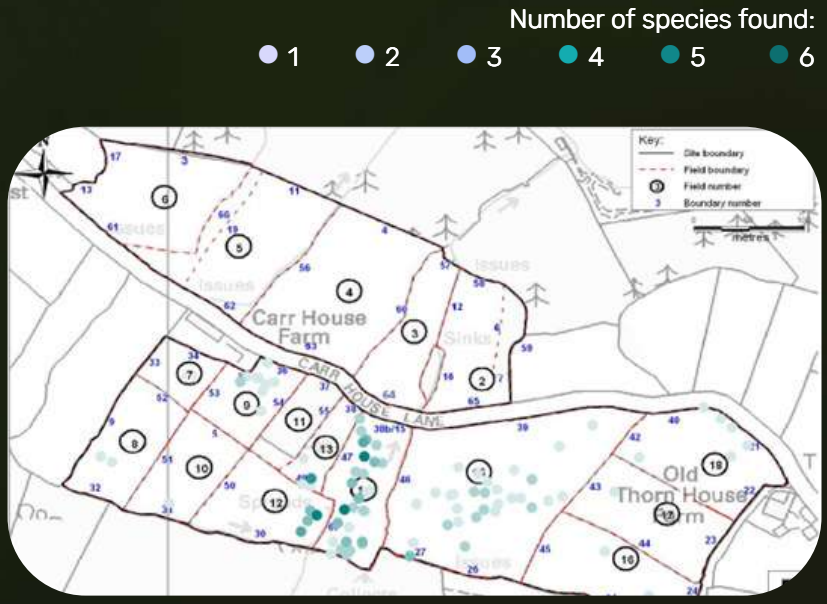


Figure 8: Number of waxcap species per quadrat examined at Carr House Fields (south) 4-6 November 2015; map credit 3

Mapping of species diversity and abundance per quadrat, as well as individual waxcap species maps, using DatMapR freeware (done by Adrian Middleton) provided detailed information to SRWT about the relationship of macrofungi to compartment characteristics (such as hay meadow vs. pasture). Quadrats were also used to assess the diversity and abundance of fungi in the site's small woodland and in the numerous hedgerows. Our study was a detailed 'snapshot' of the October fungi, which clearly demonstrated the site's mycological importance.

Waxcap

Status of grassland habitat within protected areas

Table 1: percentage of total grassland and farmland within the whole of the Sheffield district that is covered by designated sites

	Total grassland & farmland covered by site designation
Special Areas of Conservation	3.1%
Sites of Special Scientific Interest	3.8%
Local Nature Reserves	0.1%
Local Wildlife Sites	5.7%
All designated sites*	**10%**

Meadow by Greno Woods
© Helena Dolby

Sheffield's most species-rich and important grassland sites outside of the PDNP have been designated as Local Wildlife Sites (LWSs); some of these are shown earlier in this chapter in Figure 6. Again we have not included amenity grassland in this chapter as these are mostly sites of recreation, although they do have some conservation value for wildlife. All unimproved and semi-improved grasslands in the Sheffield planning area are a local conservation priority[2]. However, only a small amount of grassland and farmland habitat (10%) is covered by designated sites (Table 1). Only 5.7% is covered by LWS designation and only 10% of all habitat across LWSs is grassland and farmland. Indeed, most sites covered by LWSs that are not woodland are amenity grassland sites such as parks and recreational areas (a total of 13.5%) which also have value for wildlife. This is in contrast to moorland habitats which are well covered by SSSI and SPA designation.

Sixty-two of Sheffield's 253 LWSs have grassland as the main habitat of interest, but other sites do feature large grassland patches. Of the 73 LWSs that contain grassland patches over 0.5ha, 45 are in positive conservation management; however, this only totals 138ha (39%) of the total LWS area (Figure 9). Whilst the Limb Valley, the largest grassland LWS, is in positive conservation management, eight out of the 11 sites with grassland patches over 10ha are not. This includes Dam Flask to Rowell Bridge, Whitwell Moor and Totley Moor. In addition, few grassland sites are covered by European designations and SSSIs and almost none by LNRs. These figures perhaps highlight the need to designate and positively manage more grassland sites within the Sheffield district.

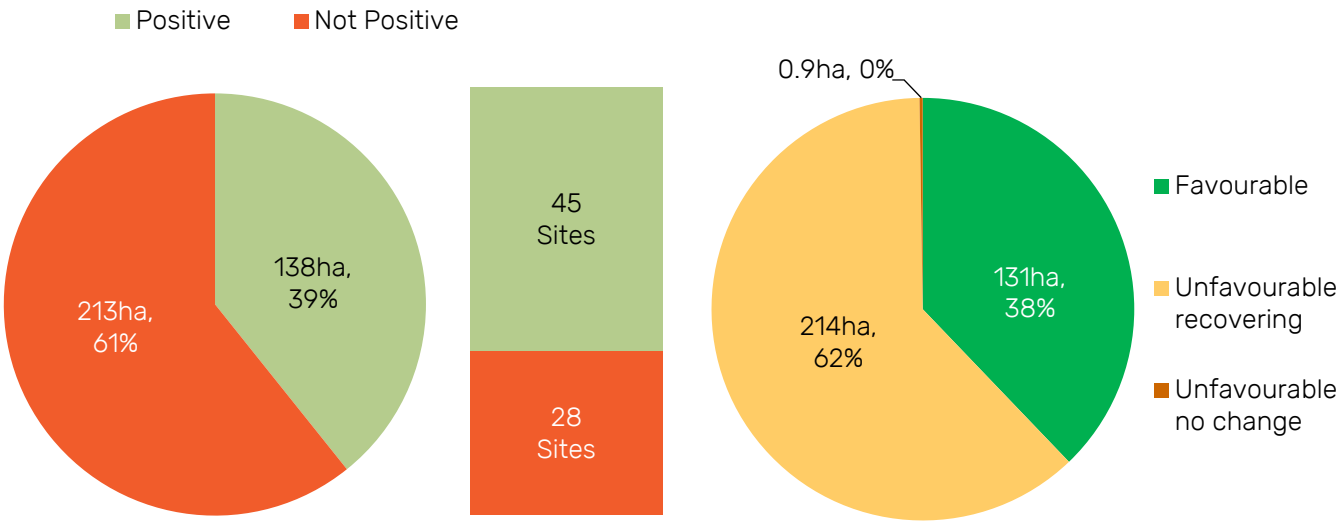


Figure 9: management status of grassland and farmland habitat within LWSs by proportion and area size (left) and condition of grassland and farmland sites within SSSI units (right). Only sites containing grassland patches larger than 0.5ha were considered to remove sites where these habitats are unlikely to inform the management plan.

Grassland and farmland species highlights

Ringlet on yellow rattle © Ross Hoddinott/2020VISION

Tormentil © Rudmer Zwerver/Saxifragia

Sphecid solitary wasp © Paul Richards

Yellow rattle

This hemi-parasitic annual plant of grassland utilises nutrient-poor grasslands including permanent pastures, hay meadows, rough grazing, roadside verges and marginal land. It underwent a marked decline in the 20th century linked to farming practices, particularly cutting hay meadows before mid-July[11]. Now the situation appears to be improving, increasing from eight 1km squares in the 1988 Sheffield Flora Atlas to 35 1km squares in the 2011 South Yorkshire Plant Atlas[7,8].

Tormentil

A low-growing, creeping perennial, this plant provides a rich source of nectar for bees and butterflies. It is common with a stable population throughout the UK. Locally, it was noted in 82 1km squares within Sheffield in the 1988 Sheffield Flora Atlas and in 201 1km squares within Sheffield in the 2011 South Yorkshire Plant Atlas.

Invertebrates

Grassland habitats support huge communities of invertebrates that are vitally important in shaping grassland ecosystems. Lowland acid grassland is characterised by having clumps of vegetation and bare ground that allows many invertebrates to flourish, including ants, grasshoppers, butterflies and solitary bees and wasps[12]. Heavily grazed grasslands tend to have low floral diversity and support fewer invertebrate species than less intensively managed land[13]. Carefully managed grassland can support a wide range of invertebrates, which in turn support small mammals such as shrews and bats, and birds such as song thrushes[14].

© Ross Hoddinott /2020VISION

Arable weeds

Wildflowers associated with arable land – commonly known as arable weeds as they are often early colonisers of farmland - have become increasingly rare over the last 100 years in response to the increased efficiency of farming. This, coupled with the relatively low cover of arable land in the Sheffield area, has resulted in a complete lack of recent Sheffield records for species now considered rare or threatened in the UK, although a small proportion of these were known to occur in the past. Species include red hemp nettle, corncockle, corn marigold and corn chamomile.

Harvest mice

At only 5-7cm in size and weighing just 4-6g[15] harvest mice, like our other small mammals, are not easy to spot. The best way to determine the presence of harvest mice is by finding their nests which are spherical, woven structures in tall and dense vegetation. Breeding nests are around the same size as a cricket ball and non-breeding nests are smaller, more flimsy and are not lined. Nest surveys should be done, by experts, outside of the breeding season so as not to cause disturbance.

Harvest mice are near the top of their range in South Yorkshire. There are 267 harvest mice records in the SBRC; consisting of 263 nests, four cat-kills and only one live sighting, all from the eastern side of Sheffield. Of all records (1991-2017), 231 are from the Beighton Marsh area, from where an annual count has been carried out since 2007 (except 2010 due to foot and mouth disease) by Sorby Natural History Society's harvest mouse 'flying squad', supported by SCC. Numbers have varied over the years, with a high of 29 nests found in 2009 and only two nests in the recent survey in 2017[16, 17]

Harvest mice are a (NERC Act Section 41) Species of Principal Importance in England as they are believed to have become much scarcer in recent years. Conservation plans are required to reverse the decline.

Changes in habitat management and agricultural methods are thought to be the main cause for the loss of populations from certain areas, although there have been no reliable studies to quantify this change[15].

Harvest mouse
© Rob Bates

Case study: Farmyard dung heap invertebrate communities
Paul Richards, Sheffield & Rotherham Wildlife Trust, Sorby Invertebrate Recorder

The moist, warm, detritus rich environment of a dung heap is a very inviting habitat for many invertebrates. Locally there are a number of species that are primarily only found in such habitats and to a lesser extent in compost heaps and around farmyards. Three such species include the lesser earwig, *Labia minor* and the woodlice *Porcellionides pruinosus* and *Porcellio dilatatus*. These three species have quite a scattered distribution and are considered to have been more widespread in the past due to greater reliance on horse-drawn transport[18,19]. A recent increase in recreational horse-riding and growth in riding schools may be advantageous to such species. However a corresponding expansion in the use of antiparasitic drugs such as anthelmintics, macrocyclic lactones (e.g. Ivermectin, Doramectin etc), pyrethroids (e.g. Permethrin) and organophosphates (e.g. Dichlorvos) in livestock may in turn restrict the expansion of species due to medicinal residues impacting dung communities[20,21,22].

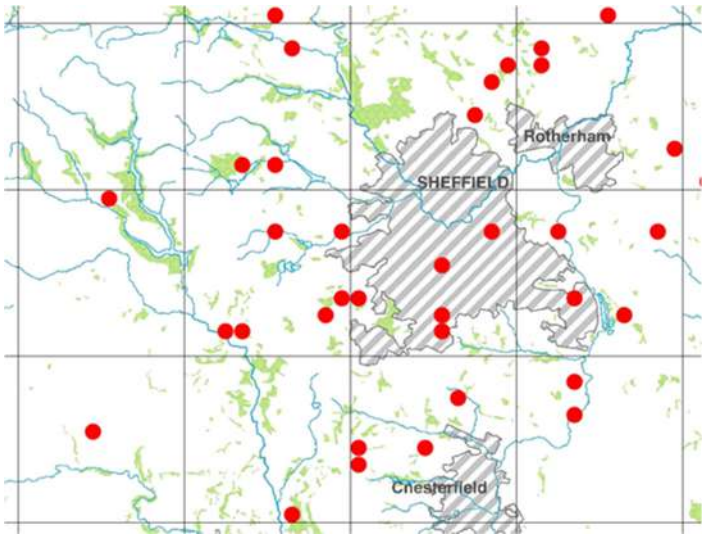


*Figure 10: Combined records of the three dung heap associated species in the Sheffield area (*Labia minor, Porcellionides pruinosus *and* Porcellio dilatatus, *pictured below, left to right). Mapped using DatMapR. Images © Paul Richards.*

Farmland bird species highlights

Skylark

Skylarks are a protected species under Section 41: Species of Principal Importance in England and are a 'Birds of Conservation Concern' red list species due to recent national population declines. Between 1970 and 2015, numbers have declined by 59% nationally[23] and in their natural preferred breeding site of arable fields, national numbers have declined by 75% between 1972–1996[24].

In Sheffield, the percentage of areas with skylarks has decreased by 13% between 1980–2008. Numbers of skylarks in migrating flocks have also declined significantly over this period[25]. Their main routes of a connectivity corridor are concentrated to the west in and around the Peak District National Park, including areas of unimproved grassland, arable land and the moorland fringe[26]. Some 2017 figures for skylark give the highest number of singing birds - double-figure counts on the Eastern Moors in April as part of the Eastern Moors survey[27], and 12+ over the 'plains' area at Orgreave/Waverley Lakes (in nearby Rotherham) on 4th May (reported by David Wood)[25].

Their preferred nesting and feeding habitat is arable cereal fields which provide 58.5% of their territories[28]. Upland grasslands with moderate grass length, plus restored industrial wasteland and grassed-over colliery spoil such as the old Orgreave colliery site, now part of the Waverley development on the edge of Sheffield, just in to Rotherham, are also favoured[28]. Declines in arable areas are linked to the move from spring-sown to autumn-sown cereals. This creates thicker crops at nesting time and causes difficulties in nesting and feeding, also resulting in no stubble for winter food. Nesting skylarks prefer tractor tracks as these have lower vegetation; however, this leaves them vulnerable to both tractors and predators[28,29].

Breeding density also increases with crop diversity so arable monoculture also affects success[30]. In grasslands, the change from hay-making to silage-cutting means more regular and earlier grass cutting, reducing available nesting time between cuts. The RSPB is trialling the use of unsown patches within arable fields, away from tractor tracks and field margins, and has found this successful[29].

Skylark
© Stefan Johansson

Linnet © Terry Whittaker /2020VISION

Barn owl

Barn owls are iconic countryside birds, living on a diet of small mammals, small birds and some larger mammals. They require rough grassland and field edges to hunt their prey, with a pair requiring 20-25km^2 of 'edge'[31]. They usually nest in holes in trees or in undisturbed buildings such as barns.

There are 3,000-5,000 breeding pairs resident in the UK with up to 25,000 birds overwintering[32]. The barn owl underwent a decline of 25-50% nationally up to the 1990s, but has since increased across the country by 464% (1995-2008), and is now green-listed. Data is patchy as the barn owl is largely nocturnal, so DEFRA does not include barn owl in the population decline figures for farmland birds as there are not enough data. Within the local Sheffield area, this species has declined more steeply than at the national level, with a greater than 60% decline in both occupancy and confirmed breeding[25].

Most breeding pairs in Sheffield are now found in farmland to the east and south of the area, with a scattering of pairs to the west. The decline between 1975–2008 in the wider Sheffield area is likely to be due to changes in and intensification of agricultural practices that have reduced suitable habitat for prey species. The loss of old barns and large hedgerow trees as nesting sites may also be a factor. The local population was estimated to be eight to 15 pairs in 2008[25].

The numbers of barn owls have started to increase, with the Sheffield Bird Study Group recording the species 129 times in 48 locations in 2015, and reporting nine breeding locations across their study area. A barn owl has been recorded at Blackburn Meadows Nature Reserve, and more recently, barn owls have been recorded around the Norton area of Sheffield[33].

Barn owl © Andy Rouse/2020VISION

Lapwing © Margaret Holland

Lapwing

Lapwings are a familiar bird of the open countryside and farmland, breeding on arable land, wet grassland, and moorland fringe habitats where the sward is short. However, they are declining in line with national trends. Within the Sheffield area, lapwing showed an 80% occupancy in 1975-80, compared to 63% occupied in 2003-08: a decline of 22%[25]. This decline is largely associated with changing farming practices since the mid-20th century. The moorland edge and surrounding unimproved pastures are stable with broadly the same number of occupied 2km x 2km tetrads between surveys.

Ownership and Management

Whilst the majority of farmland is within private ownership, many important grassland sites are owned by local authorities and conservation organisations, including SCC and SRWT. Management is normally linked to a farming business or, on some grassland sites, particularly on the urban fringe, to horse ownership or a livery business.

Sheffield's most species-rich and important grassland sites, outside of the PDNP, are managed by SCC. Most have been designated as LWS which affords them a degree of protection through the local planning system (see Designated Sites chapter). Their ongoing management is recorded annually (see Figure 9). In addition, a small number of grassland sites are protected through the Dark Peak and Eastern Peak District Moors SSSIs, where conservation management is secured through agri-environment schemes (see page 100).

The Environmental Impact Assessment (Agriculture) Regulations are designed to protect grassland habitats and farmland landscapes that do not have legal protection and are vulnerable to changes in agricultural practices. However, there are significant issues regarding the effectiveness of the regulations, particularly in relation to grassland conservation. For example, in the last few years, two high quality grassland sites that fell below the two hectare threshold have been lost to ploughing in the Peak District National Park.

Liz Ballard, Chief Executive of SRWT, comments: "*With Brexit on the horizon, the future management and protection of grasslands is uncertain. Many priority sites have benefitted from funding to farmers who have applied for EU agri-environment scheme payments (delivered in the UK as Countryside Stewardship). Although the Government has committed to supporting Countryside Stewarship agreements until 2022, as farms come out of current schemes or look further ahead the future is far from clear. Current proposals outlined in the DEFRA 25-year Environment Plan suggest a new environmental land management scheme may be made available to farmers and land managers post-Brexit, but details regarding its operation and the level of funding available have not been confirmed. Whatever the outcome, this will have the most profound effect on the future of our local grasslands and the wildlife they support*."

Shefield farmland
© Nabil Abbas

Case study: Rickett Field Farm, Dungworth

A small number of high wildlife value sites persist within the Pennine fringe farmlands east of the Bradfield Moors despite modern farming pressures to intensify agricultural production. One of these is found at Rickett Field Farm, Dungworth, on a north facing slope above Dale Dyke Reservoir, where over 150 species have been recorded in a rich diversity of habitats including rush dominated marshes, small springs, dry and wet heathland, acid and neutral grassland, bracken, gorse and scrub trees. The marshes include species such as marsh pennywort, marsh valerian and common spotted orchid whilst the spring communities support bog pimpernel, marsh lousewort, butterwort, flea sedge, and bog pondweed. Cotton grasses, sphagnum and cross-leaved heath are found within the areas of wet heath. The site is also of value for a wide range of invertebrates and birds including snipe.

The site is managed within a Higher Level Stewardship (HLS) Scheme agreement (see page 100) which also protects a number of acid grassland sites on steep slopes in addition to the complex pattern of field boundaries – mainly dry stone walls. This situation contrasts with the scenario in the late 1980s and early 1990s when the farm first came to the attention of conservation organisations, as financial support from the government for drainage of the wetter sites on the farm was being considered. Since then the site has been managed within a Peak District National Park Authority conservation scheme agreement before being transferred into HLS.

Managing the landscape at Rickett Field Farm is central to the dairy and sheep farming enterprise and to the provision of self-catering and bed & breakfast accommodation. The Shepherd family have owned the land since 1963 buying it from the then owners at the Haychatter pub, formerly known as the Reservoir Inn.

UK Biodiversity Indicator Focus

Birds of the wider countryside: Ca. Farmland Birds

Sheffield features all 19 species included in the farmland bird indicator list – seven generalists and 12 specialists. Of the seven generalist species, (Figure 11; right), three (43%) had declined in occupancy between 1975-80 and 2003-08. Only two species (29%) showed increases, which were small (6.4% and 9.0% for greenfinch and jackdaw respectively). Worryingly, farmland specialists are not faring well; out of the 12 species, 10 (83%) showed a decline, with four species showing a decline of over 50%. Only two species (17%) showed an increase.

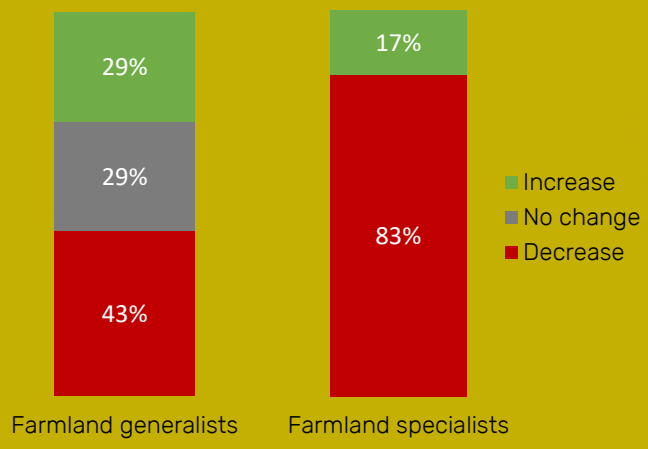


Figure 11: trends of farmland generalists and farmland specialists included as part of the UK biodiversity indicator C5: birds of the wider countryside, measured as a change in the number of tetrads occupied between 1975-80 and 2003-08[25].

Case Study: Farmland Birds, David Wood, Chair, Sheffield Bird Study Group

At a national level, the index of 12 specialist farmland species (corn bunting, goldfinch, grey partridge, lapwing, linnet, skylark, starling, stock dove, tree sparrow, turtle dove, whitethroat and yellowhammer) declined by 70% between 1970 and 2016[34]. All of these were widespread breeding species in the Sheffield area, found in at least 23% of tetrads during the 1975-80 Breeding Atlas conducted by Sheffield Bird Study Group (SBSG).

Of the species undergoing the most significant declines of distribution or abundance – or both – in the second SBSG Breeding Atlas (2003-08), four of the five most severe declines in occupation corresponded to farmland specialists, namely corn bunting (96% decline), turtle dove (91%), yellow wagtail (83%), and tree sparrow (74%). These declines have continued since the 2003-08 atlas; turtle dove was not recorded anywhere in the SBSG recording area during 2012 or 2013, nor in 2015, and corn bunting was reported just twice during 2014, with no indication of a breeding attempt and no reports at all in 2015 or 2016. It is also worth noting that the other species in decline is twite (97% decline) which has also been affected by changes in (upland) agricultural practices.

The reasons behind drastic declines in farmland specialists are well documented as national agencies seek to understand and address the situation. Major contributory factors are the changes in farming practices over recent decades, notably: reductions in mixed farming, with a massive increase in rapeseed oil production; the move to sowing arable crops in autumn rather than spring; and increased silage production with attendant changes in grassland management. The drive towards ever greater crop productivity, and the associated use of pesticides and herbicides, has also reduced the availability of seed-producing 'weeds', as well as insects and invertebrates. Such factors are exacerbated by the loss of hedgerows, which further deprive farmland breeders of feeding opportunities and of nest sites. Reduced survival is the key factor affecting resident farmland breeders, although some (such as skylark and lapwing) are also suffering from changes in cropping regimes that result in a shortened breeding season as cereal fields are harvested earlier in the summer. All of these features affect specialist farmland species around Sheffield as much as they do at a national level and play a major part in their decline.

In Sheffield specifically, the amount of land that is primarily built-up has approximately doubled between 1970 and 2010 as new homes and other structures have been built on previously undeveloped plots of land in urban and suburban areas, together with more extensive redevelopment in other areas to the east and south-east of the city. The recent intensification of agricultural practices, which has proved catastrophic for a number of species both nationally and locally, is partly the result of increased demand for low-cost food. As such, future directions on this front are our shared responsibility.

Corn bunting © Chris Gomersall/2020VISION

UK Biodiversity Indicator Focus: B1a: Area of land in agri-environment schemes

Agri-environment schemes require farmers to implement environmentally beneficial management practices and to demonstrate good environmental practice on their farms, recently through the Environmental Stewardship scheme. The entry-level part of this scheme (ELS) promotes simple and effective environmental management across all types of farmland, whilst the higher-level or targeted version (HLS) promotes environmental management aimed to conserve wildlife, maintain and enhance landscape quality and character, protect the historic environment and natural resources, and promote public access and understanding of the countryside.

Not all agri-environment schemes are active in Sheffield. Figure 12 and Table 2 shows where several grassland-specific options have been adopted.

A total of 442ha of land falls under arable options (EE3, EF6, EJ11 and HF12) of which EJ11 ('maintenance of watercourse fencing') forms the majority of the area. This is concentrated on one site.

A further 85ha of land is also under four options designed to improve grasslands for farmland birds (Figure 13). This includes 30ha of HLS options to restore wet grasslands for breeding waders (HK11) and wintering waders and wildfowl (HK12), and 55ha to manage enclosed rough grazing (UL22) and upland grassland (UL23).

In addition, 7,914m of hedgerows fall under the scheme (Figure 13), including 3,303m under the HLS (HB11 and HB12; 'maintenance of hedges of very high environmental value').

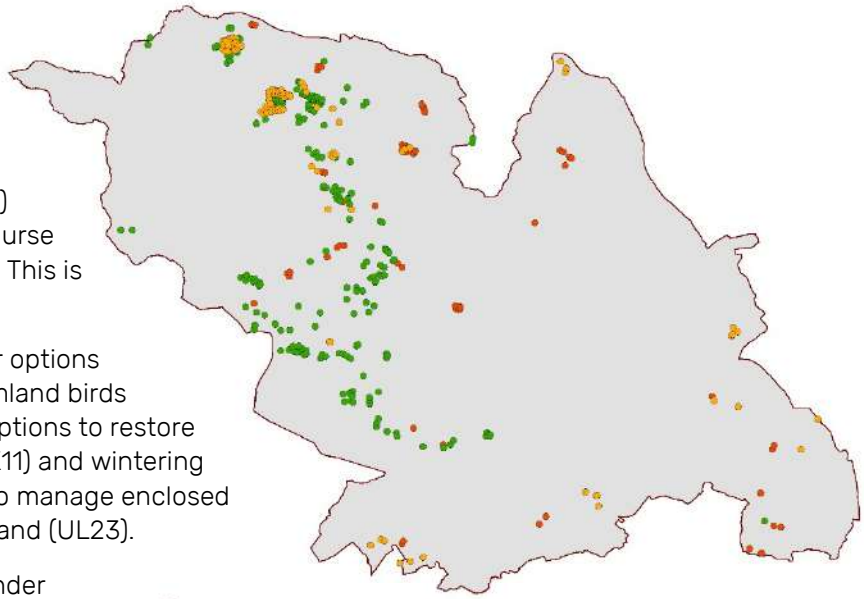


Figure 12 (top right): ELS and HLS options for grassland, classed as low input (green), species rich (orange) and targeted features (yellow). Details are given in Table 2 below. Data: Joint Nature Conservation Committee (JNCC); map credit 3.

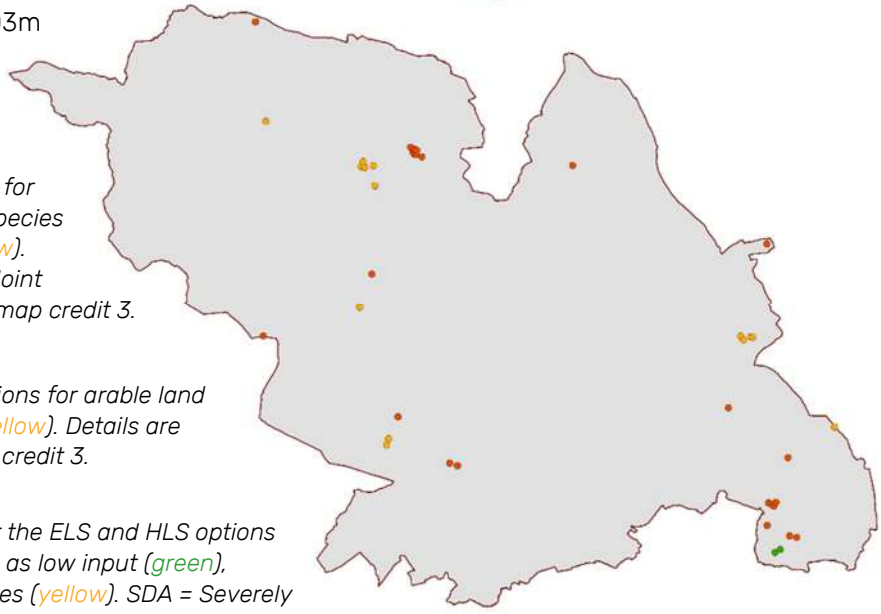


Figure 13 (bottom right): ELS and HLS options for arable land (green), hedgerows (orange) and birds (yellow). Details are given in the text above. Data: JNCC; map credit 3.

Table 2 (below): accompanying details for the ELS and HLS options for grassland shown in Figure 12, classed as low input (green), species-rich (orange) and targeted features (yellow). SDA = Severely Disadvantaged Areas. ML = moorland line. Data: JNCC.

Scheme option	Number of sites	Total area (ha)
EK3 Permanent grassland with very low inputs: outside SDA & ML	50	62.3
EK4 Manage rush pastures: outside SDA & ML	2	2.7
EL3 In-bye pasture & meadows with very low inputs: SDA land	143	336.8
EL4 Manage rush pastures: SDA land & ML parcels under 15ha	14	37.8
EL5 Enclosed rough grazing: SDA land & ML parcels under 15ha	27	109.9
Maintenance of species-rich, semi-natural grassland	27	50.0
Restoration of species-rich, semi-natural grassland	37	63.2
Maintenance of grassland for target features	42	154.9
Restoration of grassland for target features	56	102.5

Conservation in Action

Various local and national projects are working to both increase local knowledge and prevent declines of local grassland and arable habitats and species.

The National Plant Monitoring Scheme started in 2015, a joint venture between Botanical Society of Britain and Ireland, the Centre for Ecology and Hydrology, Plantlife and the Joint Nature Conservation Committee. The aim is to collect data to provide an annual indication of changes in plant abundance and diversity through transect and quadrat surveys within random 1km squares. The results will help inform the new Biodiversity Indicator 'Plants of the Wider Countryside', with data sets uploaded to the NBN gateway. Datasets for 2015 & 16 are available; the Sheffield area has one survey completed so far with more surveys to be completed and uploaded by volunteers. This will help to track plant trends in specific areas. There will not be sufficient data for statistical analysis of trends until 2020[35].

Highways England is undertaking a grassland feasibility study to enhance the wide rural road verges along the A616 Deepcar to Langsett/Flouch. It plans to enhance existing species-rich grassland strips and sow appropriate wildflower seeds on poorer quality grassland. Interesting plants such as dyers greenweed and common cudweed (both on the England Red Data List[36]) are already present on verges in Sheffield; the project's aims are to: contribute additional species-rich grassland; increase the wildflower abundance and diversity to benefit pollinating invertebrates such as butterflies, bees and bumblebees; and provide connectivity for wildlife.

In January 2018, a new Nature Friendly Farming Network was launched, hoping to encourage British farmers to restore wildlife, reverse declines in soil quality and help manage the impact of climate change at the same time as growing affordable, healthy food. The Network has said that a post-Brexit policy framework should incorporate provisions for wildlife and public service in an attempt to change Britain's approach to agriculture[37].

Carbrook Ravine restoration meadow
© Julie Riley

Case study: The Restoration Meadow at Carbrook Ravine nature reserve

In 2015, SRWT successfully created a wildflower meadow on the old college playing fields at Carbrook Ravine nature reserve near Richmond. Stradbroke College (formerly Richmond College) closed in the 1990s and was subsequently demolished. Some of the site was redeveloped for housing, but the old playing fields were left unused for 20 years. As the playing fields adjoin the SRWT nature reserve at Carbrook Ravine, the Trust took the opportunity to transform the disused fields into a wildflower meadow extending this local oasis for wildlife.

After removing scrub and fly-tipping from the area, the fields were ploughed up in spring 2015 and sowed with a mixture of wildflower seeds. The seed mix was chosen to complement the existing hay meadows on the adjacent nature reserve and to provide food plants for bees, butterflies and other insects. The flowers sown include typical hay meadow plants such as ox-eye daisy, red clover, yarrow, wild carrot, salad burnet, yellow rattle and lady's bedstraw. In 2016 and 2017 green hay and yellow rattle was harvested by staff and volunteers and used on other nature reserves and trial sites.

SRWT is delighted with the success of this project, which has created a fabulous new area for wildlife and an eye-catching sight for local people. Many people living in urban Sheffield are not easily able to access the countryside. The creation of this meadow has brought wildlife right back to the local neighbourhood, allowing people to connect with local nature.

Threats to Grassland and Farmland

What is the threat?	What does it cause?		
	Grasslands	Arable	Field boundaries
Agricultural intensification and changes in management	Loss of species diversity through fertiliser and pesticide applications, early cutting for silage, over-grazing, compaction from heavy machinery etc. Loss of priority and semi-improved grassland habitats through re-seeding and conversion to arable land.	Loss of arable weeds through pesticide applications, reduction in field headlands. Reduction in spring-sown cereals which provide nesting habitat for farmland birds. Heavier crops resulting in loss of nesting habitat for farmland birds. Reduction in seed retained in fields over winter.	Reduction in extent and quality of associated ground flora. Reduction in quality of hedgerows through intensive trimming, removal of boundary trees, and grazing pressure. Removal of field boundaries, reducing habitat availability and removing wildlife corridors.
Neglect	Under-grazing leading to loss of species diversity Encroachment of scrub and bracken leading to a loss of habitat.	-	Degradation of the boundary which ultimately leads to its loss.
Inappropriate tree planting	Loss of habitat.	-	-
Intensive horse/pony grazing	Loss of species diversity through over-grazing and compaction.	-	Reduction in the quality of hedgerows through grazing pressure.
Urbanisation and development pressure	Loss of habitat. Inappropriate mowing, tidying, planting of non-native species leading to a reduction in species diversity and loss of habitat.	Loss of habitat.	-

All of these threats result in a loss of available habitat for birds, small mammals, amphibians, reptiles and invertebrates. They all also result in habitat fragmentation and a reduction in connectivity and available wildife corridors. Knock-on effects include reduced opportunities for successful seed dispersal and a reduction in animal movements in response to changes in climate and other environmental pressures.

Meadow grasses © Matthew Roberts

Recommendations

1. Develop targeted conservation plans for harvest mice, skylark and other farmland birds as key indicator species or local species in severe decline.
2. Continue to deliver conservation actions that support the return and expansion of the barn owl. This includes habitat improvement, raising awareness of rodenticide, improved monitoring and installation of barn owl boxes.
3. Promote the value of LWSs and unprotected, important grasslands to farmers, land managers, landowners, planners and developers.
4. Focus efforts on improving the overall condition of key grassland LWSs currently in poor condition or not in positive conservation management for wildlife.
5. Ensure all presently un-mapped areas of priority grassland habitat are mapped on the national Priority Habitat Inventory.
6. Develop the positive conservation management of rural road verges to act as corridors and linkages between fragmented grassland sites.
7. Identify opportunities to plant new hedgerows where appropriate and restore connecting dry stone walls.
8. Promote the value of local, non-designated but important grassland sites by encouraging Natural England to include them within the higher tier of Countryside Stewardship or bringing them in to the PDNPA's Conservation Scheme.
9. Actively promote and practically support farmers and landowners wishing to apply for mid-tier Countryside Stewardship and any appropriate replacement scheme after Brexit.
10. Encourage the creation of new hay meadows and the planting of 'arable weeds' and meadow species where appropriate, for example, cowslip and yellow rattle.
11. Further improve our knowledge of fungi at grassland sites and promote the mycological importance of key sites.
12. Raise awareness with land managers, landowners, farmers, grounds maintenance contractors and public bodies of the impact of inappropriate or over-grazing and excessive mowing or cutting, especially at the wrong time of year, on grasslands and the wildlife they support.

Bown Hare

Sheffield farmland
© Claire Watts

Urban

Headlines

- **Sheffield has a substantial amount of semi-natural and managed green space within the urban zone. This includes 1,685ha of woodland – covering 11% of the area – and 2,724ha of amenity grasslands.**
- **Sheffield has 4,290ha of urban gardens. These are important sites for biodiversity – particularly invertebrates.**
- **Built features in the urban landscape support key protected urban species such as peregrine falcons, hedgehogs, and numerous bat species by providing foraging, shelter and breeding opportunities.**
- **Sheffield has a diverse range of urban conservation, management and landscape improvement programmes working to protect nature and improve public access to green spaces. These include Urban Nature Parks and urban Local Nature Reserves (LNRs).**
- **Nearly half of Sheffield's Local Wildlife Sites (LWSs) and over half of LNR land is found within the central urban zone.**
- **Many non-native species are found in Sheffield and some are likely to be negatively impacting local species. Gardens are often the source of non-native species introductions to the wider environment.**
- **Current threats to urban habitats and wildlife include habitat loss through development and redevelopment, litter, pollution, and changes in gardening practice and design, for example, paving and decking.**

Urban fox

Introduction

Far from being a concrete jungle, Sheffield boasts an impressive amount of green space within its urban districts. Along with the buildings and roads, the urban environment also includes parks, gardens and other green spaces such as allotments and woodlands. Above all, Sheffield's extensive spread of urban gardens provides essential habitat for wildlife in a challenging environment. As a city built on the confluence of five rivers, Sheffield's urban zone has an unusually diverse spread of habitats that allow for high biodiversity, including brownfield sites, which host specialist species and early colonising plants[1]. Transport networks support important linear habitats, such as verges, that contribute to habitat connectivity by acting as green corridors between woodlands, parklands and rivers although roads and railways can also be a barrier to wildlife. However, as development and urbanisation continues to deplete and fragment natural habitats, making new and existing urban areas more hospitable for wildlife should be an important focus.

Sheffield's 'urban zone'

As a historically industrial city, Sheffield's 'urban zone' (based on the Sheffield Development Framework and contained in the red outline; Figure 2) is focussed around the river confluences to the south-east of the district. Supporting its reputation as a green city, nearly a third of this area (33%, Figure 1) is composed of urban gardens and landscaped areas (gardens alone make up 4,056ha or 27%). This provides valuable habitat for species using the urban environment, such as hedgehogs and many garden birds. A further 16% of the urban zone is covered by amenity grassland such as parks and communal areas (such as that around many housing estates), whilst 11% of the area is covered by woodland (not including iTree data), most of which is publicly accessible. Some arable land (245ha) remains pocketed between suburban zones, concentrated mostly to the south-east in Handsworth and Woodhouse.

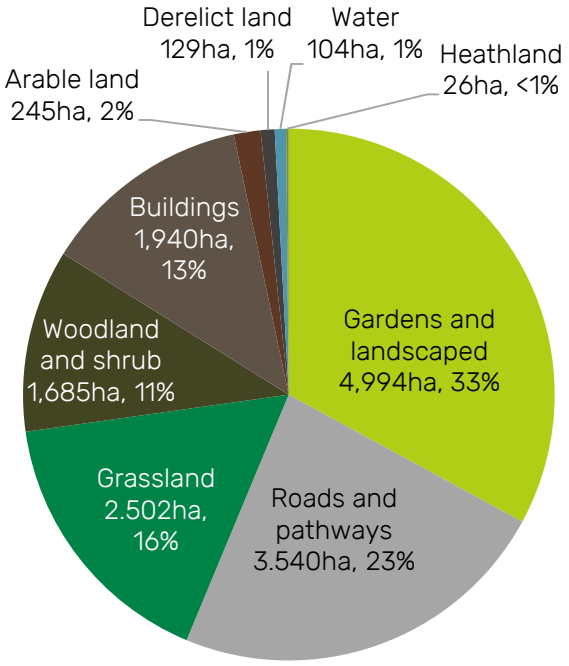


Figure 1 (above): percentage coverage of all habitat types found within the urban zone (see Figure 2 for boundary)

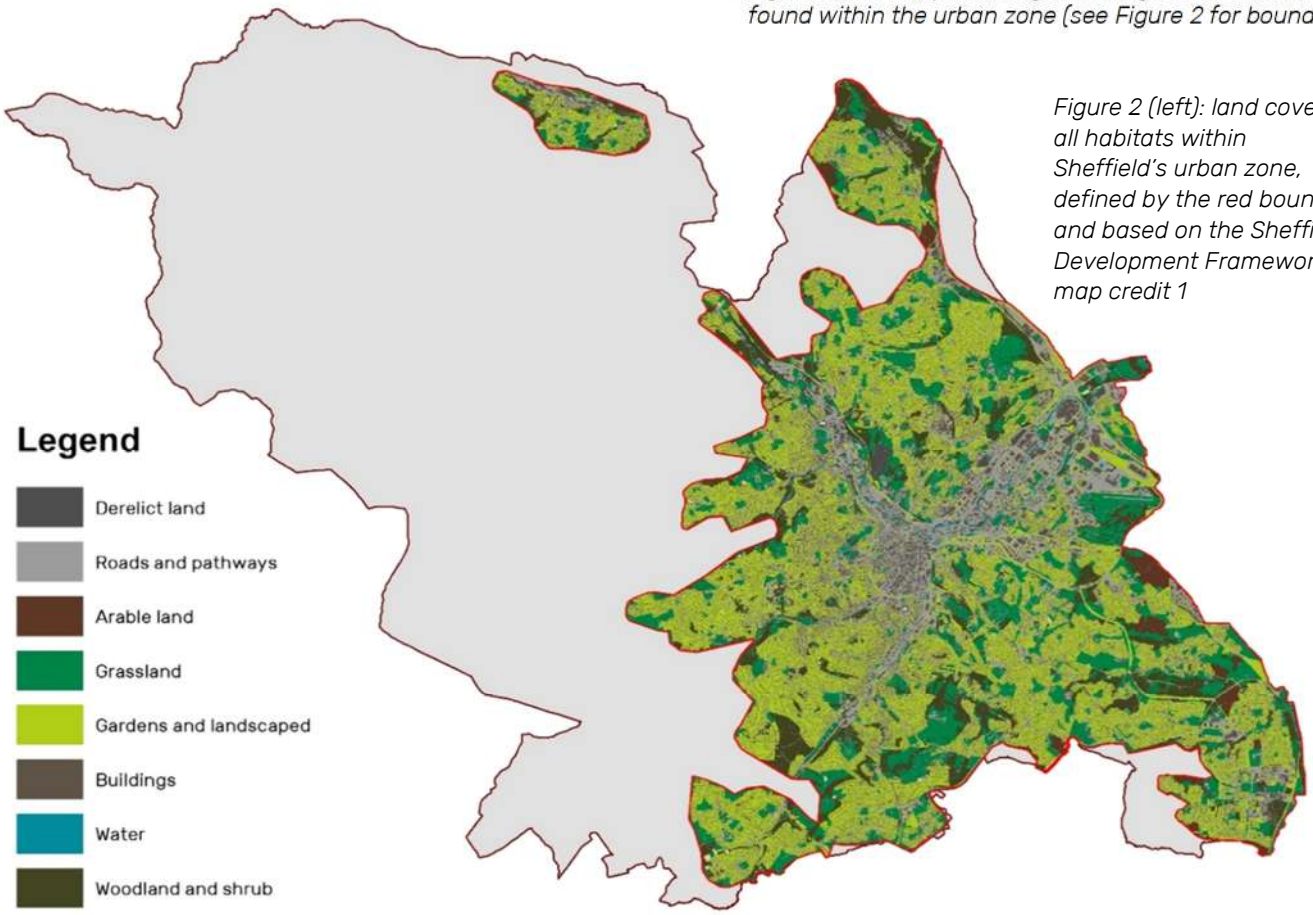


Figure 2 (left): land cover of all habitats within Sheffield's urban zone, defined by the red boundary and based on the Sheffield Development Framework; map credit 1

What urban or modified habitats does Sheffield have?

Figures 3 and 4 show the composition and distribution of habitats which are highly modified or influenced by people and the built environment, across the whole district, excluding developments such as buildings and roads. These have mostly been modified for human use, and are often intensively managed, but may contain natural features such as retained parkland trees. Private gardens, covering 4,290ha, occur throughout the residential areas of the district, concentrated across the east of the region. Amenity grasslands and parks provide considerable – and different – additional greenspace, contributing to both wildlife habitat and human well-being. Other landscaped areas, such as public gardens and greenspace around apartment blocks, also contribute to the landscape of urban green spaces. Urban roadside vegetation, mostly comprising grass verges, is often species-poor and highly managed in contrast to rural verges (see Grassland & Farmland chapter).

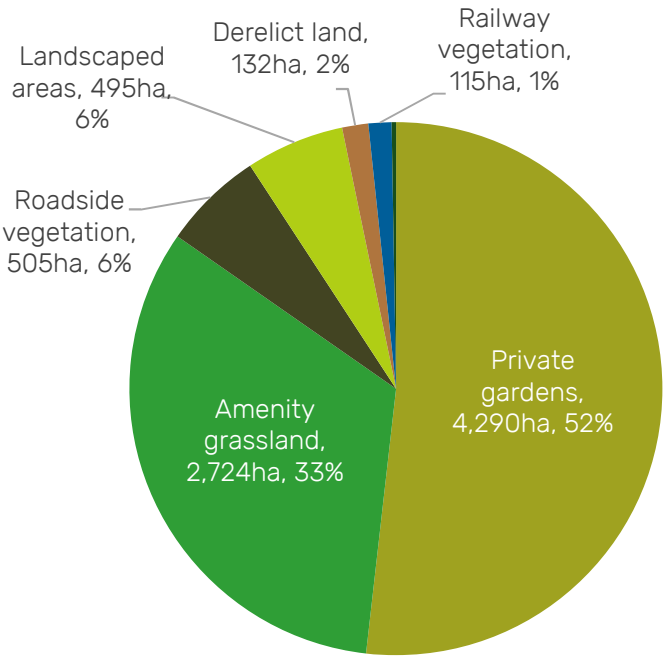


Figure 3 (above): percentage coverage of habitats, within the whole of the Sheffield district (see Figure 4 below), that are heavily modified and may be considered to be urban

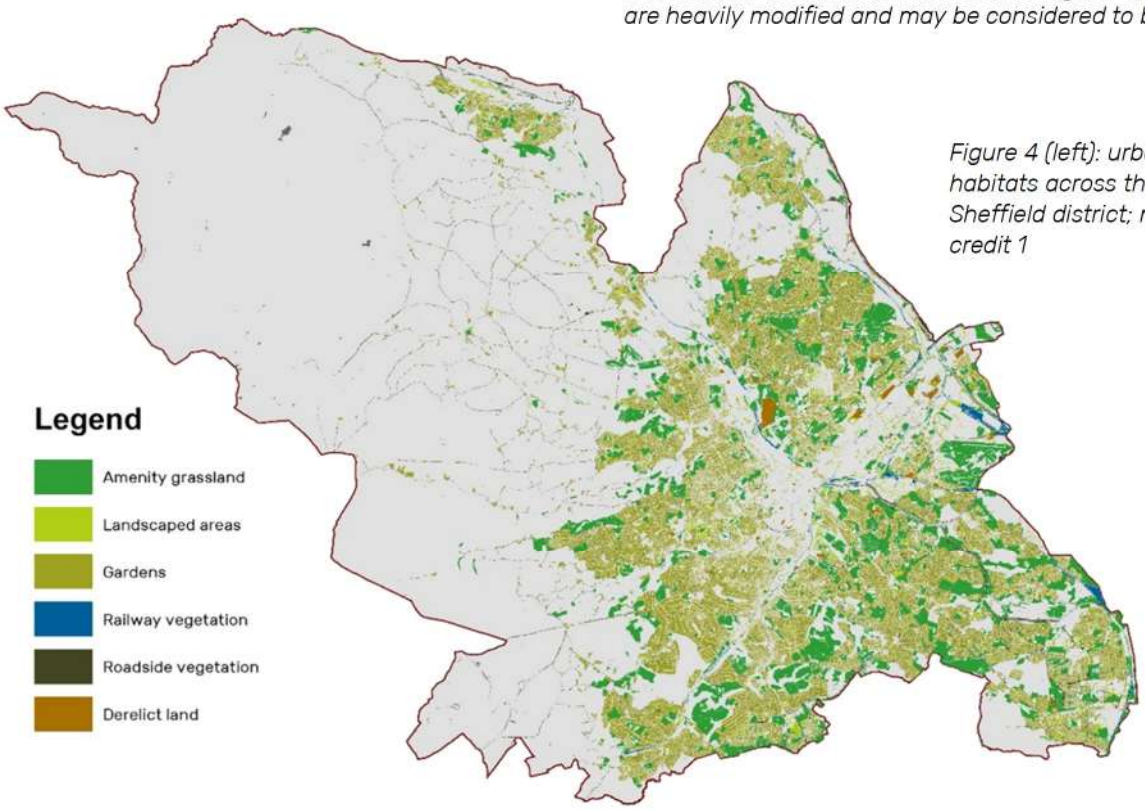


Figure 4 (left): urban habitats across the Sheffield district; map credit 1

Urban flowers
© Paul Hobson

Case study: Bats and industrial heritage in Sheffield
Robert Bell, South Yorkshire Bat Group

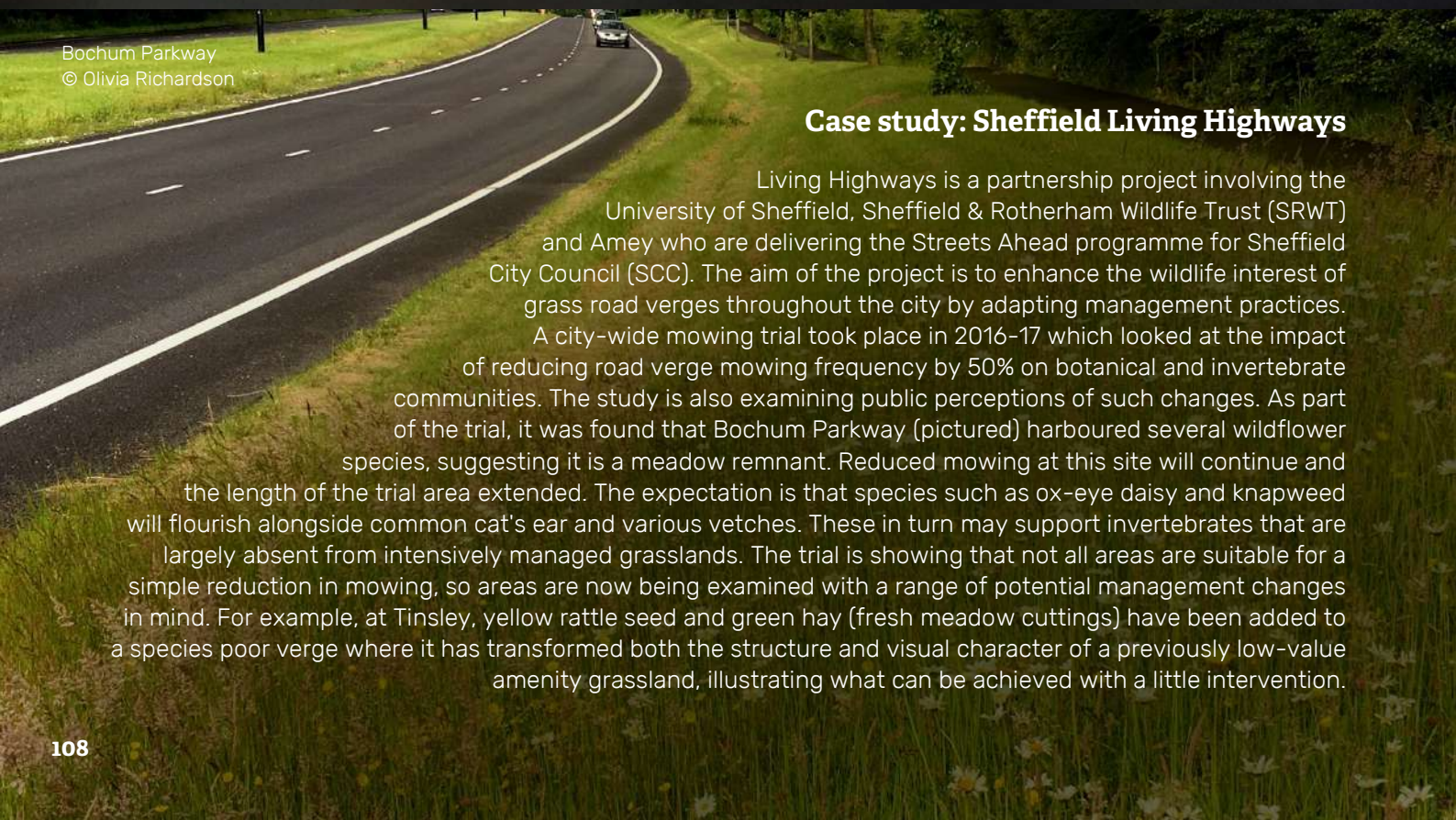
Sheffield is widely known for its proud industrial heritage and is globally recognised for its major contribution to the development of steel forging and special steel refinement. Industrialisation saw Sheffield's five rivers culverted, steel works constructed alongside water-courses, and weirs and channels created to extract water to power forges and mills. At numerous locations in surrounding hills, mining for minerals (such as the heat resistant gannister and pot clay) took place to feed the demand of brickworks within river valleys in order to make fire bricks to line the city's furnaces. Viaducts, bridges and tunnels were constructed to allow the entry of rail, canal and improved road linkages into the city, overcoming the challenges of transporting finished goods and raw materials over the rough landscape.

Image © Rob Bell

These intense bouts of construction, and the subsequent decline of numerous stone and brick structures, has resulted in the development of some excellent bat habitats often close to the city centre. An extensive cool and dark culvert system below the train station has now been occupied by Daubenton's bat, which trawls for insects throughout the day while commuters queue on the platforms above. During the winter, pipistrelle bats move into an old railway arch to hibernate, whilst other species overwinter in old brick kilns within the city. Former brick works in west Sheffield support whiskered and common pipistrelle bat small day roosts, whilst brown long-eared bats use voids between concrete roofing sheets to rear young within easy reach of woodlands. Whilst many of the old mines within surrounding hills have now been closed, some remain. One is now shown to comprise Sheffield's first confirmed autumn swarming site, with Daubenton's bat, Natterer's bat, brown long-eared bat and whiskered bat caught at the site in 2017[2,3].

Sheffield residents are rightly proud of their industrial heritage, much of which receives protection for heritage reasons. It is however important to remember that whilst our concentration was elsewhere, wildlife frequently moved in to exploit the opportunities we left behind. With sensitive repair and restoration, old buildings and structures can be maintained for people and wildlife. This is surely the way forward if we are to retain some of Sheffield's most hidden of treasures.

Brown long-eared bat © Tom Marshall



Bochum Parkway
© Olivia Richardson

Case study: Sheffield Living Highways

Living Highways is a partnership project involving the University of Sheffield, Sheffield & Rotherham Wildlife Trust (SRWT) and Amey who are delivering the Streets Ahead programme for Sheffield City Council (SCC). The aim of the project is to enhance the wildlife interest of grass road verges throughout the city by adapting management practices. A city-wide mowing trial took place in 2016-17 which looked at the impact of reducing road verge mowing frequency by 50% on botanical and invertebrate communities. The study is also examining public perceptions of such changes. As part of the trial, it was found that Bochum Parkway (pictured) harboured several wildflower species, suggesting it is a meadow remnant. Reduced mowing at this site will continue and the length of the trial area extended. The expectation is that species such as ox-eye daisy and knapweed will flourish alongside common cat's ear and various vetches. These in turn may support invertebrates that are largely absent from intensively managed grasslands. The trial is showing that not all areas are suitable for a simple reduction in mowing, so areas are now being examined with a range of potential management changes in mind. For example, at Tinsley, yellow rattle seed and green hay (fresh meadow cuttings) have been added to a species poor verge where it has transformed both the structure and visual character of a previously low-value amenity grassland, illustrating what can be achieved with a little intervention.

Key urban hotspots

Sheffield has an outstanding array of urban green spaces, featuring a variety of habitat types and covered by a number of site designations. These include city parks, cemeteries, commons, Local Nature Reserves (LNRs) and Local Wildlife Sites (LWSs). Some reserves such as Salmon Pastures and Crabtree Ponds are in the heart of the city where, together with important local wildlife sites such as Bole Hills, Clay Wood and The Cholera Monument, they offer Sheffield's residents a place to escape the hustle and bustle of city life. These cherished sites also help to create wildlife corridors across the city, including along Sheffield's urban rivers, and help connect larger woodland and parkland areas within the district. They are also valuable sites for recreation (see Figures 5 and 6 below) and education, and are often managed and maintained by volunteers.

Urban wildflowers
© Paul Hobson

Case study: Sunnybank LNR – a hidden gem
Hannah Wittram, Sheffield & Rotherham Wildlife Trust

Covering just 0.8ha, Sunnybank LNR is a small site situated to the south-west of Sheffield city centre. Created on a site where housing was demolished in the early 1980s, Sunnybank was initially managed by the Sheffield City Wildlife Group, which later became Sheffield & Rotherham Wildlife Trust.

Despite its size, the reserve is a valuable site for both urban wildlife and the local community. It features secondary woodland with ash, bird and wild cherry, rowan, silver birch, wych elm and sycamore; herb-rich grassland; a pond; and scrub patches of blackthorn, hawthorn and bramble, which provide a good food source and cover for birds. Vetch, red clover and hedge bedstraw flourish in the grassland, providing nectar-rich food sources for invertebrates. The pond provides the perfect home for amphibians, and allows water mint, water forget-me-not and spearwort to grow. This mosaic of habitats provides refuge for a variety of species in a heavily urbanised environment. The reserve also contributes to the wildlife corridors created by gardens and other green spaces. Interesting species recorded on the site include: song thrush; tawny owl; pipistrelle bat; hedgehog; five bumblebee species; and the priority white-letter hairstreak butterfly, amongst many others. One other species often found on the reserve is the common frog. Since 2002 there has been a popular annual 'Frog Rescue Day' coinciding with the hay meadow cut, with volunteers and rangers working together to get the frogs out of the way of the machines. In 2017, a record 190 frogs and one smooth newt were rescued.

A large number of people travel through the reserve every day, as it connects Ecclesall Road and Broomhall Place, and it is in the centre of a heavily populated area. This makes Sunnybank very valuable to the local community, as it provides nature right on their doorstep and a green space that local people can use, be it for dog walks, relaxing in the summer, or picking blackberries in the autumn. SRWT carries out community work days and holds reserve advisory group meetings so that locals can have a say in and help manage this little gem of a reserve for future generations and wildlife to enjoy.

Night garden © Jack Perks

Wardsend Cemetery
An abandoned Victorian cemetery which supports abundant flora and fauna with key access to banks of the River Don.

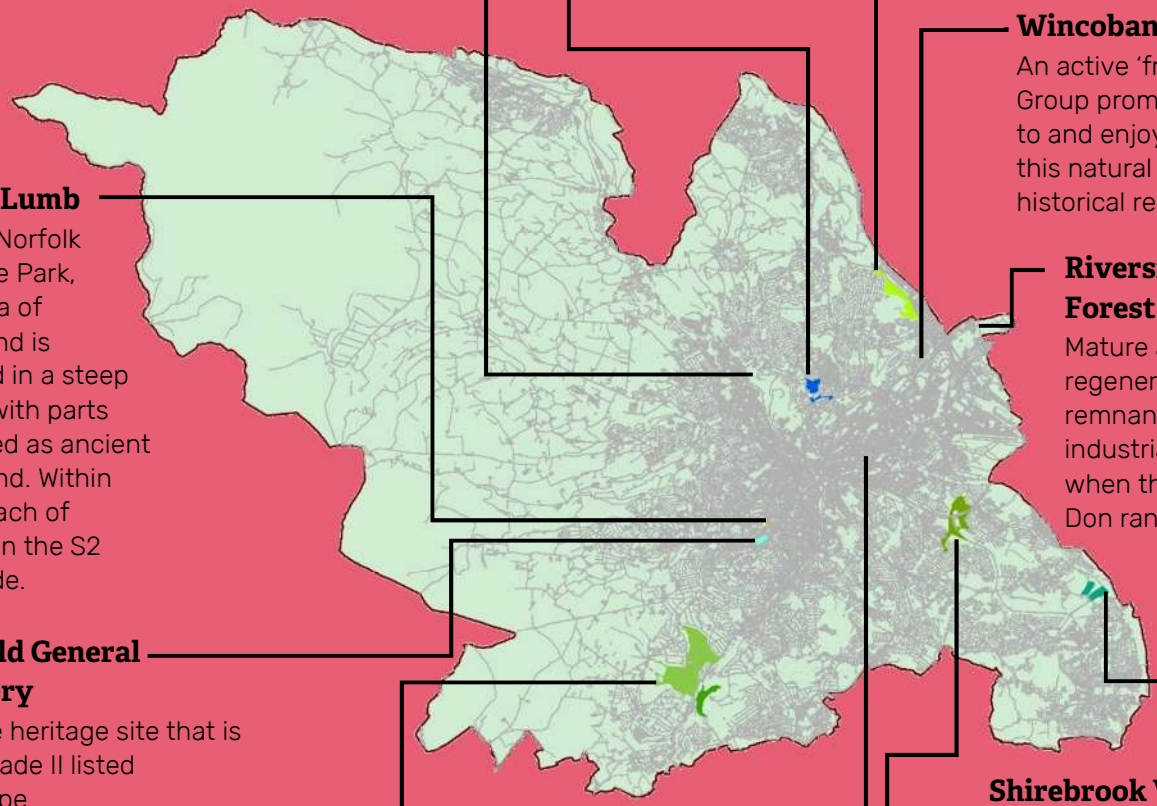
Crabtree Ponds
A small, peaceful reserve offering tranquillity in a busy urban area.

Woolley Wood
A fantastic bluebell woodland with over 200 invertebrate species recorded.

Wincobank Hill
An active 'friends of' Group promote access to and enjoyment of this natural and historical resource

Jervis Lumb
Part of Norfolk Heritage Park, this area of woodland is situated in a steep ravine with parts classified as ancient woodland. Within easy reach of people in the S2 postcode.

Riverside Fig Forest
Mature and regenerating figs, remnants of the industrial age when the River Don ran at 20°C.



Sheffield General Cemetery
A unique heritage site that is also a Grade II listed Landscape.

Shirebrook Valley
This suburban site features a variety of habitats and important BAP species.

Ecclesall Woods
An ancient bluebell woodland with a Woodland Discovery Centre hosting educational and public events.

Salmon Pastures
Once an industrial site, this tiny reserve is now an urban wildlife haven on the River Don.

Carbrook Ravine/Bowden Housteads Wood
A small but varied reserve nestled in the urban landscape.

Figure 5: key sites within Sheffield's urban zone that are likely to be easily accessible and help connect people to nature

Improving access to green space: Millennium and Doorstep Greens

Sheffield's urban zone has three Doorstep Greens – new or renovated areas of public open space close to people's homes, permanently accessible by the local community (Figure 6: right). There are also two Millennium Greens which are similar sites created to celebrate the millennium. Coupled with the various accessible designated sites and other greenspaces (e.g. Figure 5), Sheffield has many high quality accessible wild spaces. However, there is much more that needs to be done in Sheffield to meet proposed standards for greenspace access for all in cities[4].

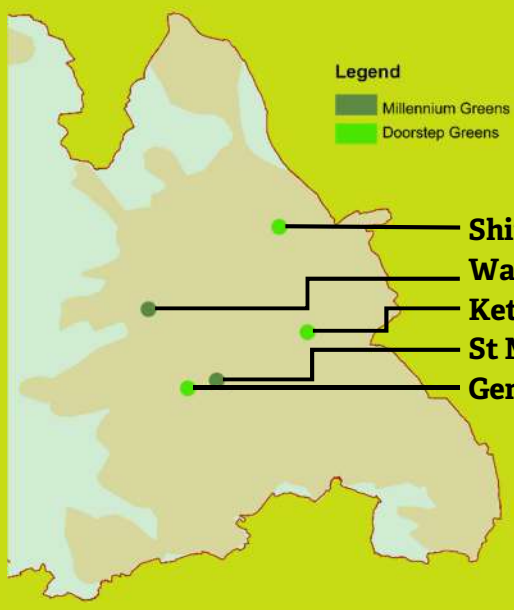
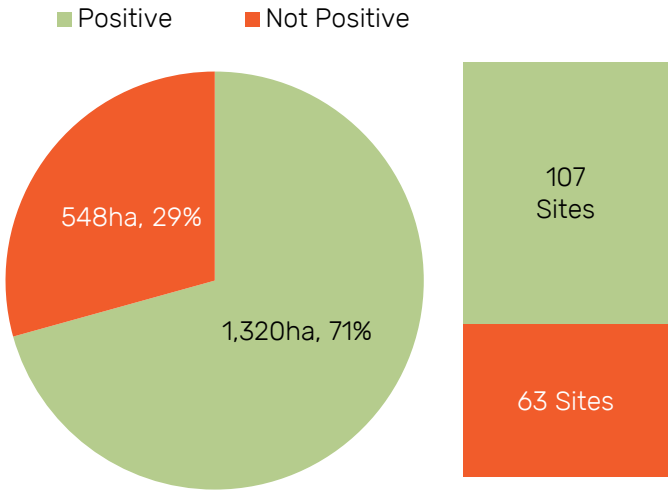


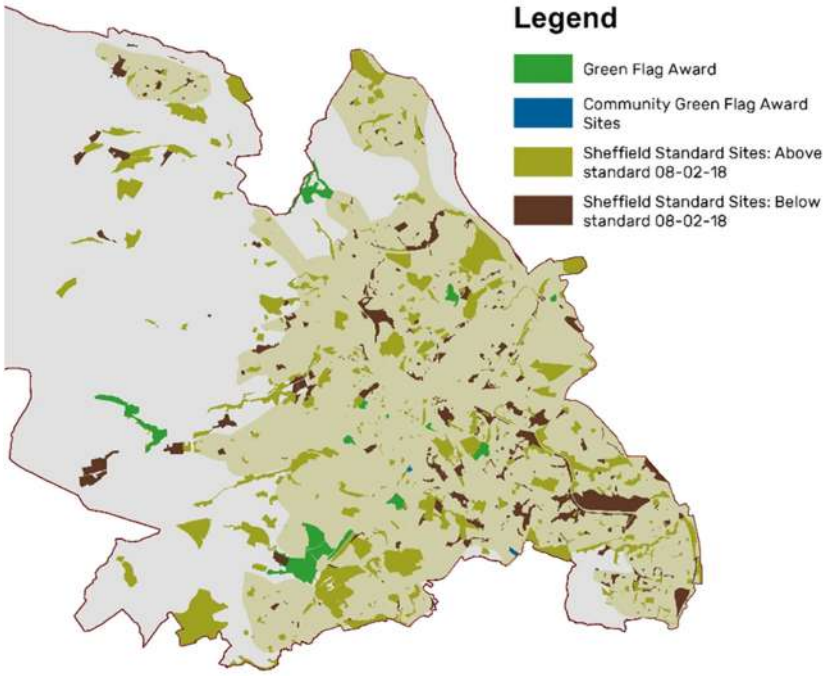
Figure 6: Millennium Greens and Doorstep Greens within Sheffield's urban zone

Designated and protected sites in the urban environment

Nearly half of all LWS land (46%) falls within Sheffield's urban zone. Similarly, 57% of Sheffield's land designated as LNRs also falls within the urban zone, meaning that it is likely to be highly accessible to the general public. Some of these key sites are detailed on the previous page. Many of these urban LWSs are in positive conservation management. This is shown in Figure 7.

Figure 7 (right): management status of LWSs within Sheffield's urban zone by size (left) and number of sites (right). Only sites larger than 0.5ha were considered to exclude sites mostly outside the urban zone.





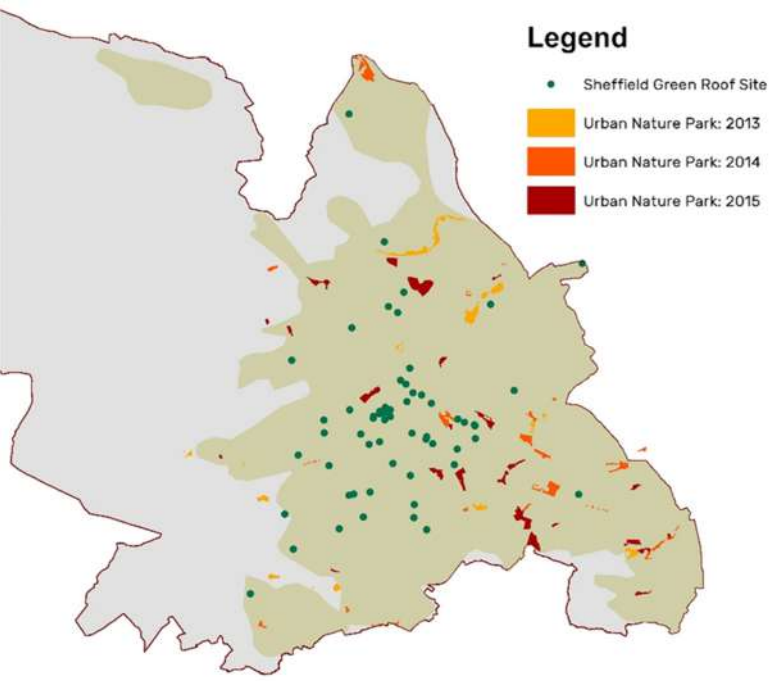


Figure 8: Sheffield Standard Sites, coloured by status on 2/2/18 (top), and Green Flag and Community Green Flag sites plus Urban Nature Parks by year plus Green Roofs (bottom).

Green space management and standards

As well as being covered by designated site status, the value of several of Sheffield's urban green spaces is also recognised by additional standards. Fifteen sites (348ha) and seven sites (7.3ha) have been awarded Green Flag and Community Green Flag status, respectively[5] (Figure 8: top left). Of note is Wyming Brook nature reserve (of Green Flag Status and part of a SSSI) which has been recognised not only for its wildlife but for its public accessibility and excellent management.

The Sheffield-specific Sheffield Standard was produced under the Green and Open Spaces Strategy (GOSS) with the intention of establishing a baseline for green spaces. As with Green Flag sites, these areas are recognised not just for wildlife but also for community benefits. Sites are managed to reach and exceed a set 'standard'.

Urban Nature Parks (UNP) are areas of green and open spaces with more biodiverse habitats, requiring less maintenance than traditional parks. Starting in 2013, from an original aim of 300ha, the UNP project converted 378ha (Figure 8: bottom left) of existing green spaces into Urban Nature Parks also under the GOSS.

Sheffield has also been a pioneer for Green Roofs, originating from a research project in 1999 through to a Marie Curie Project from 2009-2013. The city features a number of landmark green roof projects plus a centre of excellence. These sites (Figure 8: bottom) support various UKBAP species including song thrush, starling and house sparrow[6], and offer actual habitat to invertebrates with six bumblebee species recorded[7]. The Sheffield Green Roof Habitat Action Plan highlights target species and recommendations in more detail[8].

Case study: Establishing an urban wildflower meadow: Beauchief Nature Park Carol Behagg and Diana Holland, Beauchief Environment Group

The Beauchief Environment Group (est.1988) is a local volunteer group that manages an area of land consisting of ancient woodland, ancient meadows and a golf course, in S8, owned by SCC. In 2013 the group approached the Council to use a derelict former SCC tree nursery as a resource to create a wildflower and native grass meadow – a now scarce habitat across the UK. Legacy funding covered ground preparation and seed purchases.

Bramble, docks, nettle, and willowherb were rampant with only a few trees on the perimeter. Vegetation was sprayed-off twice using a tractor with additional hand digging by the group to remove stubborn bramble and other roots. The field was then harrowed to be ready for sowing in spring 2015 with a mix of suitable native grass, and both native annual and perennial meadow wild flower species, sourced from a specialist. The annual meadow species, which germinate and mature in one season, were chosen for colour and coverage in the first year and to prevent undesirable species from returning. The resulting spectacle in 2015 was amazing, with cornflower, corncockle, field camomile, field poppy, corn marigold and red campion being most evident. The perennials – red clover, tufted vetch, meadow vetchling and yarrow – also became established. After a late cut the group collected seeds which group members scattered in early spring 2016.

The summer of 2016 produced a completely different picture in the meadow. Perennial species dominated but many annuals were still present, supporting numerous pollinators. Unexpectedly, viper's bugloss also appeared and its seed was collected. The meadow was cut late summer and some 'green hay' was used by the Council on other grassland projects. The meadow grew well again in 2017 with established grasses and perennial wild flowers flourishing. As the land was nutrient rich, plant growth was tall and dense, and a second cut was needed that year. Again, green hay was saved for other Council sites. Yellow rattle seed, collected from Gulleys Wood Meadow (one of the ancient meadows) was sown on areas of exposed open soil such as molehills. Its future establishment should help to control more vigorous grasses.

The project has been truly exciting and worthwhile, and the meadow is enjoyed by all throughout the year. The area is now classified as one of Sheffield's 'Urban Nature Parks' but needs continued ongoing management. Periodic grazing or 'cut and remove' would be beneficial, but fencing is expensive. Hopefully the seeds will continue to be a valuable resource.

Below: before and after shots of scrub management and wildflower sowing

Case study: Hedgehog Heroes
Sara Blackburn & Paul Richards
Sheffield & Rotherham Wildlife Trust


Urban hedgehog
© Tom Marshall

Once a common sight in our gardens, hedgehogs are now declining rapidly across the UK, with an estimated 30% of the population disappearing over the last decade[9]. The Sorby Natural History Society (SNHS) have produced maps showing this decline locally from the 1970s to the 1990s[10], and more recently to 2016[11]. The reasons for this decline are still not known for certain, but it is likely that habitat loss and development – particularly the loss of hedgerows and suitable garden habitat, as well as habitat fragmentation and the intensification of agriculture, are to blame. Roads, garden pest control (such as the use of slug pellets), plus the increasing use of impenetrable garden fencing, are factors that particularly affect the survival of urban hedgehogs.

The Nature Counts project engaged with the general public, appealing for information on urban hedgehogs in Sheffield using both postcards and an online survey. Over two years (2016-2018) more than 500 records were collected, recording 454 live hedgehogs, 46 dead hedgehogs and 19 signs of hedgehog activity (droppings or footprints). Most sightings (both dead and alive) were from public gardens (342), with sightings also reported from school grounds, woodland edge and suburban streets. There is some degree of recorder bias in showing distributions where hedgehogs are more easily seen; roadkill data can offer a wider perspective of hedgehog occurrences beyond back gardens. The map (Figure 9) is also available at **wildsheffield.com/hedgehogmap**

The project also revealed information on public attitudes towards hedgehogs and the home-based conservation efforts that are being made to help them. Of the 491 people who responded to the survey over 75% had a hedgehog hole in their garden boundary (an aperture in a fence or wall through which hedgehogs can move), improving the overall connectivity of garden habitats. The latter has been recognised nationally as a significant limiting factor for hedgehog success[12]. Other methods for supporting hedgehogs, such as creating suitable hibernation sites, encouraging invertebrate food supplies and hedgehog-friendly gardening practices, have been promoted throughout the project. This baseline data will enable ongoing monitoring to offer a true reflection of local hedgehog numbers and hopefully an increase will be seen in subsequent years as awareness of the hedgehog's plight increases. As a result of this project, feedback on one new major housing development in the Manor means plans now include a 'hedgehog highway' – a series of planned hedgehog holes in the fences of the new houses.

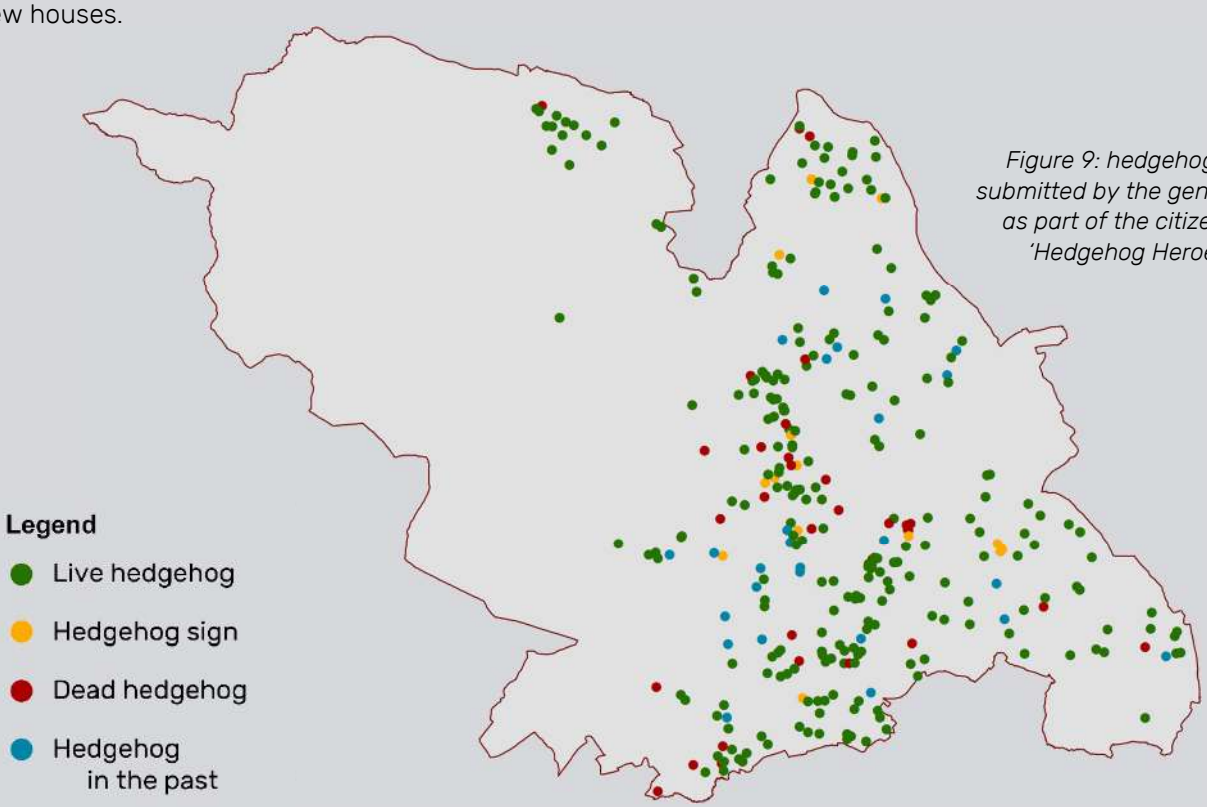


Figure 9: hedgehog sightings submitted by the general public as part of the citizen-science 'Hedgehog Heroes' project.

Urban species highlights


© Margaret Holland

Black redstart

Redevelopment of brownfield, former industrial sites and derelict buildings impacts species such as black redstart. This species has adapted to nest on buildings and is encouraged in Sheffield by green roofs (on the continent it is a garden bird). They prefer early stages of succession on brownfield sites, abandoning these as the site matures. However, they experienced a 50% decline from 1975-80 to 2003-08 and are now only an occasional visitor to Sheffield[13].


© Dawn Monrose

Bee orchid

Bee orchids are found on road verges scattered throughout the city. There is a particularly high concentration on verges on Europa Link as a result of mitigation for a recent industrial development. These dramatic plants, whose flowers mimic a bee, are a great example of a species that is taking advantage of previously disturbed ground in an urban location.


© Jon Hawkins

Waxwing

Waxwings are a welcome winter visitor and are often seen in the city centre and suburbs feeding on the winter fruit of Sheffield's trees. Some so-called 'eruption' years occur, following a good breeding season, when larger numbers are triggered by extreme weather in the breeding grounds.

Why are these species important?

These species demonstrate the diversity of habitats within urban areas of Sheffield and the opportunities that they provide. Additionally, the presence of species such as dipper and otter, which are highly sensitive to industrial pollution, indicates much improved pollution control in Sheffield. More details are given in the Waterways & Standing Water chapter.

Case study: Biodiversity in Urban Gardens projects (BUGS; 1999-2007)
Professor Phil Warren, the University of Sheffield

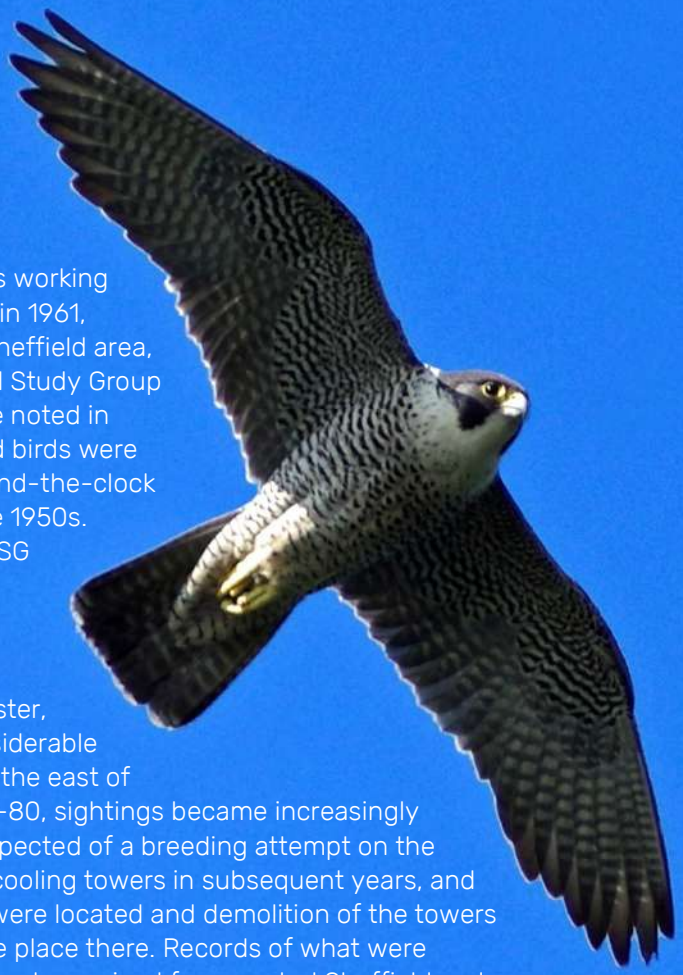
The Biodiversity in Urban Gardens in Sheffield project (BUGS), and a successor project (BUGS2) extending the research to five other UK cities, were the first large scale systematic, scientific studies of the extent and nature of garden habitats across entire cities, the factors affecting plant and invertebrate biodiversity, and the effectiveness of widely cited advice on wildlife gardening. The projects were led by Kevin Gaston, Phil Warren and Ken Thompson at the University of Sheffield, with participation of many gardeners who volunteered their plots for study. The projects gathered evidence showing the amount and type of habitat that gardens provide in cities, and that their biodiversity makes them important for both conservation and in enhancing people's contact with nature in cities. Results of systematic surveys showed that about 25% of a typical UK city are gardens; that small gardens are disproportionately important because there are so many; and that across all gardens in a city the cumulative number of habitat features such as ponds, trees, nest boxes and compost heaps are significant at the city scale[14,15].

Analyses of biodiversity showed that plant diversity was much higher within and across gardens than any other UK habitat type, and, whilst non-natives are a major component of this, native species are more widespread in gardens than often assumed[16,17]. Factors influencing invertebrate biodiversity were complex, and related both to internal features (trees and structural complexity) and surrounding land use[18]. The studies' results questioned some widely cited ideas about garden biodiversity, such as the importance of native plants over non-natives for invertebrates, and found that widely advocated garden improvements for wildlife (e.g. artificial bumble-bee nests) have varied success[19]. There were also policy and planning implications of the results: for example, in demonstrating the effects of increased housing density (and thus reduced garden sizes) on the loss of important, beneficial garden features such as trees. The work informed research projects and campaigns at the Royal Horticultural Society and Local Biodiversity Action Plans. A popular book by Ken Thompson 'No Nettles Required' has now taken the science to the wider public.

www.bugs.group.shef.ac.uk


Garden spider
© Chris Maguire

Case study: Sheffield city peregrine falcons
David Wood, Chair, Sheffield Bird Study Group (SBSG)



In the 1960s, peregrine falcons (peregrines) experienced a nationwide population crash due to organochlorine pesticides working their way up the food chain, with only 385 UK pairs recorded in 1961, mostly in Scotland. Peregrines were also very scarce in the Sheffield area, with just 14 records across the 1,200 km^2 of the Sheffield Bird Study Group (SBSG) recording area from 1958-79. Breeding attempts were noted in the Peak District in the early 1980s but eggs were robbed and birds were persecuted in suitable breeding areas in the Dark Peak. A round-the-clock nest watch in 1984 led to the first breeding success since the 1950s. A slow increase in the breeding population resulted in the SBSG area giving 5-8 annually occupied territories in the 2003-08 Sheffield Breeding Birds Atlas.

Peregrines began to breed in urban locations in the UK from the late 1990s, with pairs on cathedrals in Exeter and Winchester, while pairs in London (2001) and Derby (2006) attracted considerable media attention. After only four reports from lowland sites to the east of Sheffield (an area of around 600 km^2) during the period 1960-80, sightings became increasingly regular around the turn of the millennium, and a pair was suspected of a breeding attempt on the cooling towers at Tinsley in 2004. A pair was present on the cooling towers in subsequent years, and copulation was observed in 2007. However, no nest or eggs were located and demolition of the towers in August 2008 put an end to hopes that breeding would take place there. Records of what were presumed to be one or both of the Tinsley birds were increasingly received from central Sheffield and one roosted on St George's Church at the University of Sheffield on several dates during July-August 2005.

In summer 2008, following regular sightings of peregrines around Sheffield city centre, I persuaded the University's Pro-Vice Chancellor with responsibility for Estates that a nest platform should be placed on St George's in the hope of attracting a breeding pair. Working with staff in the University's Department of Estates we liaised extensively with those responsible for the Derby Cathedral peregrine platform, a national expert on urban peregrines, and the RSPB. The church's status as a listed building meant that certain restrictions had to be observed, but eventually we were able to find a compromise whereby the masonry of the building would not be affected.

With the support of the University of Sheffield, a nest platform was erected on a raised platform within the walls at the top of the tower on St George's Church in December 2009, but was unused despite the regular presence of adult birds. In summer 2011, staff in the Department of Estates & Facilities manufactured a nest platform on the basis of recommendations and specifications from experts in urban peregrines, and this platform was located on the north-facing external ledge at the top of the church tower. This platform was used by the pair that had taken up residence in the vicinity and they fledged two young in June 2012, constituting the first urban breeding record of peregrines in Sheffield. The same site has been used every year since then, with four eggs laid on each occasion, producing a total of seventeen fledged young to 2017. In recent years, two additional breeding pairs have been recorded in the neighbouring Rotherham District. By contrast, there were just two successful breeding attempts by peregrines in the Dark Peak between 2007 and 2014, as illegal persecution there continues.

sheffieldperegrines.wordpress.com

Sheffield peregrines
© David Wood

Brownfield sites

'Brownfield sites' are previously used, derelict commercial or industrial sites often awaiting redevelopment. Such sites are incredibly important for wildlife due to their open mosaic habitats, offering low nutrient soils with altered pH, mixed vegetation, shelter within building remains and raised temperatures due to areas of bare ground[20,21]. Brownfield or Open Mosaic Habitats on Previously Developed Land (OMHPDL) is a (NERC Act Section 41) Habitat of Principal Importance in England[22]. Usually nutrient poor, these fragmented habitats present a disturbed environment, where successional plants quickly flourish, and also provide a range of refuges for some of Britain's rarities including black redstarts, great crested newts and a number of species of bats, lizards and orchids. Rare invertebrates in particular favour these habitats: 50% of England's rare hymenoptera and 35% of rare ground beetles being found on such sites[23], with an additional estimated 15% or more of UK rare and scarce invertebrates also supported[24]. Ownership is often private and disturbance from humans will vary depending on access. The habitat provided can be short-lived or available for several years, but while available, opportunistic species will begin to colonise brownfield land.

Despite huge regeneration within Sheffield recently, many undeveloped areas still exist (Figure 10). Whilst they appear to be wasteland, they support rich biodiversity and need protecting. Brownfield land is usually used first for development, especially in favour of development on greenbelt[25]. Despite the government's push to use 'derelict' land for housing[26, 27], we should be wary that redeveloping old industrial sites may threaten a potentially unique habitat supporting rare, vulnerable species. In fact, the National Planning Policy Framework recognises this by saying that we should 'encourage the effective use of land by reusing land that has been previously developed (brownfield land), provided that it is not of high environmental value.'

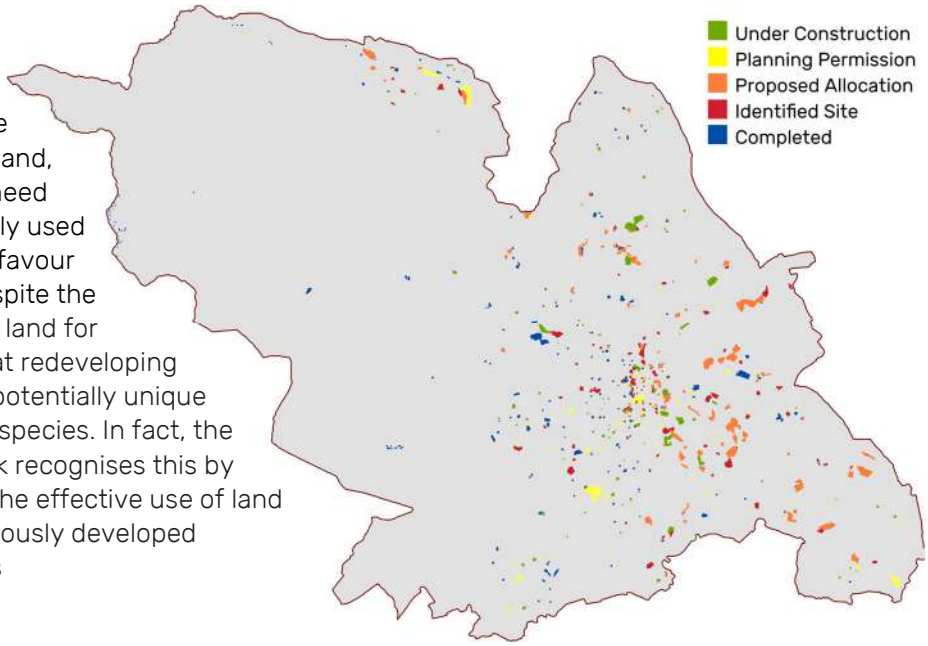


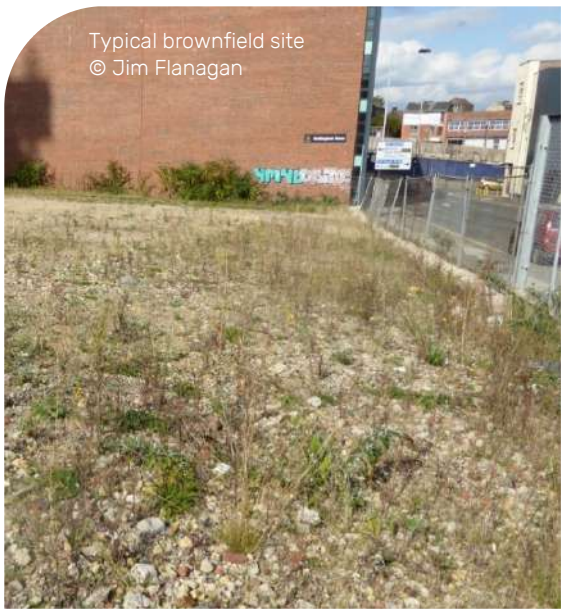
Figure 10 (above): current housing land information (as of March 2018). Data: SCC. Map credit 3

Case study: The wheat bug
Jim Flanagan, Sorby Natural History Society recorder and co-organiser of the terrestrial bugs national recording schemes

The wheat bug is one of the more recent arrivals to the UK. It is native to New Zealand, occurring in a wide range of habitats and feeding on many plants including non-native grasses and cultivated crops from Europe. Infrequently, in hot, dry years, the bug has migrated to crops and caused damage to cereals and brassicas.

The first British wheatbug record came from Suffolk in September 2007. It was found new to Yorkshire in September 2014 from a sparsely vegetated brownfield site off Rockingham Street in the centre of Sheffield, now lost to development. To the end of 2017 there have been a total of seven records for South Yorkshire.

Six other species of *Nysius* groundbug occur in the UK and all are similar in appearance. South Yorkshire now has a total of four *Nysius* species. The two most commonly found in South Yorkshire until recently were *N. ericae* and *N. thymi*, with the latter usually found on sites (including quarries) on the Magnesian Limestone with *N. ericae* more widespread on sparsely vegetated brownfield. There is evidence that the wheatbug may be as common as these, and most previous records are from brownfield sites. In Britain all *Nysius* species overwinter as adults and feed on plant sap and seeds and are found mostly in warm environments. Well-drained brownfield sites, which heat up rapidly in the sun, are favoured places. Although the bug is known to cause crop damage in New Zealand, none has yet been reported from Europe and so it is not yet considered to be a major risk to crops in the UK. However, the trend for a warming climate may increase the chance of this happening.


Typical brownfield site
© Jim Flanagan

Case study: 'Grey to Green' in Sheffield
Simon Ogden, Head of City Regeneration, Sheffield City Council

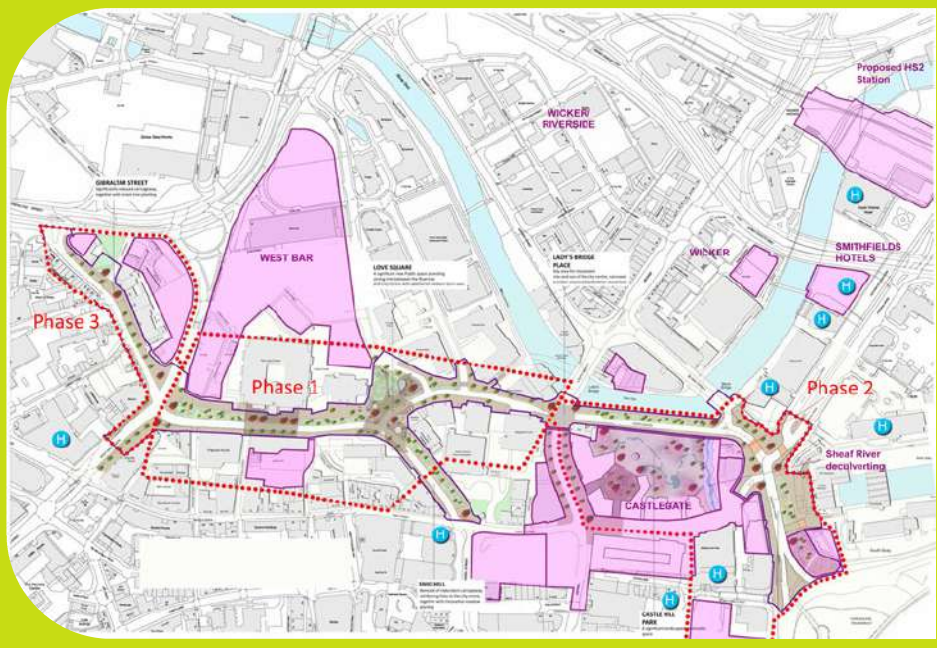
Grown from proposals in the City Centre Masterplan 2013, Grey to Green is an exciting three-phase project to transform the 'grey' redundant former Inner Ring Road space into a 'green corridor', turning once dull streets into vibrant, green public spaces of flowering meadows and wetlands in a growing business and living area.

The project aims to both enhance the environment for enjoyment, recreation, investment and regeneration and improve resilience to climate change and flooding. The scheme, designed by the Council's Landscape and Highways teams, was greatly enriched by partnership with Professor Nigel Dunnett of the University of Sheffield's Landscape Department and with local social enterprise Green Estate. It has received strong support from businesses and the public.

Completed in 2016, Phase 1 saw a significant area of wild flowers, trees and shrubs replacing redundant carriageway from West Bar to Lady's Bridge. Benches offer seating to enjoy the sights and scents of the plant life and wildlife. Sustainable Drainage (SUDS) allows the new public space to act as a rain garden to moderate the flow of water in an area that has twice been ravaged by floods. When completed it will be the largest 'retro-fit' SUDS scheme in the UK. Additionally, five colourful works of public art, forged from steel and stone, both celebrate the area's rich cultural heritage and brighten the scene in the winter when perennials are cut back.

This first phase has received national recognition through a number of awards. Highlights include Civic Trust Sheffield People's Choice 2017; Civic Voice National Award 2017; the National Green Champion Construction Category Award at the International Green Apple Awards and winning two categories at the CEEQUAL awards, plus the overall 'Eric Hughes Award 2016 for Outstanding Contribution to Improving Sustainability'. This phase cost £3.68 million and was funded by the European Regional Development Fund (ERDF), the Sheffield City Region Investment Fund (SCRIF) and SCC.

Phase 2 is in design and is planned to be built in 2018/19 subject to consultation and approvals. Further phases will take place as and when funding becomes available and updates will be available on the Council's website.

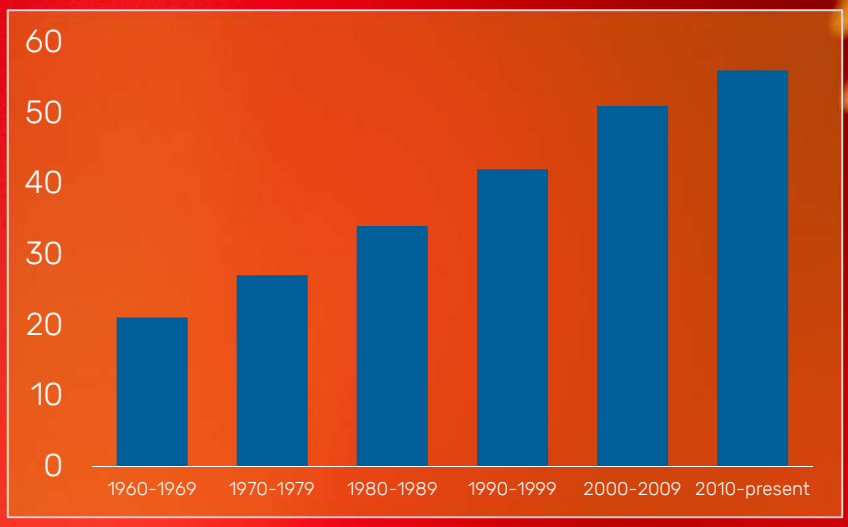


www.greytogreen.org.uk

Images © Sheffield City Council

UK Biodiversity Indicator Focus

Pressure from invasive species: B6c. Terrestrial



Harlequin ladybird
© Paul Hobson

Figure 11 (left): cumulative number of novel terrestrial invasive species recorded in Sheffield, per decade, as categorised in 'Non-Native Species in Great Britain: establishment, detection and reporting to inform effective decision making'. Data: NBN Gateway, Sheffield Biological Records Centre

Urban areas are often subject to introductions of non-native species. The combination of disturbed and anthropogenic habitats can provide opportunities for novel and invasive species to become established. These species can potentially cause problems for native species by outcompeting or predating them or by modifying habitats.

Harlequin ladybird

Thirty-two of the 46 native species of ladybird have been recorded in Sheffield but many are threatened by competition from the introduced harlequin ladybird, from eastern Asia. It was first recorded locally in 2006[28] and is now likely to be the most common species in the district[29].

Muntjac deer

Spreading into Sheffield from the south and east in 1995[30]. Along with other native species of deer – red and roe – muntjac have been sighted almost to the city centre[31].

Grey squirrel

Outcompetes red squirrels and introduces squirrelpox virus. Reds declined dramatically across Sheffield and were restricted to Upper Derwent and Ewden Valley by 1990. The last local record was taken from Greno Woods in 1987 [32].

American mink

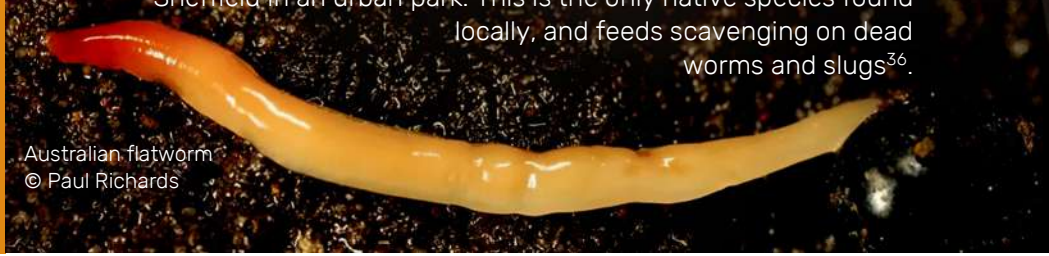
Regularly recorded in the city centre and industrial areas of the River Don with evidence of local breeding[33]. Mink coexist locally with otter, predate on local breeding birds and have eradicated most local water vole populations.

New Zealand flatworm

Translocation and introduction of plants for cultivation in gardens can bring in additional species with soil and pots. Of the 15 species of terrestrial predatory flatworm found in Britain, only four are native. These invasive species may all impact local biodiversity at some level. In 2016-17, surveys by SNHS and SRWT revealed the spread of invasive flatworms into urban Sheffield.

The New Zealand flatworm *Arthurdendyus triangulatus* is a non-native known predator of UK earthworms. A lack of tight biosecurity and extensive movement of imported plant material has allowed this species to reach the wetter, northern areas of Britain, where it now thrives. The result, revealed by a national survey[34], is a decline in earthworms and an associated reduction in soil formation and fertility. The New Zealand flatworm may also eat slugs when earthworms are scarce[35]. In an associated survey, fewer molehills were found to occur where there were flatworms, suggesting that these small invertebrates are having a big impact on more than just worms.

The surveys also revealed Australian flatworms *Australoplana sanguinea* – another earthworm-eating species. First records were also made for another smaller species from Australia, *Kontikia ventrolineata*, which predates small snails and slugs. A fourth species, *Microplana terrestris*, was also found for the first time in Sheffield in an urban park. This is the only native species found locally, and feeds scavenging on dead worms and slugs[36].



Australian flatworm
© Paul Richards

Case study: Invasive slugs and snails in Sheffield
Robert Cameron and Bob Clinging, Sorby Natural History Society

The combination of climate change, reduction in pollution and the introduction of exotic species has resulted in a number of slugs and snails being recorded recently for the first time in Sheffield, and in a great increase in numbers and area occupied by others. Among snails, there are three that deserve special mention. The common garden snail, *Cornu aspersum*, and the dark-lipped banded snail, *Cepaea nemoralis*, were very rare in Sheffield until the 1990s; the latter confined to a few allotments to the west of the city centre. Both are now abundant, found in many gardens, parks and on waste ground. The girdled snail, *Hygromia cinctella*, like *Cornu aspersum*, is not a native species, first recorded in Great Britain in 1950 in Devon. For many years it remained confined to the South West, but by 1999 it had spread as far north as Gloucestershire. Since then, it has spread rapidly. It was first recorded in Sheffield during a garden invertebrate survey in 2000. It has now been found in many sites along the Sheaf valley, and most recently in the Porter valley. It is now known from much further north, up to Edinburgh.

Among slugs there are also some recent arrivals. Most dramatic is the first Sheffield record (2017) of the ghost slug, *Selenochlamys ysbrida*. This was first discovered and described from Cardiff, although it belongs to a family restricted to the Caucasus and Crimea (where it has since been found). Like the worm slug, it is mainly subterranean and carnivorous. Until the Sheffield record was made, it appeared to be confined to South Wales, where it is often common, and to a few isolated places in southern England. There are many other invaders. The worm slug, *Boettgerilla pallens*, was first detected in Britain in 1972. Since it is subterranean it is often missed, but numerous records made by Sorby Invertebrate Group (SIG) recorders in the last 20 years show that it is now widespread in the city. *Ambigolimax valentianus*, originally described as the greenhouse slug, was known for some time only in such places. From the 1980s onward, however, it has spread rapidly out of doors. It was recorded in the Sheffield General Cemetery and in at least one garden in 2016 and will undoubtedly become widespread. Unfortunately it is hard to distinguish from another alien species, *Ambigolimax nyctelius,* that has also been spreading recently. This species is known for sure just north of the city (Elsecar) and is almost certainly here. *Deroceras invadens* was first reported in Britain in 1930. It has spread all over the country and is now very common in Sheffield.

Both images
© Paul Richards

Left: Ghost slug, Seloenochlamys ysbriba *first recorded in Sheffield in 2017.*

Far left: Cornu aspersum*, the common garden snail, was locally rare until the 1990s but is now widespread.*

Some other slugs are harder to track because identification is difficult. The yellow house slug, *Limacus flavus*, never very common, appears to have been replaced by the very similar green cellar slug, *Limacus maculatus*, which is now very abundant in gardens and compost heaps. Among the large round back slugs, *Arion* species, there are two relatively recent invaders, *Arion vulgaris*, often called the Spanish slug, and another, as yet unnamed. The latter may occur in the General Cemetery, but better material is needed to confirm the identification. These species are not easy to distinguish from the common and widespread *Arion rufus*. In all these cases, the slugs and snails are undoubtedly carried accidentally by us, but then disperse actively over much shorter distances. In conjunction with surveys carried out by SIG members, we can see how fast these incomers spread in Sheffield. Potentially, there are more to come, like *Deroceras panormitanum*, at present known only from Cardiff.

Garden snail © Austin Morley

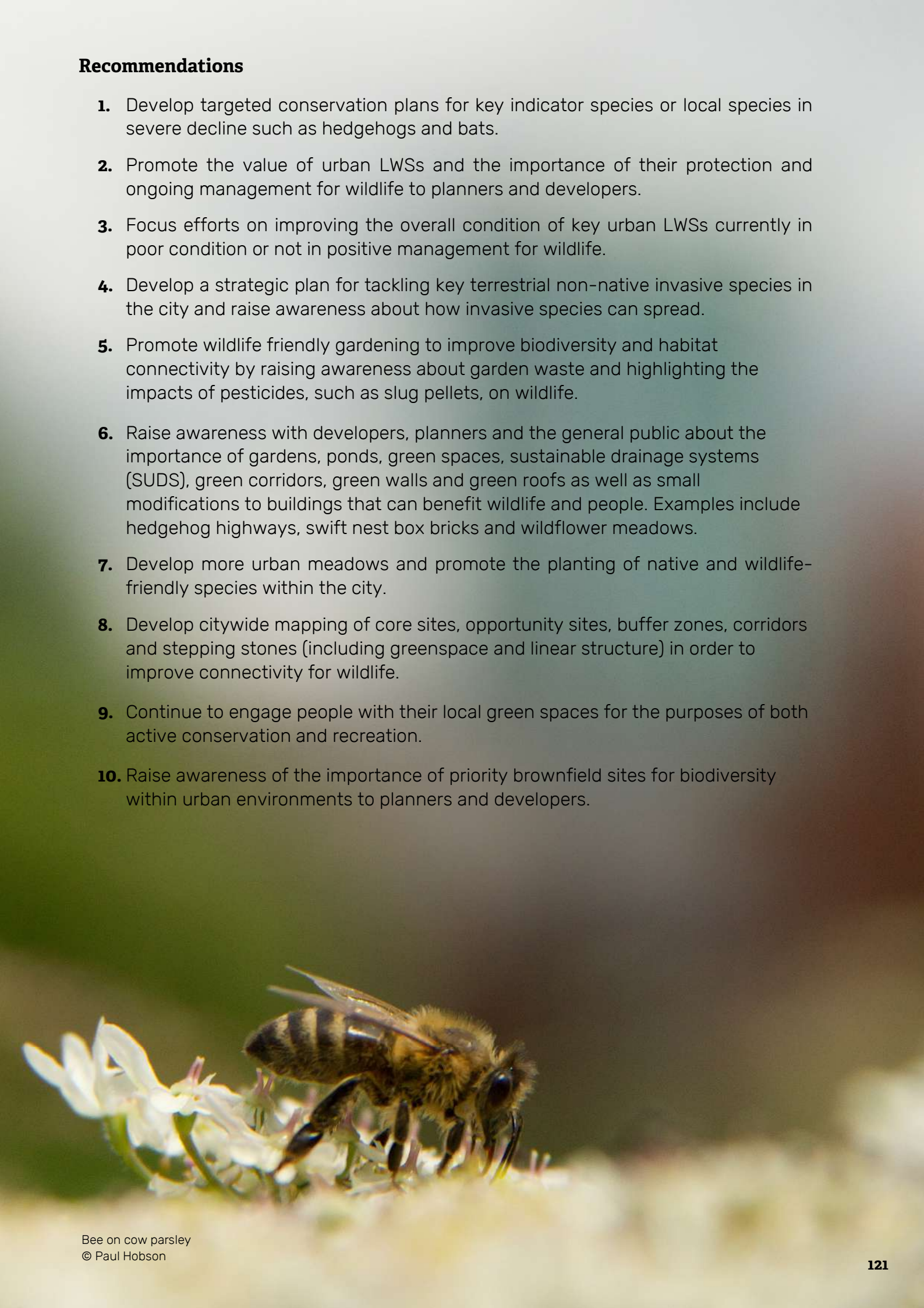
Threats to urban habitats and species

What is the threat?	What does it cause?
Residential and industrial development: urban expansion and urban development within existing greenspaces	Whilst biodiversity is considered during development, loss of suburban fringe habitats and increased residential development can lead to habitat fragmentation and a reduction of refuge sites, threatening species such as hedgehogs. Loss of greenspaces and allotments removes suitable wildlife habitat. Loss of urban trees can lead to a reduction in connectivity and availability of breeding sites for bird and butterfly species. Domestic pets can have significant negative effects on garden wildlife[37].
Litter and pollution	Litter can be lethal to small animals. Light and noise pollution can negatively affect a number of nocturnal and migratory species such as bats and breeding birds[38,39].
Transport systems	Collisions with road traffic threaten urban species such as hedgehog, badger and otter. Although rail and road networks can provide habitat connectivity along linear sections, they can also restrict animal movements if they include little associated green space such as road verges.
Invasive species	Non-native invasive species can be brought into the urban environment via the movement of goods and people into cities, coupled with deliberate imports of plants and animals. This can consequently have a negative impact on native species, for example, hybridization of native bluebells with Spanish hybrids.
Redevelopment of buildings and other urban structures	Renovation of buildings can threaten vulnerable species such as bats that use man-made structures as roosts. Redevelopment can also lead to the loss of brownfield sites which may support rare species.
Intensive gardening related to the loss, or homogenisation, of wildlife-friendly garden habitat, for example, hard landscaping	Tidier gardens may reduce biodiversity, and pesticides threaten garden wildlife. Increased fencing reduces habitat connectivity for suburban species. Hard landscaping removes available habitat for plants and associated pollinators.

Toadflax and graffiti © Paul Hobson

Recommendations

1. Develop targeted conservation plans for key indicator species or local species in severe decline such as hedgehogs and bats.
2. Promote the value of urban LWSs and the importance of their protection and ongoing management for wildlife to planners and developers.
3. Focus efforts on improving the overall condition of key urban LWSs currently in poor condition or not in positive management for wildlife.
4. Develop a strategic plan for tackling key terrestrial non-native invasive species in the city and raise awareness about how invasive species can spread.
5. Promote wildlife friendly gardening to improve biodiversity and habitat connectivity by raising awareness about garden waste and highlighting the impacts of pesticides, such as slug pellets, on wildlife.
6. Raise awareness with developers, planners and the general public about the importance of gardens, ponds, green spaces, sustainable drainage systems (SUDS), green corridors, green walls and green roofs as well as small modifications to buildings that can benefit wildlife and people. Examples include hedgehog highways, swift nest box bricks and wildflower meadows.
7. Develop more urban meadows and promote the planting of native and wildlife-friendly species within the city.
8. Develop citywide mapping of core sites, opportunity sites, buffer zones, corridors and stepping stones (including greenspace and linear structure) in order to improve connectivity for wildlife.
9. Continue to engage people with their local green spaces for the purposes of both active conservation and recreation.
10. Raise awareness of the importance of priority brownfield sites for biodiversity within urban environments to planners and developers.



Bee on cow parsley

green-veined white on urban wildflowers,
Sheffield city centre
© Paul Hobson

Appendix

Methods and data sources

Habitat mapping – general habitat coverage

The amount of each habitat within the region was calculated using data from Ebru Esroy's 2015 PhD thesis through the University of Sheffield: 'An Integrated Approach to Enhancing Ecological Connectivity and Accessibility in Urban Areas: a case study of Sheffield, UK'[1]. This dataset is herein referred to as 'EE Landcover'.

We chose to use these data for habitat mapping because the land classification scheme developed for the research was designed to be detailed, accurate and inclusive of all available datasets. Notably, data from the Land Cover Structural Analyses was used which contains habitat data from Ordnance Survey Master Map, Centre for Ecology and Hydrology- Land Cover Map 2007 (LCM2007), Forestry Commission National Inventory Woodland and Trees, Sheffield City Council- Green and Open Spaces, and MIMAS-Landmap-Cities Revealed & UK Map Datasets-Modern Aerial Photography. Further details on how these data were combined, plus their sources and references, is given in the thesis methods[1].

A description of each habitat included in EE Landcover is given later in this chapter. These include ten 'broad' habitat types and, within those, 34 'specific; habitat types, for example, 'woodland and scrub' (broad) and 'broadleaved' (specific). These definitions were based on National Land Use Database (NLUD-Version 4.4) classification schemes, which were then developed and detailed according to available data sources given in the thesis methods[1]. We used ArcMap (10.6)[2] to crop habitats to the defined Sheffield boundary, calculate coverage, and create map figures.

Habitat mapping – UK Priority Habitats Inventory (PHI) and ancient woodland

UK Priority Habitats are those defined as being the most threatened and requiring conservation action under the UK Biodiversity Action Plan (UK BAP). This has since been superseded and Natural England's Priority Habitats' Inventory (PHI) replaces previous separate BAP habitat inventories[3,4]. Data were extracted, using ArcMap 10.6[2], from the open-source spatial layer: Priority Habitat Inventory (North) (England), describing the geographic extent and location of Natural Environment and Rural Communities Act (2006) Section 41 habitats of principal importance. The dataset was downloaded from Natural England's Open Data Geoportal[5].

In addition, ancient woodlands were mapped using data from Natural England's Ancient Woodland (England) dataset[6]. This layer was additionally cropped to the EE Landcover broad habitat type 'woodland and scrub' as the ancient woodland dataset contained some cleared areas that were observed using aerial imagery (©2015 Google). This was done to increase accuracy of this national dataset at the local level.

Changes in habitat coverage

Landcover data, CORINE land cover maps (CLC) and Sentinel-2A image for Sheffield (10m spatial resolution) were used to calculate the amount of each habitat for the years 2000 and 2016. Total coverage of each broad habitat type was then calculated using ArcGIS 10.6. Further method details are outlined in the research thesis'[1].

Designated sites

Spatial data on the management status of Sheffield's Local Wildlife Sites (LWSs) were provided by Sheffield City Council Ecology Unit. Data were obtained in April 2017. Data on the positive conservation management status of sites were extracted using ArcMap 10.6[2]. For each habitat chapter, this spatial layer was cropped to the EE Landcover broad habitat type and areas under 0.5ha in size discarded. This was done to remove sites where the habitat in question was not represented at the level at which it is likely to significantly inform the conservation management of the LWS. However, this was only an assumption and may not be true in all cases.

Spatial data of Sites of Special Scientific Interest (SSSIs), Special Protection Areas (SPAs), Special Areas of Conservation (SACs) and Local Nature Reserves (LNRs) was downloaded from the data.gov.uk website in May 2017. These data were cropped to the Sheffield boundary, and, where relevant for each habitat, to the broad habitat type defined in EE Landcover. For SSSIs, data contained in the spatial datasets were then extracted regarding the current status ('favourable', 'unfavourable recovering', 'unfavourable no change', 'unfavourable declining').

UK Biodiversity Indicators

In order to set Sheffield in context with the UK, and to enable some measures of species and habitats to be tracked at a later point, we have outlined some data in line with some 'UK Biodiversity Indicators' as outlined by the Joint Nature Conservation Committee. These include invasive non-native species, measurements of water quality and assessments of key bird species as outlined below. These indicators are highlighted with specific headers within the main habitat chapters.

UK Biodiversity Indicators: C5 (a-e): Birds of the Wider Countryside

We used data from the two Sheffield Bird Study Group (SBSG) atlases – Birds of the Sheffield Area 1975-80[7] (BotSA 1975-80) and Breeding Birds of the Sheffield Area 2005-08[8] (BBotSA 2005-08) to assess changes in distribution of breeding birds considered within the UK Biodiversity Indicator C5: Birds of the Wider Countryside. These atlases looked at the confirmed, probable and possible breeding status of birds within 2km x 2km tetrads during the period of 1075-80 and 2005-08, with percentage changes in presence (occupancy) given in BBofSA 2005-08. It is important to note that these data cover a wider area than just the Sheffield district and this is reflected in the data we present from this source. Because the resolution of data did not allow for an analysis to be made regarding abundance, we used this percentage change in occupancy between the two periods to note whether the species has undergone an apparent increase (>5% change), decrease (>=5% change) or showed no change (-5% to 5% change). The time period between these mid-points of these two survey periods is 29 years, and as the UK Biodiversity indicator considers a predicted 25-year change, we considered this actual change to be comparable. However, as we did not have annual measures of occupancy, and were therefore not able to account for short term fluctuations, we used three bounds (as stated above) and not the five bounds (strong decrease, weak decrease, no change, weak increase, strong increase) given by the UK Biodiversity Indicator. This was checked and agreed by the data providers. Further methods for the UK indicator are given in the supporting document for the wild bird indicator for the UK and England[9].

Whilst our UK Biodiversity Indicator assessments can be used to some extent to measure the status of species across the Sheffield district, it is important to note that UK indicators consider abundance, not occupancy. Reasonable care should therefore be taken when comparing our local calculations to UK indicator measures.

Species data

We obtained data on species abundance and distribution via the National Biodiversity Network (NBN) and through the Sheffield Biological Records Centre (SBRC). These data were explored using Microsoft Excel and ArcGIS 10.6 to assess spatial and temporal resolution. In most cases it was not possible to present data on trends of species abundance and distribution due to lack of data, or lack of knowledge on survey effort. For case studies presenting data on species, data have originated from case study providers with their own knowledge of survey effort. Additionally, there are many studies and reports that already exist that focus on specific species and groups.

Map credits

Map credit 1. All maps unless stated otherwise are derived from: Esroy, Ebru (2017). An Integrated Approach to Enhancing Ecological Connectivity in Urban Areas: a case study of Sheffield, UK. Contains data derived from Ordnance Survey © Crown copyright; Land Cover Map 2007 (LCM2007) © Centre for Ecology; Hydrology MIMAS-Landmap-Cities Revealed & UK Map Datasets-Modern Aerial Photography © MIMAS. OS Licence number 100058740.

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Habitat descriptions

Several different classifications, sources and mapping methods have been used to assess the habitats found in Sheffield. Most notably are the broad and specific habitats mapped in the EE Landcover (see methods) and Natural England's Priority Habitat Inventory (PHI). All habitats referred to within the report are defined below. Those that are classified through EE Landcover are denoted by * and those that are classified through Natural England's PHI are denoted by †. More detailed descriptions of PHI habitats can be downloaded from the Natural England website[10].

Woodland and Trees

Broadleaved woodland*
Natural and semi-natural broadleaved plantations more than 80% cover of broadleaved species.

Conifer woodland*
Plantations with more than 80% cover of coniferous species. In Sheffield there are no native coniferous woodlands.

Shrub*
Shrub lands are characterised by rough ground growth with at least 20% cover of small, immature trees that cannot yet be distinguished as conifer or broadleaved species.

Mixed woodland*
Woodland composed of both broadleaved and coniferous species with each broad type compiling at least 20% of the total canopy cover.

Felled*
Areas of prior woodland where felling has reduced total canopy cover to less than 20%.

Young trees *
Areas with visible plantation where there is no clear difference between conifer and broadleaved species because of their immaturity.

Upland oakwood †
Woodland located in areas of high rainfall and dominated by sessile and pedunculate oaks and mainly found on nutrient-poor acidic soils. They may also contain alkaline areas associated with streams and richer plant communities.

Wet woodland†
Woodland occurring on poorly drained or seasonally wet soils and usually with alder, birch and willows as the predominant species. Often found on floodplains or as successional habitats on fens and bogs.

Traditional orchard †
Characterised by the presence of trees from the Rosaceae family which includes fruit trees. The habitat is usually composed of managed grassland with a dense arrangement of managed trees.

Lowland mixed deciduous woodland †
This habitat type covers most semi-natural woodlands across the UK. Many are ancient woodlands

Woodpasture and parkland †
A mosaic habitat of open grassland dotted with mature or veteran standing trees, historically used as grazing for livestock with natural shelter.

Ancient woodland
Woodland that has existed continuously since 1600 or before in England. They support complex communities of trees, plants, fungi, microorganisms and insects.

Waterways & Wetlands

Standing water*
Comprising all areas of natural and artificial standing water including reservoirs, lakes, ponds and canals.

Running water*
All running freshwater features and systems, mostly rivers, brooks and streams.

Marsh reeds*
Areas associated with running or standing water that are dominated by bulrushes and/or reeds.

Moorland, Upland & Heathland

Grass dominated bog *
Boggy areas, notably in the uplands, where grasses are the dominant vegetation type.

Heath dominated bog*
Boggy areas of heath habitat, found mainly on upland free-draining infertile, acidic soils and dominated by heather and low-lying shrub.

Heather*
Habitats with a high density of heather in which very few trees or bushes may occur.

Heather grassland*
Predominantly grassland that also includes a low density of heather with few trees or bushes.

Unimproved acid grassland*
See 'Grassland & Farmland' habitat definitions.

Lowland heathland †
UK dry & humid heath typically occurring on freely-draining, nutrient-poor, acidic soils. The vegetation is characteristically dominated by one or more shrubs or dwarf shrubs such as heather, gorse and bilberry. The habitat is generally dependent on grazing and burning to prevent invasion by trees and conversion to woodland.

Upland heathland †
As above, but in upland areas (typically above 300m).

Fragmented heath †
A non-priority habitat consisting of isolated areas of heathland that may be subjected to woody succession or at threat from habitat loss.

Upland flushes, fens and swamps †
Peat or mineral-based terrestrial wetlands in upland areas which receive water and nutrients from surface and/or groundwater sources as well as rainfall and remains waterlogged year-round. This habitat is restricted to upland areas and is typically dominated by sedges and *Sphagnum* sp.

Lowland fens †
Peatlands which receive water and nutrients from the soil, rock and ground water as well as from rainfall. This habitat can support a high level of biodiversity including numerous higher plants and insects. It is an important habitat for aquatic beetles.

Blanket bog †
A broad habitat definition that covers wetlands that support peat-forming vegetation and which receive mineral nutrients principally from rainfall rather than ground water.

Grassland & Farmland

Improved grassland*
Grasslands managed as pastures for agriculture including short-term grasslands and pastures that are made up of high productivity grasses often used for silage or to support livestock. Hedgerows lying between improved agricultural grassland parcels are also included in this category.

Rough grassland*
Rough grassland is a residual category containing a mixture of managed, low productivity grass areas that could not be assigned as either unimproved acid grassland or unimproved neutral grassland.

Unimproved neutral grassland*
This land cover type is characterised by vegetation dominated by grasses and herbs on a range of neutral soils.

Unimproved acid grassland*
This land cover type is characterised by vegetation dominated by grasses and herbs on a range of lime deficient soils.

Arable*
Land modified and used for annual and perennial crops and horticulture, often defined by regular ploughing.

Orchard*
All cultivated land that contains planted fruit trees and shrubs. Note that this may vary from the PHI definition of 'traditional orchard' (defined in Woodlands & Trees above)

Amenity grassland*
Amenity grasslands are dominated by grasses and managed for non-agricultural purposes for recreation and amenity facilities.

Hedgerow
A hedgerow is defined as any boundary line of trees or shrubs over 20m long and less than 5m wide, and where any gaps between the trees or shrub species are less that 20m wide.

Lowland dry acid grassland †
Nutrient-poor, free-draining soils often overlying gravel. Large areas occur in upland fringes and also form well-drained parched habitats in dryer lowland areas. It normally managed as pasture.

Lowland meadow †
Lowland neutral meadows and pastures consisting of a rich mixture of native grasses and broad-leaved herbs, often on shallow slopes or level ground with deep neutral soils. They are mostly managed by hay cropping, followed by grazing, or may be managed as permanent pasture.

Purple moor grass and rush pastures †
Marshy grasslands dominated by purple moor-grass and/or rushes. They are traditionally used as rough grazing for cattle or ponies and occasionally for hay.

Coastal and floodplain grazing marsh †
Pasture or grazed/cut meadows which are periodically flooded or have high water levels sustained by ponds or ditches.

Semi- improved grassland (non-priority) †
Neutral grasslands are usually managed for pasture or for silage or hay. These are now included in the broad habitat 'neutral grasslands'.

Grass moorland (non-priority) †
A non-priority habitat (although it is mapped within PHI) that forms a rough mosaic of other priority habitats with both grassland and moorland characteristics.

Improved grassland
Improved grasslands consist of areas with vegetation dominated by fast growing grasses and managed as pasture for agricultural purposes excluding amenity grassland managed with the purpose of recreation and amenity purposes.

Calcareous grassland
Grasslands characterised by lime-loving plants and found mainly on shallow, calcareous soils overlying limestone. These grasslands are naturally largely found on escarpments or dry valley slopes. However, as geology in Sheffield is not calcareous, patches are instead formed on imported substrate such as limestone chippings on road verges or rail sidings.

Urban/other

Derelict land*
Currently derelict, vacant or unused lands that are damaged by industrial use and beyond beneficial use without treatment.

Landscaped areas*
Vegetated and sparsely vegetated areas, including amenity greenspaces that are designed for the use of pedestrians.

Amenity grassland*
Grasslands covered with vegetation dominated by grass and managed for non-agricultural purposes for recreation and amenity facilities.

Brownfield/OMHPDL
Derelict sites for potential building development, and that have previously developed, that contain some vegetation, usually stress-tolerant species.

Glossary

Abundance (of species and/or habitats)
A measurement of the number of individuals of a species or the amount of habitat found.

Richness (of species)
A measure of the number of individual species represented in the habitat (in contrast to abundance)

Occurrence (of species and/or habitats)
The presence, or absence, of a species or habitat within a site or location.

Distribution (of species and/or habitats)
The geographical spread of a species or habitat.

Agricultural runoff
Water running off agricultural land into bodies of water, containing chemicals which affect its balance and health, e.g. excess nitrogen from fertiliser or fungicides, herbicides and pesticides from crop treatment.

Ancient trees
Very old trees that provide a range of unique services and features within a wider habitat.

Apex predator
A predator residing at the top of a food chain, on which no other creature preys.

Biodiversity
The total variety of life, including all genus, species and habitats.

Biodiversity Indicator
Assessments of biodiversity that are used to summarise and communicate broad trends.

Citizen science
Scientific data collection carried out by the general public either to simple instructions or under the guidance of a trained professional.

European Protected Species
Animals and plants that are listed in Annex IV of the European Habitats Directive and are covered under regulation (section) 41 of The Conservation of Habitats and Species Regulations (2010), offering species protection from deliberate harm.

Flash
A shallow body of still freshwater, sometimes only present in wet weather.

Growing season
The time between the last frost of spring and the first killing frost of the autumn.

Invasive Non-Native Species (INNS)
A plant, fungus, or animal species that was introduced to a specific location and that has a tendency to spread to a degree believed to cause damage to the environment usually by out-competing native species.

Local Biodiversity Action Plan species / habitat
As a signatory to the International Convention on Biological Diversity, the UK Government must create and enforce national strategies and action plans to conserve, protect and enhance biological diversity. These are delivered via the UK BAP and successively more local plans.

Local conservation priority
Species or habitats that has been defined as locally important or with a local conservation concern, usually through a Local Biodiversity Action Plan.

Lowland
Land at the level of the alluvial plain and terraces. Sometimes considered to be land below 200m above sea level.

Moorland
Upland areas, usually unenclosed, with low-growing vegetation on acidic soils, e.g. sphagnum moss, heather, bilberry and cotton. In this report moorland is characterised as heather-dominated habitat or bogs – either grass or heather dominated.

Moorland fringe
A buffer zone between open moorland and cultivated land. Sites may variously be overgrazed or overgrown grazing land or cloughs - steep sided valleys or ravines.

National Protected Species
A species that is protected within the UK under the Wildlife & Countryside Act (1981). This also contains all European Protected species

Notable trees

Large trees without veteran features that are locally important visually or may have a personal significance.

Occupancy
Presence of a species within a defined area, defined as a 2km x 2km tetrad for all bird data referenced in this report.

Heathland
Habitats that are dominated by heather species.

Priority habitat
Habitats of conservation concern as outlined by Natural England in the Priority Habitat Inventory (PHI).

Protected (species or habitat)
Many individual species and habitats receive statutory protection under a range of legislative provisions. The protection afforded is different depending on the legislation but can for example range from a duty to further the conservation of the living organisms and types of habitat to preventing intentional injury, removal or death of certain species or damage to habitats. National Protected Species are protected within the UK under the Wildlife & Countryside Act (1981). These include Section 41: Species of Principal Importance and (NERC Act Section 41) Habitat of Principal Importance in England.

Red list species
Threatened species, defined by The International Union for Conservation of Nature (IUCN) that fit precise criteria relating to their risk of extinction.

Species and Habitats of Principal Importance (NERC Act Section 41)
Species and habitats that are conservation priorities and require conservation action, usually through the production of a Biodiversity Action Plan.

Tetrad (relating to Sheffield Bird Study Group data)
Four 1km square plots arranged into a 2km by 2km square. 25 tetrads are contained in each 10km square area defined for survey purposes by the Ordnance Survey National Grid, and each is labelled A to Z (excluding O). A tetrad is then given its full reference as the 10-km square code followed by the tetrad letter (e.g. TF73G).

Upland
Land above the level of the alluvial plain.

Veteran tree
A tree usually in its second or mature stage of its life that often provides micro-habitats to nesting species.

Acronyms

ASNW
Ancient Semi-Natural Woodland

AWI
Ancient Woodland Indicator

BTO
British Trust for Ornithology

DCRT
Don Catchment Rivers Trust

DEFRA
Department of the Environment, Fisheries and Rural Affairs

EA
Environment Agency

EIA
Environmental Impact Assessment

ELS
Entry-level or generic version of the Environmental Stewardship scheme

EMP
Eastern Moors Partnership

FRES
Fellow of the Royal Entomological Society

HAP
Habitat Action Plan

HLS
High-level or targeted version of the Environmental Stewardship scheme

INNS
Invasive Non-Native Species

LNR
Local Nature Reserve

LRC
Local Record Centre

LWS
Local Wildlife Site

MIMAS
Manchester Information and Associated Services

NCA
National Character Areas

NBN
Text

NERC Act
National Environment and Rural Communities Act 2006

NIA
National Improvement Area

NNR
National Nature Reserve

NT
The National Trust

OMHPDL
Open Mosaic Habitats on Previously Developed Land

PAWS
Plantations on Ancient Woodland Sites

PDNP
Peak District National Park

PDNPA
Peak District National Park Authority

PHI
Priority Habitat Inventory

RSC
River Stewardship Company

RSPB
The Royal Society for the Protection of Birds

SAC
Special Area of Conservation

SBRC
Sheffield Biological Records Centre

SBSG
Sheffield Bird Study Group

SCC
Sheffield City Council

SMP
Sheffield Moors Partnership

SNHS
Sorby Natural History Society

SPA
Special Protection Area

SRWT
Sheffield & Rotherham Wildlife Trust

SSSI
Site of Special Scientific Interest

SYBG
South Yorkshire Bat Group

UK BAP
United Kingdom Biodiversity Action Plan

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British bluebells
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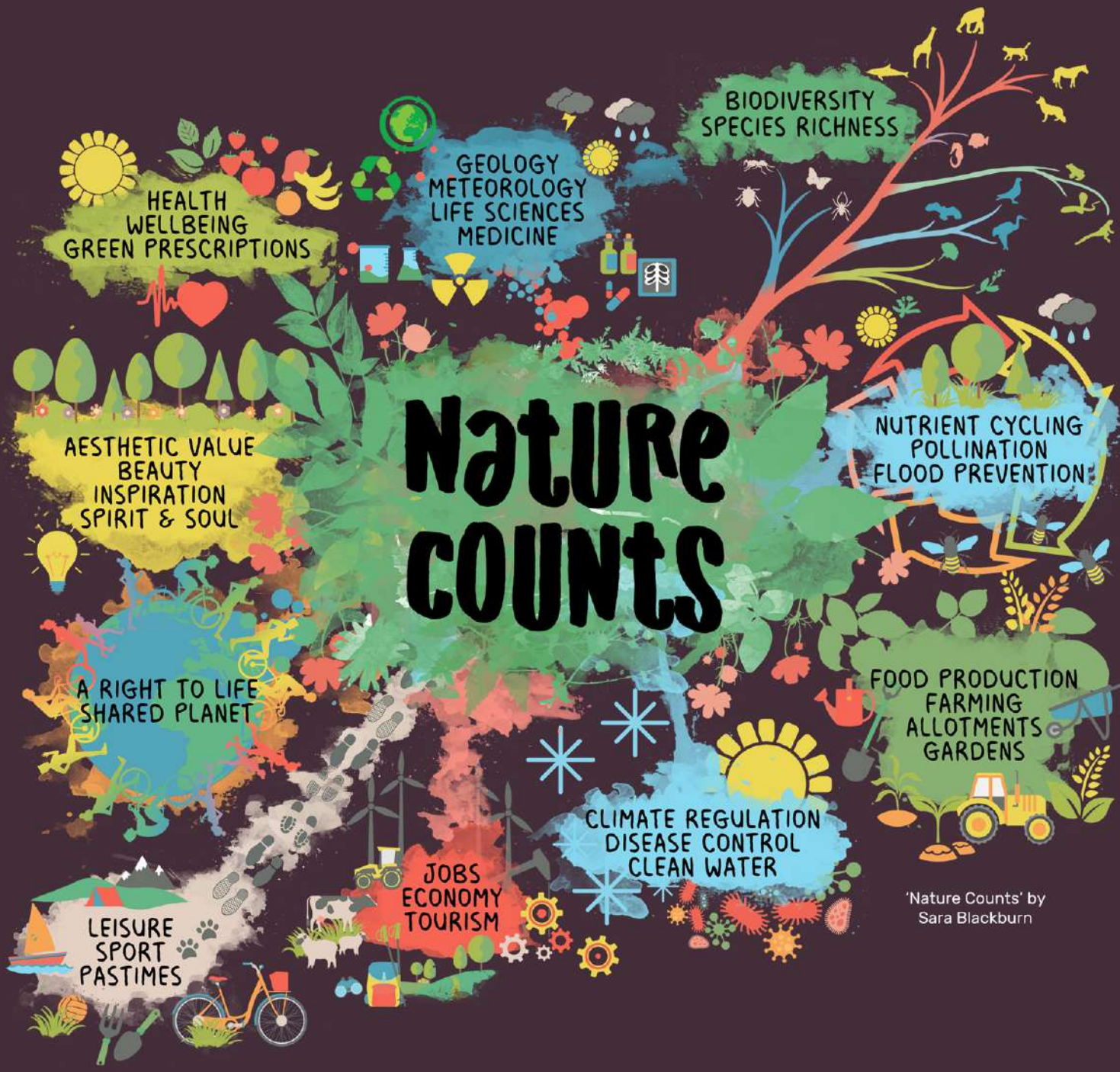

'Nature Counts' by
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