An FWR Guide

UK Freshwater and Wetland Habitats: opportunities to get involved in their conservation and restoration

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Grey heron *(Ardea cinerea)*
(Source: Matushaban / Shutterstock)

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1 Introduction – Aims and Scope

1.1 Taking joy in nature

Wondrous, the natural world delights us with its intimate detail and magnificent displays. Even though true wilderness is largely absent in our crowded islands, experiencing nature can give us great joy. Often, we take for granted the benefits derived from nature and the environment. And, blinded perhaps by the seasonal rhythms, we may be oblivious to relatively gradual, medium-long term changes in the health and status of the habitats we have access to. Until, that is, we notice that trout are much less abundant in our streams, the numbers and varieties of butterflies and birds we see and hear has declined markedly, and we read by chance our forebears' recording that otters used to frequent a stretch of our nearby stream.

At the time of writing, the UK is in the grip of the COVID-19 pandemic for which policy responses include restrictions on social interaction and social distancing rules. These restrictions and any associated economic downturn may well result in substantial collateral damage to the mental health and well-being of many people. Damage though that may have been less for those of us who have been able and fortunate enough to access natural or semi-natural landscapes, alongside streams, lakes and canals in our neighbourhood. However, all things pass and as a society we should look forward optimistically to a post-pandemic future. Here and now, we should recognise the benefits we gain from nature and make efforts to help ensure that the protection and restoration of nature is included when building that future.[1]

1.2 Aims of this Guide

The first of three aims is to help increase public awareness of the importance of biodiversity, specifically, on freshwater and wetland habitats as hosts for wildlife. And to further increase public engagement in conservation and restoration activity. Progress UK-wide has been encouraging on both fronts since 2014 (see Figure 1) but more can and needs to be done. In contributing to this end, the Guide considers three aspects:

1. The flora and fauna that may be found in freshwater habitats, their associated landscapes, and in wetlands across the UK (Chapters 2, 3 and 5 to 7 inclusive).
2. The legislative background and the UK institutional frameworks for the restoration and protection of freshwater and wetland habitats and their species (Chapter 3). A detailed description of the institutional framework prevailing in England only is given, to avoid repetition, as in many respects the arrangements in place in Northern Ireland, Scotland and Wales are analogous. Annex 4 summarises the main differences.
3. An introduction to the economic arguments for why such habitats should be restored and conserved (Chapter 4). This draws on a parallel FWR Guide on Natural Capital.[2] Basic premises of the natural capital concept are that nature and the environment provide benefits to people; that these benefits may be estimated in economic terms; and that they should be taken into consideration in planning and economic decision making. The inclusion of natural capital enhances the decision-making process and outcomes.

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[1] This point was very well set out in *The Economics of Biodiversity: The Dasgupta Review*, published February 2021. https://www.gov.uk/government/publications/final-report-the-economics-of-biodiversity-the-dasgupta-review

[222] Frost, R. C. and Faircloth, P. L. (2021). FWR publication FR/G0012, *Natural Capital and its Relevance to Improving Freshwater and Wetland Habitats* (in preparation).

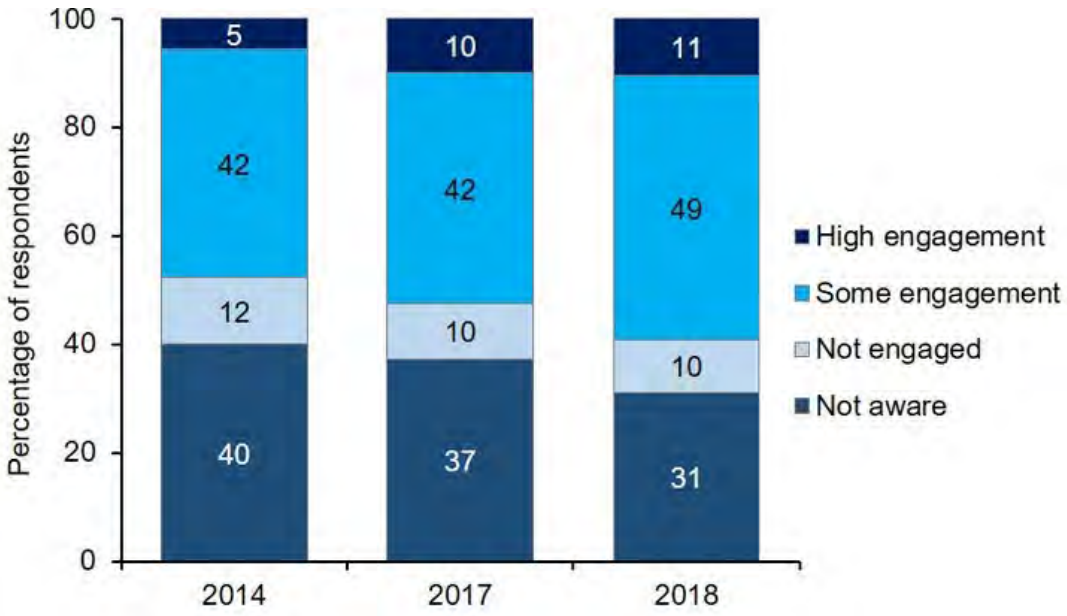

Figure 1 **UK Surveys of public awareness and engagement with biodiversity loss (2014–2018)**
Source: Joint Nature Conservation Committee[3]

A second set of aims is to summarise the pressures that threaten the natural world and provide indicative trends (Chapter 2); to characterise the selected priority habitats and highlight the range of wildlife that inhabit them (the richly illustrated Chapters 5 to 7); and to acknowledge the conservation and restoration efforts of a legion of institutions. They include statutory authorities, commercial organisations having quasi-statutory powers, landowners, farmers, businesses, Rivers Trusts, Catchment Partnerships and a host of other non-governmental organisations (NGOs) that act independently of, and in collaboration with, others (Chapters 3 and 8). Exemplar success stories of actions taken are summarised in Chapter 8.

Noting that many NGOs rely on volunteers when undertaking practical action, the third aim of this Guide is to identify the wide range of organisations with which members of the public may engage, and to indicate how the public may participate and contribute. Chapters 3 and 8, especially the latter, address this aim.

For a full range of volunteering opportunities, consult the websites provided in Section 8.3 of this Guide.

1.3 Scope

This Guide covers freshwater and wetland habitats officially designated as 'habitats of principal importance' (also known as 'priority habitats'), which support 'species of principal importance (also known as 'priority species').[4] Essentially, they signify habitats and species whose protection is a high priority. Of course, nature provides pleasure regardless of a habitat's scientific status. A community park, meadow or woodland through which a stream or brook flows may also give pleasure to members of the public. As may ponds, lakes, and other water

[3] Awareness, understanding and support for conservation: https://jncc.gov.uk/our-work/ukbi-a1-awareness/

[4] The terms 'priority habitats' and 'habitats of principal importance' and, respectively, the terms 'priority species' and 'species of principal importance', are synonymous and used interchangeably in the Guide.

features in a landscape. Indeed, the interrelations between a freshwater habitat and its immediate landscape can result in a diverse range of species being supported.

Hence, whilst this Guide focuses on priority habitats and species, its coverage extends beyond the purely aquatic zone. Examples of indicative species that may be supported and observed in river corridors and landscapes associated with freshwater, therefore, are provided in Chapters 5 to 7 especially. The two broad categories of freshwater habitat considered in detail in the Guide[5] are rivers and standing open waters. The priority wetland habitats considered lie in a greater number of broad habitat categories: fen, marsh and swamp; bogs; improved grassland (floodplain grazing marshes); and broadleaved, mixed and yew woodland (wet woodland).

They may be regarded as the UK's freshwater and wetland 'jewels', though restoration and conservation efforts applied to non-priority habitats including streams, canals, ornamental lakes and moors are valuable in a local context.

1.4 What this Guide is not

Whilst this Guide includes illustrative examples of habitat improvement, identifying practical actions, it is not a manual of restoration techniques. Its purpose is to inspire, not to serve as a template for how and when the various techniques may be deployed in practice. Should, dear reader, your appetite be whetted for more on these aspects, please consult the many other available sources for detailed information and guidance.[6]

Hyperlink references are given throughout the Guide to allow readers to directly access the primary sources of information of personal interest and relevance.

Credits for all wildlife and landscape images are provided in Annex 5.

A Glossary of terms and definitions of all acronyms used are available in Annex 6.

[5] See Chapter 3.4.1 of the Guide, which details the classification system and its background.

[6] See for example: Stephen Addy, Susan Cooksley, Nikki Dodd, Kerry Waylen, Jenni Stockan, Anja Byg and Kirsty Holstead (2016), *River Restoration and Biodiversity: Nature-based solutions for restoring rivers in the UK and Republic of Ireland,* CREW reference: CRW2014/10, available online at https://www.crew.ac.uk/publication/river-restoration; and the River Restoration Centre's *Manual of River Restoration Techniques*, (2020 edition), available online at https://www.therrc.co.uk/manual-river-restoration-techniques. Websites of the organisations listed in Chapter 8 also contain useful information and guidance.

2 Pressures on UK habitats

2.1 Status of UK habitats

In 2019 the State of Nature Partnership published its assessment of the changing state of the UK's wildlife over the years 1970 to 2016, also identifying the main pressures on nature, and the responses being made to counteract them and restore our natural heritage.[7] Whilst the assessment examined quantitative trends over the past 50 years, it commented that much habitat degradation occurred throughout the UK prior to 1970 – in general, since the onset of the Industrial Revolution. It is important to bear this in mind, therefore, when considering wildlife trends. It follows that, since biodiversity was damaged significantly prior to 1970, the status in 1970 should not be regarded as the baseline objective for habitat restoration efforts.

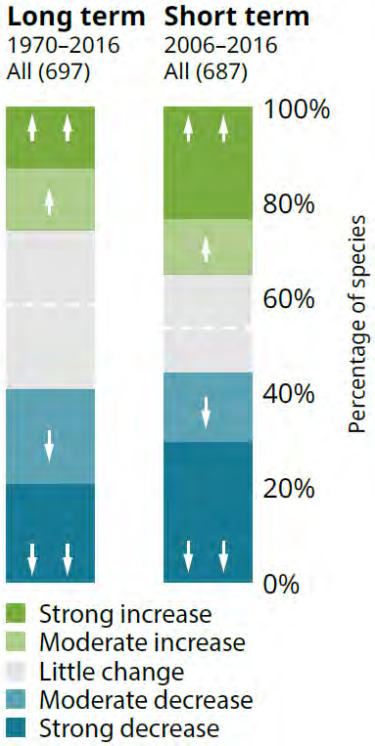

Figure 2 **Changes in species abundance over the long and short term**
Source: *The State of Nature 2019*

The *State of Nature 2019* reports trends in an overall abundance indicator for 697 terrestrial and freshwater species, showing a statistically significant decline of 13% between 1970 and 2016. However, the trends for individual species display considerable differences. This point is illustrated in Figure 2, in which species are grouped according to their change in abundance over the long term and short term, respectively: 67% of species exhibited a strong to moderate change (decrease or increase) in abundance over the long term, rising to 79% over the short term. However, two UK biodiversity indicators provide a clearer picture of declining numbers

[7] The State of Nature Partnership comprises over 70 partners drawn from the conservation NGOs, research institutes in the UK and the National Governments. *The State of Nature 2019*: Hayhow DB, Eaton MA, Stanbury AJ, Burns F, Kirby WB, Bailey N, Beckmann B, Bedford J, Boersch-Supan PH, Coomber F, Dennis EB, Dolman SJ, Dunn E, Hall J, Harrower C, Hatfield JH, Hawley J, Haysom K, Hughes J, Johns DG, Mathews F, McQuatters-Gollop A, Noble DG, Outhwaite CL, Pearce-Higgins JW, Pescott OL, Powney GD and Symes N (2019), *The State of Nature 2019*. The UK-wide assessment and national summaries are available online at: https://nbn.org.uk/stateofnature2019/reports.

(abundance indicator) and distribution (occupancy indicator) of priority species across the UK since 1970 (Figure 3).

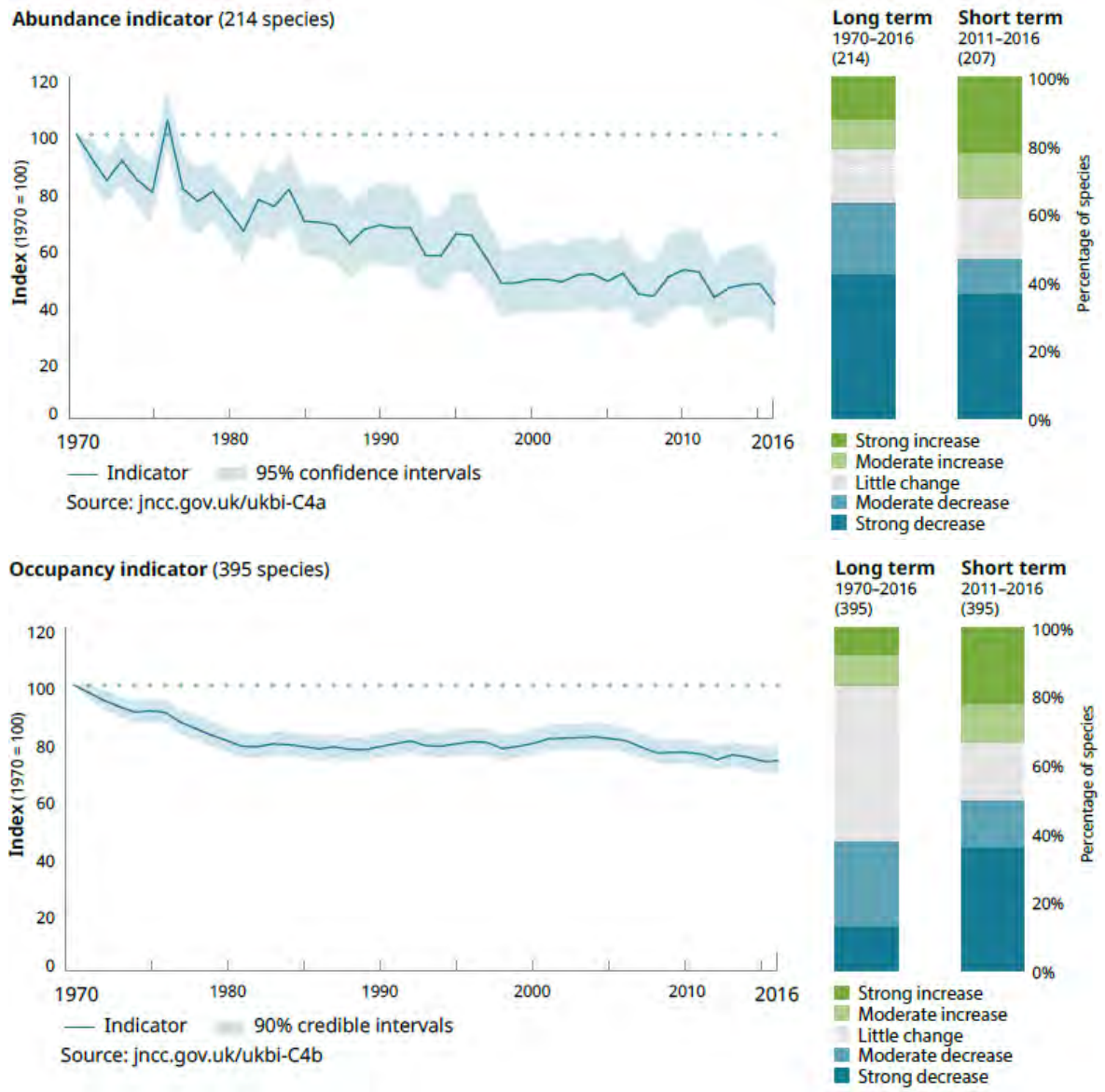

Figure 3 **UK biodiversity indicators for priority species: changes in relative abundance and distribution between 1970 and 2016**

Source: *The State of Nature 2019*

The upper chart in Figure 3 indicates that the relative abundance of 214 priority species in the UK declined by a statistically significant 60% between 1970 and 2016, the decline continuing between 2011 and 2016 (dropping by 22% over this short period). And that, whilst 22% of priority species showed strong or moderate increases in abundance, 63% exhibited strong or moderate decreases. Substantially more priority species have declined than have thrived.

The lower chart in Figure 3 indicates the relative changes in distribution (occupancy) of priority species across the UK over the years 1970 to 2016. The occupancy indicator declined by 27% over this period, the reduction in range continuing in recent years (the index was 3% lower in 2016 than it was in 2011). Over the long term, though the distribution of 16% of priority species showed strong or moderate increases, 37% of species showed strong or moderate decreases.

Overall, both the abundance and distribution of designated priority species have suffered further decline since 1970. Major pressures that have contributed to the decline in biodiversity and species abundance are introduced below.

2.2 Major pressures on UK habitats

The State of Nature 2019 report has identified seven major pressures that are responsible for biodiversity losses: agricultural management, climate change, urbanisation, pollution, hydrological change, invasive non-native species and woodland management. Most have been evident for many years whilst others have been recognised only relatively recently. Drawing extensively on *The State of Nature 2019* report, Table 1 summarises each pressure and its general effects on UK freshwater, wetland and terrestrial habitats. Examples of positive responses to counteract the pressures and mitigate their effects on freshwater and wetland habitats are introduced in Chapter 8. Websites of the organisations noted in Chapter 8 provide many other examples.

Table 1 Pressures on UK habitats (excluding marine)

Agricultural Management
About 72% of land in the UK is managed for arable and pastural farming, shaping the countryside. Increased productivity since 1970 – intensive land management, use of nitrogenous and phosphate fertilisers, and pesticide use – has impacted farmland wildlife: – Adaptable generalist species of birds, plants and insects have shown resilience, but specialist species of farmland birds, and butterflies, have seen declines in abundance. – Farming activity and run-off is a major source of water pollutants: nitrates (50–60%), phosphates (20-30%), sediment (75%) and pesticides (75%)[8]. Though the quantities of fertiliser and pesticide applied have declined since 1970, pesticide toxicity and the area treated have increased. – Other local issues can include cattle trampling and defaecating on riparian land and stream beds.
Climate Change
Climate change is one of the most significant threats to UK biodiversity. All the top ten warmest years since 1884, when records began, have occurred post-1990. All seasons have become warmer, seasonal events have advanced, and rainfall has become more variable and extreme – droughts and floods. Projections suggest that the multiple impacts observed to date may intensify, for example: – Declining abundance of moth species, an increase in flying aphids, and significant changes in plant communities in the Scottish Highlands. – Northwards movement in the distributional ranges of many bird, butterfly, moth and dragonfly species. Movement averaged 18 to 23 km per decade from the 1970s to mid-2000s. – Periods of low rainfall affecting river flows, groundwater levels, and the extent and health of lakes, ponds and wetlands. – Higher summer temperatures increasing urban water demand and water abstraction rates.
Urbanisation
The UK's human population has grown steadily for many years, accommodated mostly in urban areas. The trend continues: between 2006 and 2018 the proportion of the UK's population living in urban areas increased by 8%. Infrastructure to meet residential, transport, work and leisure demands has

[8] https://consult.environment-agency.gov.uk/++preview++/environment-and-business/challenges-and-choices/user_uploads/agricultural-and-rural-land-management-challenge-rbmp-2021.pdf

grown. Urbanisation growth has affected wildlife species more than any other habitat conversion, but the impacts of direct natural habitat loss and landscape fragmentation are complex and not all in one direction. For instance:

- Lowland heathland, mostly in southern England, has been significantly affected by habitat loss and fragmentation, impacting vulnerable species such as reptiles (sand lizard and smooth snake) and ground-nesting birds (nightjar and woodlark).
- Covering land with built, impermeable surfaces increases diffuse pollution from urban surface water run-off; however:
  - 'Green' areas – such as domestic gardens, parks, allotments, cemeteries, ponds, road verges and brownfield sites – comprise over 60% of total land cover in urban centres such as Bristol, Edinburgh, Leeds and Reading, with residential gardens covering 24–36% of each city.
  - Gardens and allotments are pollinator hotspots and, whilst classified as vulnerable to extinction, hedgehogs are showing positive signs of recovery in low-density urban habitats.
  - The biodiversity value of green areas in urban land depends on the degree of fragmentation, management, local population density and surrounding land use, but such areas are significant for the health and well-being of local people and visitors.

Pollution

In general, water and air pollution adversely impact freshwater and terrestrial wildlife, respectively. Gross pollution has reduced substantially since the 1970s in response to environmental legislation and its enforcement and the implementation of very substantial investment programmes to reduce emissions. Nevertheless, long-standing pressures remain and new ones have emerged. Pressures on freshwater quality and aquatic life include:

- Diffuse discharges of phosphates, nitrogenous compounds, suspended solids and pesticides from agricultural land and operations.
- Point-source discharges from sewage treatment plants that receive wastewater from all manner of residential and commercial properties, and (typically) from urban surface water drainage. Pollutants occurring in final effluents even after advanced treatment include nutrients (nitrogen and phosphorus – N and P), metals, microplastics, pharmaceutical compounds, and oestrogen-like chemicals (xenoestrogens).
- Intermittent point-source discharges of untreated sewage from combined sewer overflows (CSOs) and sewage treatment works.

Ambient air pollutants such as ammonia and nitrogen oxides especially impact soils and terrestrial plants directly via air quality and through deposition processes. They arise from activities that include:

- Stationary and mobile combustion processes (nitrous oxides – NOx), and
- Ammonia emissions from the management of animal manures and N-fertiliser application.

Hydrological Change

Consequent upon human activity over centuries, few pristine freshwater ecosystems remain in the UK. Activity such as the straightening and channelling of rivers, the installation of dams and weirs; abstracting groundwater and surface water for supply purposes; draining marshland and farmland; and building on flood plains. All have impacted freshwater habitats and, overall, species that are reliant on them have seen long-term decline. In 2018, for instance, the ecological status of only 35% of water bodies (adopting Water Framework Directive criteria) were classified as 'good' or 'high'.

- The abundance of all breeding water and wetland bird species fell by about 6% between 1975 and 2017, but this observation masks the influence of specific habitats. The abundance of birds of wet grassland – notably lapwing and snipe – and typically upland fast-flowing rivers declined

on average. Whereas the abundance of species associated with slow-moving and standing water, and with reedbeds, has increased on average.

- Lowland chalk streams, in particular, are vulnerable to groundwater over-abstraction.
- Weirs, dams and other physical modifications to rivers act as barriers to fish migration and movement – impeding or preventing access to spawning stretches and reducing the ability of fish to take evasive action in the event of irregular pollution events.

Invasive Non-Native Species (INNS)

By accident or design, about 2,000 non-native species have been introduced and have become established in the UK. Around 12% of these species cause adverse ecological or other impacts and are classified as INNS. Woodlands, freshwater habitats and islands are particularly affected, for example:

- Native species may be outcompeted or predated by INNS, e.g. the water vole by American mink.
- INNS may import diseases to which the native species have no resistance, e.g. the squirrel pox introduced by American grey squirrels is fatal to red squirrels.
- The native Scots pine in Scotland is threatened by fungi introduced by planting exotic pine stands.
- INNS pests and pathogens causing ash dieback is predicted to lead to the loss of insects, lichens, mosses and liverworts primarily associated with ash trees.
- Fungal infections threaten UK newt populations.
- Plant INNS can also outcompete native plants as well as choke waterways and increase flood risk.

Woodland Management

Woodland coverage in the UK has changed historically in response to human activity, from an estimated 15% coverage of England at the time of the Domesday survey, to about 5% at the end of World War I. Woodland coverage is now about 13% of the UK land area, increasing by 9% between 1998 and 2018. However, conifers account for a little over half of the woodland area on average, ranging from 74% in Scotland down to 26% in England, much being commercially planted with non-native species. Biodiversity-rich ancient woodland is estimated to cover only 2.4% of the UK land area. Woodland management practices affect woodland and its biodiversity:

- Many woods have become fragmented, intersected by roads and development, resulting in habitat degradation and the formation of barriers to wildlife movement.
- Tree disease is a worry, from the loss of 20 million elm trees to Dutch elm disease in the 1970s to more current concerns regarding ash dieback and acute oak decline.
- The grazing and browsing of an increasing deer population – that of the muntjac deer, for example, rose by about 150% between 1995 and 2018 – have reduced the natural regeneration of woodland and altered its structure, adversely affecting other dependent woodland wildlife.
- Recreational use and disturbance close to urban areas have adversely impacted soils, invertebrates, flora, birds and mammals.

As a consequence of these various pressures, UK woodland species indicators have declined:

- The woodland bird indicator fell by 25% between 1970 and 2017, especially notable in woodland specialists such as the lesser spotted woodpecker, spotted flycatcher and willow tit.
- The abundance indicator for UK woodland butterfly species – including the common blue, marbled white and meadow brown – has fallen by about 50% between 1990 and 2018, thought to result from woodland management practices and less open spaces within woods.

3 Legislative and institutional framework for protecting UK biodiversity

This chapter introduces the formal framework for biodiversity and nature conservation, starting with a background to the international commitments to which the UK is party. A brief introduction follows to the policies adopted in the UK and the present institutional arrangements for implementation. Specific arrangements within the UK's four countries are noted. Whilst a general approach is adopted, emphasis is given to freshwater-related aspects.

3.1 Background: multilateral commitments and national legislation

3.1.1 Convention on Biological Diversity, 1993

In essence, biodiversity is a measure of the variety of life at the genetic, species, and ecosystem level. Founded in 1948 and 1961, respectively, the International Union for the Conservation of Nature (IUCN) and the World Wide Fund for Nature (WWF) have been pioneers in stimulating a worldwide appreciation of nature and biodiversity.[9] Since their foundation, awareness that biological resources and diversity make vital contributions to humanity's economic and social development has grown – as has an awareness of the threats posed by human activity.

Subsequently, the raised awareness of the value and need for biological diversity (and of the threats posed by climate change) led to the convening of the United Nations' Rio 'Earth Summit' in 1992. Prior to the summit, the year 1991 saw the establishment in the UK of the JNCC (Joint Nature Conservation Committee) under the Environmental Protection Act 1990.[10] Resourced largely by staff seconded from the various country agencies, it was set up to handle science-based GB/UK and international issues. This public body advises the UK Government and devolved administrations on UK-wide and international nature conservation. Its work, and those of many other UK scientific research institutions, helped inform and develop the UK's policy position on biodiversity ahead of the Earth Summit. Parallel preparatory efforts were made by many other national governments and institutions, the collective efforts culminating in the adoption of the Convention on Biological Diversity (CBD), which opened for signature in June 1992.[11]

By June 1993 the Convention was signed by 168 countries including the UK, which subsequently became a Party to the CBD by ratification. The CBD may be seen as a major international step forward in the formal efforts to conserve biological diversity, the sustainable use of its components, and to enable the fair and equitable sharing of the benefits arising from the use of genetic resources. Since coming into force in December 1993, the CBD has provided a basis for biodiversity conservation at international and national levels (see Figure 4) though it remains the case that awareness of the value of biodiversity is not universal. This may be observed when comparing the interest and performance of countries, and within communities in any given country. Short-term market economic interests often prevail when development, conservation or restoration decisions are made. The fight to conserve, protect and restore ecological / biodiversity continues. Parties to the CBD meet periodically at a Conference of the

[9] https://www.iucn.org and https://www.wwf.org.uk

[10] https://jncc.gov.uk The website provides further information on the JNCC's formation and its antecedents.

[11] https://www.cbd.int

Parties (CoP). One of the key outputs was the Strategic Plan for Biodiversity, formed in 2010 with a planning horizon of 2020. This is introduced below.

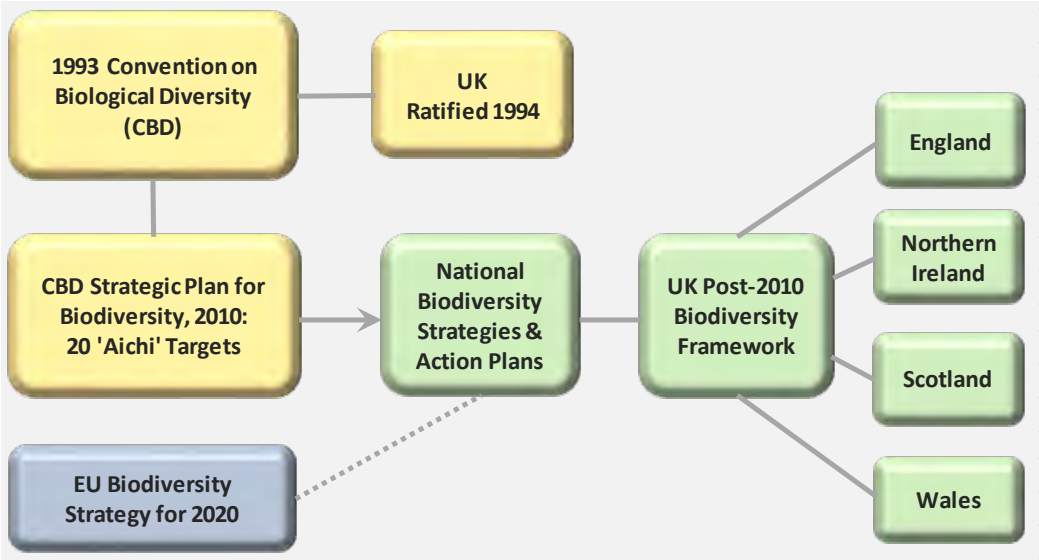

Figure 4 Genesis of the UK National Framework for Biodiversity
Source: Author, R C Frost

3.1.2 CBD Strategic Plan for Biodiversity 2010, and the Aichi Targets

The CBD's Strategic Plan for Biodiversity 2010 set five strategic biodiversity goals and 20 supportive targets, collectively known as the Aichi Targets (see Table 2). This table also provides the conclusions of the latest published assessment of the UK's progress in meeting the targets. Target 17 sets a specific requirement that each Party to the CBD formulates a national biodiversity strategy and action plan, each designed to address the other Aichi targets within its boundaries.[12] **The UK's Biodiversity Action Plan (UK BAP) published in 1994 was the first such national biodiversity action plan**. It created action plans for priority species and habitats in the UK that were most under threat so as to support their recovery.[13] The UK's Post-2010 Biodiversity Framework (the Framework) has been developed and the Aichi Targets have been cascaded down to priorities for action at a country level. Pre-Brexit, the UK was required to implement the EU's Biodiversity Strategy for 2020 – itself guided by the CBD Strategic Plan. Hence several key activities identified in the Framework refer to the EU's Strategy to 2020. For general information, Annex 1 provides a summary of the EU's updated Biodiversity Strategy for 2030.[14]

[12] In its Decision 14/34, the Conference of the Parties to the CBD adopted a comprehensive and participatory process for the preparation of the post-2020 global biodiversity framework. Negotiations are in process at the time of writing. During the fifteenth meeting of the Conference of the Parties, Parties will adopt a post-2020 global biodiversity framework as a stepping stone towards the 2050 Vision of "Living in harmony with nature".

[13] https://data.jncc.gov.uk/data/cb0ef1c9-2325-4d17-9f87-a5c84fe400bd/UKBAP-BiodiversityActionPlan-1994.pdf

[14] Communication from the Commission to the Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, Brussels, 20.05.2020, *EU Biodiversity Strategy for 2030: Bringing nature back into our lives,* https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1590574123338&uri=CELEX:52020DC0380.

Table 2 Aichi biodiversity targets and assessment of the progress made by the UK (to January 2019)

	Aichi goals and targets – all refer to these being achieved by 2020 unless specified otherwise	Assessment conclusion[15]
Goal A: Address the underlying causes of biodiversity loss by mainstreaming biodiversity across government and society		
Target 01	At the latest, people are aware of the values of biodiversity and the steps they can take to conserve and use it sustainably.	Progress but at an insufficient rate
Target 02	At the latest, biodiversity values have been integrated into national and local development and poverty reduction strategies and planning processes and are being incorporated into national accounting, as appropriate, and reporting systems.	On track to achieve target
Target 03	At the latest, incentives, including subsidies, harmful to biodiversity are eliminated, phased out or reformed in order to minimize or avoid negative impacts, and positive incentives for the conservation and sustainable use of biodiversity are developed and applied, consistent and in harmony with the Convention and other relevant international obligations, taking into account national socio-economic conditions.	Progress but at an insufficient rate
Target 04	At the latest, governments, business and stakeholders at all levels have taken steps to achieve or have implemented plans for sustainable production and consumption and have kept the impacts of use of natural resources well within safe ecological limits.	Progress but at an insufficient rate
Goal B: Reduce the direct pressures on biodiversity and promote sustainable use		
Target 05	The rate of loss of all natural habitats, including forests, is at least halved and where feasible brought close to zero, and degradation and fragmentation is significantly reduced.	Progress but at an insufficient rate
Target 06	All fish and invertebrate stocks and aquatic plants are managed and harvested sustainably, legally and applying ecosystem-based approaches, so that overfishing is avoided, recovery plans and measures are in place for all depleted species, fisheries have no significant adverse impacts on threatened species and vulnerable ecosystems and the impacts of fisheries on stocks, species and ecosystems are within safe ecological limits.	Progress but at an insufficient rate

[15] Progress JNCC. 2019, *Sixth National Report to the United Nations Convention on Biological Diversity: United Kingdom of Great Britain and Northern Ireland. Overview of the UK Assessments of Progress for the Aichi Targets*, JNCC, Peterborough, https://www.cbd.int/doc/nr/nr-06/gb-nr-06-p3-en.pdf (accessed 04/12/2020). For further information on the assessment of progress, visit: http://jncc.defra.gov.uk/page-7731 and https://www.cbd.int/doc/nr/nr-06/gb-nr-06-p3-en.pdf.

	Aichi goals and targets – all refer to these being achieved by 2020 unless specified otherwise	Assessment conclusion[15]
Target 07	Areas under agriculture, aquaculture and forestry are managed sustainably, ensuring conservation of biodiversity.	Progress but at an insufficient rate
Target 08	Pollution, including from excess nutrients, has been brought to levels that are not detrimental to ecosystem function and biodiversity.	Progress but at an insufficient rate
Target 09	Invasive alien species and pathways are identified and prioritized, priority species are controlled or eradicated, and measures are in place to manage pathways to prevent their introduction and establishment.	Progress but at an insufficient rate
Target 10	*By 2015*, the multiple anthropogenic pressures on coral reefs, and other vulnerable ecosystems impacted by climate change or ocean acidification are minimized, so as to maintain their integrity and functioning.	Progress but at an insufficient rate
Goal C: Improve the status of biodiversity by safeguarding ecosystems, species and genetic diversity		
Target 11	At least 17 per cent of terrestrial and inland water, and 10 per cent of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, are conserved and integrated into the wider landscapes and seascapes through effectively and equitably managed, ecologically representative and well-connected systems of protected areas and other effective area-based conservation measures.	On track to achieve target
Target 12	The extinction of known threatened species has been prevented and their conservation status, particularly of those most in decline, has been improved and sustained.	Progress but at an insufficient rate
Target 13	The genetic diversity of cultivated plants and farmed and domesticated animals and of wild relatives, including other socio-economically as well as culturally valuable species, is maintained, and strategies have been developed and implemented for minimizing genetic erosion and safeguarding their genetic diversity.	Progress but at an insufficient rate
Goal D: Enhance the benefits to all from biodiversity and ecosystem services		
Target 14	Ecosystems that provide essential services, including services related to water, and contribute to health, livelihoods and well-being, are restored and safeguarded, taking into account the needs of women, indigenous and local communities, and the poor and vulnerable.	Progress but at an insufficient rate
Target 15	Ecosystem resilience and the contribution of biodiversity to carbon stocks has been enhanced, through conservation and restoration, including restoration of at least 15 per cent of degraded ecosystems, thereby contributing to climate change mitigation and adaptation and to combating desertification.	Progress but at an insufficient rate
Target 16	*By 2015*, the Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization is in force and operational, consistent with national legislation.	On track to achieve target

	Aichi goals and targets – all refer to these being achieved by 2020 unless specified otherwise	Assessment conclusion[15]
Goal E: Enhance the implementation through participatory planning, knowledge management and capacity building		
Target 17	*By 2015* each Party has developed, adopted as a policy instrument, and has commenced implementing an effective, participatory and updated national biodiversity strategy and action plan.	On track to achieve target
Target 18	The traditional knowledge, innovations and practices of indigenous and local communities relevant for the conservation and sustainable use of biodiversity, and their customary use of biological resources, are respected, subject to national legislation and relevant international obligations, and fully integrated and reflected in the implementation of the Convention with the full and effective participation of indigenous and local communities, at all relevant levels.	Not assessed
Target 19	Knowledge, the science base and technologies relating to biodiversity, its values, functioning, status and trends, and the consequences of its loss, are improved, widely shared and transferred, and applied.	On track to achieve target
Target 20	At the latest, the mobilization of financial resources for effectively implementing the Strategic Plan for Biodiversity 2011–2020 from all sources, and in accordance with the consolidated and agreed process in the Strategy for Resource Mobilization, should increase substantially from the current levels. This Target will be subject to changes contingent to resource-needs-assessments to be developed and reported by Parties.	Progress but at an insufficient rate

The assessment conclusions, set out in Table 2, are consistent with the observations on habitat pressures, status and effects summarised by *The State of Nature 2019* (see Table 1 in Section 2.2). Progress reported on five procedural and cross-cutting Aichi targets is encouraging, with the expectation that they should be achieved by the set deadlines. But on thirteen targets aimed at implementation – e.g. regarding the mobilization of financial resources, Target 20 – and achieving actual biodiversity improvement targets, limited progress is reported. It is clear that much more remains to be done at the implementation level. Examples of planned action to meet the Aichi targets are given at the end of Section 3.1.3.

3.1.3 UK post-2010 Biodiversity Framework

Published 17 July 2012, the Framework was produced by JNCC and Defra on behalf of the Four Countries' Biodiversity Group (4CBG).[16] The 4CBG provides a mechanism for the environment departments of all four governments in the UK to work together. Covering the period from 2011 to 2020,[17] the Framework was developed in response to two main drivers: (i) the 'Aichi Biodiversity Targets' and (ii) the Targets and Actions of the EU's Biodiversity Strategy (EUBS 2020), which set out an ambitious strategy to halt the loss of biodiversity and ecosystem services in the EU by 2020.

It is expected that the first of these drivers will be revised in 2021 under the auspices of the CBD Conference of Parties. However, the second of these, revised and updated to a planning horizon of 2030 (see Annex 1) will not apply to a post-Brexit UK. The Framework also drew on the 2011 UK National Ecosystem Assessment (NEA), which provided a ground-breaking, comprehensive account of how the natural world provides services that are critical to human well-being and economic prosperity.[18] The NEA also showed that the provision of such eco-services is in decline and that nature is consistently undervalued in decision-making – Chapter 4 develops this aspect.

The Framework reflects a revised direction for nature conservation, towards an approach that considers the management of the environment as a whole. It acknowledges the value of nature, looking to include this in decision-making, and sets out the common purpose and shared priorities of the UK and its four constituent countries. Full details of the specific UK priorities and 22 key activities to address the five Aichi strategic goals were set out in the Framework, which is freely available online (see above reference). The Implementation Plan produced in November 2013 was updated and revised in June 2018. The UK Framework and biodiversity strategies and action plans are important documents. They are to be prepared, owned, and implemented by each of the UK's four countries. Noteworthy Framework activities included:

Strategic Goal A: Using knowledge and evidence from across the UK and internationally to identify, measure and integrate biodiversity values in accounting systems, business and other sectors; and sharing knowledge of the impact of the UK's consumption of resources. In addressing this goal, commitments 35, 40 and 41 and 44 of the *Natural Environment White Paper,* 2011, (NEWP) signalled the full inclusion of natural capital in the UK Environmental

[16] JNCC and Defra (on behalf of the Four Countries' Biodiversity Group), 2012, *UK Post-2010 Biodiversity Framework*, July 2012, available online at: https://data.jncc.gov.uk/data/587024ff-864f-4d1d-a669-f38cb448abdc/UK-Post2010-Biodiversity-Framework-2012.pdf.

[17] At the time of writing, work on an extension to the Framework until 2030 has begun but a draft is not yet publicly available.

[18] UK National Ecosystem Assessment (2011), http://uknea.unep-wcmc.org

Accounts, the publication of a roadmap for further improvements, and helping businesses understand their impacts on natural capital.[19]

Strategic Goal B: Addressing issues caused by invasive alien species. And developing a robust evidence base, from which freshwater (and other) habitats vulnerable to climate change can be identified – including those which may need special management to increase their resilience to change and facilitate adaptation.

Strategic Goal C: Provision of information to support the identification and listing of threatened species through the quinquennial review of schedules 5 and 8 of the Wildlife and Countryside Act 1981, quality assurance of the UK Species Red Lists, and access to information on the changes in distribution of species.[20]

Strategic Goal D: Building and applying the evidence base to implement the ecosystem approach and support ecosystem assessments; and facilitating the sharing of best practice in relation to climate change adaptation and green infrastructure.

Strategic Goal E: Key UK-scale activities include the international sharing of information and the formal reporting of progress on achievements; and the mobilisation of resources for biodiversity, including innovative financial mechanisms. The latter activity, for instance, may be seen as a progenitor of the Catchment Based Approach (CaBA) for improving the quality of England's water environment.[21]

3.1.4 Designation of habitats and species of principal importance

Each of the four countries of the UK is legally obliged to maintain lists of **habitats and species of principal importance** for biodiversity conservation.[22,23] Species so designated are those that are most threatened. Either because they are in greatest decline or because the UK holds a significant proportion of the world's total population. The habitats designated to be of principal importance are those which may sustain such species. The lists are mainly derived from those originally drawn up in 1994 for the UK Biodiversity Action Plan (UK BAP). The species list includes Red List designated species, whilst the habitats list includes Sites of Special Scientific Interest (SSSI, or Areas of Special Scientific Interest – ASSI – in Northern Ireland).[24]

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[19] *The Natural Choice: securing the value of nature,* https://www.gov.uk/government/publications/the-natural-choice-securing-the-value-of-nature, New Environment White Paper.

[20] The Countryside and Wildlife Act 1981 as amended may be accessed through: https://jncc.gov.uk/our-work/wildlife-countryside-act. UK Red List Species may be accessed through: https://jncc.gov.uk/our-work/red-lists-in-great-britain.

[21] The 2013 policy document, *Catchment Based Approach: Improving the quality of our water environment*, and sources of guidance on CaBA, respectively, are available from: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/204231/pb13934-water-environment-catchment-based-approach.pdf and https://catchmentbasedapproach.org.

[22] In England: Section 41 of the Natural Environment and Rural Communities (NERC) Act 2006. In Northern Ireland: Section 3(1) of the Wildlife and Natural Environment Act (Northern Ireland) 2011. In Scotland: Section 2(4) of the Nature Conservation (Scotland) Act 2004. In Wales: Section 7 of the Environment (Wales) Act 2016.

[23] 'Species of principal importance' and 'habitats of principal importance' are synonymous with the terms 'priority species' and 'natural priority habitats', respectively, introduced in COUNCIL DIRECTIVE 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora. This is available from: https://ec.europa.eu/environment/nature/legislation/habitatsdirective/index_en.htm

[24] Red Lists are a globally recognised way of identifying the threat of extinction to species, using the internationally accepted Red List guidelines developed by the International Union for Conservation of Nature (IUCN) (IUCN 2012a, 2012b, IUCN Standards and Petitions Subcommittee 2019). The procedure for assessing species at a global scale is described by IUCN 2012a and at a regional scale by IUCN 2012b. SSSI (ASSI in Northern Ireland and Isle of Man) is a conservation designation denoting a protected area. Usually, it describes an area that is of particular interest to science due to the rare species of fauna or flora it contains – or even important geological or physiological features that may lie in its boundaries.

Both lists were reviewed in 2007, increasing the total number of UK BAP habitats from 45 to 65 and the number of UK BAP species from under 600 to 1,150. Updating the lists continues, though at a country level. Table 3 identifies the freshwater and wetland habitats identified as being of principal importance in the UK.

Table 3 Updated list (December 2011) of UK freshwater and wetland priority habitats[25]

UK BAP Broad Habitat	UK BAP Priority Habitat	Changes agreed in 2007 review
Rivers and streams	Rivers (updated 2011)	New priority habitat, broader in scope than the existing Chalk Rivers. (Scope clarified in 2010)
Standing open waters and canals	Lakes – Oligotrophic and Dystrophic	New priority habitat
	Lakes – Mesotrophic	-
	Eutrophic standing waters	-
	Ponds	New priority habitat
	Aquifer-fed naturally fluctuating water bodies	-
Fen, marsh and swamp	Upland flushes, fens and swamps	New priority habitat
	Lowland fens	Revised name (previously 'Fens')
	Reedbeds	-
	Purple moor grass and rush pastures	-
Bogs	Lowland raised bogs	-
	Blanket bogs	-
Improved grassland	Floodplain grazing marshes	
Broadleaved, mixed and yew woodland	Wet woodland	
	Seven others not considered here	

The much longer list of UK BAP priority species comprises birds, fish, terrestrial mammals, herptiles,[26] fungi (including lichens), non-vascular plants, vascular plants, terrestrial invertebrates, and marine species. All but the last species types may be found in freshwater habitats or their surrounding landscapes; examples are illustrated throughout the Guide.

Comprehensive lists of UK BAP priority species (including the changes resulting from the 2007 review) may be accessed from the JNCC website.[27] For illustration, Annex 3 lists priority fish species (excluding marine-only) and their occurrence across the UK as given on the JNCC's website. Chapters 5 to 7 provide qualitative descriptions of each priority habitat and notable species to which they are host. Details of habitats and all species of principal importance in the UK's four countries may be found on the websites of Natural England, Department of

Most other legal nature/geological conservation designations in the United Kingdom are based upon them, including national nature reserves, Ramsar sites, Special Protection Areas, and Special Areas of Conservation. See: http://www.environmentlaw.org.uk/rte.asp?id=303 and the websites of Natural England, Department of Agriculture, Environment and Rural Affairs (Northern Ireland), NatureScot, and Natural Resources Wales.

[25] https://jncc.gov.uk/our-work/uk-bap-priority-habitats/. (The updated list referred to in Table 3 was published 2019_10_17 and accessed 2020_12_13). Resources that provide technical descriptions of each habitat, the qualifying criteria, and lists of UK BAP Species may be accessed via the JNCC hyperlink.

[26] Herptiles: amphibians and reptiles.

[27] https://jncc.gov.uk/our-work/uk-bap-priority-species/

Agriculture, Environment and Rural Affairs (Northern Ireland), NatureScot, and Natural Resources Wales, respectively.

3.2 UK institutional framework

3.2.1 General

The UK possesses a rich network of institutions active in the field of research into biodiversity and the conservation of nature and wildlife. Collectively, they contribute to informing policy development and implementation in the four countries, whether directly or indirectly through the JNCC and the 4CBG. Sections 3.2.2 to 3.2.4 summarise briefly the institutional arrangements for policy development and implementation in England. Analogous institutional arrangements are in place in Northern Ireland, Scotland and Wales and, in order to avoid repetition, they are not described in the Guide. However, there are differences, and these are noted in Annex 4.

UK international representation and reporting responsibilities reside with the Department for Environment, Food and Rural Affairs (Defra), which also sets policy for England.

3.2.2 England: statutory bodies

Defra, in conjunction with its triumvirate operational agencies – Natural England, the Environment Agency and the Forestry Commission – has overall responsibility to ensure the protection of Priority Habitats in England: see Figure 5.

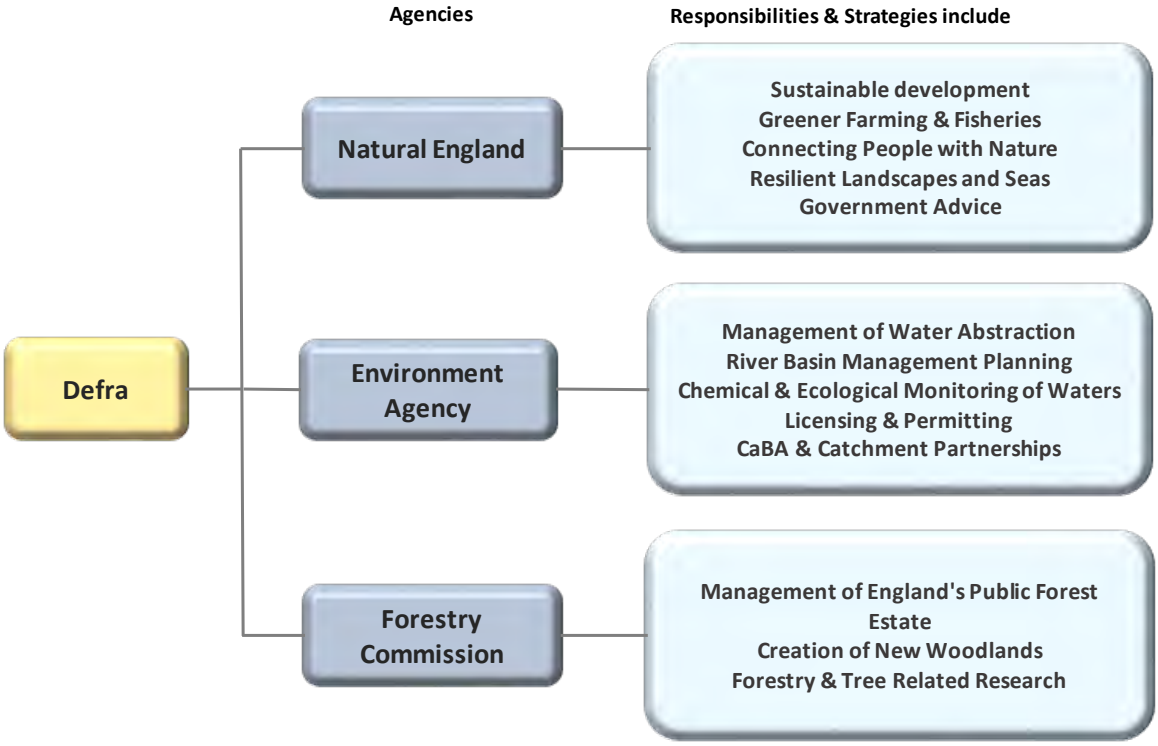

Figure 5 Principal statutory bodies relevant to priority habitat protection in England
Source: Author, R C Frost

A feature of the triumvirate's programmes – see below - is the importance placed on working through partnerships. These may be with the other Defra agencies; local authorities, water, farming and other business and development interests, as well as a host of charitable and

other non-profit-making bodies. Thus, there are many opportunities for businesses and members of the public to contribute to the work of such partnerships directly, through joining local activist organisations, or through volunteering – see Chapter 8.

Natural England: the government's adviser for the natural environment in England and the lead agency for England's Biodiversity Strategy, aimed at ensuring England's nature and landscapes are conserved, enhanced and managed – both for the services they provide and for people to enjoy.[28] Natural England is also the lead agency for implementing the European Landscape Convention.[29]

In many ways, Natural England's overarching strategy has been influenced substantially by the Lawton Report[30] which urged wildlife conservation to shift away from simply '*hanging on to what we have, to one of large-scale habitat restoration and re-creation, underpinned by the re-establishment of ecological processes and ecosystem services, for the benefits of both people and wildlife*'. A major message of the Lawton Report concerned the need to establish resilient, coherent ecological networks in England that address both the quality of existing habitats and their fragmentation.

In October 2020, Natural England published its mission for *Building partnerships for nature's recovery*.[31] This set out its guiding vision, embodied in four strategic programmes for the protection and restoration of our natural world (Table 4) so that:

- wildlife thrives
- landscapes are beautiful and resilient
- people can benefit from nature in towns, cities, in the countryside and at sea, and
- Natural Capital improvements are made, driving sustainable economic growth, healthy food systems and prospering communities.

[28] https://www.gov.uk/government/organisations/natural-england

[29] https://www.coe.int/en/web/landscape. The Convention was adopted on 20 October 2000 in Florence (Italy) and came into force on 1 March 2004 (Council of Europe Treaty Series no. 176). The Convention's aim is to promote the protection, management and planning of European landscapes and organise European co-operation on landscape issues.

[30] Lawton Report (2010): "making Space for Nature: A review of England's wildlife sites and ecological network". https://webarchive.nationalarchives.gov.uk/20130402170324/http:/archive.defra.gov.uk/environment/biodiversity/documents/201009space-for-nature.pdf

[31] This document may be accessed from the website below (accessed 19 December 2020): https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/924682/Natural-England-building-partnerships-for-natures-recovery.pdf

Table 4 Natural England's *Building partnerships for nature's recovery*

Natural England's *Building partnerships for nature's recovery* Four Strategic Programmes
Resilient Landscapes and Seas: to create thriving, beautiful landscapes teeming with wildlife, and seas rich in plants and aquatic life: – Working with local authorities to develop Local Nature Recovery Strategies (LNRS) in partnership with communities to promote action and targeted investments – Integrating LNRS into a national Nature Recovery Network to ensure connected spaces and collaborative action across England – Ensuring that designated sites – including SSSIs, National Nature Reserves, AONBs and National Parks – lie at the heart of the Nature Recovery Network – Conducting monitoring and evaluation programmes to track changes over time – Making effective use of science, strong partnerships and local support.
Sustainable Development: creating beautiful places for people to live and work, in which both nature and people can thrive: – Adopting a biodiversity Net Gain approach when providing advice, in order to ensure that all developments result in measurably more biodiversity, and creating a framework for this national initiative – Providing planning advice in timely fashion so that Nature is considered at the earliest design phase, so as to deliver high environmental quality developments – Working creatively and constructively in partnerships to prevent breaches of environmental permits at important protected habitats – Creating better places to live, work and play by embedding green infrastructure standards into all development planning – Helping to level up observed social and health inequalities by using green space and nature to build back greener.
Greener Farming and Fisheries: in order that improving natural capital becomes central to decision making in farming and fishing businesses: – Developing a customer-focused on-farm environmental advice service, building on the Catchment Sensitive Farming Scheme, to deliver better results for nature – Advising Defra as it develops new legislation and reward systems for farmers and fishers delivering public goods, recognising these as making vital contributions to the Nature Recovery Network and the government's 25 Year Environmental Plan targets – Continuing to work with water companies, the Environment Agency and Defra to establish common monitoring standards with the aim of improving water quality.
Connecting People with Nature: fostering deep connections between people and nature and ensure people have ready access to nature-rich places: – Enabling 'environmentally deprived' communities to access nature on their doorstep through, for instance, a Nature Recovery Network and improved National Trails – Embedding green infrastructure standards into local authority planning strategies, focusing on areas of deprivation – Partnering with the National Academy for Social Prescribing to test the effectiveness of nature-based solutions for people with mild to moderate health conditions – Using people-and-nature related evidence to help government shape better policies to reduce inequality and deprivation.

Environment Agency (EA): the lead agency with responsibilities relating to the protection and enhancement of the environment in England. It plays an important role in the protection of freshwater habitats being responsible for, amongst other things:

- Maintaining and ensuring improvements in the chemical and ecological quality of surface waters and groundwaters, monitoring the quality of rivers, lakes, the sea and groundwater on a regular basis.
- The River Basin Management Planning process, licensing and permitting – including controls over the abstraction of surface and groundwater.
- Administering the Catchment Based Approach (CaBA) for river management and the hosting arrangements for over a hundred Catchment Partnerships. The latter bring together local organisations with the aim of helping them to work collaboratively on the conservation and improvement of river stretches and habitats within each defined catchment area.[32]

Apart from its monitoring, permit and licence setting, inspection and enforcement role, the work of the EA is central to delivering the goals laid out in the government's 25 Year Environment Plan. Relevant to the present Guide, the EA's goals presented in its June 2018 ambitions document *Creating a better place* include:

- clean and plentiful water
- thriving plants and wildlife
- using resources from nature more sustainably and efficiently
- enhancing beauty, heritage and engagement with the natural environment
- enhancing biosecurity.[33]

Forestry Commission: the government department responsible for protecting, expanding and promoting the sustainable management of woodlands, working with two agencies: Forestry England and Forestry Research. Amongst other things, the Commission requires that applications for productive multi-purpose woodland (over 10 hectares) considers impacts on biodiversity, landscape, water, historic environment, and local stakeholders. Forestry England manages more woodland and trees than any other organisation in the country and is committed to growing the nation's forests by creating new woodlands, addressing each of the following themes:

- Climate crisis: planting new forests results in locking up more carbon than is currently stored in trees, soils and leaf litter.
- Working with nature: by using a natural capital approach it is expected that the benefits that forests offer society may be brought into balance – by improving health and well-being, storing carbon, providing natural flood management, and allowing habitats for wildlife to thrive – in addition to forests being a source of sustainable wood.
- Working with people: local communities, partners and experts.
- Sustainable wood: harvesting sustainable timber helps to maintain healthy and diverse woodlands, managed in ways that support biodiversity and major natural processes.[34]

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[32] https://catchmentbasedapproach.org.

[33] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/713127/Environment_Agency_our_ambition_to_2020.pdf

[34] https://www.forestryengland.uk/

3.2.3 England: public authorities

Public Authorities: these have a duty in England to pay regard to conserving biodiversity as part of their policy or decision making. Conserving biodiversity can include restoring or enhancing a habitat or given species' population. A public authority can be a:

- local authority including a unitary, county, district, community, parish or town council
- government department or one of their executive agencies
- non-departmental government body
- NHS Trust
- utility company
- body carrying out functions of a public character under a statutory power.

For instance, when land is considered for development, councils overseeing the planning process have to consider biodiversity and habitats. Many or most councils have some form of biodiversity policy, usually linked to local open spaces, community well-being and the good mental health of their constituent population.

3.2.4 England: non-statutory bodies

The activities of a multitude of other bodies and interested parties may impact on, conserve and improve freshwater habitats and associated landscapes – see Figure 6.

Parties may make improvements as a core activity or through collaborating with others in partnership – often involving one or more of the Defra triumvirate. Their operation may be national, regional or local and their main focus may lie with a specific habitat or habitats, with certain species, or other issues. In practice, most parties have overlapping interests. This can be conducive to collaborative working – either to design and implement a specific restoration or improvement project, or to develop joint strategies and action plans. Indeed, collaborative working is a key rationale for the formation of EA part-funded Catchment Partnerships, which cover all of England. Chapter 8 includes a non-exclusive listing of non-governmental organisations with their website addresses. Profiles of a few are introduced below.

Regional Water Service Providers: nine privatised regional water service providers are mandated to supply water to the public and provide wastewater collection, treatment and disposal services in England. They also have some quasi-statutory powers regarding, for instance, the consent conditions they apply to premises discharging trade effluents to sewer. Their activities can have potentially negative impacts such as (i) reduced river flow rates resulting, in part, from abstracting surface water or groundwater for supply purposes, and (ii) river pollution and ecological damage resulting from pollutants discharged to river from combined sewer overflows (CSOs) and sewage treatment plants – regardless of whether those discharges comply with the consents issued by the Environment Agency.[35] However, water and sewerage undertakers also have a statutory obligation to conserve biodiversity and, in

[35] Sewage treatment plants receive wastewater from homes, institutions, commercial premises and, dependent on the age and design of sewerage systems in their catchment area, urban surface water run-off. Consequently, sewerage systems collect a broad range of diffuse-source pollutants. Treatment processes reduce pollutant loads significantly but cannot remove it entirely. Final treated effluent, therefore, contributes to diffuse pollution of rivers and streams.

part, many address this through working in partnership with other bodies on habitat and ecological improvement projects.[36]

Figure 6 **Interested non-statutory bodies and parties in England**
Source: Author, R C Frost

Water Companies: in addition, 13 water companies provide water supply only to over a hundred service areas with several million customers. Their activities potentially can have a negative impact on river flows through the abstraction of surface or groundwater.

River Trusts: The Rivers Trust is the umbrella organisation for over 60 local member trusts, charities dedicated to protecting and improving river environments for the benefit of people and wildlife. Their collective vision is 'wild, healthy, natural rivers, valued by all'. Members' interests cover the whole of England and Wales, and some catchments in southern Scotland, Northern Ireland and Ireland. Figure 7 indicates the range of activities undertaken by local member trusts in 2019–20 and their collective effects.

[36] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/69603/pb13829-statement-obligations.pdf. Each undertaker may have its own outward facing programme, see e.g. https://www.thameswater.co.uk/about-us/responsibility/biodiversity.

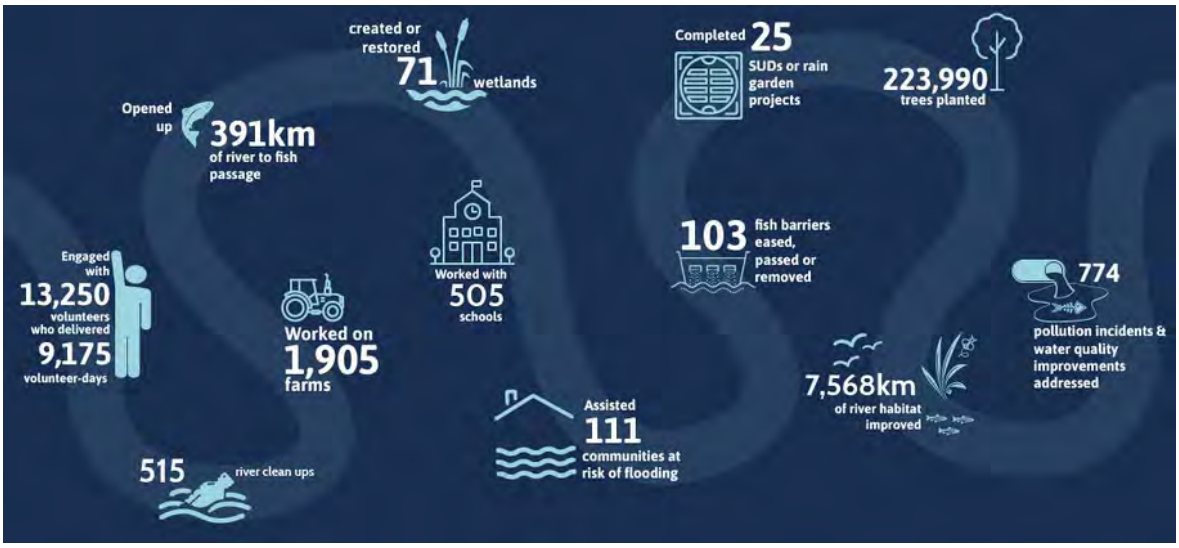


Figure 7 Rivers trusts activities and effects in 2019–20
Source: The Rivers Trust website[37]

Woodland Trust: the Woodland Trust is the UK's largest woodland conservation charity, with 500,000 members and supporters and more than 1,000 woods that are free to visit. Its offices and members are nationwide, working to realise the vision of a UK 'rich in native woods and trees, for people and wildlife', by creating havens for wildlife by planting millions of trees every year, campaigning for new laws to protect ancient woodland and restoring damaged ancient woods.

Wildlife Trusts: The Wildlife Trusts, a charity formally termed the Royal Society for Wildlife Trusts, is the umbrella organisation to which all 36 regional Wildlife Trusts in England belong, as does the Trust for Northern Ireland, the Trust for Scotland, and the five Wildlife Trusts for Wales. All the Trusts are charitable bodies, and each are formed by groups of active and motivated people getting together to make a positive difference to wildlife and future generations, starting where they live and work. The central Trust's role is to ensure a strong voice for wildlife at an England and UK level and, internally, to lead the development of the movement. Additionally, there are many not-for-profit local, regional and national bodies concerned with specific species types: birds, fish, amphibians, reptiles, mammals and invertebrates.

Catchment Partnerships: piloted by the EA/Defra in 2012/13 as a policy tool for implementing the Catchment Based Approach (CaBA), there are now about 108 Catchment Partnerships active throughout England.[38] Hosting of these collaborative groupings of like-minded bodies is part-funded by grant through the Water Environment Improvement Fund (WEIF), administered by the EA. Activities of these Partnerships are guided in part by conditions associated with the annual grant.[39]

[37] Source: https://www.theriverstrust.org/who-we-are/about-us (accessed 02_02_2021).

[38] Where river catchment areas extend across England's border with Scotland and Wales, the conjoined area is included in the scope of the English catchment partnership's activity.

[39] Web-based resources are available from the CaBA website maintained by the Rivers Trust (see above) https://catchmentbasedapproach.org.

4 Natural Capital – the economic argument

4.1 Introduction

Historically, economic theory and practice revolved around the availability of land, financial and produced capital (buildings, infrastructure, equipment and machinery), and labour. The materials and products extracted or obtained from land and water were either taken for granted as inexhaustible or, when resources became depleted, human ingenuity was relied on to identify and exploit substitutes. The depletion of woodlands as a source of charcoal, to be replaced by the mining of coal and the production of coke, illustrates the mindset. The adverse effects of development on the natural world were considered a regrettable but necessary sacrifice in the economic progress of humankind.

Also, even up to the present day, the collateral effects of development and production activities have been, if not ignored, not fully factored into investment decisions and financial analysis. So, for instance, whilst developers and operators consider the investment and operational expenses of material extraction, and of the pollution abatement equipment needed to comply with existing environmental legislation, the external impacts and economic damage costs resulting from exploitation and the discharge of unabated pollutants, have usually not been decisive considerations. Those adverse effects include, for instance, climate change, over-abstraction of groundwater, water pollution, air pollution, and impaired human health. Much the same observation may be applied to consumer consumption. The lauded 'polluter pays' principle has been applied partially.

However, much has changed at the policy level over the last two decades. There is a far greater realisation that humanity needs to be integrated with the natural world and not considered apart from it. Also that nature provides us with many benefits. They include the necessities of a healthy life – food, clean water and air, medicines – and intangible but valuable cultural assets – recreation, spiritual uplift, good mental health and a sense of place. In economic terms, therefore, the natural world has a capital value, 'Natural Capital', that delivers many valuable services to human society. This manner of thinking is infusing the environmental and biodiversity policies of UK Governments and their agencies – over the past decade in particular. Notable stages in policy development and embedding Natural Capital in legislation and practice are indicated below and elaborated in the parallel FWR Guide[40]:

- *UK National Ecosystem Assessment (UK NEA): Understanding nature's value to society*, (2011 and 2014 follow-up)
- *Fair Society, Healthy Lives*, England – The Marmot Review (2010 and 2020 follow-up)
- Environment White Paper, *The Natural Choice: securing the value of nature* (2011)
- Natural Capital Committee (advised UK government 2012-2020)
- *A Green Future: 25 Year Environment Plan*, England (2018)
- *The Economics of Biodiversity: The Dasgupta Review* (2021)
- Environment Bill (2021 in Draft)

[40] See footnote 2.

4.2 Headline policy messages and outlook

4.2.1 Policy messages

A message common to all of the above policy developments is the need to integrate nature into economic decision making. A few headlines suffice:

> *'we have worked to increase awareness of the value of the natural environment – both Natural Capital and the ecosystem services it provides. Our aim is to ensure that the value of the natural environment can be integrated more effectively into broader decision-making processes.' (JNCC)*
>
> *'the underestimation of the value of natural processes in economic terms means we take inadequately informed decision … it is essential that we learn to take account of the full value of ecosystem services in our decision making' (UK NEA)*

An ecosystem service that is often excluded or downplayed in conventional financial appraisals (and in too many economic appraisals also) is the sense of well-being that people can derive from their local environment. The Marmot Review recognised this factor as one of the social determinants of good health and that unequal access to a healthy environment was a contributory factor in the pronounced health inequalities observable in England. Poor health, physical and mental, affects not only an individual and her or his family but also places financial costs on the National Health Service and, through reducing the number of years of healthy life, incurs other economic costs.

One of Marmot's recommended policy objectives, therefore, was '*to create and develop healthy and sustainable places and communities*' (Objective E). This is echoed in the Dasgupta Review which makes global recommendations for the way forward, including (i) the conservation and restoration of ecosystems, (ii) the better management of land and sea to benefit both nature and people, and (iii) improved decision-making through Natural Capital accounting.

4.2.2 The Natural Capital Committee and its recommendations

The Natural Capital Committee was established in 2012 as recommended by the Environment White Paper of 2011. Its remit over the six years of its existence was to advise the Economic Affairs Committee of the UK Treasury on germane issues concerning Natural Capital. Its work over that period has been highly influential and many of its reports and advice to government are summarised in the parallel Guide. Amongst its many outputs it developed analytical frameworks and tools for measuring Natural Capital stocks and changes, whilst its recommendations included the preparation of a long-term 25 Year Environment Plan (for England) having Natural Capital at its heart and placing this Plan on a statutory footing.

4.2.3 Draft Environment Bill

At the time of writing the draft Environment Bill has reached its Report Stage in the House of Commons. The draft Bill includes provisions (Chapter 1.1 – authors' emphases) whereby the Secretary of State may set long-term timebound targets by regulations in respect of (a) the natural environment, or (b) people's enjoyment of the natural environment. And that the Secretary of State must exercise the power to set a long-term target in respect of at least one matter within each of four priority areas, viz: (a) air quality, (b) water, (c) biodiversity, and (d) resource efficiency and waste reduction. Chapters 1.7 to 1.9 further require that:

- The Secretary of State must prepare an environmental improvement plan for significantly improving the natural environment over a period that must not be shorter than 15 years; and that the document published 11 January 2018, *A green future: our 25 year plan to improve the environment*, is to be treated as the first such environmental improvement plan.
- The Secretary of State must prepare an annual report on what has been done to implement the current plan, whether the natural environment has improved, and the progress made on achieving the set targets.
- A review of the first environmental improvement plan must be completed by 31 January 2023 and a revised plan must be made, published and adopted.

Whilst the draft Environment Bill does not mention Natural Capital per se, the principle is ingrained in the 25 Year Environment Plan referred to above. The above provisions, amongst others not mentioned here, make clear that the government's intention is to follow through with the Natural Capital approach. Chapter 2 of the draft Bill further calls for the establishment of an Office for Environmental Protection (OEP) whose principal objective is to contribute to (a) the governance of environmental protection and (b) the improvement of the natural environment.

Looking ahead, the final form of the Environment Bill and the effectiveness with which its provisions are implemented and enforced will be important. Together, they will likely determine the actual extent to which Natural Capital considerations influence the quality of future decision making and behaviour in practice.

4.3 Ignoring Natural Capital can result in flawed decision making

Decision making that ignores Natural Capital considerations can appear short-sighted. An example illustrates. In the 1970s a stream flowing through a flourishing market town was culverted and covered over as part of a development scheme to build a new shopping centre and provide associated road works. Though beneficial in many ways for the town, residents and visitors were deprived of green space in the centre of town, and the scheme separated the upper from the lower reaches of the stream. Decades later, the local Authority initiated the preparation of plans to amend the road network in and around the town.

Local NGOs pressed the Authority to take this opportunity to uncover the stream as part of the development work, and a financial appraisal was made. The appraisal showed that uncovering the stream as proposed would incur an additional capital cost of about £2 million. Whilst Councillors appreciated the social and environmental benefits of uncovering the stream – creating an appealing green space, enhancing the experience of shoppers, workers and visitors to the town, thereby increasing footfall and stimulating business activity – they questioned whether these could justify the additional capital expenditure. To consider the issue further, the Authority commissioned consultants to examine the potential financial returns to the Authority. The assessment presumed that the stimulation provided to business activity would generate higher business rental and rate incomes to the Authority.

In parallel, interested but independent third parties undertook an economic assessment of the non-market benefits of de-culverting the stream. This adopted the ORval tool to evaluate

the benefits to visitors of using the recreated green space.[41] Significantly, this model doesn't take specific account of the co-benefits of improved health (mental and physical) and air quality, hence aggregate non-market benefits would be higher than predicted: ORval's benefit predictions may be seen as giving lower-bound values. Even so, the economic value determined using ORval was assessed as £2.9 million, exceeding the estimated capital cost. Adding to this the nett value of increased business activity (additional business income after deduction of higher rates and rents) would provide an economic benefit substantially greater than the expected expenditure. Thus providing a sound justification for approving the scheme to deculvert the stream. The third parties provided this assessment to the Authority for their consideration prior to a final decision being made on the scheme.

The limited financial appraisal conducted by the Authority's consultants suggested that higher rate and rental incomes would be generated, but Councillors considered that the pay-back period was too long to justify the expense of uncovering the stream. From what was made public, it seems clear that the broader economic justification for the scheme was given fairly short thrift. In hindsight, given the travails of the High Street retail sector in and post-pandemic, the predicted financial benefits of the proposed scheme might not have been realised. However, the economic benefits would have been little affected.

This example shows that much needs to be done to raise awareness on Natural Capital and the analytical tools that are available to assess its benefits in a development situation. This is essential for the inclusion of Natural Capital considerations in scheme appraisals and decision making to become second-nature.

[41] Utilising census data as an input, ORval (Outdoor Recreation Value) is a software tool in which is embedded a recreation demand model. ORval is one of the Natural Capital tools identified in the parallel Natural Capital Guide.

5 Rivers

5.1 Introduction

Running water is a central feature of the landscape in most of the UK. And 'Rivers and Streams' is one of the broad habitats identified in the UK's Biodiversity Action Plan (BAP). This habitat category includes all natural and near-natural running waters in the UK, whether or not classified as a priority habitat. However, 'Chalk Rivers' was the sole priority habitat included in this broad category until 2011. The scope of **UK priority river habitats** was then extended subject to seven qualifying criteria.[42] In essence:

1. **High hydromorphological or ecological status:** the statutory bodies described in Chapter 3 have developed criteria and rules to identify qualifying waterbodies[43]. In addition to river morphology the rules consider (i) vegetation status and infrastructural development adjacent to the waterbody and (ii) catchment land-use intensity.
2. **Headwaters:** a watercourse within 2.5 km of its furthest source, but excluding headwater stretches significantly altered from their natural state. Each river tributary has its own headwater, hence a catchment may contain several or many headwaters.
3. **Watercourses in which water crowfoot species** (e.g. *Ranunculion fluitantis* – Figure 11 in Section 5.3.1) **and associated vegetation occurs:** in the late summer, such watercourses are characterised by floating mats of these white-flowering species, which may modify water flow, promote the deposition of fine sediments, and provide both food and shelter for fish and invertebrates. Three subtypes are present in the UK defined by the substrate, the dominant *Ranunculus* species, and the associated assemblage of other aquatic plants: (i) rivers on chalk substrates, (ii) rivers on other substrates ranging from lime-rich oolite to hard, acidic oligotrophic rocks (e.g. granite and schist), and (iii) a mesotrophic to oligotrophic community found on hard rocks in Northern Ireland, Wales and south-west England.
4. **Chalk rivers:** are fed from groundwater aquifers, producing clear waters and a generally stable flow and temperature regime, though the headwaters of many chalk rivers may run dry in late summer. Collectively, these conditions are conducive to supporting a rich biodiversity along the river and its corridor.
5. **Active shingle rivers:** have significant reaches comprising gravel and pebble bed-material, sometimes with discrete sandy reaches or deposits in areas of low slope. Within this habitat, the riverine processes of erosion, sediment transport, deposition and storage form characteristic suites of features.
6. **Areas/Sites of Special Scientific Interest:** where these are designated for river species, riverine features or fluvial geomorphology.
7. **Species:** where the habitat supports the occurrence of (i) species listed in Annex II of the Habitats Directive, (ii) species listed as a BAP priority species, or (iii) invertebrate species that are strongly associated with and indicative of river shingle.

The underlying geology, water quality and geographical area all affect the assemblages of plants and animals that may occur in rivers and streams. For instance:

[42] Available at http://jncc.defra.gov.uk/page-5706. Note: the criteria are framed in rather technical language.

[43] http://www.wfduk.org/resources%20/river-morphology-high-status-features-and-criteria

- Swiftly flowing upland, nutrient-poor rivers support a wide range of mosses and liverworts but relatively few species of higher plants, whilst stoneflies, mayflies and caddisflies are the dominant invertebrate fauna. Fish such as salmon and brown trout should be present.
- Higher plants, by contrast, dominate the flora of slower-flowing, nutrient-rich lowland rivers, whilst coarse fish such as chub, dace and roach are the dominant fish species.
- Exposed sediments such as shingle and sand bars are important environments for a range of invertebrates such as ground beetles, spiders and craneflies.
- Marginal and bankside land and its vegetation form an integral part of a river. A habitat in its own right for a diverse range of fauna and flora, it also forms a migration corridor and supports a range of river processes.

The significance of specific river channel forms for habitats and biodiversity is introduced below, followed by descriptions in Sections 5.3 and 5.4 of chalk rivers and active shingle rivers, respectively, both classed as priority habitats.

5.2 River channel forms and their value for wildlife

5.2.1 Hydromorphology

Hydromorphology refers to the physical characteristics of a river – its shape, sinuosity and form – that are determined by its flow regime (hydrology), underlying geology and multiple erosive, sediment transport and deposition processes. In turn this determines the local habitat types present within a river and the community of species that they may support – see Figure 8. Since the character of a river changes as it flows from its headwater toward the sea, a river may contain a spectrum of habitats and community distributions.

The notable river forms and features and their value as habitats for flora and fauna, itemised below, draws on an excellent document published jointly in 2016 by the IUCN National Committee UK and Scotland's Centre of Expertise for Waters (CREW).[44] Readers interested in further detail and illustrations should consult the source CREW document and, for example, the River Restoration Centre's *Manual of River Restoration Techniques*.[45]

Waterfalls: such as High Force on the River Tees providing vertical or near vertical flow over bedrock or boulders. Waterfalls generate water spray, creating a cool, damp habitat liked by mosses, lichens and specialist beetle, stonefly and caddis species.

Rapids and cascades: rather like Low Force on the River Tees, cascades flow at a relatively steep gradient, the bed being characterised by large boulders and cobbles. High water velocities and torrential flow conditions prevail. Large boulders can provide shelter for invertebrates and fish from high velocity flows. Water hugging the rock surfaces in 'chute flow' is a favourable habitat for blackfly larvae.

[44] Stephen Addy, Susan Cooksley, Nikki Dodd, Kerry Waylen, Jenni Stockan, Anja Byg and Kirsty Holstead (2016) *River Restoration and Biodiversity: Nature-based solutions for restoring rivers in the UK and Republic of Ireland*. CREW reference: CRW2014/10. Available on-line at: https://www.crew.ac.uk/publication/river-restoration

[45] Accessible at https://www.therrc.co.uk/manual-river-restoration-techniques See also, *Guidebook of Applied Fluvial Geomorphology* published by Defra in 2003, accessible at https://www.gov.uk/flood-and-coastal-erosion-risk-management-research-reports/compiling-the-guidebook-of-applied-fluvial-geomorphology

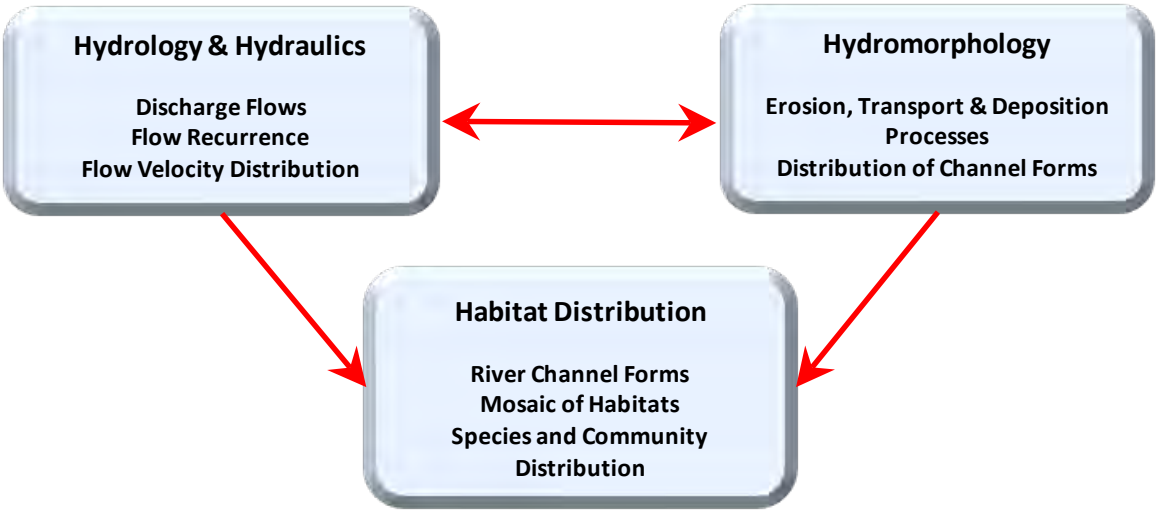


Figure 8 **Rivers: role of hydrology and hydromorphology in habitat and species distributions**
Source: Author, R C Frost

Riffles: occupying most of a river channel's width, these sections of shallow, fast-flowing water are characterised by breaking standing waves over an accumulation of cobbles, pebbles and gravel. They are formed by the local deposition of eroded material. Animals able to cling on well find a home in riffles. Fish also favour riffles (i) as a feeding area, (ii) as the broken surface may provide shelter from predators, and (iii) the highly oxygenated water encourages salmon, trout and lamprey to lay their eggs in the substrate. (Lamprey are on the IUCN Red List of threatened species)

Glides: deep water having a smooth surface and moving at intermediate velocities. Commonly associated with gravel or sandy riverbeds. Often occupied by aquatic plants, glides tend to support less species diversity than do riffles.

Pools: relatively deep, slow moving sections of a river that are maintained by scouring. Examples include waterfall plunge-pools, areas below weirs, and the outside of meander bends scoured periodically during periods of high flow. The deep water gives protection to species whilst the accumulation of organic matter on the riverbed provides them with food.

Backwaters: wet areas connected to the main river channel in which little or no flow occurs in average weather. They serve as shelter sites for adult fish, as an essential breeding habitat for dragonflies, and nursery areas for lampreys.

Aquatic macrophyte beds: emergent, submerged or floating beds of aquatic plants such as water crowfoots *Ranunculus* spp., subgenus *Batrachion*. Floating mats of these white-flowered species are characteristic of river channels in early to mid-summer and may modify water flow, promote fine sediment deposition, and provide shelter and food for fish and invertebrate animals. They form assemblages with other macrophytes such as watercress, water-starworts, water-parsnips, water milfoils and water forget-me-not. Such beds affect river flow patterns, trap sediments and raise nutrient and dissolved oxygen levels. The habitats they form provide food, shelter and spawning sites for a wide range of invertebrates, fish and amphibians.

Bars: areas of unconsolidated riverbed material, characteristically formed on the inside of distinct meander bends and exposed at low river flow, usually sloping shallowly into the water. Bars in highly active rivers are more commonly unvegetated whereas vegetated bars are more

usually observed on less active rivers. The exposed sediment is an important habitat for plants and invertebrates such as ground beetles, spiders and craneflies: the diverse range of species supported includes several rare and endangered specialists. Under certain conditions, the transition from unvegetated to vegetated bar may progress further to form a natural berm.

Riverbanks: provide specialist habitats. Steep banks are used by otters for their holts, and water voles for their burrows, while nesting sand martin colonies also use eroded riverbanks.

Trees: tree roots stabilise sediments, improve water quality and increase in-stream habitat diversity. Accumulations of in-stream woody debris create pools and eddies where fish can rest, take shelter from predators and avoid direct sunlight. Algae, fungi, bacteria, plants and insects are also able to colonise the woody surfaces. Leaf litter from trees and other vegetation inputs nutrients and food for detritus-shredding crustacean organisms (such as *Gammarus* sp.), which are important food for trout and birds such as dippers. Trees also help to regulate healthy levels of dissolved oxygen levels by providing shade during periods of low flows and high temperature. Too much shade though can suppress the growth of aquatic plants; a mix of dappled light and shade is ideal.[46]

Riparian (riverbank) vegetation: the terrestrial habit alongside a river may support many forms of terrestrial life including bats and a wide range of bird species.

Floodplain water features: these are favoured by wading birds, amphibians and dragonflies, and provide an important source of food for bats and reptiles. The habitat range is diverse and includes oxbow lakes, permanent wetlands, flushes, bogs, wet woodland and bogs (see Chapters 7 and 8).

Floodplain meadows: few of these features now remain owing to development of the land, lack of management and agricultural intensification. Those that remain provide flood storage capacity and have a high floral diversity, providing an important source of nectar for a range of insects.

5.2.2 The importance of river connectivity

A river's richness of habitat depends on its degree of connectivity. The imposition of artificial canalisation, the presence of weirs constructed for the purpose of navigation and other uses of water – mostly of historic origin – and pressures imposed on the floodplain by development and agricultural intensification all impair river connectivity. Limited connectivity constrains the formation of the physical habitats described above and the ability of species to move up and down a river.

Restoration of a modified river to a state that is more natural, therefore, requires active intervention. This may involve a combination of (i) removing weirs or providing fish and other species with alternative opportunities to bypass these barriers (such as fish passes), and (ii) management measures to create some of the forms and features noted above, encourage the effects of natural processes, and the adoption of more sensitive land use policies and practice. Ongoing riparian management is necessary to ensure that the impacts of restoration efforts are sustained over the long term.

[46] https://www.wildtrout.org/content/trees-and-rivers

5.3 Chalk rivers

5.3.1 Distribution and characteristics

Running southwards from the Yorkshire Wolds through to Lincolnshire and reappearing as a band running south-west from Norfolk to Dorset, with outcrops in Kent and Sussex, chalk downlands and chalk rivers are amongst the highlights of the English landscape (see Figures 9 and 10).

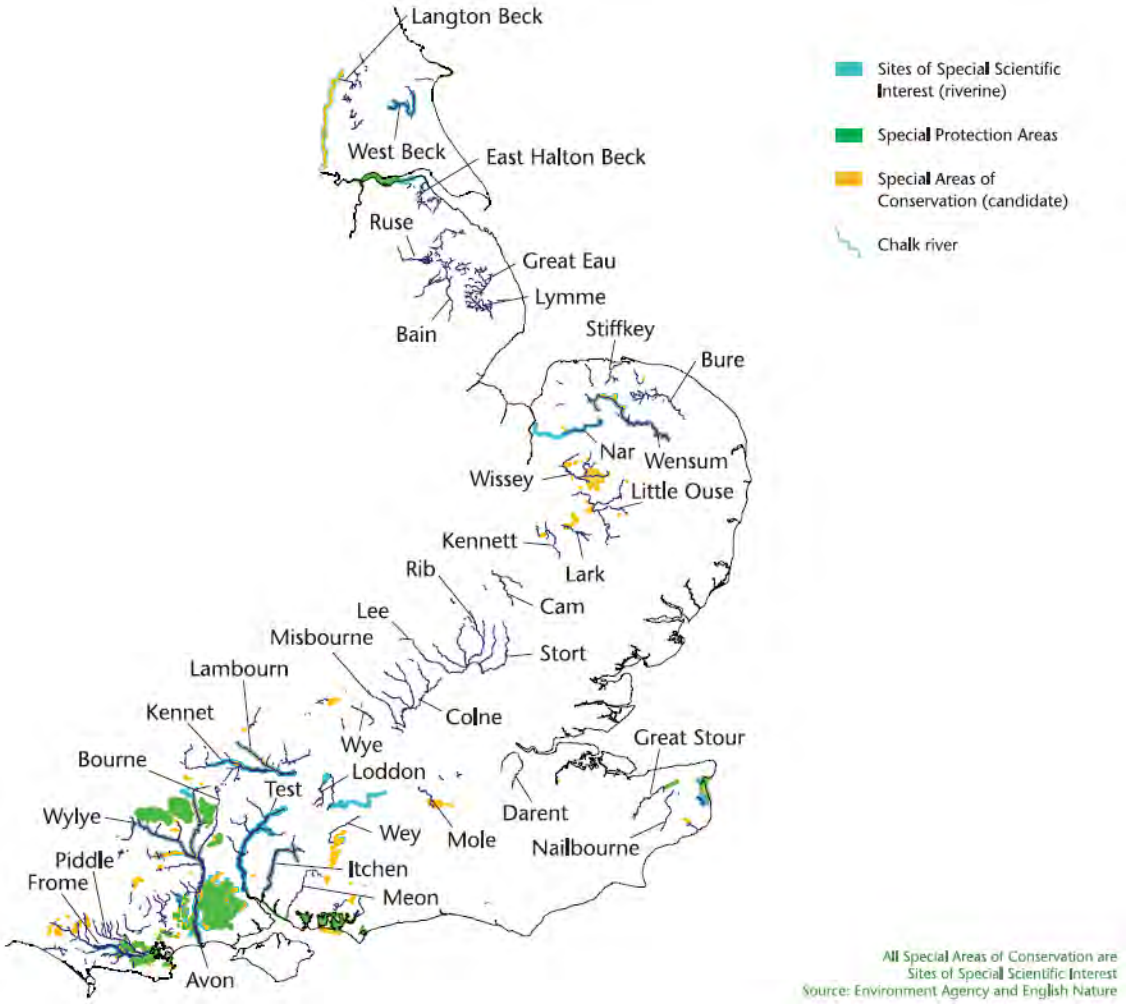


Figure 9 Locations of the chalk rivers of England
Source: *The State of England's Chalk Rivers* (2004)[47]

Globally, chalk rivers are rare, found only in east and southern England and north-east France. Their rarity and sublime character fully justify their classification as a priority habitat. Emerging as headwater springs from chalk bedrock, chalk river water is alkaline, typically crystal clear, flows at a relatively stable rate, and its temperature varies little. These characteristics are conducive to supporting a magical diversity of wildlife (see Figure 11).

The headwaters of many chalk rivers advance and retreat seasonally, the winter recharge of the chalk aquifer causing the water table to rise and springs to flow from further up the river

[47] Source: http://adlib.everysite.co.uk/resources/000/057/268/Summary_chalk_rivers.pdf, *The State of England's Chalk Rivers*, Summary Report 2004.

course. The reverse occurs in the summer months when evapotranspiration rates are high and the river may run dry in its uppermost reaches, often referred to as 'winterbournes'. The names of nearby settlements are often prefixed by 'Winterbourne'. Species adapted to these conditions include the brook or pond water crowfoot and a characteristic range of invertebrates, which enjoy the clean, mineral-rich, chalk river water.

Figure 10 A chalk river scene
Source: *The State of England's Chalk Rivers* (2004)

Chalk riverbeds typically consist of angular, flint gravel derived from natural flint deposits embedded within the chalk bedrock. In the absence of sediments carried by urban and agricultural run-off, the gravel is clean and the water well-oxygenated, creating good conditions for fish fry to thrive. Phosphate and nitrate levels in chalk river water are also low, unless affected by the run-off from agricultural land and the discharge of treated effluent from sewage treatment plants. In the absence of such pollutants, the characteristic chalk river flora of water-crowfoot species, water-starwort and lesser water-parsnip, augmented as summer progresses by watercress, and water forget-me-not growing on the margins, may blossom – providing a source of shelter and food for fish, amphibians and invertebrates. The invertebrates such as caddisflies, mayflies and stoneflies that exploit these conditions form a food source, in turn, for fish such as brown trout, salmon, grayling, bullhead and lamprey.

The riverbanks and corridors along either side of a chalk river also provide a home, hunting and foraging ground for mammals such as otters and water voles, for birds such as the kingfisher, grey heron, coot and moorhen, and for amphibians – toads, frogs and newts. Dependent on clean water and high-water levels, wetlands – wet grassland, fens and wet woodlands – form a habitat valued by amphibians and needed by birds such as lapwing, snipe and redshank for nesting and feeding. In the past, wetlands were a common sight alongside chalk rivers, but land drainage and other pressures have caused many to disappear.

Brown trout *(Salmo trutta)*

Grayling *(Thymallus thymallus)*

Otter *(Lutra lutra)*

Water vole *(Arvicola amphibius)*

Kingfisher *(Alcedo atthis)*

Water crowfoot *(Ranunculus spp.)*

White-clawed crayfish *(Austropotamobius pallipes)*

Chalk river mayfly *(Ephemera danica)*

Figure 11 Examples of the rich diversity of species present in chalk rivers and corridors
Credit: See Annex 5

5.3.2 Chalk downland

Away from the chalk river and its corridor the chalk landscape at its best is dramatic – iconic chalk grassland, the downs ending precipitately at the sea at the magnificent cliffs of Flamborough Head (Figure 12), Dover, Beachy Head, the Seven Sisters, The Needles off the Isle of Wight, and the Dorset coast. Chalk grassland displays a wealth of plant and other wildlife though comprising little more than a quarter of the area of chalk river catchments and under threat from agricultural practices, development and recreational pressure.[48]

Figure 12 Magnificent scenery – chalk downland ending at the sea at Flamborough Head
Credit: See Annex 5

The thin soil of chalk grassland is lime-rich, low in nutrients, holds little water and heats up quickly in the sun. This environment is challenging for lush grass species that otherwise tend to dominate grassland flora but allows a diverse range of herbs and plants to flourish (Figure 13).

Figure 13 A profusion of wildflowers on chalk grassland
Credit: See Annex 5

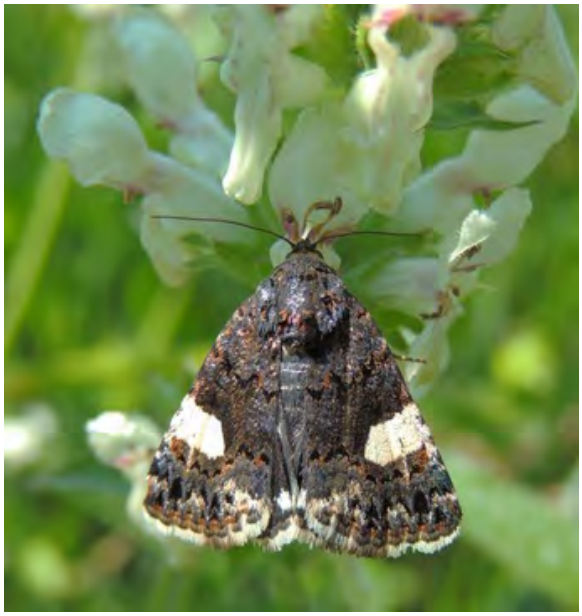
[48] http://adlib.everysite.co.uk/resources/000/057/268/Summary_chalk_rivers.pdf, *The State of England's Chalk Rivers* (Summary, 2004), English Nature and Environment Agency. See also: National Trust, *What's Special About Chalk Grassland?*, https://www.nationaltrust.org.uk/features/whats-special-about-chalk-grassland

A single square metre of chalk grassland can hold up to 40 species of flowering plants, some of which are common such as the small scabious and common bird's-foot trefoil, and some rare and specialised such as the monkey and spider orchids and the delicate pasque flower. The rich carpet of wildflowers attracts ground beetles and many pollinating insects including bees and rarer insects such as the phantom hoverfly, the wart-biter bush cricket, the Adonis blue and silver-spotted skipper butterflies, and the gothic and four-spotted moths. Chalk grassland also provides a valuable area for slow worms, adders and other reptiles to bask in, and a habitat in which skylarks and stone curlews may thrive. Figure 14 illustrates some example species that may be found on chalk grassland.

Pasque flower (*Pulsatilla vulgaris*)

Bird's-foot trefoil (*Lotus corniculatus*)

Early spider orchid (*Ophrys sphegodes*)



Four-spotted moth (*Tyta luctuosa*)

Adonis blue butterfly (*Polyommatus bellargus*)

Skylark (*Alauda arvensis*)

Adder (*Vipera berus*)

Figure 14 Examples of the colourful, rich diversity of chalk grassland life
Credit: See Annex 5

5.4 Active shingle rivers

The characteristic features of active shingle rivers are formed by the processes of erosion, sediment transport, deposition, and storage; the headwaters of such rivers usually being in mountainous or hilly upland areas, in all countries of the UK. Snowmelt and high rainfall events in upland areas of steep gradient generate high-energy discharges, causing intermittent sediment movement along the river. A characteristic feature of an active shingle river is the presence of significant reaches where the riverbed comprises gravel or pebble material ranging in size from about 2 to 260mm (Figure 15). Downstream reaches of lower slope may exhibit discrete deposits of sand or gravel ranging in diameter from about 0.06 to 2mm.

Typically, these rivers have extensive reaches whose beds consist of shingle deposits (gravel, pebble and sand) at the base of a hill or mountain and in their middle reaches. The shingle deposits are associated with a wandering, dynamic, meandering or divided channel with active erosion and sediment deposition features, taking several characteristic forms including point bars and eroding cliffs, side- and mid-channel bars, and pool-riffle sequences. Deposits are typically unvegetated, reflecting their dynamic nature. Sediment transport and the formation of these characteristic habitat features typically occurs only at high flows when bedload may

The River Tees beneath Cauldron Snout cascade, Co Durham, England

Middle reaches of the River Feshie on the western side of the Cairngorm Massif, Scotland

Figure 15 Two examples of active shingle rivers
Credit: See Annex 5

comprise up to 50% of the total sediment load in transit. Many of the large-scale features are exposed in the channel as shingle during low-flow conditions. Reaches having sand beds or deposits (material transported and deposited across a wide range of river discharges) typically exhibit micro-scale features such as ripples, dunes and planes.

Shingle rivers are usually associated with the UK's mountainous and upland areas. But when the Joint Nature Conservation Committee (JNCC) interrogated the River Habitat Survey (RHS) database for the characteristic features of active shingle rivers, it found that many lowland sites in England also exhibit indicators of active river processes. These include a gravel-dominated riverbed in combination with point- and mid-channel bars and eroding cliffs.[49]

[49] See Figure 5 in the Joint Publication JP006, *Priority River Habitat in England – Mapping and Targeting Measures* (2014). Available at: http://publications.naturalengland.org.uk/publication/6266338867675136.

As noted generally in Section 5.1, the characteristic features of active shingle rivers – point bars and eroding river cliffs, side- and mid-channel bars, and pool-riffle sequences – form a potentially hostile environment; one that is maintained by the scouring of deposited material[50] by high river flows, especially in winter, ensuring the scavenging and removal of fine sediment and any emerging vegetation. Only specialised species may flourish in these conditions. Given the relative lack of competition from generalist species, the habitats presented by swiftly flowing, nutrient-poor upland waters and exposed sediments can support a rich biodiversity:

- a range of specialised mosses and liverworts
- invertebrate species dominated by stoneflies, mayflies and caddisflies
- ground and roving beetles, craneflies and spiders on exposed sediments
- an invertebrate hunter, the dipper (Figure 16)
- salmon and brown trout.

Figure 16 **Dipper** *(Cinclus cinclus)*
Credit: See Annex 5

[50] Material deposited in these characteristic features may also be referred to as 'exposed riverine sediments'.

6 Standing open waters

6.1 Priority habitats in the BAP broad habitat category

Within the UK BAP Broad Habitat of Standing Open Waters and Canals, five priority habitats have been identified (see Chapter 3); [51] three of which are lakes along a spectrum of nutrient levels:

- **Lakes – Oligotrophic and dystrophic**: these classes of lake are typically over 2 ha in area (1 ha in Scotland) and characteristically have low alkalinity, low nutrient levels (water column total phosphorus levels of less than 0.01 mg P/l) and low biological productivity. Their catchments are usually upland areas in which the underlying rocks are hard and acidic or, in the case of dystrophic lakes, comprise peat and poor soils. Oligotrophic lakes can be expansive and usually have very clear water whilst dystrophic lakes are generally small, up to about 5 ha in size, may have higher total phosphorus levels (but not readily available), and their waters may be intensely peat-stained.
- **Lakes – Mesotrophic:** this class of lake lies in the middle of the trophic range and is characterised by their waters having a narrow range of nutrient phosphorus and nitrogen levels (0.01–0.03 mg P/l , 0.3–0.65 mg N/l). They are relatively uncommon in the UK and are largely confined to the margin of upland areas in the north and west.
- **Eutrophic standing waters:** natural and man-made waterbodies, rich in total phosphorus (at least 0.035 mg P/l) and total inorganic nitrogen (at least 0.5 mg N/l), their beds dark, rich in organic matter and anaerobic. The category includes lakes, reservoirs and gravel pits but not small pools, field ponds and brackish waters. Plant nutrients being plentiful, such waters are highly productive and characterised by the appearance of dense, long-term populations of green algae in mid-summer, often colouring the water.
- **Ponds:** permanent and seasonal standing waterbodies with areas of up to 2 ha that meet one or more of five criteria regarding their biotic and ecological significance.
- **Aquifer-fed naturally fluctuating water bodies:** natural surface water bodies that are directly connected to an underlying groundwater system and are characterised by a regime of extreme fluctuation in water level. Intrinsic to such water bodies is their periodic complete or near drying out. Rising groundwater levels recharge the surface water subsequently via swallow holes or smaller bed openings.

Sections 6.2 to 6.6 inclusive describe further the five priority habitats.

6.2 Oligotrophic and dystrophic lakes

Oligotrophic and dystrophic lakes occur throughout Scotland, Snowdonia and the Cambrian mountains of Wales, and the Lake District of England (see Figure 17).[52,53,54] Some of Scotland's largest waterbodies such as Loch Ness (5,640 ha, maximum depth 227m) and Loch Morar (2,670 ha, maximum depth 310m) are oligotrophic, as are thousands of sparsely-vegetated

[51] https://jncc.gov.uk/our-work/uk-bap-priority-habitats
[52] https://www.nature.scot/sites/default/files/2018-02/Priority%20Habitat%20-%20Oligotrophic%20And%20Dystrophic%20Lakes.pdf,
[53] http://nora.nerc.ac.uk/id/eprint/2138/1/Lakes-Tour-2005-Finalreport.pdf
[54] https://www.researchgate.net/publication/275350395_Lake_BAP_Priority_Areas_in_Wales_-_a_Strategic_Overview

lochs on acid, generally impermeable geology. Oligotrophic lakes are common in Wales though relatively small, the 157 oligotrophic lakes of 1 ha or more having an average area of 8.9 ha. Fifteen lakes in Wales have been identified as dystrophic, having an average area of 3.5 ha. Ranging from 90 to 330 ha, five of the lakes in England's Lake District surveyed in 2005 – Wastwater, Crummock Water, Buttermere, Ennerdale Water, and Thirlmere - were found to be oligotrophic, whilst three other lakes were reported as mesotrophic-bordering-oligotrophic. Lough Melvin, straddling Northern Ireland and Eire, is mesotrophic though it also represents oligotrophic characteristics.

Llyn Idwal, Snowdonia

Loch Morar, western Scotland

Figure 17 Oligotrophic lake scenery
Credit: See Annex 5

Vegetation in these lakes typically comprises a small number of species of submerged plants in the shallower areas, dominated by such as quillworts – spore producing plants that are highly reliant on water dispersion, water lobelia – spikes of pale flowers rising above a submerged rosette of narrow cylindrical leaves, dense swards of shoreweed, bulbous rush, awlwort and stonewort. Figure 18 shows two example species. Diverse lichen and bryophyte assemblages, including scarce mosses, may be found on lakeside boulders. Some lakes are fishless but others may contain brown trout, its relative the Arctic charr (Figure 19), eel, stickleback, and minnow.

Water lobelia (*Lobelia dortmanna*)

Bulbous rush *(Juncus bulbosus)*

Figure 18 Two example plant species of oligotrophic lakes
Credit: See Annex 5

Figure 19 Two Arctic charr (*Salvelinus alpinus*) **near their spawning ground in the inflow to Ennerdale Water**
Credit: See Annex 5

Many oligotrophic lakes are stained brown to some extent due to the presence of boggy areas in their catchments. In practice, there is a continuum between oligotrophic and dystrophic lakes. The latter occur on or close to areas of deep peat and are usually strongly acidic from weak organic acids leached from the peat: pH values of less than 5 are common. Dystrophic lakes tend to have a naturally low biodiversity of specialist species, closely associated with those occurring in blanket bogs (see Chapter 7).

6.3 Mesotrophic lakes

Largely confined to the margins of upland areas in the north and west of the UK (Wales, Scotland, Cumbria and Northern Ireland) mesotrophic lakes are not common.[55] Characterised by having moderate levels of alkalinity and nutrient concentrations, typically 0.01–0.03 mg P/l and 0.3–0.65 mg N/l, these lakes have clear, well-oxygenated water that is usually warmer than in oligotrophic lakes. Mesotrophic lakes tend to occur at lower altitudes and in more sheltered locations, often having a mixture of hard and soft substrates with attendant marginal swamp, fen and wet woodland along their edges (Figure 20). These factors combine to create a more productive habitat that can sustain a diverse wildlife, though the health and status of these lakes are vulnerable to nutrient inflows from agricultural practices.

Figure 20 A mesotrophic loch in Scotland
Credit: See Annex 5

Mesotrophic lakes, therefore, support potentially the most diverse range of macrophytic plant life of any lake type, a high proportion of the aquatic plants being nationally scarce. Stony and exposed shorelines, for instance, may be inhabited by shoreweed, water lobelia and quillwort. Whilst sheltered bays with a more stable water column may support Nuttal's or Canadian pondweed, water milfoil and a variety of broad- and fine-leaved pondweeds. Areas of fine sediment found around lake outflows and inflows, on the other hand, can be dominated by stonewort species. Invertebrates such as dragonflies, water beetles (such as *Hygrotus novemlineatus*), stoneflies and mayflies are well represented in mesotrophic lakes.

These lakes may also support a range of salmonid fish species, coarse fish such as pike and perch, the rare ice-age relict vendace (Figure 21) – now found only in Derwentwater in the English Lake District, and *Coregonus lavaretus* (known commonly as the schelly in England,

[55] Wales: Tristan Hatton-Ellis (2014), *Lake BAP Priority Areas in Wales – a Strategic Overview*. http://aquaticrestorationpartnership.org.uk/resources/lake-bap-priority-areas-in-wales-a-strategic-overview/
Scotland: https://www.nature.scot/priority-habitat-mesotrophic-lakes.
Cumbria: https://cumbria.gov.uk/elibrary/Content/Internet/538/755/1929/17716/17717/4215110383.PDF and http://nora.nerc.ac.uk/id/eprint/2138/
N. Ireland: https://www.daera-ni.gov.uk/publications/northern-ireland-habitat-action-plan-mesotrophic-lakes.

gwyniad in Wales and powan in Scotland). Otter and white-clawed crayfish may also be found. Northern Ireland priority species associated with this type of lake include the globeflower and chaffweed.

Figure 21 Vendace (*Coregonus albula),* an ice age relict found only in Derwentwater, a mesotrophic lake in Cumbria, England
Credit: See Annex 5

Mesotrophic lakes are also important for breeding and wintering waterfowl, including mallard, wigeon, tufted duck, goldeneye and coot.

6.4 Eutrophic standing waters

Natural eutrophic standing waters are mainly lowland lakes that have formed above soft rocks or deposits of glacial drift and have high alkalinity and nutrient levels (see, for instance, Lough Neagh, Figure 22). Eutrophic waters are most typically present in hard water areas of the lowlands of southern and eastern Britain, but occur in the north and west also, especially near the coast. Many lowland water bodies, though, are now polluted and have nutrient concentrations far in excess of the values cited in Section 6.1. The Priority Habitat description

Figure 22 Lough Neagh, Northern Ireland
Credit: See Annex 5

in the UK's BAP Action Plan estimated that the total area of eutrophic standing waters (each of at least 1 or 2 ha) was about 180,000 ha, 53% of which was in Northern Ireland, 30% in England, 14% in Scotland and 3% in Wales. The UK's largest lake by area (39,200 ha), Lough Neagh, accounts for 42% of Northern Ireland's eutrophic standing waters' area.

Though some eutrophic standing waters can be deep in parts, many are relatively shallow, less than 5m deep thus allowing light to penetrate, their margins commonly supporting dense reedbeds, bulrushes, and marginal swamp vegetation. Mud banks left dry by retreating water may support an abundant growth of bryophytes such as the viola crystalwort. The main body of a eutrophic lake has a high degree of biodiversity, the nutrient levels supporting the growth of planktonic algae and zooplankton in abundance and the characteristic beds of floating-leaved species such as the yellow water lily. Invertebrates such as snails, dragonflies and water beetles thrive, as does the native freshwater crayfish on calcareous sites. Figure 23 portrays some characteristic wildlife forms that can be observed in the UK's eutrophic standing waters.

Yellow water lily (*Nuphar lutea)*

Shoveler duck (*Anas clypeata*)

Roach (*Rutilus rutilus*)

Tench (*Tinca tinca*)

Figure 23 Some wildlife of eutrophic standing waters
Credit: See Annex 5

Amphibians are often present, including the great crested newt, and the abundance of food at sites such as Loch Leven and Lough Neagh can attract internationally important populations of waterfowl including over-wintering whooper swan, great crested grebe, and breeding ducks such as the wigeon, gadwall and shoveler.

Coarse fish such as roach, tench and pike are characteristically present though salmonid fish also occur naturally in some waters. A large fish, the pike can grow to over a metre in length and is found in waters that have a lot of vegetation, using these plants to hide when hunting (Figure 24) bursting out at great speed from its hiding place to catch fish, frogs, small mammals or ducklings. Predators such as pike are important to control the numbers of herbivorous and

planktivorous fish, whose over-grazing can otherwise cause a lake to revert to a phytoplankton-dominated 'green soup'.

Figure 24 A pike *(Esox lucius)* 'on patrol'
Credit: See Annex 5

Amongst other freshwater sites, Lough Neagh is also involved in the mysterious, migratory life cycle of the European eel. Its eggs are thought to drift with the Gulf Stream current from spawning grounds in the Sargasso Sea in the western Atlantic Ocean, developing into glass eels and then elvers before finding their way to the Lough. There, they mature over 10 to 15 years before making the return journey as silver eels to the Sargasso to spawn.

6.5 Ponds

Ponds are relatively small depressions in the land that fill with water, either permanently or seasonally. They are numerous and widespread throughout the UK though high-quality examples – especially in lowland areas – are localised. Outside of land attached to housing there are about 400,000 or so ponds in the UK and, of these, about 80,000 are thought to satisfy one or more of the five criteria that qualify a pond as a priority habitat[56]:

1. Meeting Annex I criteria of the Habitats Directive
2. Species of high conservation importance
3. Exceptional assemblages of key biotic groups, supporting exceptional populations of key species (amphibians, dragonflies, wetland plants, aquatic macroinvertebrates)
4. Ponds of high ecological quality, scoring at least 75% on a scale known as the 'Predictive System for Multimetrics' (PSYM)
5. Individual or grouped ponds that are recognised as important because of their age, rarity or landscape context and have a limited geographic distribution.

The above estimate for pond numbers excludes the large number of ponds under 2 ha associated with the blanket bog priority habitat (see Chapter 7) and recent man-made

[56] UK Biodiversity Action Plans, Priority Habit Descriptions: Ponds. Accessible via: https://jncc.gov.uk/our-work/uk-bap-priority-habitats

waterbodies. Ponds are and have been formed naturally in a number of ways. For instance, by glaciation and glacier retreat, by meandering rivers forming small ox-bow lakes, and by trees falling over, leaving their root pits exposed. High quality ponds may form notable landscape features in certain areas, such as: the forest and moorland pools of Speyside, the dune slack and machair pools of the Scottish Western Isles,[57] the mawn pools of mid-Wales and ponds of north-east Wales, the marl pits of Cheshire,[58] the ponds of the New Forest,[59] the pingos of East Anglia,[60] and nine important areas across Northern Ireland.[61]

Figure 25 A pond
Credit: See Annex 5

Ponds, such as that shown in Figure 25, are arguably the richest, most productive and engaging of all habitats, hosting a range of wildlife. Factors affecting the types of life found include the depth of water and whether the pond is seasonal, nutrient levels, shade, presence or absence of inlets and outlets, and effects of grazing animals.

Together with the range of pond sizes and the presence of marginal vegetation, these factors contribute to ponds in aggregate supporting two-thirds of all freshwater species found in the UK.[62] They include the common frog, common toad, teal, common great diving beetle, pond olive mayfly, blue-tailed damselfly, broad-leaved pondweed, great crested newt, pillwort, and medicinal leech. Figure 26 illustrates some of these. Coarse fish, including the predator perch (in large ponds), may also be present.

[57] https://www.wildlifetrusts.org/habitats/coastal/machair
[58] https://www.cheshirewildlifetrust.org.uk/sites/default/files/2018-06/Ponds.pdf
[59] https://www.newforestnpa.gov.uk/discover/healthy-environment/wetland/ponds/
[60] https://www.norfolkwildlifetrust.org.uk/wildlife-in-norfolk/habitat-explorer/ponds-and-pingos
[61] https://freshwaterhabitats.org.uk/wp-content/uploads/2013/09/NI_IAP_Report.pdf
[62] https://freshwaterhabitats.org.uk/habitats/pond/

Broad-leaved pondweed (*Potamogeton natans*)

Great diving beetle *(Dytiscus marginalis)*

Emerald damselfly (*Lestes sponsa*)

Common darter dragonfly *(Sympetrum striolatum)*

Great crested newt *(Triturus cristatus)*

Perch (*Perca fluviatilis*)

Figure 26 Examples of pond-life species
Credit: See Annex 5

Recent research has demonstrated that ponds contribute a great deal to biodiversity at a regional level as networks of habitat patches serve as stepping-stones, facilitating the movement of species through the landscape.[63]

[63] https://onlinelibrary.wiley.com/doi/abs/10.1002/wat2.1014

6.6 Aquifer fed naturally fluctuating waterbodies

This category of standing water habitat is rare, both in the UK and internationally. Within the UK there are three sites in Co. Fermanagh, Northern Ireland,[64] and one at Pant-y-llyn in Wales, all known as turloughs which occur over karstic carboniferous limestone. And there are about six sites known as fluctuating meres – lying in depressions in the residual ice age topsoil and fed from the underlying chalk aquifer – which occur in the Norfolk Breckland (see Figure 27). Taking the areas of maximum inundation, the areas covered by these waterbodies are about 10 ha in Northern Ireland, 1 ha in Wales and 20 ha in England. The water levels of both turloughs and fluctuating meres reflect the height of the groundwater table. Surface inflow and outflow streams are absent from both except at times of very high groundwater level when temporary outflows may develop.

Figure 27 Aerial view of a group of fluctuating meres at Wretham, Norfolk
Credit: See Annex 5

Turloughs are distinguished by periodic winter flooding, the water levels responding rapidly to groundwater fluctuations and, apart from a few small residual pools, a dry floor in summer. A feature of these water bodies is the concentric zonation in vegetation, particularly in their dry phase when grassland together with an abundance of silver weed *Potentilla anserina* may prevail except in residual swampy pools. In Northern Ireland these pools may support the white water lily *Nymphaea alba*. Apart from in these pools, aquatic vegetation is absent in the dry phase, but abundant in the wet phase when aquatic and semi-aquatic mosses characterise the inundation zone. Green Lough in Northern Ireland also supports the nationally rare fen violet *Viola persicifolia* and a rich ground beetle fauna including *Blethisa multipunctata* and *Pelophila borealis*.

Fish are absent from turloughs as a rule but a range of amphibians and many invertebrate species including dragonflies, water boatmen and diving beetles may be found. Micro-crustaceans such as water fleas, and snails such as the marsh snail *Lymnaea palustris*, are

[64] UK Biodiversity Action Plan – Priority Habitat Descriptions: *Aquifer fed naturally fluctuating water bodies*, available at: https://hub.jncc.gov.uk/assets/dec49c52-a86c-4483-90f2-f43957e560bb#UKBAP-BAPHabitats-01-AqFedWaterBodies.pdf. At least 60 unmodified turloughs of 10 ha or more in extent have been identified in the Republic of Ireland.

common. Both are equipped with survival mechanisms that allow them to withstand the inundation–drying cycles of the turlough. Woodland scrub – willow, birch, alder, ash and hazel in the main – grows around the margins of turloughs, as it does around fluctuating meres.

The inundation and drying cycle in Norfolk's fluctuating meres is more complex, the responses of meres to groundwater fluctuations being highly lagged and each mere having its own cycle. Indeed, several years may pass during which a mere is dry, followed by a prolonged period of inundation of variable depth, ranging from a few centimetres to several metres.

Fen violet (*Viola persicifolia)*

Norfolk bladder-moss (*Physcomitrium eurystomum)*

One-grooved diving beetle *(Bidessus unistriatus)*

Ground beetle *(Blethisa multipunctata)*

Figure 28 Examples of rare and interesting species found in turloughs and fluctuating meres
Credit: See Annex 5

Many of the wildlife species found in the turloughs are also found in the fluctuating meres of the Norfolk Breckland. In their dry phase, however, the characteristic vegetation of the damp centres of the meres also includes water chickweed *Myosoton aquaticum* and stinging nettle, fringed by bands of reed canary grass at slightly higher levels. In the inundation zone, the rare Norfolk bladder-moss may also be found.[65]

[65] Callaghan D, Medina R, Masson J and During H, Population status and ecology of the episodic moss *Physcomitrium eurystomum* Sendtn.in Britain, *Journal of Bryology*, April 2020, 42(3) pp1–12. Accessible at: https://www.researchgate.net/publication/340908141_Population_status_and_ecology_of_the_episodic_moss_Physcomitrium_eurystomum_Sendtn_in_Britain

As deep flooding may prevail for long periods in the meres, aquatic vegetation has a better opportunity to become established and display greater diversity here. The water plants shining pondweed and various-leaved pondweed are typical of the meres. Rare invertebrates whose presence has been recorded in the meres include large mussel shrimp *Cypris bispinosa*, the small, one-grooved diving beetle and the scarce emerald damselfly. A range of amphibians including the great crested newt can also be found. In their wet phases the meres support many water birds in the breeding season. They include coot, tufted duck, mallard, shelduck, pochard and gadwall.

7 Wetlands

7.1 Wetland priority habitats: scope

The previous two chapters considered running and standing waters, which are undoubtedly 'freshwater'. In addition, river corridors, the beds of rivers and standing waters, and the land immediately fringing standing waters are integral to biodiversity in these habitats. The freshwater and terrestrial habitats are interactive and transitional. In wetlands, the transition goes further, the resulting variety of habitats providing havens for invertebrates, waterbirds whether resident or visiting, and a wide range of plant species. Biodiversity in these habitats may be very high though the degradation of wetland habitats over the past 50 years and more has been great. Wetlands considered in this Guide comprise eight of the priority habitats defined by JNCC, lying within four UK BAP Broad Habitat categories. Notable examples of wetland plant, invertebrate, amphibian and bird species are illustrated in Figures 29 to 32. A brief overview of each priority habitat follows Table 5.[66]

Table 5 Wetland Priority Habitats for the purpose of this Guide

UK BAP Broad Habitat	Wetland UK BAP Priority Habitat
Fen, marsh and swamp	Upland flushes, fens and swamps
	Lowland fens
	Reedbeds
	Purple moor grass and rush pastures
Bogs	Lowland raised bog
	Blanket bog
Improved grassland	Floodplain grazing marshes
Broadleaved, mixed and yew woodland	Wet woodland

7.2 Habitat and species summaries

7.2.1 Upland flushes, fens and swamps

Receiving water and nutrients from rainfall, surface and/or groundwater sources, this type of wetland is restricted to upland areas above the limit of agricultural enclosure. The water table being close to or above the land surface, their soils, whether peaty or mineral, are waterlogged for much of the year. These wetlands and the run-off from them form the source of many of our streams and rivers. Though localised, they are widespread in upland areas throughout the western UK. Except in the vicinity of springs, they may be grazed by ruminants (deer, sheep, sometimes cattle). Vegetation is dominated typically by sedges, rushes and grasses with the occasional carpet of mosses and/or wetland herbs. Overall, a rich flora of vascular plants is supported with many of the species being rare. The habitat also supports a rich community of

[66] https://jncc.gov.uk/our-work/uk-bap-priority-habitats/. Priority habitats identified by the JNCC for the 'Improved Grassland' and 'Broadleaved, Mixed and Yew Woodland' broad habitat categories include many more priority habitats than those identified here. Priority habitat descriptions are available from the JNCC website and from the sites of Natural England, NatureScot, Natural Resources Wales and NIEA (DAERA Northern Ireland). The Wildlife Trusts' website also gives illustrative descriptions of these habitats and the species of flora and fauna they host.

invertebrates which, in turn, provide a food source for nesting waders such as curlew, snipe and redshank.

7.2.2 Lowland fens

Also receiving water and nutrients from rainfall, groundwater and/or surface water sources, lowland fen is found across the UK. The total area covered in 2008 was estimated at about 26,000 ha, distributed England 31%, Northern Ireland 12%, Scotland 33% and Wales 24%.[67] Areas of lowland fen are underlain by a layer of peat that is periodically waterlogged, peat domes not forming owing to the relatively high rate of decomposition of peat in this wetland type (in contrast with lowland raised bog, see below). Fen frequently forms complex mosaics with several other habitat types including reedbed, wet woodland (fen carr), lowland heath and lowland meadow. Fens can be identified as poor or rich according to the direction of water movement (vertical or horizontal) and the degree of water mineralisation.

Poor fens are fed by low-mineralised water derived typically from sandstone, granites, sand and gravel. The water is acidic (pH value less than 5) with low nutrient levels resulting in species-poor vegetation dominated by sphagnum mosses or sedges. A scattering of herbs such as common cotton grass, devil's-bit scabious, marsh cinquefoil and marsh bedstraw may also be present. The Insh Marshes in the floodplain of the River Spey, Scotland, is a notable example of poor fen.

Rich fens on the other hand receive mineral-enriched alkaline water (pH greater than 5) and host much richer plant communities. Some areas may be dominated by *Carex s*edges above a carpet of mosses and vascular plants such as common butterwort, lesser spearwort, marsh cinquefoil, marsh marigold, and ragged robin. Other areas may be dominated by black bog-rush mixed with purple moor-grass, bog asphodel, sphagnum and other mosses. Yet others by common reed mixed with tall herbs such as hemp agrimony, meadowsweet, purple and yellow loosestrifes. Orchid species including early and southern marsh-orchids, common spotted-orchid, marsh helleborine are also present as, at some sites, is the rare narrow-leaved marsh orchid or fen orchid. Though it is a secondary habitat that has developed on areas of flooded medieval peat diggings, the Norfolk Broads in England is a notable example of rich fen and the complex mosaic that lowland fen can present.[68]

Lowland fens support particularly rich invertebrate communities, all of Britain's amphibians, and many bird species. Invertebrates include Desmoulin's whorl snail, the fen raft spider, the Norfolk Hawker dragonfly, the Pashford pot-beetle, the reed leopard moth and the swallowtail butterfly. Birds include the bearded tit, bittern, Cetti's warbler, little egret, marsh harrier, marsh warbler, spotted crake and the water rail.

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[67] https://data.jncc.gov.uk/data/b0b5e833-7300-4234-8ae5-bdbf326e854c/habitat-types-lowland-wetland.pdf

[68] https://www.wildlifetrusts.org/habitats/wetlands/lowland-fen. Also: https://www.broads-authority.gov.uk/learning/broads-curriculum/the-broads-national-park

Marsh cinquefoil *(Potentilla palustris)*

Marsh lousewort *(Pedicularis palustris)*

Baltic bog-moss *(Sphagnum balicum)*

Lesser butterfly orchid *(Platanthera bifolia)*

Figure 29 Examples of notable wetland plants
Credit: See Annex 5

7.2.3 Reedbeds

Reedbeds are a transitional, waterlogged habitat formed on the edges of open water, developing into lowland fen and wet woodland as time passes and vegetation litter accumulates. Found throughout the UK, about 900 sites exist, covering about 5,000 ha in total, though most sites are less than 20 ha. In England, the largest areas are in coastal East Anglia, with important stands found also in the Somerset Levels, Humber Estuary and in the north-west. Reedbeds are widespread but thinly scattered in Scotland, where the UK's largest reedbed is found on the Tay estuary. They are also widely distributed in lowland areas of Northern Ireland and Wales.

Commonly, reedbeds incorporate areas of open water and ditches, form in lowland floodplains, and fringe streams, rivers, ditches, ponds and lakes. Dominated by the common reed, other plant species are present to a limited extent. However, invertebrate and bird communities are diverse provided that a mosaic of habitat structures is present. Also, drier areas above the winter water level may provide a burrowing habitat for water voles while scrubby islands may be used by otters.

Localised sites may host the rare reed leopard moth, rove beetle and other invertebrate species whilst reedbeds are amongst the most important habitats for birds in the UK. They

support distinctive assemblages of breeding birds including the nationally rare bittern, crane, marsh harrier, Cetti's warbler, Savi's warbler and bearded tit, provide roosting and feeding sites for a range of migratory species, and provide winter roosting sites for several raptor species.

7.2.4 Purple moor grass and rush pastures

This type of wetland occurs on poorly drained soils, usually acidic, in lowland areas of high rainfall. Total UK coverage was estimated at about 56,000 ha in the UK's BAP. They are found in south-west England, in Northern Ireland particularly in Fermanagh, widely in Scotland but most commonly in the south-west, and in southern Wales. The presence of purple moor grass and rush species is distinctive of this wetland, which commonly occurs in mosaics with wet woodlands and lowland fens. Key associated species include: wavy St John's wort, whorled caraway, meadow thistle, marsh hawk's-beard, greater and lesser butterfly orchids, marsh fritillary butterfly, brown hairstreak, narrow-bordered bee hawkmoth, curlew, snipe and barn owl.

Swallowtail butterfly *(Papilio machaon)*

Bog bush cricket *(Metrioptera brachyptera)*

Reed leopard moth *(Phragmataecia castanaea)*

Fen raft spider *(Dolomedes plantarius)*

Figure 30 Examples of notable wetland invertebrate species
Credit: See Annex 5

7.2.5 Lowland raised bog

Lowland raised bogs are a particular feature of cool, humid lowlands of north-west England, central and north-east Scotland, Wales and Northern Ireland. Typically they form at the head of estuaries, along river plains and in depressions in the landscape, where drainage has been impeded by the underlying strata or by a high water table, leading to waterlogging, a slow rate

of decomposition of dead plant material, and the gradual accumulation of peat. The accumulation of peat raises the bog and separates it from the groundwater below. The bog is then irrigated solely by rainfall and melting snow. Peat thickness is highly variable but can exceed 12m.

The bog's mosaic of pools and hummocks provides a range of water regimes and distinctive, specialised plant species. Vegetation is dominated by sphagnum mosses such as Baltic bog-moss and Skye bog-moss, together with cotton grasses, rarer bog-mosses, the higher plants bog rosemary, great sundew and cranberry. Rare invertebrates such as the large heath butterfly, bog bush cricket and mire pill beetle may be found locally at some sites. Lowland raised bogs also support a variety of wildfowl.

7.2.6 Blanket bog

Blanket bog is a peatland habitat confined to cool, wet, typically oceanic climate regions. A globally limited wetland, blanket bog is one of the most extensive semi-natural habits in the UK and the JNCC report that the UK holds about 13% of the world's stock.[69] It ranges from Devon in south-west England to Shetland in the north. This habitat is long-standing, the initiation of blanket peat formation dating back some 1,500 to 9,000 years. Waterlogging is required as with lowland raised bog, but blanket peat can cloak a whole landscape and is not confined to areas of poor drainage – it may form on slopes of up to 30 degrees.

In addition to sphagnum mosses, typical vegetation cover includes heather, cross-leaved heath, deer and cotton grass, though their relative proportions vary between sites. More localised species include cloudberry (high altitude bogs), alpine bearberry (northern bogs), and black bog-rush (western bogs). This habitat also supports a wide range of terrestrial and aquatic vertebrates and invertebrates, similarly variable locally. Bird species that are notable for the density of their breeding populations on blanket bog include the red-throated diver and the Eurasian golden plover.

Common frog *(Rana temporaria)*

Palmate newt *(Lissotriton helveticus)*

Figure 31 Examples of notable wetland amphibians
Credit: See Annex 5

[69] In recognition, Natural England published *A Strategy for the Restoration of Blanket Bog in England* in 2015, which may be accessed at: http://publications.naturalengland.org.uk/publication/5476256970702848

7.2.7 Floodplain grazing marshes

Grazing marsh consists of pasture that is periodically inundated with freshwater, or meadow with ditches, to maintain water levels. Sites may contain permanent ponds with emergent swamp communities as well as seasonal water-filled hollows. The ditches are especially rich in plants and invertebrates, providing an important source of food for adult birds and for their chicks. The marshes can provide an excellent habitat for curlew, lapwings (which prefer short-grazed swards), and breeding waders such as snipe that like a more varied sward height.

Curlew *(Numenius arquata)*

Snipe *(Gallinago gallinago)*

Bittern *(Botaurus stellaris)*

Marsh harrier *(Circus aeruginosus)*

Figure 32 Examples of notable wetland birds
Credit: See Annex 5

Wintering populations of wildfowl including Bewick and whooper swans are significant internationally. Several bat species also use these areas for foraging. Floodplain grazing marshes are found in all four countries of the UK. A total of about 300,000 ha of floodplain grazing marshes may lie on low-lying coasts, the lower reaches of rivers and along estuaries throughout the UK, but the full extent is not currently known.

7.2.8 Wet woodland

Wet woodland occurs on poorly drained or seasonally wet soils on flood plains, along streams and hillside flushes, in peaty hollows, and as successional habitat on fens, mires and bogs. Alder, birch and willows form the predominant tree species. Wet woodland on fens occurs notably in East Anglia, Shropshire and Cheshire in England, whilst wet hillside and plateau alder woodland tends to be restricted to Wales, Cumbria and western Scotland. Rare fragments of ancient floodplain forest are found in the New Forest in England and in northern Scotland.

While few rare plant species depend on wet woodland as such, sites may contain species such as the marsh fern as relicts from when they were open wetland. And the habitat is favourable for many wildlife species. The high humidity of wet woodland favours the growth of bryophytes whilst a large number of invertebrate species – including the highly localised beetles *Melanopion minimun* and *Rhynchaenus testaceus* – are associated with alder, birch and willows. Craneflies may be attracted to even quite small patches of water, whilst the association of dead wood with water, for instance, can provide a specialised habitat for the rare fly *Lipsothrix nigristigma*, which is associated with log jams in streams. Wet woodland also provides cover and breeding sites for otters.

8 Responding to habitat pressures – opportunities to get involved

8.1 Introduction and scope

Preceding sections of the Guide have focused on priority habitats, though the authors appreciate that most habitats not qualifying as a 'priority' may have significant local value. Regardless of their status, moreover, all habitats in the UK are subject to one or more of the seven pressures summarised in Chapter 2. Now, in this final chapter, the specific effects on freshwater and wetland habitats of the seven identified pressures are highlighted (see Table 6) and examples are given of the range of responses that have been, and are being, made.

Table 6 Specific effects of pressures on freshwater and wetland habitats

Pressure	Effects
Agricultural Management	Loss of river corridor habitat, and habitat fragmentation, caused by intensive land management and drainage schemes
	Water pollution (nutrients, sediments) caused by run-off from farmland and spills from slurry management practices
Climate Change	Higher risk of hot dry summers, leading to increased water demand, rates of abstraction (urban water supply and irrigation), and lower groundwater levels and river flow rates
	Increased risk of extreme flooding in winter
Urbanisation	Loss of river corridor habitat, and habitat fragmentation, resulting from the development and expansion of urban areas onto flood plains – partly driven by an increasing population and by decreasing average household sizes
	Diffuse-source water pollution from urban surface water run-off
Hydrological Change	Impeded fish migration to spawning grounds and cutting off their escape from pollution events – caused by the presence of weirs, dams and other barriers on rivers
	Reduced river flow rates resulting from the over-abstraction of groundwater
	Unnatural flow regime and habitat loss resulting from the canalisation and covering of rivers and streams
	Loss of wetland habitat, and habitat fragmentation, resulting from land drainage practices
Pollution	River water pollution from diffuse sources (agricultural land and urban surface water run-off), and from point sources – mostly effluent from sewage treatment plants and intermittent combined sewer overflows (CSOs)
	Pollution of wetlands from atmospheric deposition of nitrogen gases emitted from combustion processes and agricultural practices
INNS	Displacement of native species in rivers and river corridors through their being outcompeted or predated by INNs introduced into the UK
	Choked waterways and increased risks of flooding resulting from exuberant growths of invasive, non-native plant species
Woodland Management	Loss of wet woodland habitat, and habitat fragmentation, resulting from land drainage practices and urban expansion

Three broad categories of organisation or body are active in responding to the specific pressures and effects noted in Table 6. The first comprises government, its agencies, and quasi-statutory organisations such as the water service undertakers, whose policies and practice play a leading role. Secondly, landowners and tenants. And thirdly, civic society taken in the broadest sense – comprising NGOs and individuals mainly; though social media, TV, news and other outlets can also play a significant role.

Some pressures can only be resisted through policy development and investments undertaken by governments, their agencies, and water service undertakers. Major areas that have received and continue to receive attention include:

- embedding the concept of Natural Capital and a commitment to sustainability in national policy
- law and practice
- regulating water abstraction rates
- reducing water pollutant discharges from sewerage, wastewater treatment plants, and agriculture
- land-use planning
- environmental stewardship schemes
- establishing a well-managed nature recovery network
- development of the Catchment Based Approach
- and many more.

Disappointingly though, public sector investment in biodiversity has declined since 2008/09, both in absolute terms (at constant 2016/17 prices) and as a proportion of national GDP (see Figure 33) putting the achievement of the government's ambitions in some jeopardy. And, given the possible economic and financial climate post-pandemic and post-Brexit, reversal of this trend seems unlikely any time soon without changes in governmental priorities. All the more reason, therefore, for supporting the growing efforts of the NGO sector, whose biodiversity expenditure increased by 24% over the five years to 2017/18.

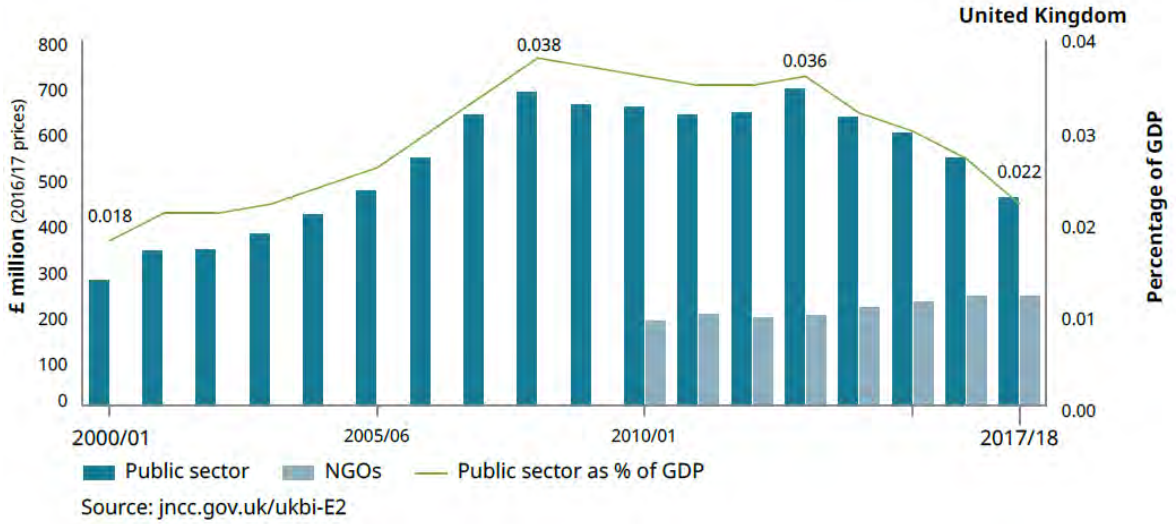


Figure 33 Expenditure on biodiversity in the UK, 2000/01 to 2016/17
Source: *The State of Nature 2019*, p49

Inputs from all three respondent types are often helpful and complementary. Indeed, many ground-level activities are usually best undertaken through such partnerships in which civic society can play a major role. A few examples to illustrate the range of partnership-led projects and activities undertaken, and the opportunities for members of the public to participate, are provided in Section 8.2. Concluding this chapter, Section 8.3 identifies a non-exclusive set of NGOs through whose websites may be found many opportunities to enjoy nature and engage in practical activity to conserve and restore habitats and species.

8.2 Example responses in action

8.2.1 Rivers and standing open waters

The chalklands of the River Kennet catchment and the Chilterns form a west-to-east arc to the south and north, respectively, of the River Thames. Two bodies lead collective efforts to conserve and restore the chalk rivers of the respective areas:

- **Action for the River Kennet (ARK)**, a River Trust
- **Chilterns Conservation Board**, which leads the Chilterns Chalk Streams Project (CCSP).

Both bodies engage in a range of activities, usually in collaboration with other organisations. A brief selection of their activities provides a flavour of the types of work undertaken by these bodies and the many other similar bodies throughout the UK. They include:

Raising awareness of the importance of chalk streams and the need to conserve them.

Providing advice on riverside management, or example:

- CCSP help landowners and managers to conserve and enhance their rivers and riverside land by providing best practice management advice. It provides free advisory visits, can produce management plans on request, and is producing management advice leaflets for each of the Chilterns' rivers – including the Chess, Misbourne, and Wye – downloadable free of charge as they are published.

Practical conservation to improve habitats for wildlife, for example:

- In 2019, ARK ran a community river restoration project on the River Dun in the village of Little Bedwyn in partnership with the Little Bedwyn Playing Field Trust (owners of the stretch of river and adjoining water meadow). Accessible to the public, the Trust wanted to improve their river stretch for wildlife and the enjoyment of local residents. Under ARK supervision and led by regular, trained volunteers, villagers worked on volunteer tasks over several weekends to transform this stretch. They removed a small weir that was impeding flow and were shown how to make hazel faggots. These were installed along the riverbank to create sinuous meanders in the river (Figures 34 and 35), increase river flow velocities and shift the thick silt that had been smothering the gravel riverbed. Coppicing, and cutting back some trees and shrubs, was undertaken to reduce shade, giving a better balance of light and shade. Native marginal plants were planted within the brushwood mattresses to hold the riverbank together and create a rich habitat for wildlife. And, to allow villagers easier access to their river, a small 'beach' was made.
- Current ARK activity includes working with partners on the Sparkling Streams Project, which takes a catchment-based approach to improving some of the failing rivers in the Kennet catchment and builds on years of catchment sensitive farming and river restoration work undertaken by ARK and its partners. The project will involve removing

barriers to fish migration; creating new wetland, hedge and woodland habitats; applying nature-based solutions such as sediment ponds and leaky dams to clean feeder waters; and the strategic planting of hedges and trees to slow overland flows, reduce soil erosion and improve water quality. Volunteering opportunities are plentiful.

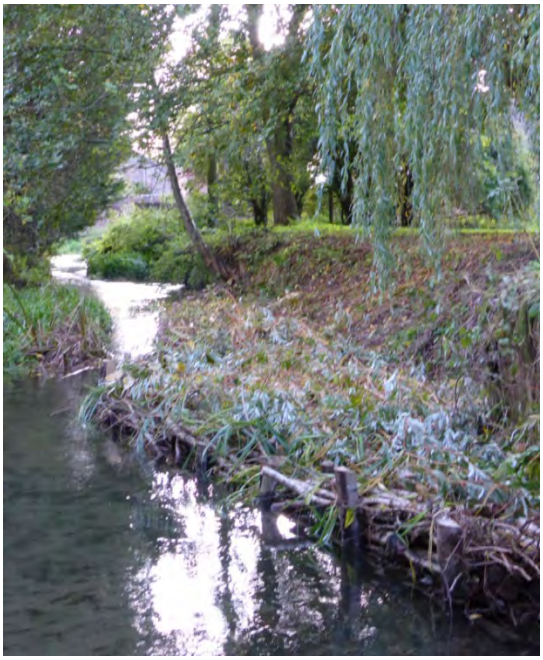
- Another ARK partnership activity is the Thames Catchment Community Eels Project, to help the long-term survival of the European eel. Once common, the eel is now critically endangered and the project is developing a standard methodology for undertaking eel barrier walkover surveys, so that trained volunteers may deploy citizen science to assess and map barriers to eel migration. This information will allow strategic prioritisation for future eel projects.

Making hazel faggots

Backfilling a brushwood mattress

Figure 34 Volunteers on the River Dun community restoration project
Credit: Action for the River Kennet

Before



After

Figure 35 The River Dun – before and after community restoration project work
Credit: Action for the River Kennet

Surveys to assess the quality of wildlife habitats and locate rare species, for example:

- Starting in 2001 and working with local organisations, landowners and volunteers, CCSP has undertaken surveys to determine the distribution of water voles along the Chilterns chalk streams. Anecdotal evidence indicated that water voles had been present on most Chiltern rivers in the recent past, but the 2001 and 2002 surveys revealed that they only inhabited the River Chess and Ewelme Stream. Sightings of mink, an INNS, prompted a repeat survey in 2003 undertaken by CCSP and a local Wildlife Trust, which revealed that the water vole population of the River Chess had declined by 97% relative to that in the 2001 survey – despite there being no significant changes in habitat quality over the two-year period.

  Hence CCSP implemented a strategic mink control scheme in partnership with the Wildlife Trust and Environment Agency, and with the assistance of landowners. The river was monitored for mink which, once found, were captured and removed. In parallel, CCSP and landowners undertook a series of habitat enhancement schemes to increase the amount of suitable habitat for water voles and link together areas of good habitat. In part this involved fencing the river to enable bankside vegetation to grow and provide a home for water voles and other wildlife. Subsequent surveys showed that by 2011 the population of water voles had recovered to 2001 levels. By 2015, associated with new sightings of mink, the population had declined again, and the mink control scheme was reinstated – with positive results. The surveys show how mink control combined with habitat enhancement, especially at catchment scale, can bring about a recovery in water vole numbers. The commitment of landowners and local volunteers was essential to the success of this local project.

- ARK run winter redd (nests of brown trout) spotting mornings at locations on the Kennet to train volunteers who would like to become ARK Redd Spotters. Spotting redds involves walking the riverbank and using polarised sunglasses to spot the mounds of clean gravel that may contain thousands of eggs. During the spawning season volunteers walk their designated stretch at least once every fortnight, logging new observed redds on to ARK's Redd Spotter App.

- As part of the Riverfly Partnership, ARK also participate in a national initiative to regularly monitor water quality. Trained ARK volunteers monitor 62 sites on the River Kennet and its tributaries to check the health of the river and pick up otherwise undetected pollution incidents.

Provide education resources for schools to help children understand the chalk stream environment, for example:

- Both CCSP and ARK produce education materials for schools on the special features, wildlife and history of chalk streams in their areas. They have set up a number of school-based 'Trout in the Classroom' projects to introduce children to their local river and the wildlife that lives there. Running for 10–12 weeks a year, a project begins in December/January with the installation in the school of an aquarium designed to recreate river conditions. Brown trout eggs are put into the tanks and placed in the care of the schoolchildren under the supervision of a teacher. After the eggs have hatched and fry (alevins) have left the gravel and begin to look for food, the children keep the tank clean and feed the fish while also learning about the trout's life cycle and chalk streams. Pupils release their trout into a local river at designated sites and pay a return

visit in the summer to engage in activity linked to learning more about the wildlife in chalk streams.

Improving physical access to streams, where appropriate, and providing information about their special qualities.

Concerning standing, open waters, the **Million Ponds Project** may be mentioned. A collaboration between partners, including major landowners and land managers, led and coordinated by the Freshwater Habitats Trust, this project aims to create an extensive network of new ponds across the UK, to reverse a century of pond loss and ensure that once again the UK has over one million countryside ponds.

A critical element of the project is that these new ponds have clean water. This is important because most countryside ponds are now badly damaged by pollution, and evidence shows that pond wildlife is declining across the UK. Making new, clean ponds is one of the simplest and most effective ways to protect freshwater wildlife. Phase I of the project ran from 2008 to 2012 and laid the foundation for Phase II to 2020 in England and Wales. Best practice information is now readily available and the importance of creating new, clean water ponds has become widely recognised. Activities have included:

- Identifying Important Areas for Freshwaters (IAFs) nationally – these are core areas in which to protect existing habitats, and from which stepping-stones can be created into the wider countryside.
- Developing targeted landscape-scale pond creation projects in areas like the New Forest and in more intensively managed landscapes, such as catchments in Oxfordshire and Leicestershire.
- Investigating the potential to further embed pond creation into national policy initiatives, such as conservation credits, which could potentially create many thousands of new, clean water ponds in the future.

8.2.2 Wetlands

The Great Fen Project[70] is a nationally important habitat restoration project being undertaken between Peterborough and Huntingdon in eastern England. One of the largest restoration projects in the country, it aims to create 3,700 hectares of wetland and connect existing National Nature Reserves (Woodwalton Fen and Holme Fen) to create a larger site with conservation benefits for wildlife and socio-economic benefits for people. A key element of this nationally important project, Woodwalton Fen features a variety of fen habitats that hosts an impressive list of rare plants and animals. The project engages volunteers to assist in all manner of activities including digging or raking, counting birds, pond dipping together with children, media work in the office, taking photographs and even making the tea.

8.2.3 Species recovery projects

The *State of Nature Report 2019* noted that policies delivered across landscapes and aimed at relieving the major pressures on nature may not be enough to ensure the survival and restoration of all priority species. Targeted species recovery projects (SRP) are also needed. Some of the more resounding successes of this approach include the restoration of pine

[70] Project managed in partnership by the Environment Agency, Huntingdonshire District Council, Middle Level Commissioners, Natural England and the Wildlife Trust for Bedfordshire, Cambridgeshire and Northamptonshire. https://www.greatfen.org.uk

martens in Wales, restoring the breeding range of red kites, and the establishment of the lady's slipper orchid at sites in northern England. Conservation action targeting one species can benefit others: for instance, creating reedbeds for bitterns can help water voles and the reed leopard moth.

However, the Report identifies that such conservation efforts have disproportionately focused on mammals and birds as opposed to invertebrates and plants; see Figure 36 which contrasts the taxa composition of the UK BAP priority species with that of SRPs targeted at BAP priority species.

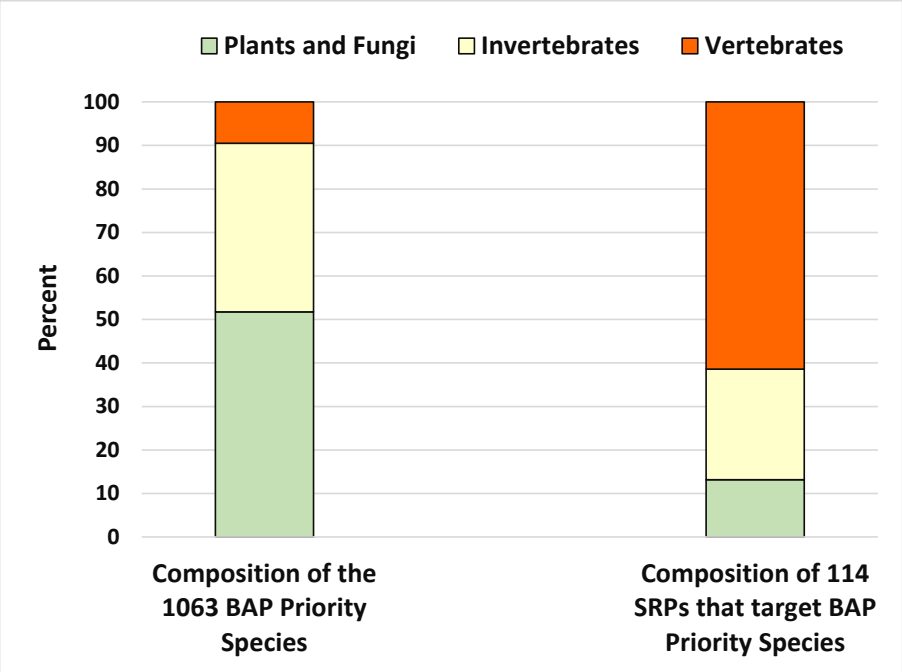


Figure 36 Illustration of the disproportionate focus of SRPs on mammals and birds
Source: Prepared by author, R C Frost, based on information in *The State of Nature (2019),* p48

Through 19 projects delivering across England, the 'Back from the Brink' conservation project aims to save 20 species from extinction and benefit over 200 more. It includes example SRPs that target invertebrate priority species such as the little whirlpool ramshorn snail.[71] This tiny aquatic snail needs unpolluted, chalky water such as may be found in marshland ditches in parts of south-east England. Rarely more than 5mm in diameter, it is one of the rarest, most restricted and vulnerable of freshwater molluscs. They are in trouble due to a loss of suitable wetland habitat, inappropriate management of remaining wetlands and poor water quality. Led by the RSPB, this project in the Arun Valley, West Sussex, aims to assess and better understand the habitat requirements of this snail. With the assistance of volunteers, ditches are being managed and monitored. At the time of writing, the results of ditch management are promising, the snail is occupying a new ditch and two of the spurs created to provide additional habitat. Colonisation by the rare sharp-leaved pondweed and other aquatic plants indicative of good water quality, such as frogbit, has also occurred.

A mammal, lying toward the other extreme in size, the European beaver (*Castor fiber*), is making a comeback to mainland Britain after being hunted to extinction by the end of the 16th

[71] All projects and results are described at: https://naturebftb.co.uk/ (accessed 24/04/2021).

century. Herbivorous, beavers are a 'keystone species' within their ecosystem (Figure 37). They create wetlands which provide habitats for a range of wildlife such as water voles, otters, dragonflies and amphibians. They can coppice waterside trees and shrubs, letting in light to help plants grow and allowing the scrub to grow back as dense cover for birds and other animals. And their dams trap sediment, improve water quality, reduce the risk of flooding downstream, and increase cover for trout and salmon.

Figure 37 A European beaver *(Castor fiber)* emerging from water
Credit: See Annex 5

In Scotland a five-year trial reintroduction of beavers to Knapdale in mid-Argyll was licensed and beavers were reintroduced in May 2009. The trial, undertaken by several wildlife organisations working collaboratively, ran until May 2014. Subsequently, the Scottish Government made the landmark announcements that beavers were to remain in Scotland (November 2016) and be legally protected with effect from May 2019.[72]

In England the release of European beavers into an enclosure began in Devon in 2011 to restore a nationally important wet grassland site and wild European beavers were observed in the east of the county in 2014. Subsequently, Natural England announced that the beavers could stay as long as they were of Eurasian descent and disease-free, leading to the mounting of a five-year monitoring programme – the River Otter Beaver Trial – which has had positive results.[73] Since then many other research projects have made controlled releases, with monitoring to determine how beavers impact the environment (in Cornwall, Kent, Cheshire, and Dorset) and others are planned (in Derbyshire, Hampshire and Sussex).

In Wales, following a public consultation, a license was issued in March 2021 for the transfer of a beaver family from Scotland and their release into an enclosed site at Cors Dyfi Nature Reserve in Powys.[74]

[72] https://www.scottishbeavers.org.uk/ and https://scottishwildlifetrust.org.uk/species/beaver/

[73] https://www.wildlifetrusts.org/saving-species/beavers . The *River Otter Beaver Trial: Science and Evidence Report* which is available from this site provides full details of the trial and its results. See also https://beavertrust.org/

[74] https://www.northwaleswildlifetrust.org.uk/welshbeaverproject

8.3 Engagement opportunities

The examples of habitat improvement and species recovery given in Section 8.2 barely scratch the surface of the opportunities available to engage as a volunteer. Additional to statutory organisations such as Natural England and NatureScot, a wealth of NGOs and other organisations welcome volunteers and donations. They also serve as sources of information and provide many practical opportunities to enjoy nature.

Tables 7 and 8 provide partial listings of such organisations for habitats and species respectively, though the overlap in interest is substantial in practice. A website contact address is provided for each, and most sites contain a webpage where you can register your interest in conservation engagement. The volunteering opportunities are many, including practical field-working in teams (under supervision and adopting appropriate procedures for health and safety) and participating in citizen science activities.

Table 7 Organisations active in the conservation of rivers, wetlands and habitats

Organisation	Website
Action for the River Kennet (ARK)	http://www.riverkennet.org/
Association of Local Environmental Records Centres	https://www.alerc.org.uk/
Broads National Park	https://www.visitthebroads.co.uk/discover-the-broads/wildlife-in-the-broads
Canal and River Trust	https://canalrivertrust.org.uk
Chilterns Chalk Streams Project	https://www.chilternsaonb.org/projects/chalk-streams-project
Freshwater Habitats Trust	https://freshwaterhabitats.org.uk/
Great Fen Project	https://www.greatfen.org.uk
Lincolnshire Chalk Steams Project	https://www.lincswolds.org.uk/chalk-streams
The National Association for Areas of Outstanding Natural Beauty	https://landscapesforlife.org.uk/
National Biodiversity Network	https://nbn.org.uk/
National Parks UK	https://www.nationalparks.uk/
National Trust	https://www.nationaltrust.org.uk
Partnership for Biodiversity in Planning	https://www.biodiversityinplanning.org/
People's Trust for Endangered Species	https://ptes.org
Rewilding Britain	https://www.rewildingbritain.org.uk/
The Rivers Trust[75]	https://www.theriverstrust.org/who-we-are/about-us/
Wildfowl and Wetlands Trust (WWT)	https://www.wwt.org.uk
The Woodland Trust	https://www.woodlandtrust.org.uk/
World Wide Fund for Nature	https://www.wwf.org.uk/

[75] Scrolling down the page reveals an interactive map, allowing the viewer to connect to the website of each selected regional River Trust (most recent access 24/04/2021).

Table 8 Organisations active in the conservation of wildlife

Organisation	Website
Amphibian and Reptile Conservation Trust	https://www.arc-trust.org
Bat Conservation Trust	https://www.bats.org.uk/
Beaver Trust	https://beavertrust.org
British Dragonfly Society	https://british-dragonflies.org.uk/
The British Lichen Society	https://www.britishlichensociety.org.uk/
British Mycological Society	https://www.britmycolsoc.org.uk/
Buglife	https://www.buglife.org.uk
Butterfly Conservation	https://butterfly-conservation.org
Freshwater Habitats Trust	https://freshwaterhabitats.org.uk/
The Fungus Conservation Trust	http://www.abfg.org
The Grayling Society	https://www.graylingsociety.net/
The Mammal Society	https://www.mammal.org.uk/
The Pike Anglers Club	https://pacgb.com/
Plantlife	https://www.plantlife.org.uk
Royal Society for the Protection of Birds (RSPB)	https://www.rspb.org.uk
Salmon & Trout Conservation	https://salmon-trout.org/
Water Vole	https://watervole.org.uk/
The Wild Flower Society	https://www.thewildflowersociety.com
The Wildlife Trusts	https://www.wildlifetrusts.org/
UK Wild Otter Trust	http://www.ukwildottertrust.org
Wild Trout Trust	https://www.wildtrout.org/

Should you see anything untoward you may also, as a private citizen, act as the 'eyes and ears' of the Environment Agency (in England) alerting it via a Hotline to an actual or potential incident – see call number below:

Environment Agency Incident Hotline
24 hours a day

0800 80 70 60

For the public to report:

- Damage or danger to the natural environment
- Pollution to water or land
- Poaching or illegal fishing
- Dead fish or fish gasping for air
- Main rivers blocked by a vehicle or fallen tree causing risk of flooding
- Flooding from any river, stream, canal or natural spring
- Incidents at Environment Agency-regulated waste sites
- Illegal removals from watercourses
- Unusual changes in river flow
- Collapsed or badly damaged river or canal banks

ANNEXES

Annex 1 EU Biodiversity Strategy for 2030

1.1 Background

The European Commission set out the European Green Deal for the European Union (EU) and its citizens (Green Deal) on 11 December 2019.[76] This reset the Commission's commitment to tackling climate and environmental-related challenges as a defining generational task. The Green Deal is a particular response to these challenges, framed against a background in which:

- the atmosphere is warming
- the climate is changing with each passing year
- forests and oceans are being polluted and destroyed
- one in eight of the eight million species on the planet are at risk of being lost.

The Green Deal presents a growth strategy that aims to transform the EU into a fair and prosperous society, with a modern, resource-efficient and competitive economy where there are no net emissions of greenhouse gases in 2050 and where economic growth is decoupled from resource use.

It also aims to protect, conserve and enhance the EU's Natural Capital, and protect the health and well-being of citizens from environment-related risks and impacts. At the same time, it acknowledges that this transition must be just and inclusive. Putting people first, and paying attention to the regions, industries and workers who will face the greatest challenges. Since its realisation will bring substantial change, it states that active public participation and confidence in the transition is paramount if policies are to work and be accepted. The Green Deal also makes clear that a new pact – the EU Biodiversity Strategy for 2030 – is needed to bring together citizens in all their diversity, with national, regional, local authorities, civil society and industry working closely with the EU's institutions and consultative bodies.

1.2 EU Biodiversity Strategy for 2030

One of the key pillars of the European Green Deal is the EU Biodiversity Strategy for 2030 – a comprehensive, systemic and ambitious long-term plan for protecting nature and reversing the degradation of ecosystems.[77] With the subtitle of 'Bringing Nature back into our Lives', it has an objective to put Europe's biodiversity on the path to recovery by 2030 and sets out new ways to implement existing legislation more effectively with new commitments, measures, targets and governance mechanisms.

Damaged ecosystems are more fragile and have a limited capacity to deal with extreme events and new diseases. Well-balanced ecosystems, by contrast, protect us against unforeseen disasters and, when we use them in a sustainable manner, they offer many of the best solutions to urgent challenges. Losing biodiversity is an issue for:

- Climate–damaging and destroying ecosystems and soils speeds up global warming while nature restoration mitigates climate change.
- Business – natural capital provides essential resources for industry and agriculture.
- Security and safety – loss of natural resources, especially in developing countries, can lead to conflicts and increases everywhere vulnerability to natural disasters;

[76] Communication from the European Commission COM (2019) 640 final 11 December 2019

[77] Communication from the European Commission COM (2020) 380 final 20 April 2020

- Food security – plants, animals including pollinators, and soil organisms play a vital role in our food system.
- Health – the destruction of nature increases the risk and reduces our resilience to diseases. Nature also has a beneficial effect on people's mental health and welfare.
- Equity – loss of biodiversity hurts the poorest most of all, making inequalities worse.
- Intergenerational fairness – robbing our descendants of the basis for a fulfilled life.

In the post-pandemic context, the Biodiversity Strategy aims to build societies' resilience to future threats such as climate change impacts, forest fires, food insecurity or disease outbreaks, including by protecting wildlife and fighting illegal wildlife trade.

1.2.1 Main elements of the EU Biodiversity Strategy for 2030

The Strategy contains specific commitments and actions to be delivered by the Commission and Member States by 2030, and these include:

- Establishing a **larger EU-wide network of protected areas on land and at sea**, building upon existing Natura 2000 areas, with strict protection for areas of very high biodiversity and climate value.
- An **EU Nature Restoration Plan**. A series of concrete commitments and actions to restore degraded ecosystems across the EU by 2030, and manage them sustainably, addressing the key drivers of biodiversity loss.
- A set of **measures to enable the necessary transformative change**: setting in motion a new, strengthened governance framework to ensure better implementation and track progress, improving knowledge, financing and investments and better respecting nature in public and business decision-making.
- Measures to tackle the **global biodiversity challenge**, demonstrating that the EU is ready to lead by example towards the successful adoption of an ambitious global biodiversity framework under the Convention on Biological Diversity.

1.2.2 Annex to the EU Biodiversity Strategy for 2030

This contains details of the Key Actions to be taken by the European Commission to achieve the overall objectives of the EU Diversity Strategy and an indicative timetable for completion. It is divided into several sections dealing with the development of: (i) a coherent network of protected areas, (ii) an EU nature restoration plan, (iii) enabling transformative change, and (iv) an ambitious EU global diversity agenda.

1.2.3 Fact sheets

Of particular interest, the European Commission also published in May 2020 a number of fact sheets in connection with the Biodiversity Strategy for 2030. They include:

- Bringing nature back into our lives – including an explanation as to (i) why we need to protect biodiversity and (ii) how the EU will establish protected areas and restore degraded ecosystems on land and at sea.
- The Business Case for Biodiversity.
- EU Biodiversity Strategy Information Sheet.

Annex 2 EU Habitats, Birds and Fish Directives

The **Habitats Directive** seeks to ensure the conservation of a wide range of rare, threatened or endemic animal and plant species.[78] It covers the protection of over 1,000 animal and plant species, as well as 200 habitat types. The Directive aims to promote the maintenance of biodiversity, taking account of economic, social, cultural and regional requirements. It forms the cornerstone of Europe's nature conservation policy with the Birds Directive and led to the setting up of Natura 2000, a network of Special Areas of Conservation. Together with existing Special Protection Areas they form a network of protected sites across the European Union to safeguard against potentially damaging developments.

Natura 2000 is a network of core breeding and resting sites for rare and threatened species, and some rare natural habitat types which are protected in their own right. It stretches across all EU countries, both on land and at sea. The aim of the network is to ensure the long-term survival of Europe's most valuable and threatened species and habitats, listed under both the Birds Directive (see below) and the Habitats Directive. Natura 2000 protects 27,312 sites having a terrestrial area 787,606 km^2 (around 18% of the land of the EU countries) in 2017 and is considered almost complete in the EU terrestrial environment.[79]

The **Birds Directive** was adopted on 30 November 2009. The latest consolidated version was published on 1 July 2013.[80] It aims to protect all European wild birds and the habitats of listed species, in particular through the designation of Special Protection Areas (SPAs). As such, the Directive applies to all the listed species of birds, their eggs and habitats. With the Habitats Directive, the Birds Directive is one of the EU's two Directives in relation to wildlife and nature conservation.

The **Fish Directive** concerns the quality of fresh waters and applies to those waters designated by the Member States as needing protection or improvement in order to support fish life.[81] It aims to protect or improve the quality of those running or standing fresh waters which support or which, if pollution were reduced or eliminated, would become capable of supporting fish belonging to:

- indigenous species offering a natural diversity
- species whose presence is judged desirable for water management purposes by the competent authorities of each Member State.

[78] The Habitats Directive is known formally as 'Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora': https://www.legislation.gov.uk/eudr/1992/43/contents

[79] Post-Brexit, the UK is no longer a member of Natura 2000. However, the Brexit Regulations mean that similar regulations are in force in the UK unless and until the government decides otherwise.

[80] The Birds Directive is known formally as *Council Directive 2009/147/EC on the Conservation of Wild Birds*, https://www.legislation.gov.uk/eudr/2009/147/contents

[81] The Fish Directive is known formally as *Directive 2006/44/EC of 6 September 2006 on the quality of fresh waters needing protection or improvement in order to support fish life,* https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2006:264:0020:0031:EN:PDF

Annex 3 Priority fish species and their occurrence in the UK

Table 9 List (2007) of UK BAP priority fish species (excluding purely marine) and their occurrence in England, Scotland, Wales and Northern Ireland.

Taxon	Name		Occurrence (Y / N)			
	Common	Scientific	England	Northern Ireland	Scotland	Wales
Bony fish	Common sturgeon	*Acipenser sturio*	Y	Y	Y	N
	Allis shad	*Alosa alosa*	Y	Y	Y	Y
	Twaite shad	*Alosa fallax*	Y	Y	Y	Y
	European eel	*Anguilla anguilla*	Y	Y	Y	Y
	Spined loach	*Cobitis taenia*	Y	N	N	N
	Vendace	*Coregonus albula*	Y	N	Y	N
	Pollan	*Coregonus autumnalis*	N	Y	N	N
	Whitefish (Powan, Gwyniad or Schelly)	*Coregonus lavaretus*	Y	N	Y	Y
	Burbot	*Lota lota*	N	N	N	N
	Smelt (sparling)	*Osmerus eperianus*	Y	Y	Y	Y
	Atlantic salmon	*Salmo salar*	Y	Y	Y	Y
	Brown/sea trout	*Salmo trutta*	Y	Y	Y	Y
	Arctic char	*Salvelinus alpinus*	Y	N	Y	Y
Jawless fish	River lamprey	*Lampetra fluviatilis*	Y	Y	Y	Y
	Sea lamprey	*Petromyzon marinus*	Y	Y	Y	Y

Annex 4 Differences in institutional arrangements within the UK

Analogous institutional arrangements to those in England are in place in the devolved administrations – see Table 10. Likewise, most of the non-statutory bodies and NGOs identified for England in Chapter 3 are also active in Northern Ireland, Scotland and Wales though there are some notable differences:

- The Water Service Undertakings in Northern Ireland and Scotland are in public ownership.
- River Trusts do not cover all areas within the territories.
- Formal Catchment Partnerships are not established.

Table 10 Institutional arrangements for undertaking statutory responsibilities in the UK

Country	Institutions with primary executive responsibility for:	
	Nature	Water
England	Natural England	Environment Agency
Northern Ireland[82]	Northern Ireland Environment Agency (NIEA)	Northern Ireland Environment Agency (NIEA)
Scotland[83]	NatureScot	Scottish Environment Protection Agency (SEPA)
Wales[84]	Natural Resources Wales	Natural Resources Wales

[82] The NIEA is an executive agency of the Department of Agriculture, Environment and Rural Affairs (Northern Ireland). See https://www.daera-ni.gov.uk

[83] See https://www.nature.scot and https://www.sepa.org.uk

[84] See https://naturalresources.wales/?lang=en

Annex 5 Credits for wildlife and landscape images

Fig	Image #	Credit
	Cover/Front: Grey Heron *(Ardea cinerea)*	Matushaban / Shutterstock
11	Brown trout *(Salmo trutta)*	Rostislav Stefanek / Shutterstock
11	Grayling *(Thymallus thymallus)*	Rostislav Stefanek / Shutterstock
11	Otter *(Lutra Lutra)*	Belizar / Shutterstock
11	Water vole *(Arvicola amphibius)*	Ian Schofield / Shutterstock
11	Kingfisher *(Alcedo atthis)*	Philippe Clement / Shutterstock
11	Water crowfoot *(Ranunculus spp.)*	Environment Agency[85]
11	White-clawed crayfish *(Austropotamobius pallipes)*	Bristol Zoological Society
11	Chalk river mayfly *(Ephemera danica)*	Martin Jacobs
12	Magnificent scenery – chalk downland ending at the sea at Flamborough Head	Martina Hardiman, Snap and Saunter (www.snapandsaunter.com)
13	A profusion of wildflowers on chalk grassland	ColleenSlater Photography / Shutterstock
14	Pasque flower (*Pulsatilla vulgaris)*	Bernard Dupont
14	Bird's-foot trefoil (*Lotus corniculatus)*	Photograph by Luke Morton/plantlife.org.uk
14	Early spider orchid (*Ophrys sphegodes*)	© Kelley Finney – Wild Flower Finder
14	Four-spotted moth *(Tyta luctuosa)*	xulescu_g – Butterfly Conservation
14	Adonis blue butterfly (*Polyommatus bellargus*)	Peter Eeles – Butterfly Conservation
14	Skylark *(Alauda arvensis)*	Elizabeth Dack
14	Adder *(Vipera berus)*	Holm94 / Shutterstock
15	The River Tees beneath Cauldron Snout cascade, Co Durham, England	George Tod
15	Middle reaches of the River Feshie on the western side of the Cairngorm Massif, Scotland	Rowena Hepple
16	Dipper *(Cinclis cinclus)*	Tom Marshall (rspb-images.com)
17	Llyn Idwal, Snowdonia	Doug Thomas
17	Loch Morar, western Scotland	John A Cameron / Shutterstock
18	Water lobelia (*Lobelia dortmanna*)	ukwildflowers.com
18	Bulbous rush *(Juncus bulbosus)*	© RWD - Wild Flower Finder
19	Two Arctic charr (*Salvelinus alpinus*) near their spawning ground in the inflow to Ennerdale Water	Linda Pitkin / 2020 Vision (Nature Picture Library)
20	A mesotrophic lake in Scotland	© Lorne Gill / NatureScot

[85] https://environmentagency.blog.gov.uk/2017/09/22/celebrating-our-chalk-streams-on-world-rivers-day/

Fig	Image #	Credit
21	Vendace (*Coregonus albula),* an ice age relict found only in Derwentwater, a mesotrophic lake in Cumbria, England	Jussi Murtusaari [86]
22	Lough Neagh, Northern Ireland	© Crown Copyright https://www.daera-ni.gov.uk/protected-areas/lough-neagh-assi
23	Yellow water lily *(Nuphar lutea)*	Aleksei lutea / Shutterstock
23	Shoveler duck *(Anas clypeata)*	© Nigel Key
23	Roach *(Rutilus rutilus)*	Kuttelvaserova Stuchelova / Shutterstock
23	Tench *(Tinca tinca)*	Rostislav Stefanek / Shutterstock
24	A pike *(Esox Lucius)* 'on patrol'	Martin Prochazkacz / Shutterstock
25	A pond	Freshwater Habitats Trust
25	Broad-leaved pondweed (*Potamogeton natans*)	John Somerville http://www.british-wild-flowers.co.uk
26	Great diving beetle *(Dytiscus marginalis)*	Martin Pelanek / Shutterstock
26	Emerald damselfly *(Lestes sponsa)*	Ainars Aunins / Shutterstock
26	Common darter dragonfly *(Sympetrum striolatum)*	Elizabeth Dack
26	Great crested newt *(Triturus cristatus)*	© Lorne Gill / NatureScot
26	Perch (*Perca fluviatilis*)	Erni / Shutterstock
27	Aerial view of a group of fluctuating meres at Wretham, Norfolk	www.mike-page.co.uk
28	Fen violet (*Viola persicifolia)*	Martin Fowler / Shutterstock
28	Norfolk bladder-moss (*Physcomitrium eurystomum)*	Des Callaghan [87]
28	One-grooved diving beetle *(Bidessus unistriatus)*	© Arthur Ewing
28	Ground beetle *(Blethisa multipunctata)*	© Roy Anderson
29	Marsh cinquefoil *(Potentilla palustris)*	Sarah2 / Shutterstock
29	Marsh lousewort *(Pedicularis palustris)*	ukwildflowers.com
29	Baltic bog-moss *(Sphagnum balicum)*	Blanka Aguero, Consortium of North American Bryophyte Herbaria[88]
29	Lesser butterfly orchid *(Platanthera bifolia)*	© Zoë Devlin, www.wildflowersofireland.net
30	Swallowtail butterfly *(Papilio machaon)*	Iain Leach – Butterfly Conservation
30	Bog bush cricket *(Metrioptera brachyptera)*	Bojanan, CC BY-SA 4.0 <https://creativecommons.org/licenses/by-sa/4.0>, via Wikimedia Commons

[86] https://www.researchgate.net/figure/Our-study-species-vendace-Coregonus-albula-L-Photograph-by-Jussi-Murtosaari_fig6_290273196

[87] Population status and ecology of the episodic moss Physcomitrium eurystomum Sendtn. in Britain. April 2020, Journal of Bryology 42(3):1-12. https://www.researchgate.net/publication/340908141

[88] https://bryophyteportal.org/portal/taxa/index.php?tid=160917&taxauthid=1&clid=0

Fig	Image #	Credit
30	Reed leopard moth *(Phragmataecia castanaea)*	© Mark Skevington - https://ukmoths.org.uk/species/phragmataecia-castaneae#prettyPhoto
30	Fen raft spider *(Dolomedes plantarius)*	Matt Wilkinson (rspb-images.com)
31	Common frog *(Rania Temporaria)*	© Alan Hunt (cc-by-sa/2.0) https://www.geograph.org.uk/photo/4153396
31	Palmate newt *(Lissotriton helveticus)*	Sourced via Google search
32	Curlew *(Numenius arquata)*	Elizabeth Dack
32	Snipe *(Gallinago gallinago)*	Gallinago - https://commons.wikimedia.org/wiki/File:Gallinago_gallinago_a1.JPG#filelinks
32	Bittern ***(****Botaurus stellaris)*	Elizabeth Dack
32	Marsh harrier *(Circus aeruginosus)*	Bird Wise North Kent [89]
37	A European beaver (*Castor fiber*)	Rocchas / Shutterstock

[89] https://northkent.birdwise.org.uk/meet-the-birds/marsh-harrier-circus-aeruginosus

Annex 6 Acronyms and Glossary of Terms

4CBG	Four Countries Biodiversity Group: established to reflect the interests of the whole of the UK following devolution
ABS	Access and Benefits Sharing: as defined in the Nagoya Protocol
AONB	Area of Outstanding Natural Beauty
ARK	Action for the River Kennet
BAP	Biodiversity Action Plan: a programme that is designed to protect and restore biological systems, addressing threatened species and habitats. BAPs may be produced at national and subsidiary levels.
Biodiversity	Variety and variability of life on Earth – typically a measure of variation at the genetic, species, and ecosystem levels.
Breckland	A heathland area straddling south Norfolk and north Suffolk in England. It is designated a Special Protection Area (SPA) due to its high degree of biodiversity and the threats to it.
Bryophyte	A member of a large group of non-vascular, seedless green plants that reproduce via spores. Found mostly in damp environments, they comprise liverworts, hornworts and mosses.
CBD	Convention on Biological Diversity: dedicated to promoting sustainable development, signed by Governments at the 1992 Rio Earth Summit.
CCSP	Chilterns Chalk Streams Project
CEO	Chief Executive Officer (of companies and enterprises)
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora: an international agreement signed 3 March 1973 and entering into force 1 July 1975. It is designed to ensure that international trade in animals and plants does not threaten their survival in the wild.
CRoW 2000	Countryside and Rights of Way Act 2000: it introduces the freedom to roam, i.e. the general public's right to access certain public or privately owned land, lakes, and rivers for recreation and exercise in England and Wales. The Land Reform (Scotland) Act 2003 introduces similar rights in Scotland.
CSOs	Combined Sewer Overflows
Defra	Department for Environment, Food and Rural Affairs of the UK Government.
Dystrophic	A water body having brown acidic water, low in oxygen and nutrients, and supporting little life – see oligotrophic also.
EC	European Commission: executive branch of the European Union (EU), responsible for proposing legislation, implementing decisions, upholding EU treaties and managing the day-to-day business of the EU.
ERS	Exposed Riverine Sediments or Active Shingle Rivers: mineral deposits (normally sand, gravel and pebble with cobble) in river channels that are exposed during low flows, particularly in the spring and summer.
EU	European Union comprising 27 Member States. Post-Brexit the UK is no longer a member of the EU.
EUBS 2030	EU Biodiversity Strategy for 2030 and associated Action Plan
Eutrophic	A lake rich in nutrients (nitrogen N, and phosphorus P) such that it supports dense populations of algae, vegetation, invertebrates and fish. If nutrient levels exceed an optimum value, the decomposition of dying organisms can deplete

	the levels of dissolved oxygen to the extent that the remaining life forms die from lack of oxygen.
Externalities	Externalities occur when producing a good, or its consumption, causes an impact on a third party or parties not directly involved in the transaction. Externalities can either be positive or negative. Being vaccinated against an infectious disease, for example, has a positive externality effect by protecting other people from becoming infected. Negative externalities include the climate change effect of carbon dioxide emissions to air from the legal combustion of fossil fuels.
Habitats Directive	European Council Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora.
INNS	Invasive Non-Native Species
Invertebrates	Animal species that have no backbone. Most animal species are invertebrates. They include arthropods (insects, arachnids, crustaceans), molluscs (e.g. snails and slugs), and annelid (earthworms and leeches).
IUCN	International Union for Conservation of Nature: an international organisation working in the field of nature conservation and sustainable use of natural resources.
JNCC	Joint Nature Conservation Committee – the public body that advises the UK Government and devolved administrations on UK-wide and international nature conservation.
LMO	Living Modified Organism – a living organism that possesses a novel combination of genetic material obtained through the use of modern biotechnology.
LNRS	Local Nature Recovery Strategies
Macrophytes	Aquatic plants growing in or near water. They may be either emergent, i.e. with upright portions above the water surface, submerged or floating. Examples of macrophytes include cattails, hydrilla, and duckweed.
Mere	A (small) shallow lake, pond or wetland.
Mesotrophic	Of freshwater lakes – containing medium levels of nutrients
Nagoya Protocol	The Nagoya Protocol on ABS (see above): adopted 29 October 2010 in Nagoya, Japan, entering into force on 12 October 2014. It is also known as the Aichi Protocol. Its objective is the fair and equitable sharing of benefits arising from the utilisation of genetic resources, thereby contributing to the conservation and sustainable use of biodiversity.
Natural Capital	The stock of natural resources – including soils, air, water and all living organisms – some of which provide people with goods and services, often called 'ecosystem services'. Clean water, air and fertile soil underpins our economy and society and makes human life possible. The stock may be considered at local, regional and national levels.
Natural Capital Committee (NCC)	The NCC advises the government on natural capital, such as forests, rivers, minerals and oceans. It is an independent advisory committee that provides advice to the government on the sustainable use of natural capital and the benefits so derived.
Natural England	An agency of Defra, it is responsible for ensuring that England's natural environment, including its land, flora and fauna, freshwater and marine environments, geology and soils, are protected and improved. It also has a responsibility to help people enjoy, understand and access the natural environment.

Natural Habitats	Terrestrial or aquatic areas that are distinguished by geographic, biological (biotic) and physical (abiotic) features. The term was introduced by the Habitats Directive.
NCD	Natural Capital Declaration: launched at the Rio + 20 Summit in 2012, this is a commitment by CEOs from the World's major finance sector to work towards integrating natural capital criteria into their products and services.
NCP	Natural Capital Protocol: a decision-making framework that enables organisations to identify, measure and value their direct and indirect impacts and dependencies on Natural Capital.
NEA	UK National Ecosystem Assessment 2011
NEWP	Natural Environment White Paper 2011
NIEA	Northern Ireland Environment Agency
NERC 2006	Natural Environment and Rural Communities Act 2006: this Act places a duty to conserve biodiversity on public authorities in England.
NFU	National Farmers Union (England and Wales)
NGO	Non-Governmental Organisation
NP	National Park
OEP	Office for Environmental Protection
Oligotrophic	The term 'oligotrophic' is commonly used to describe terrestrial and aquatic environments with very low concentrations of nitrates, iron, phosphates, and carbon sources. The water of an oligotrophic lake is usually clear – in contrast to a dystrophic lake which is stained brown from peaty acids.
Priority Natural Habitats	Semi-natural habitat types that were identified in the UK Biodiversity Action Plan (UK BAP) as being the most threatened and requiring conservation action.
Priority Species	Biological species that are most threatened or rapidly declining and need urgent conservation action
RBMP	River Basin Management Plans
RSPB	Royal Society for the Protection of Birds
SEPA	Scottish Environment Protection Agency
SPA	Special Protection Areas: designated under the EU Directive on the Conservation of Wild Birds (2009/147/EC), which places a duty on EU Member States to safeguard the habitats of migratory birds and certain particularly threatened birds. Post-Brexit, SPAs are regulated under the Conservation of Habitats and Species Regulations 2017, as amended by the Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019 – the so-called '2019 Regulations'.
SRP	Species Recovery Project
Stoneworts	An ancient group of aquatic plants that are complex algae, looking similar to higher plants. They are so-called owing to their growing an external skeleton of calcium carbonate, instead of using cellulose for structural support as seen in flowering plants. They attach themselves to bare substrate by root-like rhizoids.
UK BAP	UK Biodiversity Action Plan, published in 1994. It is the UK's response to the Convention on Biological Diversity (CBD) which called for the development and enforcement of national strategies and associated action plans to identify, conserve and protect existing biological diversity, and to enhance it wherever possible.

UK Habitats of Principal Importance	Habitats in the UK that are most threatened, are in greatest decline, or where the UK holds a significant proportion of the world's total population of given species.
UK Species of Principal Importance	Species that have been designated to be of 'principal importance for the purpose of conserving biodiversity' and are the most threatened, in greatest decline, or where the UK holds a significant proportion of the world's total population.
UNEP	United Nations Environment Programme: this coordinates the UN's environmental activities and assists developing countries in implementing environmentally sound policies and practices.
WFD	EU Water Framework Directive 2000/60/EC, which commits EU Member States to achieve good qualitative and quantitative status of all national water bodies. In the UK, post-Brexit, now regulated nationally by, for instance, the Water Environment (Water Framework Directive) (England and Wales) Regulations 2017.
WWF	World-Wide Fund for Nature (formerly the World Wildlife Fund): an international non-governmental organization founded in 1961, working in the field of wilderness preservation, and the reduction of human impact on the environment.