State of Nature in the West of England

2024

Bristol Regional Environmental Records Centre

Sorbus bristolensis

Produced by Aidan Pick on behalf of the Bristol Regional Environmental Records Centre and in collaboration with the Bristol Naturalists' Society.

Our thanks to the many naturalists who submit their sightings each year to BRERC.

BRERC's website: www.brerc.org.uk

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An Introduction to the West of England

Located in the south-western quadrant of the country, the West of England is a term used to describe the area of four Unitary Authorities (Bristol City Council, Bath & North East Somerset Council, North Somerset Council and South Gloucestershire Council) that formerly comprised the County of Avon; home to approximately 1.1 million people.

Situated within a band of lowland that spans most of the western edge of England, the region would have been historically dominated by broadleaved woodland with smaller areas of moorland and other grasslands where conditions or grazing by wild herbivores did not favour trees. This began to significantly change with the advent of agriculture. By the 17th century mapping indicates that already large swathes of land had been altered into orchards or farmland with many of the remaining woodlands managed to favour game species, with their associated predators rendered extinct in prior centuries. Over the following years, ever increasing areas of land were converted for agricultural practices to feed growing populations, a trend only furthered by technological advancements in fertilisers and machinery in the early 20th century.

Despite recent decades seeing a decline in the total farmed land within the West of England, it is still, by far, the most predominant habitat within the region.

Figure 1. The location of the West of England region

Figure 2. The boundaries of the Unitary Authorities within the West of England

Executive Summary

This report on the State of Nature in the West of England, commissioned and produced by the Bristol Regional Environmental Records Centre (BRERC), provides a unique insight into how the region's habitats, and the species that reside within them, are faring.

With increasing recognition of the effect that human activity is having upon nature globally, attention from legislating bodies towards protecting biodiversity has substantially risen in the last decade. Nationally, the UK government has set a target to halt a decline in species abundance by 2030, whilst on a regional level the West of England Combined Authority has committed to increasing the abundance of wildlife by 30% between 2020 and 2030. Climate and/or Ecological Emergencies and associated action plans have been declared by all of the region's four Unitary Authorities.

As the central repository of the region's wildlife data, BRERC is committed to providing high quality information, accessible to anyone. BRERC has collaborated with the Bristol Naturalists' Society to produce this report.

The evidence gathered by this report indicates that many pressures that are globally associated with declines in species richness and abundance are being felt here, for example urban development. Using Ordnance Survey data, BRERC have calculated that over the last 10 years the West of England has observed an approximate 10% increase in the proportion of land covered by roads, buildings and other man-made developments. This was also seen on Sites of Nature Conservation Interest (SNCIs) where there was an increase of over 100 hectares (ha) of land covered by man-made features over the last decade.

Urban development is just one of a multitude of factors affecting the West of England's environment with many of the causes of change being a result of activities further afield. Climate change certainly poses the largest long-term threat to the West of England's existing ecosystems, with rising temperatures and increasing rainfall threatening the niches that many of the species within the region have adapted to.

Simultaneously, these changes provide the platform for new species to gain a foothold within the region. This report details an increase in the number of new species to the region across the last decade such as the Wasp Spider and the Willow Emerald Damselfly, whilst species such as the Great White Egret, that were once rare winter residents to our region, have now become more common.

This State of Nature report highlights an undeniable change in the makeup of the region's wildlife and provides evidence to suggest that the majority of national level declines in species richness and abundance are not being avoided in the West of England. Despite this, there is still time to turn things around; greater emphasis is needed on habitat restoration, conservation and monitoring to ensure that the West of England plays its part in halting the global climate and ecological crisis.

Bristol Regional Environmental Records Centre

The Bristol Regional Environmental Records Centre (BRERC) was created in 1974 by the Bristol City Museum & Art Gallery with the role of putting museum specimens into a current and regional context. Since then, BRERC's role has expanded to encompass the collection and management of ecological and geological data for the West of England region, making this information accessible to others, from interested members of the public to national government bodies. This has included the publishing of five books covering: Flora, Butterflies, Moths, Dragonflies and Damselflies, and Geological Sites in addition to guides on: Hoverflies, Snails, and Grasses. BRERC has also recently produced a revised edition of *Geological Sites of the Bristol Region*, and is currently preparing *Wild Plants of the Bristol Region*.

BRERC currently holds and manages the largest digital database in the West of England including 4 million species records (99,000 of which are of globally threatened species), 60,000 mapped land parcels (e.g. fields, habitats and sites) in addition to approximately 15 million records in the form of thousands of paper reports, recording cards, historic maps and diaries. These records span over 600 years and come from a variety of sources, with the vast majority of data provided by amateur individuals with additional records from professionals and organisations, all of which has been submitted voluntarily. All species data is made available to the National Biodiversity Network atlas (NBN atlas) and the Global Biodiversity Information Facility (GBIF) from where it has been downloaded over 110,000 times.

Ideally, for monitoring purposes, data should be recorded systematically, for instance on the same day each year, at the same place and time with the same methods. However, due to the nature of publicly sourced data, most records BRERC receives are not collected in such a manner, as people note things as and when it suits them. Nevertheless, there are ways to analyse and interpret data not collected in a systematic manner, especially when the data is on a scale of which BRERC possesses, some of which are showcased in this report.

Tim Corner - *Manager, BRERC*

Bristol Naturalists' Society

The Bristol Naturalists' Society (BNS) is a thriving volunteer-run charity which has been encouraging the study and conservation of the wildlife and geology of the Bristol region since 1862. Throughout that time, the BNS has worked closely with organisations such as the University of Bristol, Bristol Museum & Art Gallery and BRERC in facilitating research and education into the natural world. It also played a key role in calling for the foundation of the Avon Wildlife Trust in the late 1970s.

Throughout its history, the Society has maintained a reputation for expertise within its membership and the passing on of such knowledge to others. Its annual publications are *Nature in Avon* (previously the Proceedings of the BNS) and, jointly with the Bristol Ornithology Club, *Avon Bird Report.* Together these are the only detailed publications recording the changes taking place locally in wildlife and our understanding of the fauna and flora and the geological sites in the region. As such, they complement the publications of BRERC.

The Society holds regular field and indoor meetings across the year and the monthly bulletin *Bristol Naturalist News* keeps members up to date on sightings and events and activities happening locally. The membership has access to an excellent library held within Bristol Museum & Art Gallery.

The BNS warmly welcomes new members, whether complete novices in wildlife and geology or established experts in their field, amateurs and professionals.

Ray Barnett - *Archivist, BNS*

Data analysis and presentation

Maps
Spatial mapping of habitat and species data used in this report has been produced by BRERC using data held at BRERC. Specific boundary and spatial data using OS licensed data: Crown copyright and database right 2024 Ordnance Survey AC0000807971.

A number of key terms will be used to describe and compare habitat mapping within this report.

- **Priority habitat:** Habitat of high value to nature conservation, e.g. Calcareous Grassland, Broadleaved Woodland and Coastal Saltmarsh
- **Potential priority habitat:** Areas of potential high value to nature conservation, this could be due to the potential to modify the land or that the land has not been sufficiently recorded as to determine its quality.
- **Non priority habitat:** Habitat of less value to nature conservation, e.g. Improved Grassland, Arable or Conifer Plantations.

The data used to determine these Priority Habitats are, for the purposes of this report, divided into two categories.

- **BRERC Phase 1 Habitat Map (Phase 1):** Data for this map was collected over the course of the 1990s.
- **West of England Habitat Map (WoE Map):** Data for this map contains the most up to date information for habitats within the region; however, in cases where no more recent surveys have been conducted, information from the Phase 1 Map has been used.

In graphs and tables some of the names of the four Unitary Authorities that comprise the West of England may be abbreviated.

- **UA:** Unitary Authority
- **BCC:** Bristol City Council
- **BNES:** Bath & North East Somerset Council
- **NSOM:** North Somerset Council
- **SGLOS:** South Gloucestershire Council

Graphs
A variety of graphs are used in this report utilising a range of data. All graphs are original to this report although some of the data used to produce graphs were acquired from other sources; where appropriate these are referenced.

BRERC's data modelling tool
Commissioned by BRERC to enable further analysis of the organisations species data, work was initially carried out by Danielle Edwards and continued by Aidan Pick.

The results of BRERC's data modelling tool present information on how well a species has fared compared to others in the table, in respect to its distribution between respective time periods. They also contain additional information on changes in the number of records between time periods, however, this may be influenced by recorder intensity and effort, so should not be used in isolation.

Example table and how to interpret results
Throughout this report there are tables including outputs of the BRERC data modelling tool which will contain two sets of data for each species: the observed change in the total number of grid squares occupied and a ranking based on relative changes in distribution. All tables in the report are ordered by ranking species in respect of how their distribution has fared compared to others in the table. Table 1 below has been ordered as such, from this we can see that Species A has fared relatively better in respect to its distribution than Species B or C, and C has fared worse than B or A. This is presented alongside the percentage change in the number of grid squares occupied for the same period. However, this can be significantly affected by recorder effort and recording intensity so may not be representative of actual changes in distribution. Consequently, particular attention should be paid to the ranking as opposed to the percentage changes.

Species name	Change in occupancy	Rank
Species A	-10%	1
Species B	-53%	2
Species C	5%	3

Table 1. Example of data modelling tool results

Habitats

Bluebell *Hyacinthoides non-scripta* woodland: Abigail Pedlow

Woodland

The total area of woodland within the West of England has been relatively stable when compared to the losses experienced by other habitats in recent decades. This is largely as a result of the better protection afforded to this habitat type than to most others but this is not to say that all woodlands have retained their nature conservation value.

Figure 3. Assessment of woodland quality based on BRERC's West of England Habitat Map

Active management of many woodlands ceased in the early- to mid-20th century and the impacts these changes brought about are still being felt [1]. Chief amongst these are the development of a more closed canopy [2] and the consequent thinning of the understorey and a reduction in the more light-demanding ground flora species, although it is doubtful whether any plant species have been completely lost in this process. The decline in woodland management has led to a decline in butterfly species such as Small Pearl-bordered Fritillary *Boloria selene* that are dependent on sunny conditions within woods, and also possibly to declines in moths such as Birch Mocha *Cyclophora albipunctata* and Broad-bordered Bee Hawk-moth *Hemaris fuciformis*, whose larvae feed on plants that would have been favoured by regular opening of the tree canopy. It is likely that there have been invertebrate species that have benefited from darker conditions within woodlands, but any such changes are yet to be quantified.

Wild Garlic *Allium ursinum* woodland: Abigail Pedlow

The conversion of semi-natural woodland to conifer plantation has been less prevalent in our area than it has in many other parts of Britain, but there are sites, for example in the Failand area, where coniferisation has had significant effects. The most obvious of these are suppression of the ground flora and understorey as shading increases [3].

The spread of other non-native species has affected a greater proportion of our woodlands, most significant is probably the effect caused by evergreen species such as Holm Oak *Quercus ilex*, which now dominates large swathes of woodland in North Somerset, and Cherry Laurel *Prunus laurocerasus*, which is increasingly frequent in woodlands around Bristol. Both of these were introduced as ornamentals, whilst several other nuisance species, including Snowberry *Symphoricarpos albus* and Wilson's Honeysuckle *Lonicera nitida*, were planted as game cover. All of these species, like the conifers, suppress ground flora and the regeneration of other woody species. The effects of other non-native species are more subtle, with Sycamore *Acer pseudoplatanus* now a long-established co-dominant in many woods, but the recent spread of species such as Horse Chestnut *Aesculus hippocastanum*, presumably aided by climate change, is likely to be having some effect.

Snowberry *Symphoricarpos albus*: Abigail Pedlow

Type	Area
Non priority habitat	792
Potential priority habitat	2,996
Priority habitat	8,119
Total	**11,907**

Table 2. Comparing the area (ha) of recorded woodland habitats in the West of England over time

The international trade in plants for forestry and horticulture has been responsible for the introduction of several pests and diseases to our area [4], and climate change is aiding the spread of several of these. The most serious of these diseases, Ash die-back, is a particularly severe problem because Ash *Fraxinus excelsior* is the dominant tree canopy species in many of the region's semi-natural woodlands. Because Ash is relatively late to come into leaf, the ground flora is often particularly diverse in these woodlands, which also support better growths of bryophytes and lichens. It remains unclear what the mortality rate from Ash die-back will be. At present, survival amongst older trees

Woodland: Abigail Pedlow

in particular is fairly high and the greatest threat currently may come from an over-reaction to the threat of the disease. Whilst it is clearly essential that trees that pose a threat to health and safety are removed, wholescale removal of largely healthy trees using heavy machinery, as has happened in some woods in the north-eastern part of the West of England, may yet present a far greater threat to biodiversity than the disease itself.

It is possible that the coming years will see a significant increase in the overall area of woodland, encouraged by national schemes such as Biodiversity Net Gain and the Woodland Carbon Guarantee Scheme. As a result, there is potential for significant gains for wildlife as a consequence of planting, but only if appropriate sites, avoiding habitats that are currently of value, are selected and if schemes are correctly designed. Many planting schemes carried out over the past few decades have resulted in dense, even-aged, monospecific stands that are vulnerable to pests and diseases, and lack ground or shrub layers, and are therefore of very limited value for birds, insects or other wildlife.

Rupert Higgins *(BNS)*

Woodland makes up just 8.9% of the West of England

Grassland

Grasslands remain the dominant habitat over large parts of the West of England (WoE), but their biodiversity value varies enormously. Unimproved grassland is a tremendously biodiverse habitat, which supports a wide range of plants and invertebrates, the species present varying according to the nature of the soils, current and historical management practices, and variations in micro-climates.

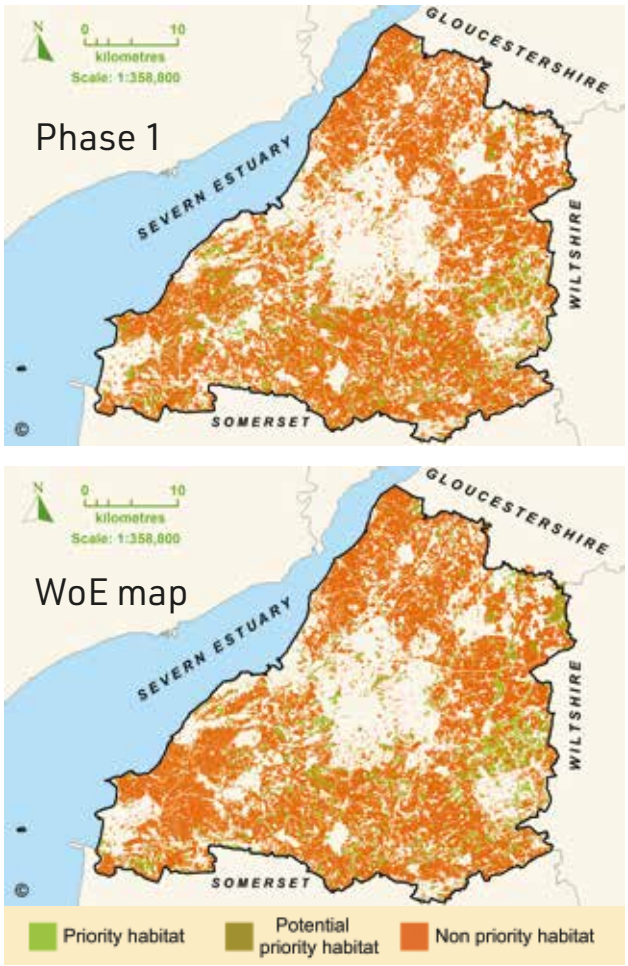

Figure 4. Comparison of the change in assessment of grassland quality over time

Unfortunately, most of this fascinating diversity has vanished as grassland management changed with more than 97% of unimproved grasslands being lost (at a national level) since the Second World War [5]. The most significant of the management changes has been the vastly increased use of artificial fertilisers, which have created grasslands that are very productive, but support an extremely low diversity of plants and animals [6]. In the West of England, however, there have been areas of unimproved grassland that have survived, providing some of our most biodiverse and significant habitats.

Meadow: Abigail Pedlow

There are several reasons why some grassland escaped this fate: topography is probably the most usual, but some areas remained under more traditional management because they were either adjacent to, or encapsulated within, urban areas. Unfortunately, sites of this kind were, and remain, under development pressure, meaning that a number of these species-rich grasslands have been lost.

It is possible that under-management is now a greater threat to our remaining species-rich grasslands than over-management. Livestock farming is declining in some areas and unimproved grasslands, which in many cases retained their status because they are steep, marshy or in awkward corners, are often difficult to graze and even harder to mow. This can lead to a level of under-management that sees the loss of species associated with short swards and with early successional habitats, to scrub and secondary woodland. A similar threat may come from increasing initiatives to plant more trees: inappropriate siting of any such schemes brings the risk of replacing diverse threatened habitats with species-poor examples of a different habitat.

However, there is also likely to be a rise in schemes seeking to create species-rich grassland as awareness in their importance increases. Grassland revitalisation can be done with spectacular success, but there is also a high risk of failure. The key to success is to provide soils that are low in nutrients: if this is done then grassland of high conservation value will establish itself without the need for seeding, particularly if the new site is close to an existing area of unimproved grassland. If soil nutrient levels are high, for example as a result of previous agricultural management, then attempts to establish species-rich grassland will fail in the medium and long terms as coarse grasses re-assert their overwhelming dominance, although efforts may appear successful for a few years [7]. Wildflower seed mixes, even from reputable sources, invariably contain non-native species and varieties, and species-rich establishments can require high levels of intervention, often including herbicide application.

Rupert Higgins *(BNS)*

All of Avon		
Type	**Phase 1**	**WoE**
Non priority habitat	63,320	61,590
Potential priority habitat	8,656	10,890
Priority habitat	3,271	3,982
Total	**75,427**	**76,462**

Table 3. Comparing the area (ha) of recorded grassland habitats in the West of England over time

Meadow close-up: Abigail Pedlow

Just 5.2% of grasslands are considered priority habitat in the West of England

Wetland

The history of wetlands in the West of England has been one of losses and gains, often involving radical changes in habitat type, rather than one of irreversible decline. Large waterbodies are not a natural feature of the region's landscape, but it now contains nationally important lakes, created for water supply, and a range of smaller pools left by extractive industries, or created for recreational angling.

Hemp-agrimony *Eupatorium cannabinum* and Great Willowherb *Epilobium hirsutum* beside a lake: Abigail Pedlow

There have been huge losses in both the number of farm ponds and the quality of those that survive, but many gardens now have ponds, and wetlands are a popular component of habitat creation schemes. Small wetlands are frequently provided around developments as a part of Sustainable Drainage Systems infrastructure. Large areas of wet grassland, particularly across the inland levels, have been drained. The drainage ditches (rhynes in the southern part of the area, rhines in the northern part) that separate the fields support hugely important populations of aquatic plants and invertebrates; unfortunately, many have been lost as a consequence of neglect, and many of those that survive are suffering from nutrient enrichment as a result of processes such as a result of agricultural runoff or the release of untreated sewage [8] into bodies of water.

Figure 5. All recorded wetland areas and bodies of water in the West of England

These trends are reflected in the long-term declines suffered by species that rely upon bodies of water for food and reproductive purposes such as Grass Snake *Natrix helvetica* and newts. In other areas the increase in bodies of water have seen large increases in species such as Tufted Duck *Aythya fuligula*, Great Crested Grebe *Podiceps cristatus* and Coot *Fulica atra* and also in species associated with reedbeds, such as Brown-veined Wainscot *Archanara dissoluta* and Twin-spotted Wainscot *Lenisa geminipuncta*. In recent decades, many dragonfly species have also become more common, probably aided by climate change as well as wetland creation with some, such as Scarce Blue-tailed Damselfly *Ischnura pumilio* and Red-veined Darter *Sympetrum fonscolombii*, particularly associated with artificial wetlands.

There have been large losses in the number of farm ponds within the West of England

Reedbed: Daniel Marshall

Chew Valley Lake: Tim Corner

Climate change is having obvious impacts on wetland wildlife, examples being the massive increase in egret species and the colonisation of the region by Lesser Emperor dragonfly *Anax parthenope*, yet reduced numbers of wintering birds such as Bewick's Swan *Cygnus columbianus*, Goldeneye *Bucephala clangula* and Goosander *Mergus merganser*. It is likely that impacts such as warming of ponds and the drying of small wetlands in more frequent summer droughts are already affecting many aquatic invertebrates, and will continue to do so. Climate change may also contribute to the spread of invasive species such as Floating Pennywort *Hydrocotyle ranunculoides*, with potentially serious consequences for wetland wildlife.

There has been little or no change in the extent of flowing water, with pollution being the main factor impacting the biodiversity of rivers and streams. For decades there was a gradual improvement in water quality, reflected in the spread of pollution-sensitive species such as Otter *Lutra lutra*, White-legged Damselfly *Platycnemis pennipes* and Loddon Pondweed *Potamogeton nodosus*. In light of renewed concern over pollution, the fortunes of such species over the next few years will be informative.

Rupert Higgins *(BNS)*

Climate change is changing our wetlands, with droughts affecting many aquatic invertebrates

Coast

The West of England has important examples of a range of coastal habitats. The region's saltmarshes and intertidal mudflats are particularly significant, but there are also areas of sand dune (notably at Sand Bay) and limestone cliffs. These and the open water of the Severn Estuary provide an important but poorly understood habitat for fish and other marine wildlife.

Figure 6. The Severn Estuary borders the West of England for approximately 60km (37.5 miles)

Human impacts on most coastal habitats have, to date, been relatively minor, although this may well change as climate change takes hold. Levels of pollution in the Severn Estuary have fluctuated widely, but the impact on wildlife is difficult to identify. Levels of heavy metals in invertebrates, particularly molluscs, are known to have been very high, apparently without any deleterious impacts on the animals themselves. There may, however, have been effects on species higher up the food chain, but there is little evidence of any such impact.

The Severn Estuary: Tim Corner

Low tide at Weston-Super-Mare: Daisy Bickley

Levels of organic pollution, chiefly from untreated sewage, were previously much higher than they are now. Identification of any resultant effects on wildlife is difficult. There may have been some localised positive impacts on birds, due to improved productivity within mudflats and higher invertebrate populations, but negative impacts may have been experienced by a range of wildlife, including fish and Harbour Porpoise *Phocoena phocoena*.

The future stability of coastal habitats is far from guaranteed, with climate change having the potential to produce greater changes than any seen in recorded history. Rising sea levels and consequent coastal squeeze are likely to restrict the area of saltmarsh and threaten nationally important populations of several species, including Slender Hare's-ear *Bupleurum tenuissimum* and Bulbous Foxtail *Alopecurus bulbosus,* and restrict feeding habitats for fish and roosting sites for wading birds. There is potential to mitigate some of these impacts through measures such as coastal retreat, but the effectiveness of any such scheme is far from guaranteed, especially when it comes to rare species. The likely increase in the frequency and ferocity of storms may have adverse impacts on inter-tidal mudflats and therefore on the populations of wading birds that feed there. Climate change is already impacting migratory habits of several bird species, leading, for example, to lower counts of Dunlin *Calidris alpina* and higher numbers of Black-tailed Godwit *Limosa limosa*.

Rupert Higgins *(BNS)*

Urban

The expansion of towns and cities into surrounding greenfield sites (often referred to as urban sprawl) has become a necessary result of increasing human population. The West of England region has seen an increase in the coverage of its cities, towns, roads and other developed features by nearly 10% since 2012.

UA	2012	2021	Change
SGLOS	7,519	8,696	15.7%
BNES	4,797	5,278	10.0%
BCC	6,877	7,072	2.8%
NSOM	6,325	6,999	10.7%
Total	**25,518**	**28,045**	**9.9%**

Table 4. Using Ordnance Survey data to assess the change in the amount of urban areas between 2012 and 2021 (ha)

Whilst this expansion is often into areas considered of little conservation value such as improved grassland or arable, a decrease in open ground and, most significantly, hedgerows undoubtedly leads to an overall decrease in biodiversity and the elimination of the previous ecosystem within the area.

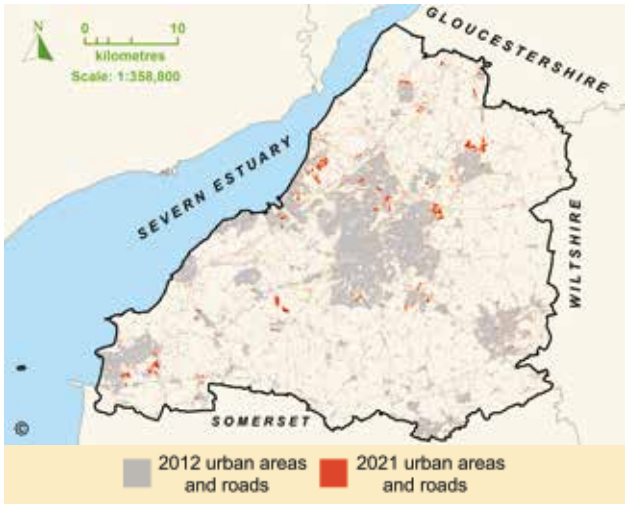

Figure 7. The expansion of urban areas in the West of England

There has been a 10% Increase in urban land over the last decade

This rapid change in environment provides opportunities for species that are capable of adapting quickly, typically generalists [9] such as Red Fox *Vulpes vulpes*, Brown Rat *Rattus norvegicus*, gulls and Feral Pigeon *Columba livia* (feral) which have had extraordinary success in taking advantage of the abundance of food scraps present in the bins and on the streets of urban areas.

Disused railway running through central Bristol: Tim Corner

However, urban areas also provide a surprisingly diverse offering of unique habitats with a range of structures and microclimates, even tall buildings help support species such as the Peregrine *Falco peregrinus*, lichens and a wide range of invertebrates. The landscape is ever changing, with derelictions, new builds, extensions and changes to gardens and parks which in themselves can enable ephemeral and ruderal species to thrive.

This range in building material, quality and age creates a wide variety of niches that suit a diverse mix of specialist species more usually associated with specific habitats from calcareous and limestone grasslands to woodlands and waterways.

Despite this, a diverse habitat does not necessarily equate to a healthy one, as whilst some insects have had success within cities, the overall reduction in the extent of areas for plants to grow within the urban setting has most certainly impacted the biomass of insect fauna needed for a healthy ecosystem.

Male House Sparrow *Passer domesticus* on a garden fence: Abigail Pedlow

Red Fox *Vulpes vulpes*: Tim Corner

This is exacerbated by many gardens within urban areas using non-native plants and artificial grass which further reduce the tentative foothold many species, importantly pollinators, have within towns and cities.

When combined with the expansion of intensive agriculture within the region over the last 80 years, this can paint a particularly bleak picture for wildlife with many species struggling to survive in environments both within urban and rural areas.

With the further expansion of urban areas seemingly inevitable, new schemes and building practices are being designed to provide benefits to wildlife. New initiatives such as Biodiversity Net Gain, Green Infrastructure strategies and the Local Nature Recovery Strategy [10], offer opportunities to improve practices that incorporate nature into new builds. In addition, this enables the offsetting of the further adverse impacts of development in appropriate habitats and sites, with binding agreements to monitor the anticipated gains in diversity and richness.

Aidan Pick *(BRERC)*

Figure 8. All urban and agricultural land in the West of England

Important sites for nature

Often referred to as 'designated sites', important sites for nature are areas of particular ecological importance that have been identified to help conserve their value to wildlife. These sites can be protected either directly by law (statutory protection) or indirectly by local authorities or environmental Non-Governmental Organisations (eNGOs) being expected to safeguard them appropriately according to their policies (non-statutory protection).

Site name	Abbreviation	Level of protection	Significance
RAMSAR sites		Statutory	International
Special Areas of Conservation	SAC	Statutory	
Special Protection Areas	SPA	Statutory	
National Nature Reserves	NNR	Statutory	National
Site of Special Scientific Interest	SSSI	Statutory	
Local Nature Reserve	LNR	Statutory	Regional
Sites of Nature Conservation Interest	SNCI	Non-Statutory	
Regionally Important Geodiversity Sites	RIGS	Non-Statutory	
Avon Wildlife Trust Reserves	AWT reserve	Non-Statutory	
Yatton and Congresbury Wildlife Action Group Reserves	YACWAG reserve	Non-Statutory	

Table 5. Designated sites within the West of England, along with their level of protection and significance

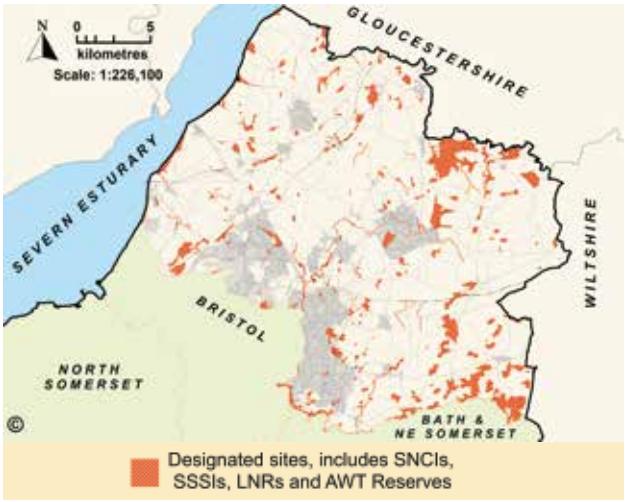

Figure 9. Selected designated sites within South Gloucestershire

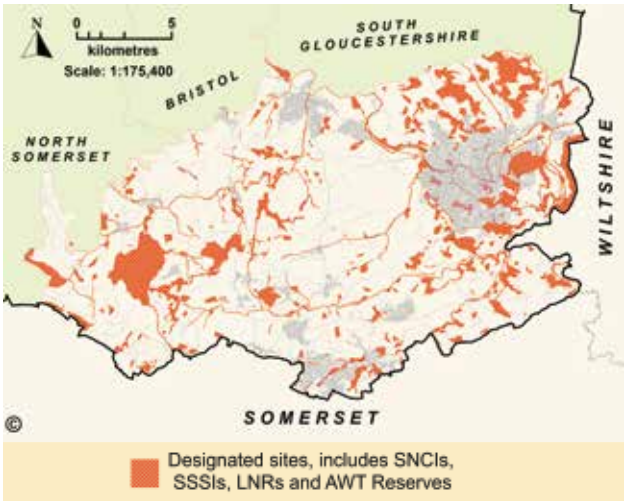

Figure 10. Selected designated sites within Bath & North East Somerset

With many sites facing increasing pressures from a variety of factors over recent years, it is crucial that their condition is properly assessed to maintain their value. However, many sites, especially SNCIs, have received little or no attention for several years.

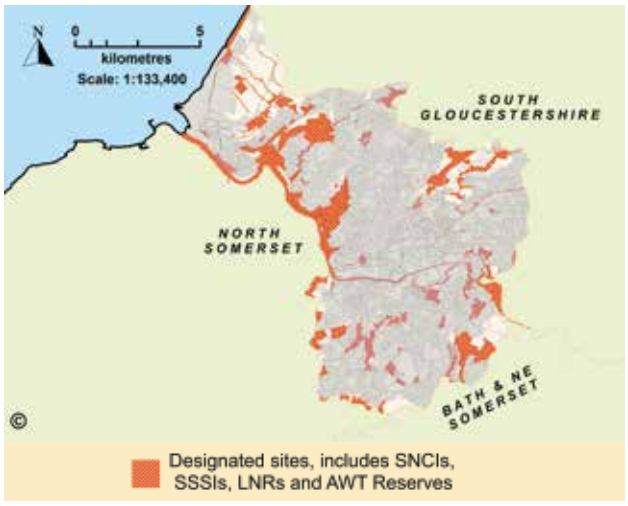

Figure 11. Selected designated sites within Bristol

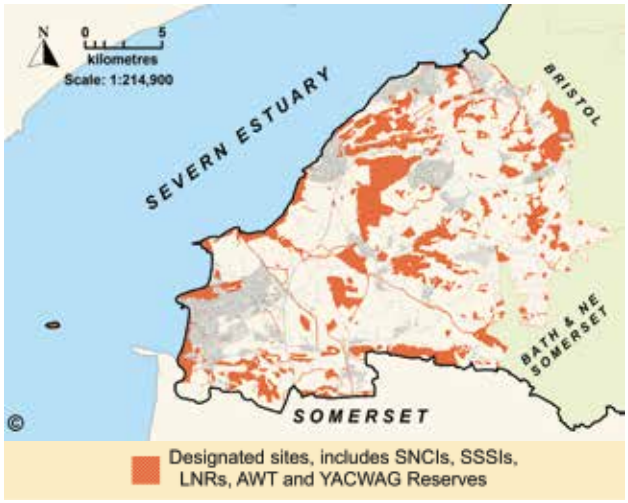

Figure 12. Selected designated sites within North Somerset

UA	2012	2022	Change
BCC	61.18	77.81	+16.6
BNES	68.28	98.17	+29.89
NSOM	71.72	108.05	+36.33
SGLOS	52.38	72.78	+20.4
Total	**253.56**	**356.81**	**+103.3**

Table 6. Change in the amount of urban areas in SNCIs for each UA (ha)

Total area	Within designated sites	Outside designated sites
15,007	9,301	5,706

Table 7. The total area (ha) of priority habitat within and outside of selected designated sites (SNCIs, SSSIs, LNRs, AWT and YACWAG Reserves)

Using digital mapping it is possible to see that over the last decade there has been an increase of over 2,500 hectares in land used for housing, roads and other manmade. This has affected SNCIs; with an increase of 103.3 ha in developed land within SNCIs across the West of England. Most SNCIs include land used for agricultural practices; with 454 of the West of England's SNCIs containing arable and or improved grassland: totalling approximately 739 ha.

However, there are still a large number of areas of value to nature conservation not covered, with approximately 5,706 ha of land described as priority habitat currently unprotected by designation.

Whilst more in-depth study is required to ascertain the true extent to which the make-up of SNCIs in the West of England has changed, preliminary viewing indicates that sizeable areas of land may have lost significant value to nature. However, these designations also provide a political and ecological justification to restore sites. Whilst fundamental damage to soil biology in habitats can greatly reduce the capacity of a habitat to return in its original state, with seed banks capable of remaining dormant for years, even degraded habitats could be restored with careful management, protection and time.

Aidan Pick *(BRERC)*

Over 38% of priority habitat is found outside of designated sites

Wildlife

Grass Snake *Natrix helvetica*: John Aldridge

Plants

Plants and their photosynthesising relatives are the basis for almost all multicellular life on this planet [11], without which virtually all ecosystems will cease to exist. Over eons countless complex interactions have evolved between specific plants and species that use them for food, shelter or reproductive purposes. This makes it is possible to assess the health of a habitat and its vertebrate and invertebrate residents based on the richness and abundance of its plants.

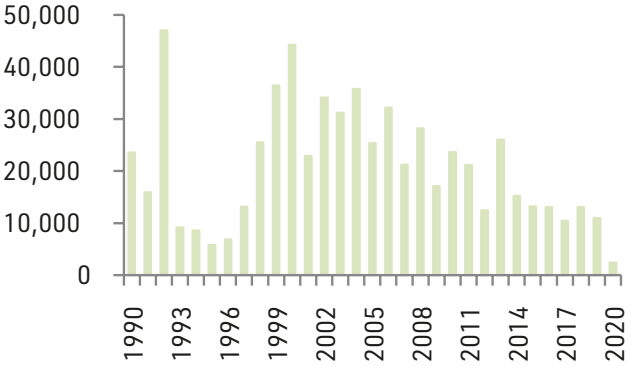

Figure 13. Number of plant records processed per year by BRERC since 1990

As such, the majority of habitats are defined by the plants that reside within them; this has meant that the recording of plant species has often been closely tied with the frequency of habitat surveying within the region. Unfortunately, over the last two decades the West of England has had a substantially lower amount of habitat surveying.

Wild Daffodil *Narcissus pseudonarcissus*: Abigail Pedlow

This can be observed in BRERC's West of England Habitat Map, which contains the most up-to-date habitat information for the region. This map shows that the most recent survey for approximately 60% (54,000 ha) of the region was conducted over 20 years ago. The result of this has been a marked decline in the number of plant records submitted to BRERC in recent years. Luckily, there are still groups and individuals dedicated to monitoring the taxa.

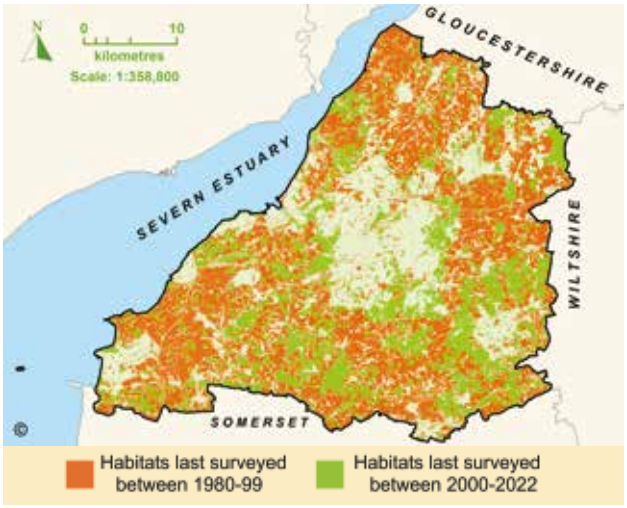

Figure 14. A comparison of the area and currency of habitat survey data for the West of England

The decline of wild plants

The primary cause for the decline in the abundance and diversity of wild plants within the West of England is habitat destruction brought on by development (urban sprawl), changes in land management for the purposes of intensive agriculture [12] and the loss of traditional practices such as hay making, hedge-laying and coppicing [1, 13]. However, where land is protected from such developmental pressures, threats still continue from other sources such as the pollution of waterbodies, affecting wetland plant species [14]. These secondary pressures are even more potent in built-up environments; particularly where plant communities are isolated from one another. Additionally, climate change has begun to bring evermore challenging conditions for many species with wetter winters, hotter summers and less predictable weather cycles.

Species	Change in occupancy	Rank
Wild Daffodil	-26.7%	1
Primrose	-21.2%	2
Wood Anemone	-11.2%	3
Nettle-leaved Bellflower	-17.9%	4

Table 8. The relative range changes and change in occupancy for select woodland plant specialists (1998-2008 vs 2009-2019)

Despite all of these known threats, and in part as a result of previously mentioned factors, systematic recording of plants is rare; initiatives such as the National Plant Monitoring Scheme have begun to appear but their relevance to local decision-making is yet to be clear, with plants' sensitivity to slight variations in climactic and geological factors sure to change the makeup of communities on a regional scale. Therefore, whilst it is not possible to ascertain the true abundance changes of these species at present using data held by BRERC, an initial attempt to assess changes in the distribution of wild plant specialists generally associated with three habitat types has been attempted.

Meadow Crane's-bill *Geranium pratense*: Dylan Peters

Species	Change in occupancy	Rank
Water-starwort	-47.6%	1
Purple Loosestrife	-17.6%	2
Marsh-bedstraw	-43.1%	3
Gypsywort	-40.3%	4
Chara spp.	-61.8%	5
Water Forget-me-not	-8.3%	6
Amphibious Bistort	-23.9%	7
Marsh Woundwort	7.0%	8
Celery-leaved Buttercup	-62.4%	9
Marsh Ragwort	-62.4%	10
Creeping-Jenny	-41.4%	11
Watercress	-42.3%	12
Marsh-marigold	-23.9%	13
Water-pepper	-53.9%	14

Table 9. The relative range changes and change occupancy for select wetland plant specialists (1995-2006 vs 2007-2018)

Over 60% of habitats were last surveyed over 20 years ago

Species	Change in occupancy	Rank
Harebell	49.5%	1
Field Scabious	25.4%	2
Betony	9.2%	3
Meadow Crane's-bill	37.1%	4
Quaking-grass	33.6%	5
Cowslip	27.2%	6
Glaucous Sedge	10.9%	7
Adder's-tongue	-15.5%	8
Crested Dog's-tail	12.3%	9
Kidney Vetch	-4.3%	10
Tormentil	-13.7%	11
Yellow-rattle	82.0%	12
Common Stork's-bill	-12.3%	13
Greater Knap-weed	14.0%	14
Sweet Ver-nal-grass	5.4%	15
Vernal Sedge	-3.4%	16
Eyebright	24.6%	17
Wild Thyme	4.5%	18
Goat's-beard	10.7%	19

Table 10. The relative range changes and change in occupancy for select grassland plant specialists (1993-2005 vs 2006-2015)

Accompanying the decline of many wild plants, and potentially contributing to the demise of some, an increasing number of non-native plants have become well established and in some cases they can dominate once balanced plant communities. Over millennia, humans have imported many non-native species to the British Isles. Historically, many of these species would have come from mainland Europe and typically these species posed little threat to ecosystems as many were not too dissimilar from the species that resided within Britain, meaning that their populations were controlled by native fungal, invertebrate and vertebrate species. However, over the last 300 years there has been an increase in plant species imported from areas increasingly further

Eyebright *Euphrasia nemorosa*: Dylan Peters

from Britain. These species typically come from warmer climates and, in cases where the species were able to cope with our different climate, they were often so alien to native species that they faced little threat from herbivores or parasites, enabling them to become quickly widespread.

This phenomenon is still prevalent today. With there being fewer controls on imported plant species when compared to animals, for example, many species may be grown and sold in garden centres for long periods of time before the realisation of their impact when released into ecosystems. There are also many other examples of accidental importing of non-native plant species. From the importation of goods and materials such as wool and bird food, to the spread of topsoil and aggregates through construction, there are seemingly endless ways humans perpetuate the spread of plants.

As previously hinted at, one of the biggest barriers to the spread of many non-native species which have a higher potential to become invasive is the climate, however as average temperatures rise, the potential for these species to spread increases.

Dylan Peters *(BNS)*

Lower Plants

The information on so-called lower plants, a term that covers bryophytes (liverworts and mosses), lichens and fungi, is very limited. This is particularly unfortunate, since Britain is of great importance in an international context for these groups [15].

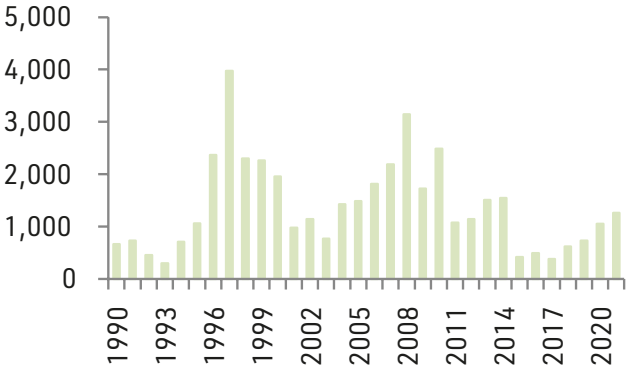

Figure 15. Number of lower plant records processed per year by BRERC since 1990

It is inevitable that these groups have undergone many of the declines associated with habitat loss and change that are more obvious in vascular plants. The decline in unimproved grassland will have caused a huge decline in populations of grassland fungi [16], which include important groups such as waxcaps, earthtongues and spindles. Lack of suitable management has probably reduced populations of many lichens and mosses as seen elsewhere in the UK [17].

Scarlet Elfcup *Sarcoscypha austriaca*: John Aldridge

Many species of both are dependent on features such as well-lit rock exposures and well-grazed short turfs, which have become less frequent as many herb-rich grasslands have been allowed to grow longer or lost to scrub. Although evidence is lacking, widespread agricultural use of fungicides will have inevitably reduced the diversity of fungi on farmland habitats and in adjacent areas.

Wetland drainage is likely to have damaged populations of specialist fungi associated with these habitats with the loss of features such as springs also causing localised and undocumented losses of valuable bryophyte populations.

Shaggy Parasol *Chlorophyllum rhacodes*: Abigail Pedlow

Within woodlands, the cessation of coppicing has reduced the number of well-lit tree trunks, reducing suitable habitat availability for many lichens and bryophytes, although the more constant environment in unmanaged woodlands favours many lichen species in the long term. Fungi are less likely to have been affected by this trend, and many species associated with conifers have become more widespread as they gradually colonise plantations, if these are allowed to mature they may also become increasingly important for bryophytes.

The loss of unimproved grassland will have had a drastic effect on grassland fungi

Air quality is a hugely important factor influencing the distribution of many lower plants. The deleterious impacts of sulphur dioxide pollution, caused by coal-burning, on many lichens is well known, however epiphytic (growing on trees) mosses and liverworts were also severely affected [18]. As sulphur dioxide levels have fallen steeply, there have been indications of a rapid recovery in the distribution of lichens such as *Evernia prunastri, Ramalina* species and species of *Parmelia* and related genera on younger trees; the bark of many older trees remains acidified and lichen populations have yet to recover. Similar trends are evident in mosses such as *Cryphaea heteromalla* and several species of *Orthotrichum*. Conversely, pollution acidified rainwater favoured some bryophytes associated with acidic habitats, such as the liverwort *Lepidozia reptans* and the moss *Aulacomnium androgynum*, and these species have become less widespread in recent decades.

Fly Agaric *Amanita muscaria*: Abigail Pedlow

A decline in atmospheric sulphur dioxide has seen a recovery in many species of lichen

However, the changing effects of air pollution, particularly on lichens, are more complex than is often realised. Widespread species such as *Xanthoria parietina* and *Physcia tenella* have become increasingly visible in urban areas, aided by the steep rise in atmospheric levels of nitrates from agricultural and traffic sources but this rise has also caused steep declines in populations of many other lichens. In the early 1990s, beard-lichens *Usnea* spp. for example, were frequent in many Mendip sites and on willows around Chew Valley and Blagdon Lakes, and small thalli could even be found on trees on the edge of Bristol. These lichens are now difficult to find even in their former strongholds and have disappeared entirely from many areas.

Nitrate pollution is also responsible for lush growth of some vascular plants, including Common Nettle *Urtica dioica* in woodland and wetland habitats and False Oat-grass *Arrhenatherum elatius* in grasslands. This has reduced, for example, the extent of sparse grassland communities that provide a habitat for lower as well as vascular plants, leading to localized losses of species including various *Cladonia* lichens and *Weissia* mosses.

Most lower plants disperse by means of spores, which are highly mobile, allowing them to colonise newly suitable environments quicker than most other taxa. This means that they are highly responsive to, and early indicators of, climate change. A warming climate is probably responsible for the rapid northwards spread of some species, for example the lichen *Flavoparmelia soredians,* and the recent finding of hitherto Mediterranean lichen species such as *Acarospora similis* and *Ocellomma picconianum* in the Bristol area.

Higher rainfall levels have seen some species spread into the area from the west. One example is the liverwort *Myriocoleopsis minutissima* (formerly *Cololejeunea minutissima*), which was formerly rare but is now widespread, even on street trees in Bristol, and is thought to have benefited from both climate change and reduced sulphur dioxide levels.

Figure 16. Locations of first recordings of *Myriocoleopsis minutissima* in the West of England

It is likely, however, that in coming years we will also lose many species, particularly if rising temperatures cause levels of humidity to drop.

Ash die-back presents another particular risk to lichens and bryophytes. The bark of Ash has a high pH, compared to that of many other trees, and its leaf canopy is relatively open and develops late in the spring, resulting in high light levels. These factors allow the development of diverse and profuse communities of epiphytic bryophytes and lichens. The loss of Ash trees presents a grave threat to many species and the removal of trees before they show any signs of mortality is probably a greater threat than the disease itself. The conservation of these epiphytic communities will depend on sensitive management of the disease and, where necessary, selection of suitable species when planning replanting schemes.

Rupert Higgins *(BNS)*, assisted by **David Hill** *(BNS)*

If rising temperatures continue, we are set to lose many lower plants from the region

Invertebrates in general

After plants, invertebrates are one of the most significant groups in maintaining functioning ecosystems. Their generally small sizes and short lifecycles have allowed them to evolve and diversify at a rate that has enabled them to become one of the most successful groups of species in Earth's history.

In a modern context these very traits make them ideally suited to monitoring environmental change, with their populations capable of drastic change from year to year depending on conditions [19, 20]. It is therefore disappointing that continuous, research grade monitoring of invertebrate species is currently lacking in comparison to other taxa in the UK and indeed across the globe [21].

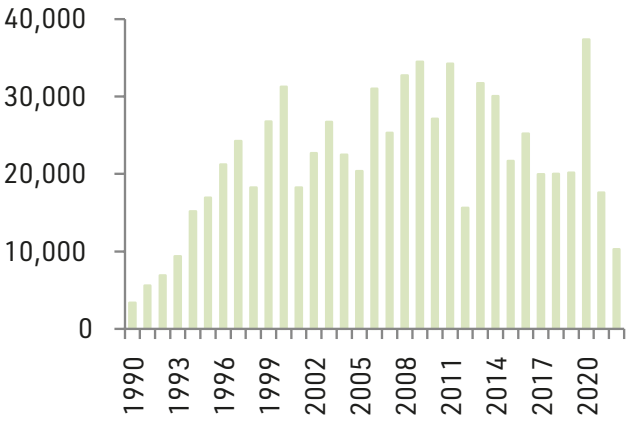

Figure 17. Number of invertebrate records processed per year by BRERC since 1990

Despite this lack of funded research, the UK has a long standing tradition of study of its invertebrate fauna by amateur and semi-professional enthusiasts [22] making it well placed to understand and infer from the data collected by communities as to what types of changes are taking place, what is causing them and potentially how to implement strategies that protect our native species.

The invertebrate data held at BRERC originates from a variety of sources which includes some funded survey work, but is by far dominated by observations from unpaid naturalists who are passionate about nature and its conservation.

Unsurprisingly, and in line with international trends, data held at BRERC is most comprehensive for larger, more easily recognisable species whose identification guides are freely available [21]. Data for Lepidoptera (Butterflies and Moths) is strongest although there is good knowledge of other groups (e.g. Hoverflies, some species of Beetle and increasingly Bees and Wasps) which is improving, especially as identification guides, apps and online advice groups have developed.

Hoverfly *Myathropa florea*: John Aldridge

There are strong indications within the data BRERC holds, that, over the last 30 years, invertebrate populations have experienced dramatic changes. Most easily noticed are the many documented cases of new species arriving or being discovered in the West of England region.

These are thought to be the result primarily of three causes: recognition of overlooked or misidentified species, introduction of invasive species, often as a result of the relatively poor controls on horticultural imports [4], or natural invasion and establishment of European species as our climate has begun to change [23].

Over the last 30 years, insect populations have experienced dramatic changes in the West of England

Downland Villa fly *Villa cingulata*: Dylan Peters

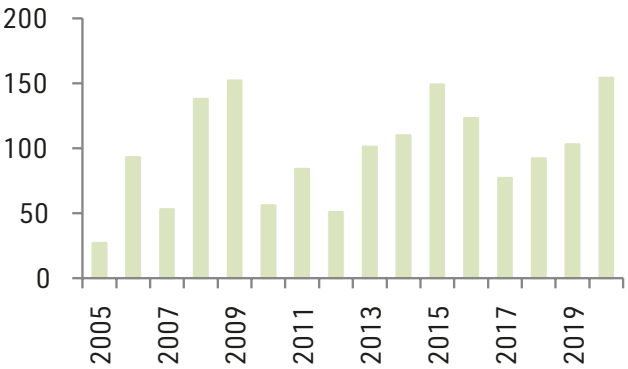

Figure 18. Number of new invertebrate species recorded per year in the West of England (2005-2020)

In addition, but much harder to quantify, is that of numbers of common native species which appear to have declined substantially. For example, the Small Tortoiseshell butterfly *Aglais urticae* was regarded in the BRERC *Common Butterfly Survey* of 1983 as 'A very common butterfly of parks and gardens' [24], butterfly recorders in 2023 would certainly not be able to write such a sentence, with organisations such as the UK Butterfly Monitoring Scheme observing its decline at a national level [25].

Figure 19. The first two Wasp Spider records in the West of England (2018 and 2019)

Our understanding of the changes in invertebrate populations in the less well-recorded orders is naturally poorer but undoubtedly mirrors changes we observe in better-recorded groups such as Lepidoptera. *Volucella inanis* is a case in point, a hoverfly restricted to the south-east of England until a few years ago and now a regular in Bristol gardens in 2023. The Downland Villa fly *Villa cingulata* was thought to have become extinct in the UK in the 1920s before being rediscovered in the Bristol Region in the early 2000s. At the time a Biodiversity Action Plan was written by Bath & North East Somerset Council in recognition of its rarity but now it is relatively common across the region and what we were probably witnessing was a recolonisation of the UK from Europe.

Over 1,000 new invertebrates have been identified in the region since 2011

Roesel's Bush-cricket *Roeseliana roeselii*: Dylan Peters

Wasp Spider *Argiope bruennichi*: Dylan Peters

Further examples of new arrivals include the Wasp Spider *Argiope bruennichi* which was once confined to the south coast of England but has very recently arrived in the region, and in 2023 was consolidating its position with new colonies found at Yatton and in the centre of Bristol for example. Similarly, the Long-winged Cone-head *Conocephalus fuscus* and Roesel's Bush-cricket *Roeseliana roeselii* in the Orthoptera represent recent massive expansions from the southern England populations and were reported right across the region in 2023.

Despite this, the greater concern must be for the continued loss of abundance of the invertebrates long present, and which remain commonplace, but in much reduced numbers. Whether this decline is due to climate change or other factors which could be much more easily controlled or influenced at a local level (e.g. reductions in the use of pesticides) is not yet known. Arrivals of new species do not compensate in biomass for the decline in our common native species. If this is not addressed, it will continue to result in declines of species which rely on invertebrates as food, such as many bird species and bats [26, 27]. This also poses a significant threat for many sectors of the local economy, for example agriculture, where a decline in pest controlling and pollinating species [28] will severely affect crop yields.

Ray Barnett *(BNS)*

Despite the arrival of new species, this in no way replaces the loss of native ones

Moths

Moth populations in the region continue to be well monitored by naturalists, primarily by running non-lethal light traps in back gardens and in some instances on nature reserves and other sites.

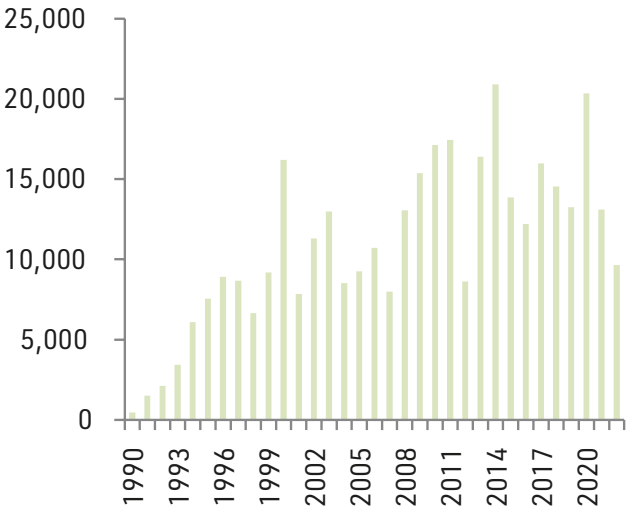

Figure 20. Number of moth records processed per year by BRERC since 1990

Monitoring by the Bristol Moth Group (coordinated by BRERC) has been continuing since its formation in 1991 and that data shows an increasing number of both new colonists arriving along with species previously considered extinct recolonising after a long absence.

Micro-Moths	Macro Moths
Caloptilia honoratella	Beautiful Marbled
Gelechia senticetella	Cloaked Pug
Grapholita caecana	Porter's Rustic
Spoladea recurvalis	Sombre Brocade
Triaxomasia caprimulgella	Spiny Hook-tip
Yponomeuta irrorella	

Table 11. Moth species new to the West of England region in 2023

In 2023, eleven new species (Table 11.) were found in the region adding to a list which extends back over approximately 200 years of local recording. The majority of these species represent European species naturally colonising the UK, a situation generally regarded to be unprecedented in the number and extent of species compared to previous decades.

Species name	Change in occupancy	Rank
Heart and Dart	-1.2%	1
Flame Shoulder	-22.6%	2
Silver Y	-31.4%	3
Setaceous Hebrew Character	-34.1%	4
Brimstone Moth	-18.3%	5
Lesser Yellow Underwing	-10.6%	6
Garden Carpet	-22.7%	7
Dark Arches	-2.2%	8
Large Yellow Underwing	-16.8%	9
Shuttle-shaped Dart	-7.8%	10

Table 12. The relative range changes and change in occupancy for the most-recorded macro moths (2000-2010 vs 2011-2023)

These new arrivals come on top of those which have similarly appeared in the last few years including the very large and impressive Clifden Nonpareil *Catocala fraxini* again recolonising the UK naturally, as well as the strikingly white Box Tree Moth *Cydalima perspectalis*. The latter is an accidentally introduced pest of Box which has arrived via the horticultural trade and is now posing a severe threat to Box hedges on National Trust properties and elsewhere [29, 30]; it is now a common moth in gardens across the West of England.

11 moth species new to the region were discovered in 2023

Clifden Nonpareil *Catocala fraxini*: John Aldridge

Box Tree Moth *Cydalima perspectalis*: John Aldridge

Figure 21. Locations of first sightings of Humming-bird Hawk-moth in 2023

Species name	Change in occupancy	Rank
Common Marble	-23.2%	1
Diamond-back Moth	59.3%	2
Mother of Pearl	3.4%	3
Olive Pearl	-4.8%	4
Small Magpie	0.7%	5
Straw Grass-veneer	-38.8%	6
Mint Moth	10.4%	7
Satin Grass-veneer	-25.7%	8
Common Grass-veneer	-28.7%	9
Anania coronata	-6.6%	10
Rush Veneer	-62.2%	11

Table 13. The relative range changes and change in occupancy for the most-recorded micro moths (2000-2010 vs 2011-2023)

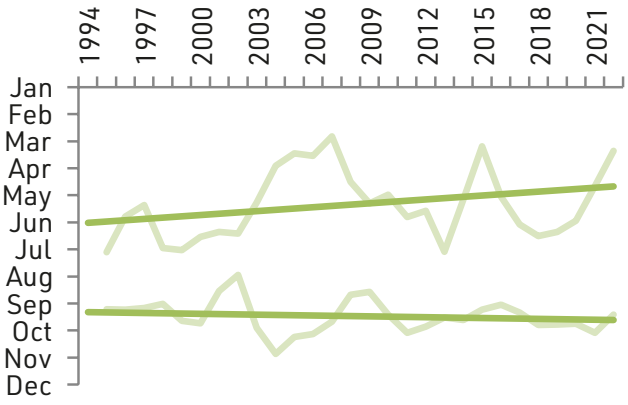

Figure 22. First and last recorded flight times of Humming-bird Hawk-moth

Further evidence of the impacts of warmer wetter winters may be the fact that Humming-bird Hawk-moths *Macroglossum stellatarum*, which were regarded as unable to overwinter in the country and only seen as a summer immigrant, are increasingly seen very early in the year.

These could represent over-wintered examples or, alternatively, early migration from the continent (or a mix of both). Either way they reflect the way the changing climate is, and will increasingly, change the accepted norms for our fauna [31].

Ray Barnett *(BNS)*

Butterflies

The butterfly fauna of the West of England region remains fairly depleted, with few of the UK's rarer or more localised species present in significant abundance. With regard to Fritillaries, the Silver-washed *Argynnis paphia* remains relatively common in woodlands across the region, with a few scattered records of the Dark Green *Speyeria aglaja*. The Marsh Fritillary *Euphydryas aurinia* is only known from a couple of widely spaced localities and remains at risk of being lost completely as it has been in the past (although colonies persist in surrounding counties). The Small Pearl-bordered Fritillary has a stronghold on the Mendips with some of the sites creeping in to the BRERC region but otherwise is largely absent.

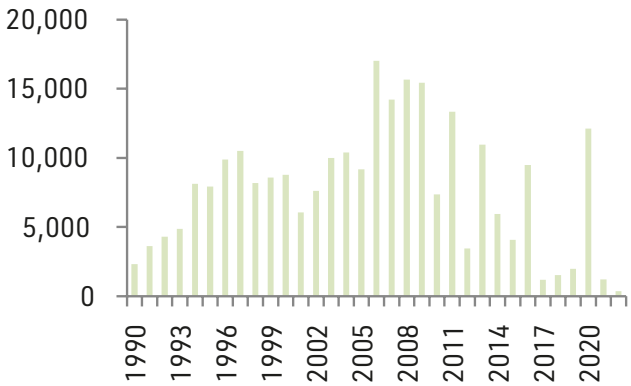

Figure 23. Number of butterfly records processed per year by BRERC since 1990

Silver-washed Fritillary *Argynnis paphia*: Abigail Pedlow

Butterfly numbers in 2023 were boosted by it being a very good year for the Red Admiral *Vanessa atalanta* which was one of the most commonly recorded species, especially later in the summer. This butterfly appears to be taking advantage of milder and wetter winters and is managing to hibernate in the UK more than was possible in decades past. Of the much more localised species of butterfly, concern must be focused on the spring-flying Grizzled Skipper *Pyrgus malvae* and Dingy Skipper *Erynnis tages* (requiring quality grassland) whose populations in the region seem to be declining.

Figure 24. Of all Grizzled and Dingy Skipper records, 95.7% were within priority habitat grasslands

Two of our most attractive species are present in very small numbers. The White Admiral *Limenitis camilla* is found in just two or three localities, and the presence of the Purple Emperor *Apatura iris* at one site in South Gloucestershire remains the only confirmed location despite an apparent increase of this species across England over the last couple of years.

Over 95% of Grizzled Skipper and Dingy Skipper records were within priority habitat grasslands

White Admiral *Limenitis camilla*: John Aldridge

Small Blue *Cupido minimus*: Abigail Pedlow

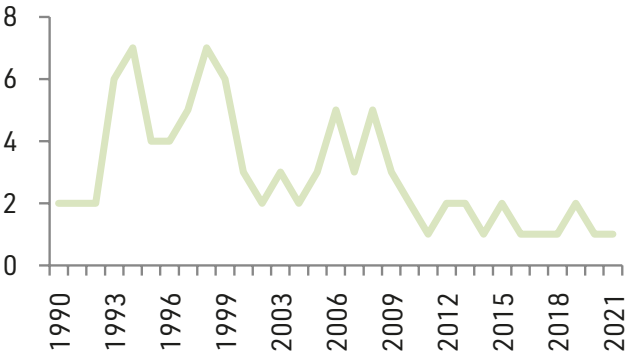

Figure 25. The number of sites (1km grid squares) that White Admirals were recorded in (1990-2021)

The Chalk Hill Blue *Polyommatus coridon* and Small Blue *Cupido minimus* can be found in a small number of grassland sites where the larval food plants (Horseshoe Vetch *Hippocrepis comosa* and Kidney Vetch *Anthyllis vulneraria* respectively) can be found. The Chalk Hill Blue is of concern and vulnerable to habitat loss or degradation. The Small Blue is harder to find and can exist at low populations but suffers from inexperienced recorders assuming that a blue butterfly of small size must be this species when both Holly Blue *Celastrina argiolus* and Common Blue *Polyommatus icarus* can throw up dwarf forms on occasion, a tip being to note the upperside of the individual which can appear brown rather than blue in the Small Blue.

Although Holly and Common Blue remain common, the latter does appear to be declining locally, though the evidence for this is anecdotal. Brown Argus *Aricia agestis* however, remains relatively common in the region after a heavy national decline in the 1980s and 90s and recovery in the 2000s [25]; Small Copper *Lycaena phlaeas* remains widespread.

Within 100m of Horseshoe Vetch or Kidney Vetch	Within 200m of Horseshoe Vetch or Kidney Vetch
65.1%	79.6%

Table 14. The percentage of Chalk Hill and Small Blue records within a specified distance of Horseshoe or Kidney Vetch records

Only three of the Hairstreak butterflies are known to be present in the region at present. Green Hairstreak *Callophrys rubi* occurs on quality grassland sites and Purple Hairstreak *Favonius quercus* in most woodlands containing oak. White-letter Hairstreak *Satyrium w-album* is elusive but probably is not as rare as some would think, it is just hard to find. Regular sightings at Snuff Mills in recent years have provided a site where recorders and photographers have been almost able to guarantee a sighting. The larvae survive on Wych Elm *Ulmus glabra* and suckering English Elm *Ulmus procera*.

Within 100m of Woodland habitat	Within 200m of Woodland habitat
74.8%	92.1%

Table 15. The percentage of Purple Hairstreak records within a specified distance of woodland habitats

Amongst the 'browns' the Small Heath *Coenonympha pamphilus* continues to be the species which is of concern. As with several other species, quality grassland is needed for this species to thrive and sites may be losing some of that quality. Meadow Brown *Maniola jurtina* remains one of the most common butterflies but Ringlet *Aphantopus hyperantus* numbers may have declined recently.

Large Skipper *Ochlodes sylvanus*, Small Skipper *Thymelicus sylvestris* and Essex Skipper *Thymelicus lineola* remain frequent and widely distributed as do the Orange-tip *Anthocharis cardamines* and Brimstone *Gonepteryx rhamni*.

Large Skipper *Ochlodes sylvanus*: Dylan Peters

The loss of unimproved grassland has undoubtedly affected many butterflies such as the Small Heath

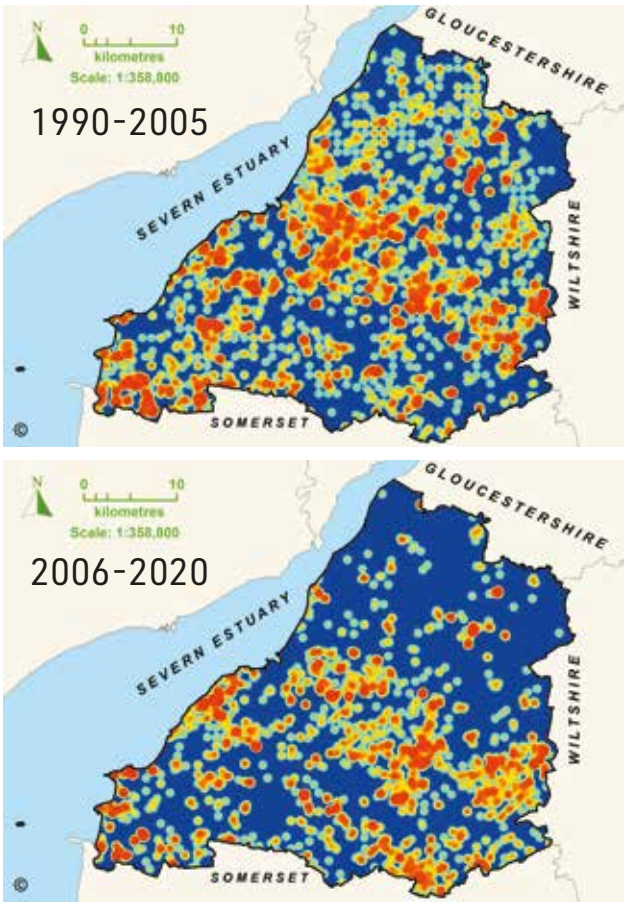

Figure 26. Heat map comparing the distribution of Small Tortoiseshell records between 1990-2005 and 2006-2020

Small Tortoiseshell numbers remain depressed as they have been for many years now, it no longer being a very familiar species to the region it once was.

2023 was not a year for Painted Lady *Vanessa cardui*, with just a smattering of records of this migrant which, in some years, can arrive in swarms.

The last quarter of the 20th century saw several species disappear from the region not to return as yet. The Duke of Burgundy *Hamearis lucina* is one such species and the Brown Hairstreak *Thecla betulae* another. As with certain other rarer species, these two can be found in counties surrounding the West of England area so perhaps there is hope that they could recolonise given suitable habitat management.

The last recorded locations of Brown Hairstreak

On a more positive note, examples of the Grayling *Hipparchia semele* and Wall *Lasiommata megera* were noted in the south-west of the region suggesting that, given the right habitats, these two species which have virtually disappeared from the region since the 1970s could make a comeback.

Overall, the abundance of common butterflies would seem to be low compared to the past and the general degradation of the countryside including continued widespread industrial agricultural practices, is considered by many to be the root cause [32, 33].

Species name	Change in occupancy	Rank
Comma	150.2%	1
Common Blue	84.3%	2
Speckled Wood	110.7%	3
Green-veined White	80.0%	4
Meadow Brown	117.8%	5
Small White	152.6%	6
Red Admiral	123.6%	7
Large White	158.3%	8
Gatekeeper	111.5%	9
Peacock	74.1%	10

Table 16. The relative range changes and change in occupancy for the most-recorded Butterflies (1990-2002 vs 2003-2022)

Butterfly recording remains very popular amongst the public and within that community are small subsets who firmly believe that by releasing captive-bred butterflies they can aid local populations to recover. In 2023, this made the headlines when Black-veined White *Aporia crataegi* (a UK species which has been extinct for a century or more but which is still found on the continent) were released by persons unknown on the edge of London [34]. Tightly controlled and authorised releases can be effective (see the success of Large Blue *Phengaris arion* reintroductions in sites both to the north and south of the West of England region) however, uncontrolled releases can potentially add poor genetic stock, new internal parasites or pathogens (fungi, bacteria and viruses) and confuse the understanding of how local populations are reacting to climate change and ultimately fail e.g. the introduced Glanville Fritillary *Melitaea cinxia* colony at Sand Point [35].

Ray Barnett *(BNS)*

The abundance of common butterflies appears to be low compared to the past

Dragonflies and Damselflies

Dragonflies and damselflies can be important indicators of habitat quality [36, 37]. The larvae develop in water over one or two years, where they predate on smaller invertebrates. The structure of the aquatic habitat is important; emergent vegetation is needed for many species to complete the transition to the flying adult which then feed on smaller insects, often flying over grasslands. They are usually found near to water, but can travel surprisingly far.

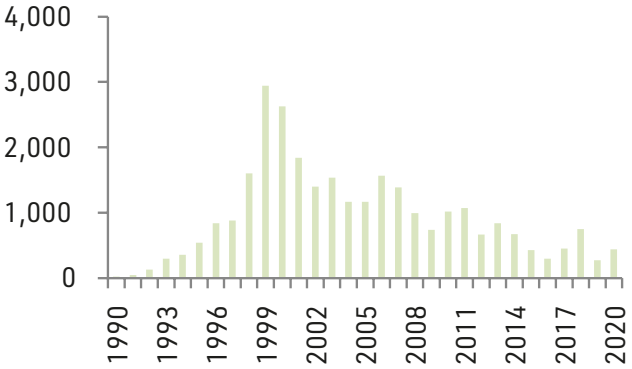

Figure 28. Number of Dragonfly and Damselfly records processed per year by BRERC since 1990

Some species, such as the Large Red Damselfly *Pyrrhosoma nymphula,* are generalist and found in most wetland habitats, others are more likely to be found near flowing water; for example Banded Demoiselle *Calopteryx splendens*, Beautiful Demoiselle *Calopteryx virgo* and the White-legged Damselfly. However, perhaps as a result of climate change, the traditional habitat types of some species are changing and riverine species are also being recorded in still waters [38].

There are 46 species on the list of resident and/or regular migrant species recorded since 2000 in the United Kingdom [38]. BRERC have records of 32 in the West of England in the same time period.

BRERC has records of 32 of the UK's 46 resident Dragonfly and Damselfly species

Large Red Damselfly *Pyrrhosoma nymphula*: John Aldridge

In the north of England and into Scotland there has been a dramatic spread of species that were previously restricted to southern England; here in the West of England we aren't positioned to see that spread clearly. However, in recent years, we have had species spreading from the east such as Small Red-eyed Damselfly *Erythromma viridulum* (first recorded locally in 2006) which has become established in our region, and Willow Emerald Damselfly *Chalcolestes viridis* (first recorded locally in 2023); both arrived in the UK from the European continent a few years previously, and spread west.

Our data reflects changes that are being observed nationally e.g. the decline of Emerald Damselfly *Lestes sponsa* and the spread of Scarce Chaser *Libellula fulva*.

As with other invertebrates the short adult life-stage is very weather dependent. Dragonflies and damselflies need warm temperatures to fly and can be damaged by high winds and heavy rainfall, particularly soon after emergence. In the aquatic stage of the life-cycle dragonflies and damselflies are vulnerable to water pollution [37], particularly by fertiliser and pesticides; habitat loss and disturbance stirring up sediment; and climate change causing changes in rainfall patterns - drying up wetland in drought, and larvae and eggs swept downstream by flooding. Recent detrimental changes to aquatic habitats include neonicotinoid pesticides – which have been shown to affect Blue-tailed Damselfly *Ischnura elegans* (one of the most

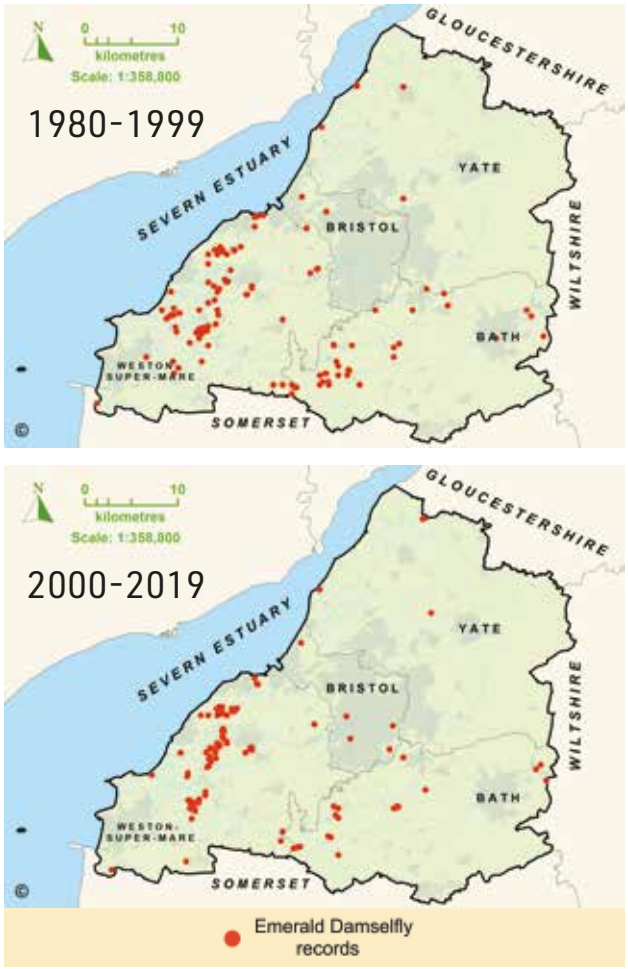

Figure 29. Map comparing the distribution of Emerald Damselfly records between 1980-1999 and 2000-2019

Species name	Change in occupancy	Rank
Azure Damselfly	-14.2%	1
Beautiful Demoiselle	13.1%	2
Banded Demoiselle	-2.8%	3
Red-eyed Damselfly	63.7%	4
Large Red Damselfly	-16.5%	5
White-legged Damselfly	-1.2%	6
Common Blue Damselfly	-33.0%	7
Blue-tailed Damselfly	-22.8%	8
Emerald Damselfly	-25.8%	9

Table 17. The relative range changes and change in occupancy for damselflies (1990-2005 vs 2006-2022)

White-legged Damselfly *Platycnemis pennipes*: John Aldridge

pollution-resistant species) [39]. There are also the unquantified effects of flea treatments both into the watercourse via domestic runoff, and via dogs entering streams and ponds [40]. It is also too early to say if there has been an effect of the well-publicised recent deterioration in water quality due to sewage outflows from water treatment works in flowing waters [41].

The popularity of garden ponds can only be positive for the suite of species that will breed in small waterbodies, including the Southern Hawker *Aeshna cyanea*, a friendly dragonfly that will often fly close to people as if to check them out. These ponds are particularly valuable if they don't contain fish which will eat eggs and larvae. Wetlands created for Sustainable Drainage Systems (SuDS), if they hold water all year round, will also add new opportunities.

Recording dragonflies and damselflies became popular in the 1990s, often as a sideline to birdwatching. However, since a high point of 2000, the number of recorders sending in records to

Species name	Change in occupancy	Rank
Southern Hawker	-9.8%	1
Migrant Hawker	-12.7%	2
Scarce Chaser	56.9%	3
Broad-bodied Chaser	-13.5%	4
Common Darter	-23.4%	5
Black-tailed Skimmer	-23.3%	6
Emperor Dragonfly	-26.6%	7
Brown Hawker	-31.6%	8

Table 18. The relative range changes and change in occupancy for dragonflies (1990-2005 vs 2006-2022)

BRERC has declined, in line with the number of records sent in and that makes interpreting declines or gains in abundance problematic. It is particularly helpful to now have statistical means to examine the data and be able to remove recording effort from results.

There is a need for more dragonfly recording in our area; excellent identification resources are available, and phones and cameras can capture these vivid insects well. BRERC are always happy to answer identification queries.

These are currently interesting times for dragonflies and damselflies in the UK - a new species to our region is expected imminently; the Norfolk Hawker *Anaciaeschna isoceles* has been seen to the south and north of the West of England so could turn up any day. Norfolk Hawker used to be very localised and restricted to one type of habitat in the east of England, so potentially other extremely localised species could spread in the future and there are other European species which could become established in the UK.

Abigail Pedlow *(BRERC)*

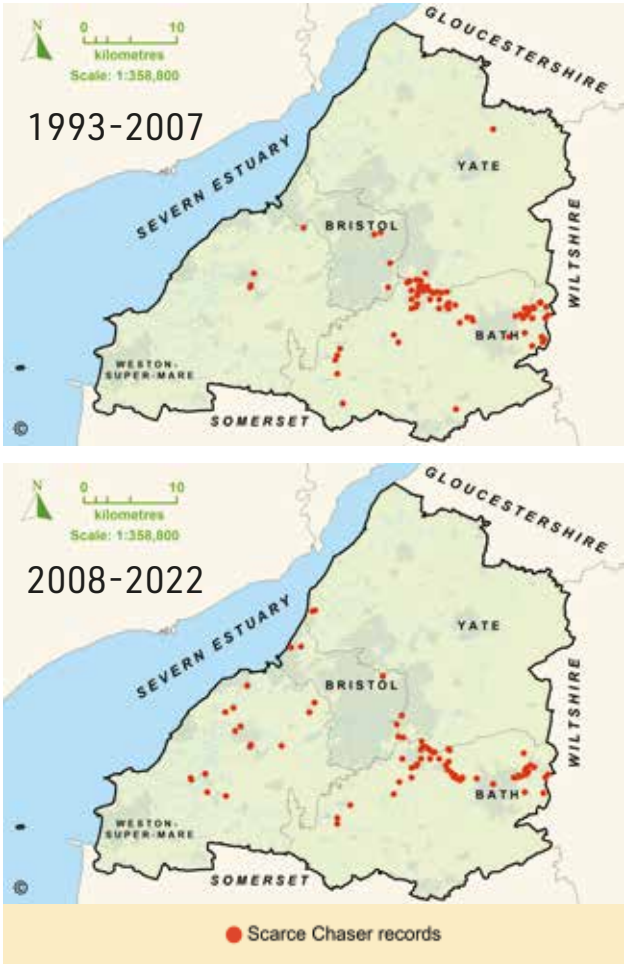

Figure 30. Map comparing the distribution of Scarce Chaser records between 1993-2007 and 2008-2022

Female Southern Hawker *Aeshna cyanea*: Abigail Pedlow

Birds

The depth of knowledge of our bird populations, compared to that of other taxa, is exceptional with the commitment of a large number of volunteers to schemes such as the *Breeding Bird Survey* and *Winter Bird Survey* meaning that we can quantify population changes affecting most species [42]. The quality of this information, much of which is published annually in the *Avon Bird Report* [43], means that birds can give a unique insight into wider environmental trends. Unfortunately, this access to data has seldom been matched by any improvement in the fortunes of the birds themselves. The accounts below will firstly consider species that are generally familiar and widely distributed across the region's farmland, woodland and gardens, then move on to discuss species associated with a small number of particular habitats and sites.

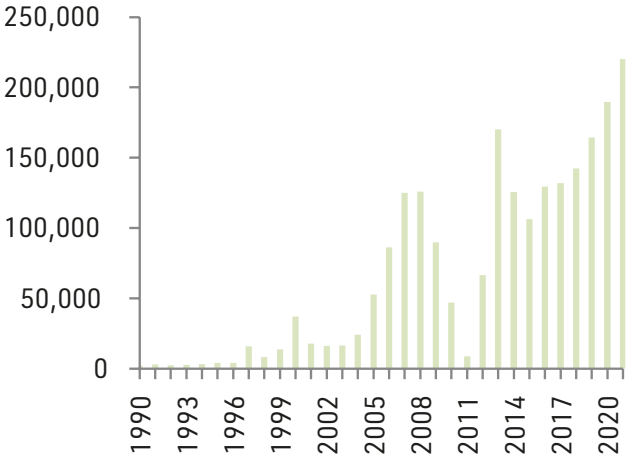

Figure 31. Number of bird records processed per year by BRERC since 1990

There have been massive changes in abundance of many widespread species over the past 30 years, meaning that conservation alerts have been attached to several birds, which remain familiar but whose population sizes have fallen enormously. Particularly marked declines have been seen in Lapwing *Vanellus vanellus*, Kestrel *Falco tinnunculus*, Little Owl *Athene noctua*, Cuckoo *Cuculus canorus* and Willow Warbler *Phylloscopus trochilus,* meaning that these species can no longer be described as everyday members of our avifauna.

Kestrel *Falco tinnunculus*: Abigail Pedlow

Species	Approximate decline over last 30 years
Chaffinch	>75%
House Martin	
Linnet	
Rook	
Starling	
Swift	
Bullfinch	50-74%
Goldcrest	
Greenfinch	
Long-tailed Tit	
Skylark	
Yellowhammer	
Blue Tit	30-49%
Great Tit	
Magpie	
Mistle Thrush	
Song Thrush	
Swallow	
Chiffchaff	10-29%
Dunnock	
Wren	

Table 19. Bird species and their approximate decline over the last 30 years in the West of England (AOG, 1986-2022).

The picture is not universally negative, however with several species increasing in abundance over the last 30 years. One species that deserves mention is House Sparrow *Passer domesticus*: Catastrophic declines in the London population have led to a perception that it has suffered everywhere, but its abundance in the West of England has hardly changed.

Species	Approximate increase over last 30 years
Buzzard	>75%
Goldfinch	
Great Spotted Woodpecker	
Woodpigeon	
Blackcap	30-50%
Whitethroat	
Robin	10-29%

Table 20. Bird species and their approximate increase over the last 30 years in the West of England (AOG, 1986-2022).

It is possible to identify the factors driving some of these trends, although a combination has probably affected most species. Agricultural intensification has been the most important factor for many decades. Changes such as the decline in mixed farming; the loss of scrub and hedges [44]; the decline in species-rich grassland and increased pesticide use [26], are largely responsible for declines in numbers of Rook *Corvus frugilegus*, Starling *Sturnus vulgaris*, Skylark *Alauda arvensis*, Linnet *Linaria cannabina*, Yellowhammer *Emberiza citrinella* and other species.

Food preference	Rank	Change in occupancy
Predominantly seeds/ fruits/nuts	1	43.5
Omnivorous	2	57.3
Predominantly Insects	3	15.4

Table 21. The relative range changes and change in occupancy for selected farmland birds based on their food preferences (2012-2014 vs 2020-2021)

Declining insect populations and loss of nest sites are primarily responsible for declines in Swift *Apus apus*, House Martin *Delichon urbicum* and Swallow *Hirundo rustica*. Infectious disease is largely responsible for the loss of Chaffinch *Fringilla coelebs*, Greenfinch *Chloris chloris* and Bullfinch *Pyrrhula pyrrhula* [38]. The loss of rough grassland has been problematic for Kestrel, Cuckoo and Little Owl, and drainage and the changed management of arable for the almost total loss of breeding Lapwings [46]. Climate change, especially a trend towards rapid shifts between hot and cool weather and late, cold springs, is probably the main factor driving the declines of Blue Tit *Cyanistes caeruleus*, Great Tit *Parus major*, Goldcrest *Regulus regulus* and Wren *Troglodytes troglodytes*, and is causing ever more problems for many migratory species [47].

Great Tit *Parus major*: Dylan Peters

We have lost several breeding species entirely; most of these were already very rare, or had already disappeared, thirty years ago. The losses include Snipe *Gallinago gallinago*, Grey Partridge *Perdix perdix*, Lesser Spotted Woodpecker *Dryobates minor*, Turtle Dove *Streptopelia turtur*, Wood Warbler *Phylloscopus sibilatrix*, Whinchat *Saxicola rubetra*, Nightingale *Luscinia megarhynchos* and Tree Sparrow *Passer montanus*. Other species, including Hobby *Falco subbuteo*, Yellow Wagtail *Motacilla flava* and Spotted Flycatcher *Muscicapa striata*, are teetering on the brink.

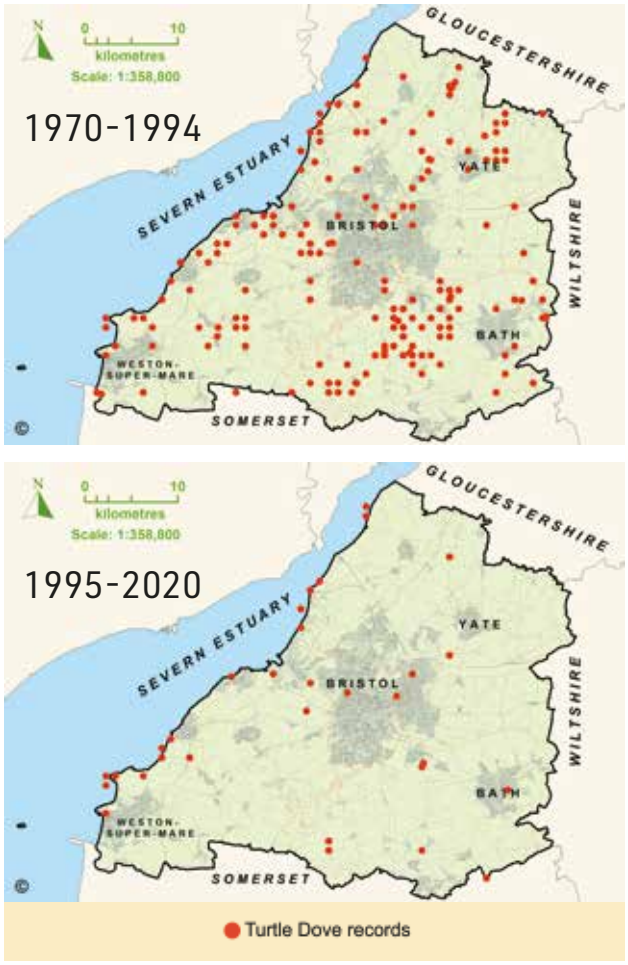

Figure 32. Map comparing the distribution of Turtle Dove sightings between 1970-1994 and 1995-2020

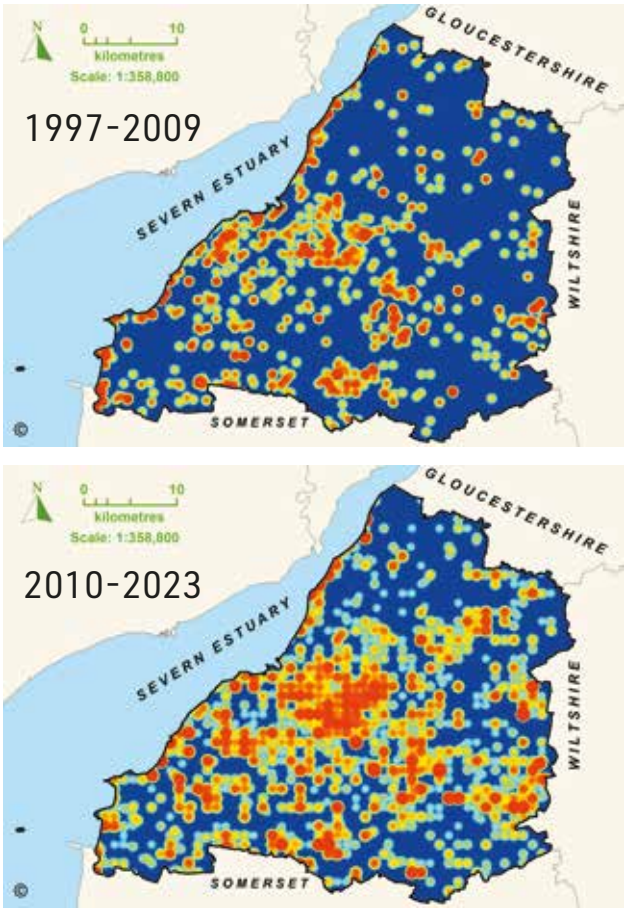

Figure 33. Heat map comparing the distribution of Raven records between 1997-2009 and 2010-2023

On the other hand, Peregrine, Raven *Corvus corax* and Cetti's Warbler *Cettia cetti* have become much more common. Firecrest *Regulus ignicapilla* and Siskin *Spinus spinus* have probably colonised our area, as has Red Kite *Milvus milvus*, following its successful reintroduction to England, and Goshawk *Accipiter gentilis*. The drivers of the declines of rare species are probably due to those previously mentioned, whilst factors behind the colonisations include a reduction in persecution; gradual colonisation of conifer plantations and other artificial habitats; and climate change.

The outstanding specialised habitats in our area are wetlands, both estuarine and freshwater, which are of particular value for migratory birds and therefore highly susceptible to changes in environmental conditions well beyond our area.

The Severn Estuary continues to hold large numbers of ducks and waders outside the breeding season. The estuarine habitat itself has changed little, but may be susceptible in coming years to climate change, with rising sea levels likely to reduce the area of saltmarsh, whilst more frequent and severe storms may wash away the silty mudflats that support most feeding waders. Adjacent to the estuary, there has been considerable housing and commercial development, affecting wet grassland in particular; development pressure is unlikely to ease in the future. There is, however, clear potential for habitat improvement, as demonstrated at Pilning Wetlands, which results in significant gains over a short time scale.

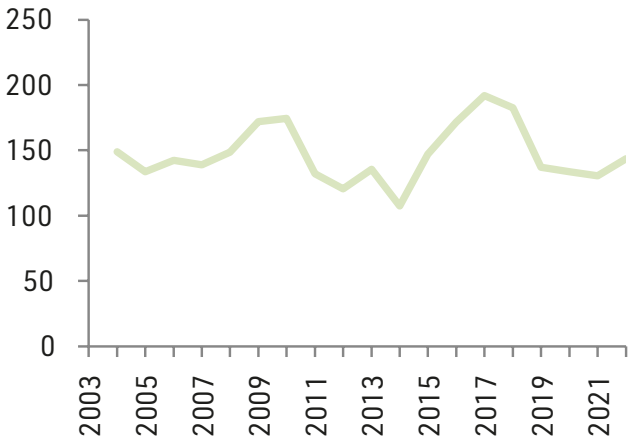

Figure 34. Two year moving average of the number of juvenile Shelduck reported (AOG, 1986-2022)

Shelduck *Tadorna tadorna* is the only duck species to nest along the Estuary in significant numbers, and non-breeding flocks are also significant. Its populations, in both summer and winter, have remained fairly stable, although breeding birds will be increasingly vulnerable to loss of habitat caused by development.

Other species, have become less numerous in our area with a potential cause being a warming climate allowing them to remain closer to their breeding sites, in regions to our north and east [48]. This phenomenon, known as short-stopping, is also partly responsible for a gradual decline in numbers of Dunlin, our most abundant wader, however a reduction in the quality of feeding habitat within the West of England and pressures affecting their breeding habitat in the north is also likely to be contributing to their diminishing numbers.

Wigeon *Mareca penelope*: John Aldridge

Other species, including Whimbrel *Numenius phaeopus*, Turnstone *Arenaria interpres* and Ringed Plover *Charadrius hiaticula*, as well as a range of less common passage migrants such as Curlew *Numenius arquata*, Sandpiper *Actitis hypoleucos*, Greenshank *Tringa nebularia* and Spotted Redshank *Tringa erythropus*, may also be suffering from reduced breeding productivity in the far north. The UK breeding population of Curlew is also known to be in steep decline [49, 50] but numbers wintering in our area have been relatively stable.

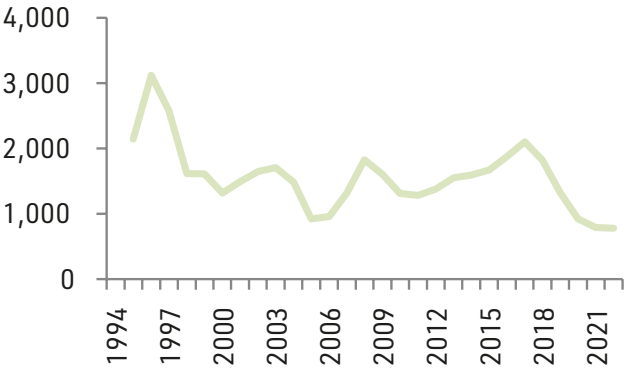

Figure 35. Two year moving average of the mean count of Dunlin across three areas in the West of England (AOG, 1986-2022)

A warming climate in northern countries such as Iceland has been beneficial for a few wader species [51], with increases in their habitable range in summers leading to population increases. As a result, over-wintering populations have risen in the region by about 50% and the increase in the Black-tailed Godwit population, from an effective base of zero to over 1,000, has been astonishing. Avocet *Recurvirostra avosetta* is another species that is now recorded much more frequently than it was in past decades. With further improvements to help create more habitat such as suitable pools behind seawalls there is scope to establish a robust population within the region.

Our other major wetlands are artificial reservoirs, created for water supply in the twentieth century. The largest are Chew Valley and Blagdon Lakes; the former, like the Severn Estuary, has an international designation for its migratory water birds; the latter is of national importance.

Water quality is crucially important in any freshwater ecosystem: changes in aquatic vegetation suggest that it has improved (from a very low base) at Chew but has declined at Blagdon. A large increase in recreational pressure, including an expansion of angling and of areas open to the public, at both sites, has also had the potential to affect bird numbers, although most species have proved remarkably resilient.

It is sensible to consider the two lakes as one, as birds of many species move between the two. Perhaps the most striking trend over the last 30 years has been an enormous increase in numbers of Tufted Duck and Coot, with smaller improvements shown by Mute Swan *Cygnus olor* and Gadwall *Mareca strepera*. The most important factor here is probably increased growth of water plants, and associated improvements in conditions for invertebrates, linked to improvements in water quality. The fortunes of Wigeon *Mareca penelope* also reflect changes in vegetation: there was a long term decline as feeding habitat on open grassland was colonised by scrub, but then a recovery associated with flocks feeding on the beds of water plants that have appeared in recent years.

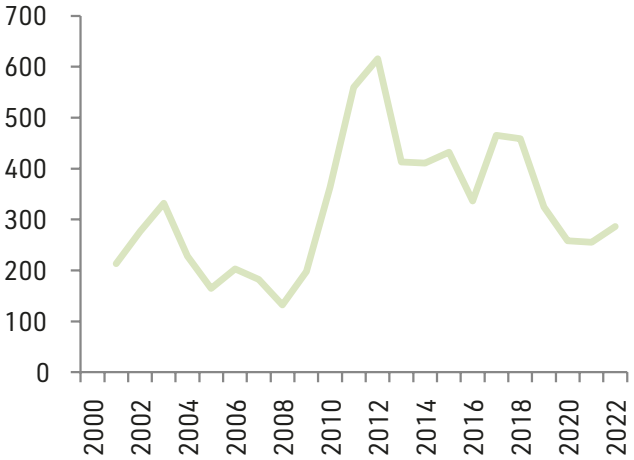

Figure 36. Two year moving average of the mean highest monthly count of Wigeon across three areas in the West of England (AOG, 1986-2022)

Although the overall number of birds at the lakes has risen markedly over the last 30 years, there have been declines, some of which are linked to wider population changes. Counts of Mallard *Anas platyrhynchos* and Pochard *Aythya ferina*, for example, have both fallen in line with national trends, and short-stopping has resulted in lower numbers of Goldeneye, Smew *Mergellus albellus* and Goosander. Ruddy Duck *Oxyura jamaicensis* was previously one of the most numerous species at the lakes. Following a cull carried out in response to concerns that birds from the UK might threaten the Spanish population of White-headed Duck *Oxyura leucocephala* it is now a very rare visitor. This is perhaps the only example in recent centuries of any species of plant or animal being deliberately eradicated from our area.

Species Name	Change in occupancy	Rank
Goosander	4.9%	1
Pochard	-19.2%	2
Smew	-78.6%	3
Mallard	21.4%	4

Table 22. The relative range changes and change in occupancy for selected duck species (2011-2016 vs 2017-2022)

Chew Valley Lake supports a huge winter gull roost. This is rarely monitored, but a recent count revealed that numbers are well down on those of previous decades. The species that has suffered the most was Black-headed Gull *Chroicocephalus ridibundus*; likely drivers of this decline include: short-stopping; loss of and declining habitat condition at breeding sites; reduced populations of grassland invertebrates; and mortality caused by avian influenza. Although the lakes are primarily of importance for non-breeding birds, they also have significant, but declining, value for breeding birds, formerly being considered nationally important for breeding ducks.

Populations were already in decline thirty years ago, due to changes in both marginal vegetation and populations of aquatic invertebrates. This decline has since been exacerbated by the unauthorised introduction of Pike to the lakes, leading to a catastrophic increase in predation of chicks, followed by the virtual loss of previously healthy

populations of Great Crested and Little Grebe *Tachybaptus ruficollis*. Completely at odds with this trend, and with climate change, has been the success of small numbers of Goldeneye, otherwise a species of areas well to our north, in rearing broods at Chew. The reedbeds at Chew support a nationally important population of Reed Warbler *Acrocephalus scirpaceus* and much lower numbers of Water Rail *Rallus aquaticus*. Bittern *Botaurus stellaris* and Bearded Tit *Panurus biarmicus* have each bred at least once and Marsh Harrier *Circus aeruginosus* seems likely to do so in the near future.

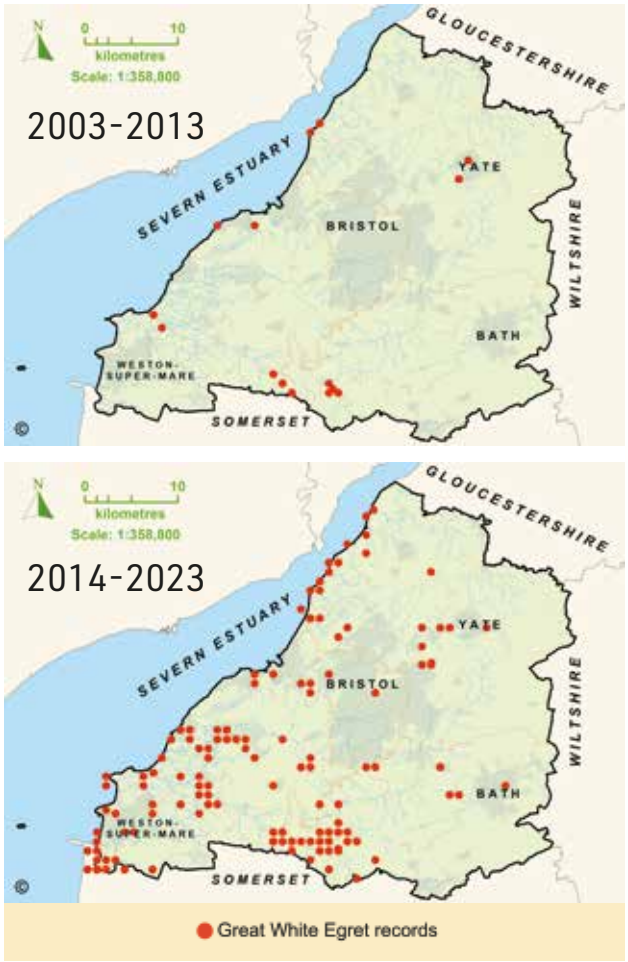

Figure 37. Map comparing the distribution of Great White Egret records, between 2003-2013 and 2014-2023

Three species of egrets becoming an established element of our avifauna has been a remarkable change over recent decades. The status of Little Egret *Egretta garzetta*, Great White Egret *Ardea alba*, and Cattle Egret *Bubulcus ibis* has gone from vagrant to resident in the last thirty years, a consequence of reduced persecution, global warming and wetland creation. None is yet known to breed at the lakes, but all are now numerous when conditions are suitable, and the maximum count of Great White Egret (58) at Chew is currently a UK record. Although nothing can be guaranteed in natural history, there are currently signs that Glossy Ibis *Plegadis falcinellus* and Spoonbill *Platalea leucorodia* might follow suit.

Great Crested Grebe *Podicepts cristatus*: Abigail Pedlow

This demonstrates that there has been some success in the conservation of uncommon birds. It is also evident that bird populations can recover from persecution, and that newly created habitats can be of real value for birds. What is also evident, however, is that there have been substantial declines in the populations of many widespread species. With the last century being a period in which our landscape, both urban and rural, has become massively impoverished, we face a future in which once familiar birds might either disappear completely, or become restricted to the fringes of a human-dominated world. As noted at the start of this piece, birds are unusual in that large quantities of quantitative data are available. That we possess this level of knowledge only exists due to the countless hours devoted to recording by dedicated and knowledgeable volunteers, a resource unequalled outside the UK. It is sobering to think what the trends experienced by many birds suggest about the wider environment and what similar data, if they were available, might tell us about the fortunes of other elements of our biota.

Rupert Higgins *(BNS)*

Mammals

It is surprising how relatively few mammal records BRERC has compared with birds, plants and invertebrates.

Over the last 50 years within the West of England there has been considerable research on certain species, however, much of that data is not readily available, currently remaining with the universities and organisations who conducted the research. This is compounded by the nocturnal nature of many of the region's mammals, making them a less common sighting despite their abundance. For species such as Badger *Meles meles*, Otter, Dormouse *Muscardinus avellanarius* and Mole *Talpa europaea* evidence of their activity rather than sightings of the animals themselves is used to monitor their presence with spraints, latrines, feeding remains, mole hills and tracks being much easier to observe.

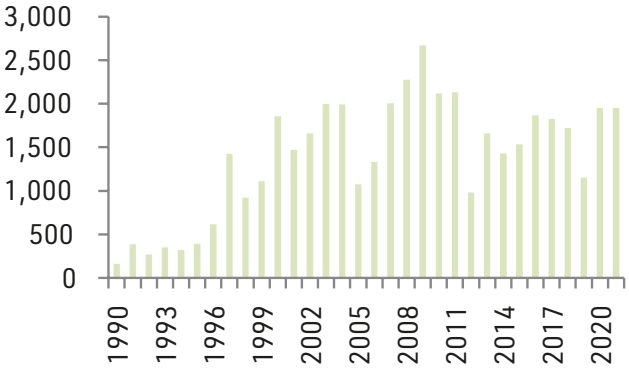

Figure 38. Number of mammal records processed per year by BRERC since 1990

However, there are some species that are regularly recorded including Bats, Badger, Otter and Hedgehog *Erinaceus europaeus*. Bats and Badger are often recorded in relation to planning applications, with their roosts and setts protected by law. Otter, Water Vole *Arvicola amphibius* and Hedgehog tend to be recorded as part of recording schemes or projects, with the former two being indicators of the health of rivers and streams and the latter for urban ecosystems. Despite this, even when mammals have been recorded systematically within the West of England, it has tended to be for limited periods, meaning there is a lack of robust data for mammals in the region.

Species	Change in occupancy	Rank
Red Fox	-14.8%	1
Otter	25.4%	2
Badger	-33.5%	3
Hedgehog	179.9%	4

Table 23. The relative range changes and change in occupancy for selected terrestrial mammals (1997-2008 vs 2009-2018)

Some species are less well-recorded due to difficulty in observing them, as well as being more easily misidentified. Examples of this are Water Shrew *Neomys fodiens*, Yellow-necked Mouse *Apodemus flavicollis* and Weasel *Mustela nivalis*. For example, BRERC currently receives more records of Beaver *Castor fiber* than of Water Shrew despite the lack of licensed Beaver releases within the region and the fairly short span of time in which populations in nearby counties have had time to disperse to the West of England.

Red Fox *Vulpes vulpes*: Dylan Peters

With this in mind it is difficult to have the same kind of certainty as to how well mammals are currently faring. Some species tend to be routinely reported to BRERC from the public. This includes mammals such Hedgehog, Red Fox, Grey Squirrel *Sciurus carolinensis* and Rabbit *Oryctolagus cuniculus* which are easily identified and commonly seen in parks, back gardens and streets.

BRERC receives records of these species irrespective of schemes, initiatives or projects as people seem to tell us of the animals they are fond of or dislike. These are species most people can recognise and include:

Rabbit

Rabbit is a species that our data shows a sharp decline in the number of records, the number of sites and the number of people recording them. This could be because there are fewer people recording them or because there are fewer Rabbits to record. However, it is noticeable that this species which was once so abundant is now rarely to be seen in large quantities.

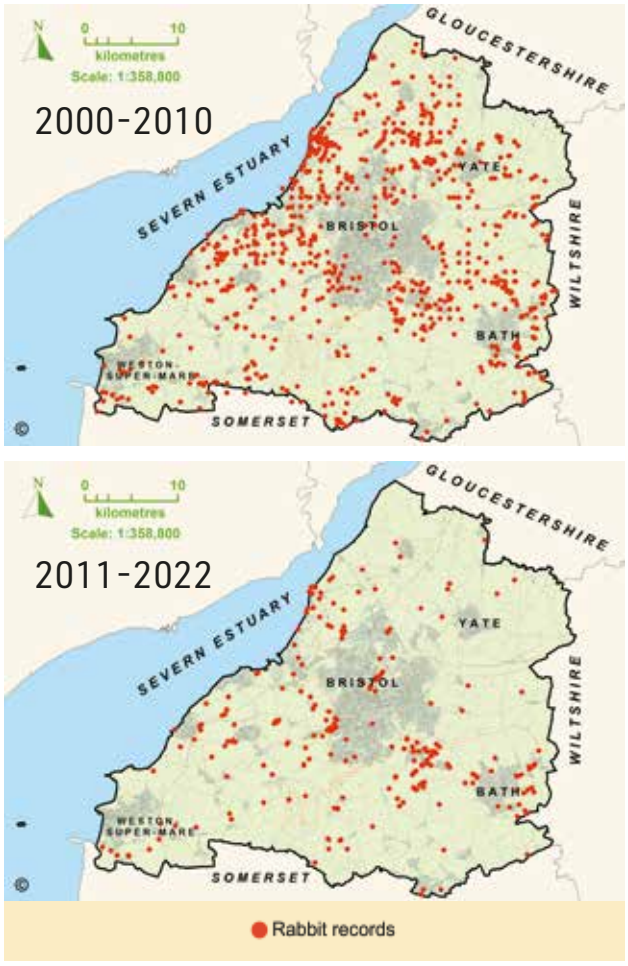

Figure 39. Map comparing the distribution of Rabbit records between 2000-2010 and 2011-2022

Because Rabbits have recently been suffering with Viral Haemorrhagic Disease (in addition to the long-lasting effects of Myxomatosis), we still cannot be sure whether their numbers have also been affected by habitat change or other factors.

Rabbit *Oryctolagus cuniculus*: John Aldridge

Roe and Muntjac Deer

All the BRERC digitised deer records, and probably those in paper format, are ad-hoc ones. These are usually reported by the public with a few noted from professional land surveys.

As with Rabbit they easily recognisable and have always been recorded by the public meaning we can be more assured that the recording efforts have remained fairly consistent over time than we can for species requiring a level of expertise to observe them.

Anecdotally, there is evidence to suggest that both Roe Deer *Capreolus capreolus* and Muntjac *Muntiacus reevesi* have become more abundant over the last 20 years. However, it is likely that the non-native species, the Muntjac, has observed a larger increase in its populations locally.

Muntjac have been spreading across the country since they were released in 1901. Prior to 1992 BRERC had just four records and since then we have received approximately 175, an increase of over 4,000%.

Muntjac are about the size of a Labrador dog and can move beneath denser scrub than larger species such as Roe Deer and consequently are harder to observe in natural habitats. Increasingly, Muntjac are now seen as victims of road-kills.

This increase in deer populations is also thought to have resulted a rise in Ticks, however other contributing factors such as climate change also been likely contributors to this rise in parasites.

Roe Deer *Capreolus capreolus*: Abigail Pedlow

Polecat

Polecat *Mustela putorius* is a species whose status is much harder to gauge. Generally recorded as road-kills they can easily be misidentified; most are considered to be escaped captive bred hybrids (Polecat crossed with Ferret). There is insufficient data held at BRERC to be certain whether their population is increasing, decreasing or stable.

Water Vole

For more than 20 years the main stronghold of this endangered species within the West of England has been near the industrial area of Avonmouth and not on the levels and moors as one might expect. This population has been regularly surveyed but the data is inconclusive to be able to determine how they are faring since most records are of feeding remains, burrows and droppings. However, it appears they remain present at the site, with recent introductions at a nearby site at Hallen likely to further secure the species' foothold within the region.

Badger

Protection of the Badger relates to its home, the sett. Unfortunately Badger-baiters still operate in the region and therefore BRERC maintains sett data as sensitive (confidential). Because of this, all sett records are held in a separate database, in a mapped format, and that information has not been evaluated for this report. Badger sightings have decreased by 26% over the last 20 years.

Brown Rat

This is an example of a species that most people assume does not need to be recorded since they are apparently very common and un-loved. There is insufficient data to be certain whether the Brown Rat is increasing, decreasing or remains stable, however, their adaptability and generalist diet likely ensures that the species is not threatened within the region.

Tim Corner *(BRERC)*

Reptiles and Amphibians

Of the eight reptile and amphibian species native to the West of England, relatively little is known of their historical extent and abundance relative to other taxa, despite a reptile being the source of BRERCs oldest terrestrial species record; a clutch of non-native Wall Lizard *Podarcis muralis* eggs found in mortar dated to the early 17th century.

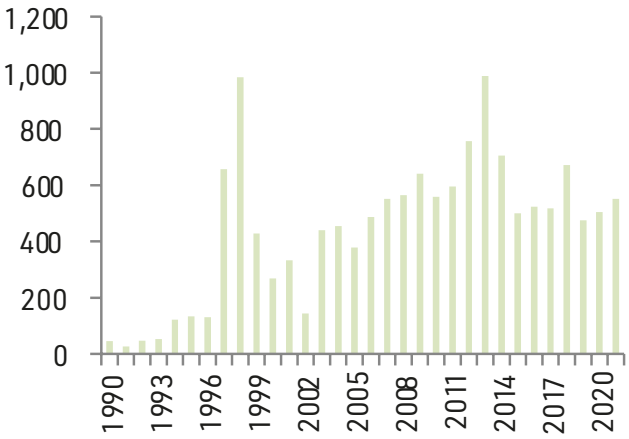

Figure 40. Number of reptile and amphibian records processed per year by BRERC since 1990

However, this has begun to change over the last 20 years, beginning with BRERC re-forming the Avon Reptile and Amphibian Group (ARAG) in 1999. Over the last few years in particular, the group has expanded their network of Toad Patrols and reptile transect surveys across the West of England. Whilst these surveys and patrols are structured in their recording methods, it is still very challenging to compare year-on-year data. Unpredictable weather patterns and fluctuations in surveying activity make things complicated.

Whilst there have been anecdotal indications of recovery for some of the region's reptile species, this has been hard to verify, with a lack of historic data making it difficult to ascertain whether records in new areas are a result of an expansion of species ranges, or surveys in new areas discovering populations for the first time.

Whilst still present within the region the Adder is at risk of disappearing from the West of England

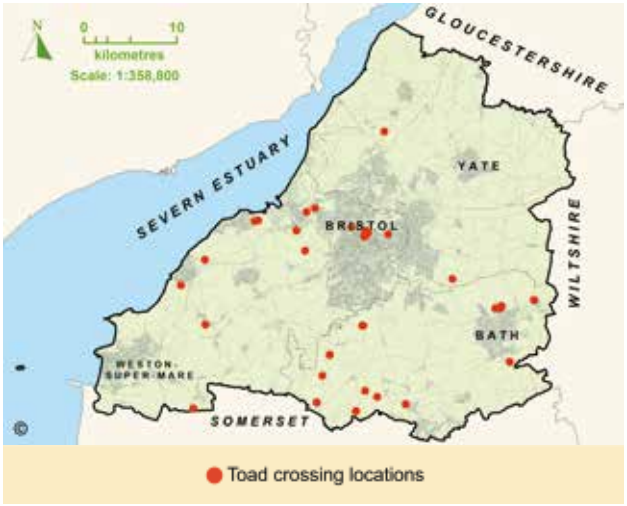

Figure 41. The locations of Toad Patrols across the West of England

Within the West of England the species of most concern is the Adder *Vipera berus*. Adder have disappeared from other counties in recent years, facing various challenges across the UK such as habitat loss, predation by Pheasant *Phasianus colchicus*, persecution, disturbance by dogs or well-intentioned members of the public and reduced genetic diversity due to small populations hanging on in fragmented habitats.

Grass Snake have been recorded at many new sites over the last couple of years: work with landowners to improve habitats for all life-stages from egg-laying and prey availability to hibernation has undoubtedly begun to help ensure the species remains within the region.

ARAG have recently confirmed the presence of Common Lizard *Zootoca vivipara* at a number of historic and new sites with the long term aim of reintroducing the species to certain sites where they were found historically and where habitat can be improved to increase suitability and connectivity.

The state of the region's amphibians is likely to be less positive with decreases in the number of ponds and small bodies of water likely to be one of the main drivers in the decline of a group that rely upon ponds and lakes to reproduce.

Grass Snake *Natrix helvetica*: John Aldridge

Common Frog *Rana temporaria*: Dylan Peters

Fewer waterbodies not only limits the number of places in which the species can lay their spawn but also by the reduction in the ability of individuals to disperse from pond to pond. This can often lead to the isolation of small groups of newts where a limited gene pool makes communities more susceptible to disease and lowers fertility.

This can be most acutely observed in Great Crested Newt *Triturus cristatus*, which cannot travel as far between bodies of water as their Smooth Newt *Lissotriton vulgaris* and Palmate Newt *Lissotriton helveticus* cousins. With an increase in the number of individuals turning up at Toad Patrol sites in recent years, the concern is that individuals are being forced to search more widely for suitable places to breed, however, there is the possibility that the species is simply more wide-ranging than previously thought.

Palmate Newt are being found much more frequently at Toad Patrols. It is thought that, being marginally more tolerant of acidic water than other newt species, Palmate Newt may have benefited slightly as garden ponds have become more acidic as a result of pollutant contamination and rising atmospheric carbon dioxide levels.

Increasingly unpredictable weather, as a result of climate change, may substantially affect the breeding migration of toads

As for Common Frog *Rana temporaria* and Common Toad *Bufo bufo*, population trends are still being assessed; although evidence from Toad Patrols indicate that variable weather conditions have a marked effect on the movement of toads when breeding, an ominous sign as climate change is set to cause the region's weather to become increasingly unpredictable.

In an effort to combat these pressures, ARAG launched their ReSSSuscitate Project aimed at improving semi-wild habitats bordering urban areas within the Frome Valley. The aim is to make habitats more suitable for existing, but fragmented, reptile and amphibian populations allowing reptiles to bask and breed more successfully.

ARAG are also now working with Bristol City Council and others to survey and improve ponds. The group aims to encourage landowners to manage land sympathetically and to introduce habitat features that will benefit reptiles and amphibians over the longer term. As well as parks and green spaces there are also schools and allotments within the project zone and ARAG will now be aiming to engage those stakeholders to improve linked habitat in the wider West of England region to ensure that reptiles and amphibians remain a feature of the landscape.

Andy Ryder *(ARAG)*

Afterword - Avon Wildlife Trust

This, the first State of Nature report for the West of England, highlights the importance of taking action for nature to ensure that future generations inherit functioning ecosystems. Those still capable of providing clean water and air, healthy food and the well-being benefits of spending time in nature.

There is a wide base of scientific evidence showing that to achieve this, 30% of land and sea must be managed for the benefit of wildlife by 2030. This is known as the 30x30, an ambitious goal which underpins the strategy for Avon Wildlife Trust and the wider national Wildlife Trust movement.

This report demonstrates the scale of the challenges we face.

Development and urbanisation have resulted in the West of England seeing an increase in the coverage of cities, towns, roads and other developments by nearly 10% since 2012. Worryingly development on locally protected sites (SNCIs: Sites of Nature Conservation Interest), has increased by over 100 hectares over the last decade.

The report also identifies numerous signs of our rapidly warming climate. Occasionally these changing patterns or new species are welcomed, such as with the arrival of Egret species in the area, or the colonisation by Lesser Emperor dragonfly. Sadly, these small bonuses are far outweighed by the negatives, with the shifting migratory habits of birds already being reflected in bird counts and ever-increasing threats from invasive species such as the aquatic Floating Pennywort.

Overall, this report provides a tentative insight into the degradation of our region's habitats and the changing dynamics which are accelerating the decline of individual species and entire ecosystems.

Thankfully, there has been a surge in action for nature in recent years; Bristol, North Somerset, South Gloucestershire, Bath & North East Somerset

councils and the West of England Combined Authority have all declared Climate and Ecological Emergencies, strong partnerships have formed and action for nature is being embedded into policies and strategies.

A key action is the development of a Local Nature Recovery Strategy (LNRS), mandated by the 2021 Environment Bill. Each local authority has to produce an LNRS map setting out local priorities for nature's recovery, this will guide public and private investment into Nature's Recovery for years to come.

The introduction of Biodiversity Net Gain as a legal requirement for new developments is designed to prevent any further decline of nature. In an area like ours, where development pressures are high, this new approach could play a major role in preventing further losses, while enabling the homes so desperately needed to be built. Here at Avon Wildlife Trust, we have set up pilot projects on our own reserves and in partnership with local farmers and landowners, demonstrating how BNG can work to restore nature and financially support landowners.

We need to make the most of these opportunities, accelerating work to create more space for nature, provide wildlife corridors into urban areas and restore natural processes. By doing so, we can tackle the climate and ecological emergencies simultaneously, with healthier ecosystems helping us to adapt to, and mitigate, climate change. In a bid to accelerate our own work, Avon Wildlife Trust has committed to the creation or restoration of 1,000 hectares of new habitat. This will be achieved through new land purchases and working hand in hand with farmers and landowners to unlock the potential across large swathes of our landscape.

To truly restore and protect the natural world a cultural shift is needed, one where we recognise the real value of healthy ecosystems and the intrinsic right of all life to exist, survive and thrive. It is widely understood that creating a cultural shift of this magnitude requires behaviour change from 1 in 4 people. This is why 1 in 4 people taking action for nature is the ultimate goal of Avon Wildlife Trusts Team Wilder. Team Wilder is a new approach to engagement, one that puts communities in the driving seat, with our expert staff offering advice and support so communities can make their own goals a reality.

Thankfully we're not alone in this work, with many fantastic local initiatives underway, such as Nextdoor Nature, Really Wild Lockleaze, Warmley Nature Action Zone, BS3 Wildlife Group, City Nature Challenge, Festival of Nature, Bathscape and Somer Valley Rediscovered, to name but a few.

If you want to Take Action for Wildlife too, you can find out more and join Team Wilder on our website www.avonwildlifetrust.org.uk

Technical Details

Maps

Maps in this report were produced using MapInfo Pro 2023.

BRERC's Data Modelling tool

This tool incorporates a variety of analytical packages (available in R), running a series of steps to reformat BRERC data before a series of tests and checks, producing outputs per time period per species for:

- Change in the number of records.
- Change in the number of sites (grid squares occupied).
- Change in the number of recorders.
- Telfer Index ranking[52].

The changes are assessed between two defined time periods, e.g. 2000-2009 versus 2010-2019, where the two time periods assessed are not equal in length the change in the number of records, sites occupied and recorders is assessed by working out the average number per year per time period and assessing the percentage change between these two values.

The last part of the tool utilises a change index developed by Mark Telfer which assess the relative change in the range of assessed species between different time periods. The benefit of using the Telfer Index is its capacity to analyse data containing inconsistencies in recording effort and biases [52]. The results produced are the standardised residuals of a weighted linear regression based on the number of grid squares occupied within the surveyed area per species.

The residuals (Telfer Index score) are either positive or negative numbers which can be used to rank the results from highest to lowest in terms of value: if a specific species has a Telfer Index score that is more positive than another, it is assumed that the species has fared better in respect to its range.

This is especially useful for BRERC's database which contains data collected from a variety of sources that often have no standardised recording procedures, therefore, changes in the number of records over time do not necessarily reflect changes to abundance of species.

For the ease of understanding in this report the residuals produced by the index are simplified into a ranking system whereby the highest value is ranked: 1, the second highest: 2, and so on.

Want to be involved?

The West of England has a rich heritage of recording nature, environmental research and innovative approaches to wildlife conservation. There are many local schemes and projects where people can get involved to help wildlife recover whilst learning about and enjoying the natural world in our region.

They enable anyone from any background to take meaningful action and enable local authorities and bodies to make informed decisions. These schemes range from promoting window boxes to landscape-scale projects. Most welcome new members, volunteers or visitors.

The following are just a very small sample:

Avon Bat Group
Avon Reptile & Amphibian Group
Avon RIGS Group (geological sites)
Avon Wildlife Trust
Bath Natural History Society
Bathscape (Bath & North East Somerset)
Belmont Estate - Watercress Farm (rewilding, North Somerset)
Bristol & District Moth Group
Bristol Avon Rivers Trust
Bristol Museums
Bristol Naturalists' Society
Bristol Ornithology Club
Bristol Regional Environmental Records Centre (BRERC)
Bristol Spider Group
Butterfly Conservation local groups
Cam Valley Wildlife Group (Bath & North East Somerset)
City Nature Challenge
Festival of Nature
Fluttering through History (Bristol Museums)
Friends of groups such as the Friends of Badock's Wood
Greening the High Street (South Gloucestershire)

Healthier with Nature
Neighbourhood groups such as BS3 Wildlife Group
North Somerset Bat Survey
North Somerset Levels Bird Surveys
RSPB Bristol Group
Somer Valley Rediscovered (Bath & North East Somerset)
Think Global Act Local (Bristol Museums)
Wild About Nature (South Gloucestershire)
Yatton & Congresbury Wildlife Action Group (YACWAG)

References

1 Kirby, K.J., Buckley, G.P. and Mills, J. (2017) 'Biodiversity implications of coppice decline, transformations to high forest and coppice restoration in British woodland', *Folia Geobotanica*, 52(1), pp. 5–13. doi:10.1007/s12224-016-9252-1.

2 Košulič, O., Michalko, R. and Hula, V. (2016) 'Impact of canopy openness on spider communities: Implications for conservation management of formerly Coppiced Oak Forests', *PLOS ONE*, 11(2). doi:10.1371/journal.pone.0148585.

3 Bunce, R.G. *et al.* (2014) 'The landscape ecological impact of afforestation on the British uplands and some initiatives to restore native woodland cover', *Journal of Landscape Ecology*, 7(2), pp. 5–24. doi:10.2478/jlecol-2014-0013.

4 Potter, C. and Urquhart, J. (2017) 'Tree disease and Pest epidemics in the anthropocene: A review of the drivers, impacts and policy responses in the UK', *Forest Policy and Economics*, 79, pp. 61–68. doi:10.1016/j.forpol.2016.06.024.

5 Fuller, R.M. (1987) 'The changing extent and conservation interest of lowland grasslands in England and Wales: A review of Grassland Surveys 1930–1984', *Biological Conservation*, 40(4), pp. 281–300. doi:10.1016/0006-3207(87)90121-2.

6 Pallett, D.W., Pescott, O.L. and Schäfer, S.M. (2016) 'Changes in plant species richness and productivity in response to decreased nitrogen inputs in grassland in southern England', *Ecological Indicators*, 68, pp. 73–81. doi:10.1016/j.ecolind.2015.12.024.

7 Walker, K. *et al.* (2004) 'The restoration and re-creation of species-rich lowland grassland on land formerly managed for intensive agriculture in the UK', *Biological Conservation*, 119(1), pp. 1–18. doi:10.1016/j.biocon.2003.10.020.

8 Charlton, M.B. *et al.* (2018) 'Mapping eutrophication risk from climate change: Future phosphorus concentrations in English rivers', *Science of The Total Environment*, 613–614, pp. 1510–1526. doi:10.1016/j.scitotenv.2017.07.218.

9 Concepción, E.D. *et al.* (2015) 'Impacts of urbanisation on biodiversity: The role of Species Mobility, degree of specialisation and spatial scale', *Oikos*, 124(12), pp. 1571–1582. doi:10.1111/oik.02166.

10 West of England Combined Authority (2024) *The Local Nature Recovery Strategy - west of England Combined Authority, West of England Combined Authority - Our aim is to deliver economic growth for the region and address challenges around productivity and skills, housing and transport*. Available at: https://www.westofengland-ca.gov.uk/what-we-do/environment/the-local-nature-recovery-strategy/ (Accessed: 16 March 2024).

11 Willis, K.J. and McElwain, J.C. (2014) *The evolution of plants*. Oxford: Oxford University Press.

12 Baude, M. *et al.* (2016) 'Historical nectar assessment reveals the fall and rise of floral resources in Britain', *Nature*, 530(7588), pp. 85–88. doi:10.1038/nature16532.

13 Kovács-Hostyánszki, A. *et al.* (2017) 'Ecological intensification to mitigate impacts of conventional intensive land use on pollinators and pollination', *Ecology Letters*, 20(5), pp. 673–689. doi:10.1111/ele.12762.

14 Lambert, S.J. and Davy, A.J. (2010) 'Water quality as a threat to aquatic plants: Discriminating between the effects of nitrate, phosphate, boron and heavy metals on charophytes', *New Phytologist*, 189(4), pp. 1051–1059. doi:10.1111/j.1469-8137.2010.03543.x.

15 Clubbe, C. *et al.* (2020) 'Current knowledge, status, and future for plant and fungal diversity in Great Britain and the UK overseas territories', *Plants, People, Planet*, 2(5), pp. 557–579. doi:10.1002/ppp3.10142.

16 Griffith, GW. (2013) 'The International Conservation Importance of Welsh "waxcap" grasslands', *Mycosphere*, 4(5), pp. 969–984. doi:10.5943/mycosphere/4/5/10.

17 Alday, J.G. *et al.* (2022) 'Long-term effects of sheep-grazing and its removal on vegetation dynamics of British upland grasslands and moorlands; local management cannot overcome large-scale trends', *Ecological Indicators*, 139, p. 108878. doi:10.1016/j.ecolind.2022.108878.

18 Pescott, O.L. *et al.* (2015) 'Air pollution and its effects on lichens, bryophytes, and lichen-feeding lepidoptera: Review and evidence from Biological Records', *Biological Journal of the Linnean Society*, 115(3), pp. 611–635. doi:10.1111/bij.12541.

19 Parikh, G., Rawtani, D. and Khatri, N. (2020) '"insects as an indicator for environmental pollution"', *Environmental Claims Journal*, 33(2), pp. 161–181. doi:10.1080/10406026.2020.1780698.

20 Samways, M.J. *et al.* (2020) 'Solutions for humanity on how to conserve insects', *Biological Conservation*, 242, p. 108427. doi:10.1016/j.biocon.2020.108427.

21 Borges, F.L. *et al.* (2021) 'Terrestrial invertebrates as bioindicators in restoration ecology: A global bibliometric survey', *Ecological Indicators*, 125, p. 107458. doi:10.1016/j.ecolind.2021.107458.

22 Gardiner, M.M. and Roy, H.E. (2022) 'The role of Community Science in Entomology', *Annual Review of Entomology*, 67(1), pp. 437–456. doi:10.1146/annurev-ento-072121-075258.

23 Hulme, P.E. (2016) 'Climate change and biological invasions: Evidence, expectations, and response options', *Biological Reviews*, 92(3), pp. 1297–1313. doi:10.1111/brv.12282.

24 Bristol Regional Environmental Records Centre (1983) *BRERC Common Butterfly Survey*.

25 UK Butterfly Monitoring Scheme (2022) *The State of the UK's Butterflies*.

26 Hallmann, C.A. *et al.* (2014) 'Declines in insectivorous birds are associated with high neonicotinoid concentrations', *Nature*, 511(7509), pp. 341–343. doi:10.1038/nature13531.

27 Russo, D. *et al.* (2021) 'Do we need to use bats as bioindicators?', *Biology*, 10(8), p. 693. doi:10.3390/biology10080693.

28 Goulson, D. (2019) 'The insect apocalypse, and why it matters', *Current Biology*, 29(19). doi:10.1016/j.cub.2019.06.069.

29 Plant, C. *et al.* (2019) 'The Box-Tree moth Cydalima perspectalis (Walker, 1859) in Britain: an overview of its spread and current status', *The Entomologist's Record and Journal of Variation*, (131), pp. 122–147.

30 Hodor, K. *et al.* (2021) 'Identification and analysis of problems in selected European Historic Gardens during the COVID-19 pandemic', *Sustainability*, 13(3), p. 1332. doi:10.3390/su13031332.

31 Halsch, C.A. *et al.* (2021) 'Insects and recent climate change', *Proceedings of the National Academy of Sciences*, 118(2). doi:10.1073/pnas.2002543117.

32 Gilburn, A.S. *et al.* (2015) 'Are neonicotinoid insecticides driving declines of widespread butterflies?', *PeerJ*, 3. doi:10.7717/peerj.1402.

33 Habel, J.C. *et al.* (2019) 'Agricultural intensification drives butterfly decline', *Insect Conservation and Diversity*, 12(4), pp. 289–295. doi:10.1111/icad.12343.

34 Gardner, F. (2023) *'extinct' butterfly species reappears in UK*, *BBC News*. Available at: https://www.bbc.co.uk/news/uk-65804939#:~:text=The%20species%2C%20previously%20described%20as,hedgerows%20in%20south%2Deast%20London (Accessed: 30 March 2024).

35 Pullen, L. *et al.* (2021) *Glanville Fritillaries in North Dorset*, *Dorset Butterflies*. Available at: https://www.dorsetbutterflies.com/2021/05/glanville-fritillaries-in-north-dorset/ (Accessed: 31 March 2024).

36 Kutcher, T.E. and Bried, J.T. (2014) 'Adult Odonata conservatism as an indicator of freshwater wetland condition', *Ecological Indicators*, 38, pp. 31–39. doi:10.1016/j.ecolind.2013.10.028.

37 Perron, M.A. and Pick, F.R. (2020) 'Water quality effects on dragonfly and damselfly nymph communities: A comparison of urban and natural ponds', *Environmental Pollution*, 263, p. 114472. doi:10.1016/j.envpol.2020.114472.

38 British Dragonfly Society (2021) *State of Dragonflies 2021*.

39 Barmentlo, S.H. *et al.* (2019) 'Environmental levels of neonicotinoids reduce prey consumption, mobility and emergence of the damselfly (*Ischnura elegans*)', *Journal of Applied Ecology*, 56(8), pp. 2034–2044. doi:10.1111/1365-2664.13459.

40 Perkins, R. *et al.* (2021) 'Potential role of veterinary flea products in widespread pesticide contamination of English Rivers', *Science of The Total Environment*, 755, p. 143560. doi:10.1016/j.scitotenv.2020.143560.

41 Giakoumis, T. and Voulvoulis, N. (2023) 'Combined sewer overflows: Relating event duration monitoring data to wastewater systems' capacity in England', *Environmental Science: Water Research & Technology*, 9(3), pp. 707–722. doi:10.1039/d2ew00637e.

42 British Trust for Ornithology (no date) *Projects-BTO*, *BTO Webpage*. Available at: https://www.bto.org/our-science/projects (Accessed: 25 March 2024).

43 Avon Ornithological Group (1986-2022) *Avon Bird Report*.

44 Sage, R. *et al.* (2024) 'Winter game crop plots for gamebirds retain hedgerow breeding songbirds in an improved grassland landscape', *Wildlife Biology* [Preprint]. doi:10.1002/wlb3.01156.

45 Ganas, P. *et al.* (2013) 'Multi-locus sequence typing confirms the clonality of *trichomonas gallinae* isolates circulating in European finches', *Parasitology*, 141(5), pp. 652–661. doi:10.1017/s0031182013002023.

46 Silva-Monteiro, M. *et al.* (2021) 'Habitats supporting wader communities in Europe and relations between agricultural land use and breeding densities: A Review', *Global Ecology and Conservation*, 28. doi:10.1016/j.gecco.2021.e01657.

47 Pearce-Higgins, J.W. and Green, R. (2014) *Birds and climate change: Impacts and conservation responses*. Cambridge, United Kingdom: Cambridge University Press.

48 Fox, A.D. *et al.* (2016) 'Seeking explanations for recent changes in abundance of wintering Eurasian wigeon (*Anas Penelope*) in Northwest Europe', *Ornis Fennica*, 93(1). doi:10.51812/of.133884.

49 Franks, S.E. *et al.* (2017) 'Environmental correlates of breeding abundance and population change of Eurasian curlew (*numenius* arquata) in Britain', *Bird Study*, 64(3), pp. 393–409. doi:10.1080/00063657.2017.1359233.

50 Jellesmark, S. *et al.* (2022) 'The effect of conservation interventions on the abundance of breeding waders within nature reserves in the United Kingdom', *Ibis*, 165(1), pp. 69–81. doi:10.1111/ibi.13106.

51 Alves, J.A. *et al.* (2019) 'Linking warming effects on phenology, demography, and range expansion in a migratory bird population', *Ecology and Evolution*, 9(5), pp. 2365–2375. doi:10.1002/ece3.4746.

52 Telfer, M.G., Preston, C.D. and Rothery, P. (2002) 'A general method for measuring relative change in range size from biological Atlas Data', *Biological Conservation*, 107(1), pp. 99–109. doi:10.1016/s0006-3207(02)00050-2.

Roesel's Bush-cricket *Roeseliana roeselii*: Abigail Pedlow