# 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'<sup>1</sup>. 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<sup>1</sup>.

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<sup>1</sup>. We used ArcMap (10.6)<sup>2</sup> 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 This has since been superseded and Natural England's Priority Habitats' Inventory (PHI) replaces previous separate BAP habitat inventories<sup>3,4</sup>. Data were extracted, using ArcMap 10.6<sup>2</sup>, 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<sup>5</sup>.

In addition, ancient woodlands were mapped using data from Natural England's Ancient Woodland (England) dataset<sup>6</sup>. 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'<sup>1</sup>.

# **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<sup>2</sup>. 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 1975-807 (BotSA 1975-80) and Breeding Birds of the Sheffield Area 2005-08<sup>8</sup> (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<sup>9</sup>.

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
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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<sup>10</sup>.

# 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

# 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.

# 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. 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.

# Marsh reeds\*

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

# 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 freelydraining, 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.

# **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.

# 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.

# 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.

# 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.

# 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.

# **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.

# 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.

# **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 outcompeting 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 lowgrowing 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 0). 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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