



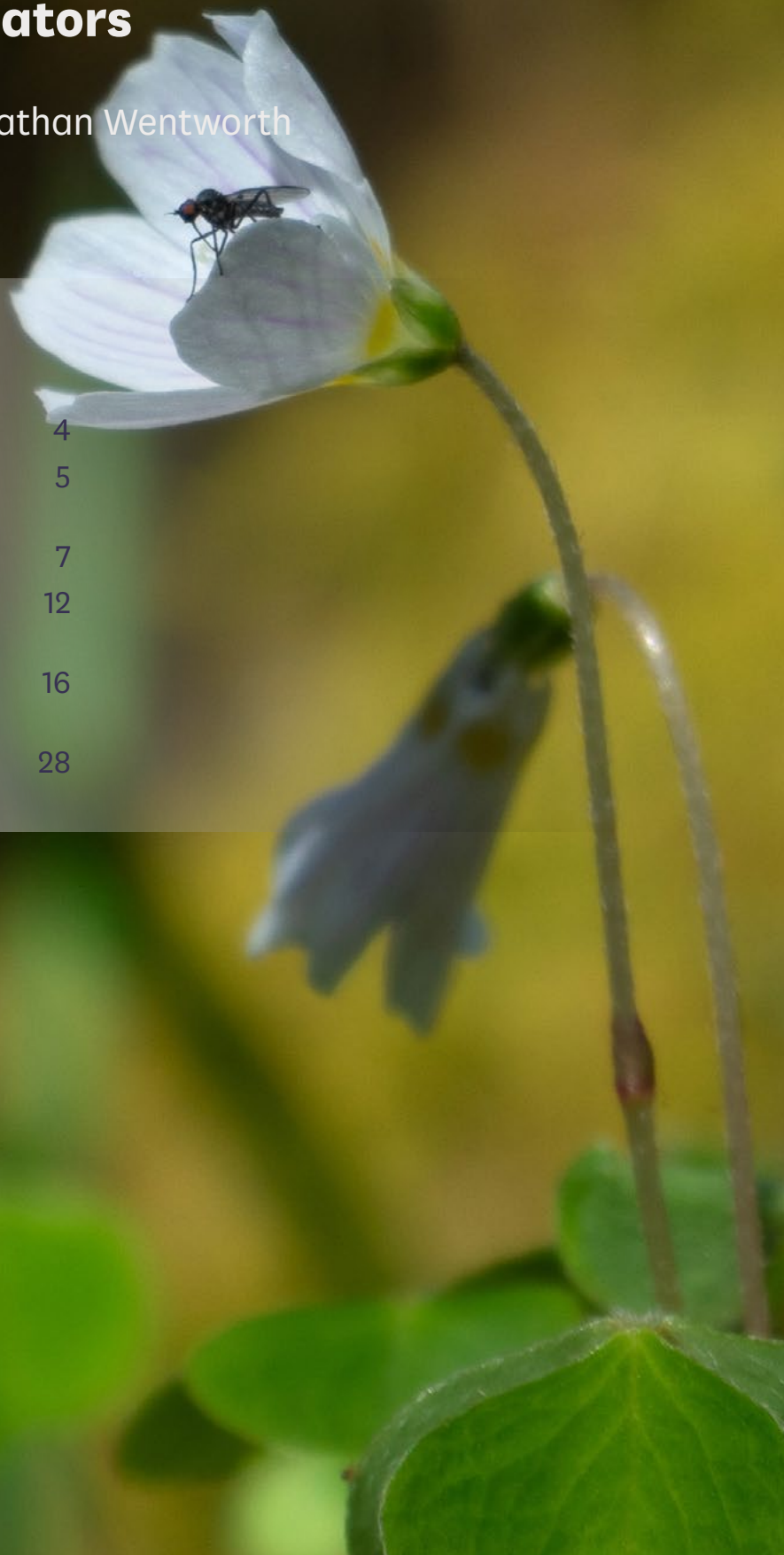
## Biodiversity indicators

By Lauren Henly and Jonathan Wentworth

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## SUMMARY

The UK is committed to targets under international biodiversity agreements to value, conserve and restore biodiversity, which is the variety of life on earth ranging from genes to ecosystems.

The four UK nations will each develop new 10-year biodiversity strategies in response to the post-2020 Global Biodiversity Framework that will be agreed at the 15<sup>th</sup> Conference of the Parties to the Convention of Biological Diversity (CBD) in October 2021. The Environment Bill, which also contains biodiversity commitments, was announced in the Queen's speech and has been carried over from the previous Parliamentary session; its progress will continue this year.

One of the ways in which it will be possible to determine success against biodiversity targets will be through the use of biodiversity indicators, which are designed to summarise and communicate trends in complex biodiversity monitoring data.

Individual indicators monitor specific aspects of biodiversity, such as genetic diversity or the change in abundance of a group of species. Multiple indicators (sometimes called suites of indicators) can be used to assess and infer information about the state of biodiversity as a whole.

Various suites of indicators have been developed at the UK and devolved levels. The complex nature of biodiversity itself along with the availability, volume, quality and breadth of the underlying biodiversity monitoring data, has led to diversified approaches to the development and application of biodiversity indicators between nations.

The representation of species, habitats and facets of biodiversity in headline biodiversity indicators at the UK and country level varies between the suites of indicators.

This POSTbrief summarises the different suites of indicators at both the devolved- and UK-level and complements POSTnote 644, which describes the challenges surrounding the effective use of biodiversity indicators in the context of the post-2020 CBD Global Biodiversity Framework.

# BACKGROUND

## What is biodiversity and why is it essential to human existence?

Biodiversity – the variety of life on earth – is essential to human existence. It plays critical roles in mitigating and adapting to climate change, as well as contributing to food security, human health and well-being ([PN 617](#), [PN 627](#)).<sup>1</sup>

The 2021 Dasgupta Review on the economics of biodiversity highlighted that nature is also an asset that our economies depend on.<sup>2</sup> The review stated that the current demands on nature are unsustainable and far exceed its capacity to supply us with the goods and services we all rely on. This endangers the prosperity of current and future generations.<sup>2</sup>

Global biodiversity is declining at rates faster than at any time in human history, with approximately one million plant and animal species facing extinction - many within decades.<sup>1,3</sup>

## Biodiversity goals and targets

The UK is committed to multiple international biodiversity goals and targets, such as those set out by the Convention on Biological Diversity (CBD) and the Oslo/Paris Convention for the Protection of the Marine Environment of the North-East Atlantic.

In the UK, biodiversity is a devolved responsibility: England, Scotland, Wales and Northern Ireland have each developed, or are developing, their own biodiversity or environment strategies in response to international and UK policy commitments.<sup>4-8</sup> A biodiversity strategy has also been developed for the UK Overseas Territories ([PN427](#)), which are not covered in this POSTbrief.<sup>9</sup>

Biodiversity is complex and encompasses a wide range of facets, from genes to ecosystems, as well as the interactions between species and their physical habitats, structures of biological networks, and the overall functioning and resilience of ecosystems.<sup>10</sup>

Due to the complexity of biodiversity, measuring its state and change over time is difficult. The different components of biodiversity can be measured in different ways, but it is widely accepted that no single metric can adequately describe biodiversity as a whole.<sup>11-14</sup> There are numerous metrics that could

be used to better understand particular facets of biodiversity, but no single one can provide a comprehensive picture of the 'state of biodiversity'.

Performance against biodiversity targets is assessed using currently available biodiversity monitoring information, which is summarised into simple, standardised and communicable figures called indicators. The UK and each devolved nation have a suite/suites of biodiversity indicators that are used to assess progress towards biodiversity goals and targets.

Discussions around the proposed targets, indicators, and monitoring approaches for the Post-2020 Global Biodiversity of the CBD are now in the advanced stages and are set to be agreed during the 15th Conference of the Parties in Kunming, China in October 2021.<sup>15</sup> These agreements will likely influence and necessitate further revision of national indicator suites (multiple indicators that are used together to assess the overall state of biodiversity) to compliment the global biodiversity framework and associated targets.

This POSTbrief complements POSTnote 644, which describes the challenges surrounding the effective use of biodiversity indicators.

# BIODIVERSITY MONITORING AND INDICATORS

## Biodiversity monitoring in the UK

Biodiversity monitoring data in the UK are collected for multiple uses including ecological research, informing conservation management, and to fulfil statutory and operational requirements (e.g. reporting against international, national and local biodiversity goals and targets).<sup>16-19</sup>

At the local level, monitoring natural resources can also empower local stakeholders to put forward their views of how resources should be managed to enable equitable sharing of the benefits of biodiversity based on the available evidence.<sup>20-22</sup>

Biodiversity monitoring is limited by practicality, ease of data collection, expertise, and funding ([PN644](#), [PN490](#)).<sup>23</sup> The majority of terrestrial biodiversity data in the UK is collected by skilled volunteers (citizen scientists).<sup>24-26</sup> Despite some of the challenges this can bring in terms of data quality ([PN644](#), [PN476](#)), engaging committed and enthusiastic volunteers in monitoring efforts can contribute to the success of long term and large scale monitoring programmes that would otherwise require substantial funding, and methods have been established to analyse such volunteer collected data, accounting for a variety of possible biases.<sup>20,27-30</sup>

However, many UK biodiversity monitoring schemes, rather than being structured and systematic, have been criticised for not being sufficiently strategic as they are usually established by people who are directly interested in particular groups of species.<sup>29,31</sup> Nevertheless, this can encourage public participation in science and countryside recreation. These data can also be used to produce accurate and statistically rigorous results and indicators, which have been used successfully to understand broad changes in the biodiversity that has been monitored.<sup>32-35</sup>

## Biodiversity indicators

Global, regional, national and local biodiversity indicators are used to measure and communicate progress towards biodiversity targets.<sup>36</sup> There are many challenges associated with the effective use of biodiversity indicators including the types, varieties and number of indicators used;

challenges of assessing progress towards targets; and data availability. [These are discussed in PN644.](#)

Indicators can be composed of one or more measures that summarise complex data into simple, standardised, and communicable figures.<sup>37</sup> There is no widely accepted definition of a biodiversity indicator, and when referring to biodiversity the word indicator is often used interchangeably, to refer both to the organisms being monitored and the numeric measure (sometimes called the ‘index’) derived to express a trend (such as the bird indicators; Box 1).<sup>12,38-40</sup>

Whichever way the term is used, the value of an indicator (either the presence/absence of a species or the numeric value of an index), can be used to monitor specific aspects of biodiversity, such as genetic diversity. Multiple indicators (sometimes called suites of indicators) can be used to assess and infer information about the overall state of an ecological system.<sup>41,42</sup>

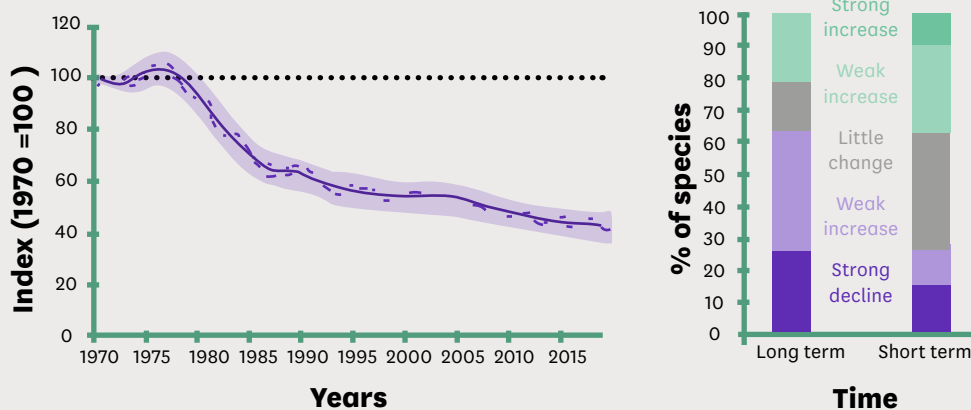
### Box 1. Bird indicators

Bird indicators are common across the various indicator suites in the UK (see sections below). Data on the abundance of birds, which are largely collected by volunteers contributing to national bird monitoring schemes such as the Breeding Bird Survey<sup>43</sup> and Wetland Bird Survey<sup>44</sup>, are used to calculate the value of the bird indices in the various suites of biodiversity indicators in the UK annually.<sup>4,36,45,46</sup> The UK bird indicators<sup>47</sup> and England bird indicators<sup>48</sup> are produced jointly by the British Trust For Ornithology (BTO), the Royal Society for the Protection of Birds (RSPB), Wildfowl and Wetlands Trust, Seabird Monitoring Programme, Environment Agency and Joint Nature Conservation Committee for Defra, and the Scottish bird indicators are produced by the BTO for NatureScot.

The UK indicator ‘Birds of the wider countryside and at sea’ (indicator C5; Table 1) is one of the indicators in the UK Biodiversity Indicator suite, and shows the relative changes in the abundance of common native birds of farmland (Figure 1), woodland, freshwater and marine habitats in the UK.

Birds are a relatively well-studied group of species in the UK and there are considerable long-term data (since around 1970 for most species) on trends in bird populations.<sup>12,49,50</sup> Bird populations in the UK occupy a wide range of habitats and respond to environmental pressures that also operate on other groups of wildlife and so are considered to provide a good indication of the broad state of wildlife in the UK. For example, farmland birds are used as an indicator of the general quality of farmed environment because birds sit near the top of the food chain and trends have been well monitored by the British Trust for Ornithology since 1967.<sup>51</sup> Drivers of change for bird populations are better understood than for some other species groups, which enables interpretation of observed changes in the population.<sup>36</sup> However, the way that birds use the environment is different to many other groups of species, as they are highly mobile and many species are migratory, meaning their populations may change in response to environmental changes over large areas.<sup>49</sup> There is little direct evidence on how the changes in bird populations over time and space correspond with changes in other groups of species.<sup>12,49</sup>





**Figure 1. Changes in the abundance of 19 breeding farmland bird species in the UK**

**The left hand line graph** shows the breeding farmland birds index over time. The solid line in this graph represents the smoothed trend. The dashed line represents the unsmoothed trend. The shaded cloud represents the 95% confidence intervals around the smoothed line. From 1970 to 1990, there was a steep decline in the trend; reflecting changes in farmland management. An index value of 100 is assigned to the first year in the data series. An increase in the indicator from 100 to 110 would mean that there is a 10% change in the index, which is an average across the individual species trends included. Source: British Trust for Ornithology, Defra, Joint Nature Conservation Committee, Royal Society for the Protection of Birds. Figure adapted from JNCC (2020).

**The right hand column graph** shows the percentage of species within the indicator that have increased, decreased or shown little change, based on set thresholds of annual change in the long- and short-term.

## Frameworks for categorising indicators

Several frameworks have been developed to categorise biodiversity indicators within suites. These frameworks help categorise the issues and problems relating to the state of biodiversity, including the drivers of changes in biodiversity and the conservation efforts developed in response to biodiversity loss. Grouping the indicators within a suite into categories provides some structure to the way that complex issues can be conceptualised and can allow the links between human activities, changes in biodiversity, policy and management to be better understood. Indicator frameworks also enable the evaluation of key knowledge gaps and identification of priorities for further indicator development. Some of the most common frameworks are:

- **Pressure-State-Response (PSR):** the PSR framework is one of the earliest and most simplistic indicator frameworks to be developed.<sup>52</sup> PSR indicators propose to evaluate the Pressures (P) of human activities on environmental States (S) and to provide political Responses (R) in order to return to a desirable state.<sup>52,53</sup> Some researchers advocate for the use of this framework to simplify communication of the links between human activities, changes in biodiversity and policy.

- **Driver-Pressure-State-Impact-Response (DPSIR):** there are a number of variations of the PSR framework, including the widely-adopted DPSIR framework, which is used to describe interactions between society and the environment.<sup>54</sup> According to its terminology, Drivers (D) such as social and economic developments exert Pressures (P) on the environment and, as a consequence, the State (S) of the environment changes. This leads to Impacts (I) on ecosystems, human health, and society, which may elicit a societal Response (R) that feeds back on Driving Forces, on State or on Impacts via various mitigation, adaptation or curative actions.<sup>55</sup> The DPSIR framework is currently used to categorise the indicators in The State of Natural Resources Report (SoNaRR) in Wales.<sup>56,57</sup>
- **Pressure-State-Benefits-Response (PSBR):** the PSBR framework is another variation of the PSR framework and is the framework currently used to categorise the UK Biodiversity Indicators.<sup>36</sup> By categorising the indicators in this way, which mirrors the goals of the UK Biodiversity Strategy to 2020, the UK aims to identify ways in which to: reduce the direct Pressures (P) on biodiversity and promote sustainable use; improve the Status (S) of biodiversity by safeguarding ecosystems, species and genetic diversity; enhance the Benefits (B) to all from biodiversity and ecosystems and; enhance implementation (Responses, R) through planning, knowledge management and capacity building.<sup>58</sup>
- **Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) Conceptual Framework (CF):** the IPBES CF aims to describe interactions between society and the environment by engaging both developing and developed countries. The framework identifies the main elements of biodiversity-human interactions (below) that are most relevant to IPBES's goal, which are therefore the focus for assessments and knowledge generation to inform policy:
  - **Nature:** The diversity of living organisms and their interactions among themselves and with their environment.
  - **Nature's benefit to people:** The benefits that humanity obtains from nature; ecosystem goods and services.
  - **Institutions, governance and other indirect drivers:** The ways in which people and societies organise themselves and their interactions with nature.
  - **Direct drivers:** The changes, both natural and human-caused that affect nature directly.
  - **Good quality of life:** The achievement of a fulfilled human life.

## Selection of indicators

The specific indicators used within different suites in different countries vary in response to several factors, but the processes used to select indicators for the different suites are not always detailed and consistent.<sup>40,59,60</sup> Most indicators are selected on the basis of a predetermined list of suitability criteria, including: their relevance to the policy or legislation they are being chosen for, the availability of existing indicators or of potential data sources for new indicators, cost efficiency or effectiveness, the potential

for the indicator to be representative of other species or groups of species, and their relevance across different habitat types or environments.<sup>59,61-63</sup>

However, some researchers suggest that the level of fulfilment of the indicators to these criteria is rarely backed up with any robust evaluation of the indicator's suitability or performance.<sup>40,64,65</sup> The particular indicators used in different suites may also vary as a result of differences in ecological conditions, physical processes, geological properties or the specific culturally valued species or groups between nations or regions.

# UK BIODIVERSITY INDICATORS

The UK biodiversity indicators suite comprises 24 indicators, which are made up of 52 measures (Table 1). Some of the indicators are currently under development, or have gone through the initial stages of development, and are considered as experimental statistics that are currently under review. The indicators are grouped by the five strategic goals (A–E) of the Strategic Plan for Biodiversity 2011–2020:

- **Strategic goal A** aims to “address the underlying causes of biodiversity loss by mainstreaming biodiversity across government and society”. The indicators under this goal track the public’s awareness of biodiversity as well as how biodiversity is considered by decision makers and businesses.

The strategic goals B–D broadly relate to the categories of the PSBR framework (described above). The indicators under these goals generally fit within the respective PSBR categories, with some exceptions:

- **Strategic goal B** aims to “reduce the direct **pressures** on biodiversity and promote sustainable use” and includes indicators that monitor resource use (e.g. land use and fisheries) and aid understanding of the pressures on biodiversity including pollution, invasive species, and climate change.
- **Strategic goal C** aims to “improve the **status** of biodiversity by safeguarding ecosystems, species and genetic diversity”. The indicators under this goal generally reflect the ‘state’ of different ecosystems, species and genetic diversity, for example, the extent and condition of protected areas and the relative abundance and/or distribution of particular species.
- **Strategic goal D** aims to “enhance the **benefits** to all from biodiversity and ecosystems” and consists of one indicator that aims to quantify biodiversity and ecosystem services using three measures: fish size classes in the North Sea, removal of greenhouse gases by UK forests, and status of pollinating insects.
- **Strategic goal E** aims to “enhance implementation [**responses**] through planning, knowledge management and capacity building”. The indicators under this goal highlight the availability of biodiversity data that can be used to improve knowledge of biodiversity and track public and non-governmental expenditure on both UK and international biodiversity.

The UK indicators were selected following consultation and agreement between the devolved nations and their main purpose is for international reporting, such as the national reports to the Convention on Biological Diversity (CBD). They are also published annually by Defra and the Joint

Nature Conservation Committee (JNCC – the public body that advises the UK Government and devolved administrations on UK-wide and international nature conservation), reporting progress against the UK’s Post-2010 Biodiversity Framework.<sup>36,58,66</sup>

The UK biodiversity indicators provide a flexible framework and a common set of methodologies, which in some cases can also be used for reporting at the devolved level.<sup>36</sup> Many of the UK biodiversity indicators were adopted, or adapted, from existing long-term surveillance or monitoring programmes, but some have been developed more recently or are currently under development (Table 1).<sup>59</sup> Gaps in the indicator suite have been identified, and some of the indicators have been criticised by researchers for containing biases, [as described in PN644](#).<sup>67</sup>

**Table 1: The UK Biodiversity Indicator suite**

The UK Biodiversity Indicator suite. The indicators are grouped by the five strategic goals (A–E) of the Strategic Plan for Biodiversity 2011–2020. Indicators that are currently under development (\*\*) or under review as an experimental statistic (\*) are highlighted within the table. Each indicator is composed of one or more measures that show trends over time. Many indicators have a single measure, but where data cannot be combined logically, the indicator will have more than one measure, which are outlined in the measure(s) column.

Indicator	Measure(s)
<b>Goal A. Address the underlying causes of biodiversity loss by mainstreaming biodiversity across government and society</b>	
A1. Awareness, understanding and support for conservation	
A2. Taking action for nature: volunteer time spent in conservation	
A3. Value of biodiversity integrated into decision making**	
A4. Global biodiversity impacts of UK economic activity / sustainable consumption**	
A5. Integration of biodiversity considerations into business activity	
<b>Goal B. Reduce the direct pressures on biodiversity and promote sustainable use</b>	
B1. Agricultural and forest area under environmental management schemes	B1a. Area of land in agri-environment schemes
	B1b. Area of forestry land certified as sustainably managed
B2. Sustainable fisheries	B2a. Percentage of marine fish stocks harvested sustainably
	B2b. Biomass of marine fish stocks at full reproductive capacity

## B3. Climate change adaptation\*\*

## B4. Pressure from climate change (Spring Index)

B5. Pressure from pollution	B5a. Air pollution	B5a(i). Area affected by acidity
		B5a(ii). Area affected by nitrogen
B5b. Marine pollution		
B6. Pressure from invasive species	B6a. Freshwater invasive species	
	B6b. Marine (coastal) invasive species	
	B6c. Terrestrial invasive species	
B7. Surface water status		

**Goal C. Improve the status of biodiversity by safeguarding ecosystems, species and genetic diversity**

C1. Protected areas	C1a. Total extent of protected areas: on land	
	C1b. Total extent of protected areas: at sea	
	C1c. Condition of Areas/Sites of Special Scientific Interest	
C2. Habitat connectivity*		
C3. Status of European habitats and species	C3a. Status of UK habitats of European importance	
	C3b. Status of UK species of European importance	
C4. Status of UK priority species	C4a. Relative abundance	
	C4b. Distribution	
C5. Birds of the wider countryside and at sea	C5a. Farmland birds	
	C5b. Woodland birds	
	C5c. Wetland birds	
	C5d. Seabirds	
	C5e. Wintering waterbirds	
C6. Insects of the wider countryside (butterflies)	C6a. Habitat specialists	
	C6b. Species of the wider countryside	
C7. Plants of the wider countryside*		
C8. Mammals of the wider countryside (bats)		
C9. Genetic resources for food and agriculture	C9a. Animal genetic resources – effective population size of Native Breeds at Risk	C9a(i). Goat breeds
		C9a(ii). Pig breeds
		C9a(iii). Horse breeds
		C9a(iv). Sheep breeds
		C9a(v). Cattle breeds
	C9b. Plant genetic resources – Enrichment Index	

**Goal D. Enhance the benefits to all from biodiversity and ecosystems**

D1. Biodiversity and ecosystem services

D1a. Fish size classes in the North Sea

D1b. Removal of greenhouse gases by UK forests

D1c. Status of pollinating insects

**Goal E. Enhance implementation through planning, knowledge management and capacity building**

E1. Biodiversity data for decision making

E1a. Cumulative number of records

E1b. Number of publicly accessible records at 1km<sup>2</sup> resolution or better

E2. Expenditure on UK and international biodiversity

E2a. Public sector expenditure on UK biodiversity

E2b. Non-governmental organisation expenditure on UK biodiversity

E2c. UK public sector expenditure on international biodiversity

**UK Post-2020 Biodiversity Strategy and indicators**

The UK's post-2020 Biodiversity Framework will be developed following the agreement of the CBD's Global Biodiversity Framework (Box 2). The framework will be developed by the JNCC and Defra on behalf of the Four Countries' Biodiversity Group, through which the environment departments of all four governments in the UK work together. The post-2020 framework will replace the Post-2010 Biodiversity Framework, joining up the strategies of the four UK countries to achieve the goals and targets set out in the CBD Post-2020 Framework.

The UK biodiversity indicator suite will be reviewed in line with the new strategy, but it is likely that many of the current indicators will remain relevant, especially where they provide information on status of wildlife (Goal C1-9) or the pressures on the natural environment (Goal B1 -7). Many of the current biodiversity indicators in the UK suite have valuable, long-term data sets (starting from around the 1970's) associated with them.

Despite the potential for new indicators and monitoring programmes to fill gaps in the current indicator suite, setting baselines at the start of a new data time-series may result in unambitious targets, as biodiversity loss may have occurred before monitoring began ([PN644](#)). For example, the 2016 UK State of Nature report highlighted that the UK is among the most nature-depleted countries,<sup>68</sup> meaning many biodiversity monitoring baselines are unlikely to represent a time where biodiversity loss was negligible. It is therefore likely that any new indicators will complement existing indicators, rather than replace them, although some contributors suggest there should be an evaluation of the utility of the current indicators.

# NATIONAL-LEVEL BIODIVERSITY INDICATORS

## Box 2. UK commitments to biodiversity policy

### Global policy

- **The Convention on Biological Diversity (CBD) post-2020 Global Biodiversity Framework** will replace the Strategic Plan for Biodiversity 2011–2020 and will set out global biodiversity goals and targets for the next ten years. The Conference of the Parties in Kunming, China (COP15) will ratify formal biodiversity actions and targets. This framework will provide the context for development of new national biodiversity strategies.
- **Oslo/Paris (OSPAR) Convention for the Protection of the Marine Environment of the North-East Atlantic** was ratified by the UK in 1998. The OSPAR Commission has adopted five strategies for directing its work including a Biodiversity Strategy which consists of measures and programmes to identify ecological quality objectives for the North Sea, develop lists of species and habitats in need of protection, identify and select marine protected areas, and prevent and control adverse impacts from human activities.

### UK policy

- **The UK's biodiversity strategy to 2030** will be developed in response to the CBD's framework, replacing the post-2010 Biodiversity Framework. The Framework will show how the work of the four UK countries joins up at a national level to achieve the goals and targets set out in the CBD post-2020 Framework.

### Devolved policies

In the UK, responsibility for biodiversity is devolved, so each country has developed separate biodiversity strategies in response to the UK's post 2010 Biodiversity Framework, which will be updated following the development of the biodiversity strategy to 2030.

- **Biodiversity 2020: A Strategy for England's Wildlife** provides a comprehensive picture of how England is implementing international and EU commitments. It sets out the strategic direction for biodiversity policy to 2020 on land (including rivers and lakes) and at sea. The Biodiversity Strategy links to and complements the Environment Bill:
- **25 Year Environment Plan (YEP):** in 2018 DEFRA published 'A Green Future: Our 25 Year Plan to Protect the Environment'. This plan sets out the UK Government's long-term approach to protecting and enhancing the environment in England for the next generation. It covers many aspects of environmental management, including biodiversity conservation. The plan sets a wider strategic policy context within which England's biodiversity strategy has been implemented and a post-2020 Nature Strategy will be developed, setting an overarching goal of 'thriving plants and wildlife'. The new Nature Strategy will be aligned with the publication of the new international framework for the Convention on Biological Diversity in late



2020. The 25-Year Environment Plan ambition to develop a growing and resilient network for nature recovery includes the following core long-term goals and commitments: restoring 75% of terrestrial and freshwater protected sites to favourable condition; restoring or creating 500,000 hectares of wildlife-rich habitat outside protected sites; taking action to recover threatened, iconic or economically important species and, where possible, to prevent human-induced extinction or loss of threatened species; planting 180,000 ha of woodland by 2042 to help increase cover to 12% by 2060; and establishing a Nature Recovery Network. An Outcome Indicator Framework (OIF) with 66 indicators arranged into 10 broad themes, many of which relating to biodiversity, has been developed to describe environmental change as it relates to the 10 goals in the 25 YEP.<sup>69</sup>

- **Wales' Nature Recovery Action Plan** sets out how Wales will address the CBD's Strategic Plan for Biodiversity. It was first published in 2015 and consists of Part I (Our Strategy for Nature) and Part II (Our Action Plan). Indicators will also be developed to measure the progress of the Nature Recovery Action Plan against objectives. To accompany the plan, a Nature Recovery Framework will set out the roles and responsibilities of the key players for delivery of action for biodiversity in Wales, and how they are linked together. The Nature Recovery Action Plan links to and complements The Well-being of Future Generations (Wales) Act 2015 and the Environment Act (Wales) 2016.
- **Wales' Natural Resources Policy (NRP) 2017** is a statutory product of the Environment (Wales) Act 2016 and a key part of the delivery framework for the sustainable management of natural resources established by the Act. The NRP sets out the challenges our natural resources and ecosystems face and the opportunities they can provide. Through actions such as increasing resource efficiency, reducing pollution, and creating resilient ecological networks the aim is to build greater resilience into ecosystems. The NRP highlights three national priorities for the management of our natural resources: (1) delivering nature-based solutions, (2) increasing renewable energy and resource efficiency, and (3) taking a place-based approach.<sup>70</sup>
- **Scottish Biodiversity Strategy:** 'Scotland's biodiversity: it's in your hands' was published in 2004 in response to the CBD's strategic plan. In 2013, it was supplemented by the '2020 Challenge for Scotland's Biodiversity'. Both documents together now constitute the Scottish Biodiversity Strategy. The 2020 Challenge for Scotland's Biodiversity sets out the major steps needed to improve the state of nature in Scotland. The Scottish Biodiversity Strategy links to and compliments the Nature Conservation (Scotland) Act 2004. Scotland's progress towards meeting the Convention on Biological Diversity Aichi 2020 Targets has recently been published in a progress report.<sup>71</sup> The Scottish Biodiversity Strategy will be refreshed in line with the outputs of COP15. Scotland is also developing a Strategy for the Conservation of Wild Plants, which as well as being informed by the CBD and Scottish Biodiversity Strategy, will link in with the successor to the Global Strategy for Plant Conservation.
- **Biodiversity Strategy for Northern Ireland to 2020** is a strategy for Northern Ireland to meet its international obligations and local targets to protect biodiversity and ensure that the environment can continue to support people and economy. Northern Ireland's Biodiversity Strategy to 2020 links to and compliments the Wildlife and Natural Environment Act (Northern Ireland) 2011.

In the UK, responsibility for biodiversity is devolved to the four nations: England, Wales, Scotland and Northern Ireland (and to the UK Overseas Territories). Each UK nation has developed separate biodiversity strategies and suites of indicators to monitor progress in response to the CBD's biodiversity strategy. In addition to reflecting CBD commitments, the national indicators should ideally align other policy commitments at the devolved, UK, and global levels (Box 2) so that reports on national progress towards other environmental targets and legislative commitments are consistent and place the least burden on data suppliers.

There are some areas of overlap between the different suites of indicators at the devolved level, some of which also overlap with the UK Biodiversity Indicators (see section on comparing indicator suites). However, the complex nature of biodiversity itself along with the availability, volume, quality and breadth of the underlying biodiversity monitoring data, has led to diversified approaches to the development and application of biodiversity indicators between nations.<sup>72</sup> There is unlikely to be a single, most effective approach to biodiversity conservation, particularly when there is variation in ecological conditions, physical processes, geological properties or the specific culturally valued species or groups between nations.

## England

The suite of England biodiversity indicators comprises 24 indicators, which are made up of 51 measures (Table 2). The England biodiversity indicators to 2020 were grouped by the 4 themes of the EU Biodiversity Strategy. Many of the indicators and measures in the England suite are geographically restricted versions of those in the UK suite. The indicators that have an equivalent in the UK indicator suite have been highlighted in Table 2.

Only two measures in the England Biodiversity Indicator suite do not have a direct comparison to a measure in the UK suite; Wildlife gardening (under indicator 14: Taking action for the natural environment), and Local sites under positive conservation management (under indicator 16: Integrating biodiversity considerations into local decision making).



**Table 2: The England Biodiversity Indicator suite to 2020**

The indicators to 2020 were grouped by the 4 themes of the EU Biodiversity Strategy. The UK equivalent column indicates the corresponding indicator in the UK Biodiversity Indicator suite.

Indicator		Measure(s)	UK equivalent
<b>Theme 1. A more integrated large-scale approach to conservation on land and at sea</b>			
1	1. Extent and condition of protected areas	Extent of protected areas on land	C1a
		Extent of protected areas at sea	C1b
		SSSIs in favourable or unfavourable recovering condition	C1c
2	2a. Status of threatened habitats	Extent of priority habitats	C3
		Condition of priority habitats	C3
2	2b. Status of threatened habitats: habitats of European importance	Percentage of habitats of European importance in favourable or improving conservation status	C3a
3	3. Habitat connectivity in the wider countryside	Experimental statistic on functional connectivity in the UK	C2
4	4a. Status of priority species: relative abundance	Change in relative abundance of priority species in the UK	C4a
	4b. Status of priority species: distribution	Change in distribution of priority species in the UK	C4b
	4c. Status of threatened species: species of European importance	Percentage of species of European importance in favourable or improving conservation status	C3b
5	5. Species in the wider countryside: farmland	Breeding birds on farmland	C5a

		Butterflies of the wider countryside on farmland	C6a
		Bat populations	C8
		Experimental statistic on abundance of farmland plant species	C7
6	6. Species in the wider countryside: woodland	Breeding birds in woodland	C5b
		Butterflies of the wider countryside in woodland	C6b
		Experimental statistic on abundance of woodland plant species	C7
7	7. Species in the wider countryside: wetlands	Breeding wetland birds	C5c
		Wintering waterbirds	C5e
		Experimental statistic on abundance of wetlands plant species	C7
8	8. Species in the wider marine environment	Breeding seabirds	C5d
9	9. Biodiversity and ecosystem services: terrestrial	Cumulative net removal of greenhouse gases by forests	D1b
10	10. Biodiversity and ecosystem services: pollination	Distribution of pollinating insects in the UK	D1c
11	11. Biodiversity and ecosystem services: marine	Fish size in the North-western North Sea	D1a
12	12a. Genetic resources for food and agriculture: animal genetic resources – effective population size of native breeds at risk in the UK	Goat breeds	C9a(i)
		Pig breeds	C9a(ii)
		Horse breeds	C9a(iii)
		Sheep breeds	C9a(iv)
		Cattle breeds	C9a(v)
	12b. Genetic resources for food and agriculture: plant genetic resources	UK Cumulative Enrichment Index	C9b

### Theme 2. Putting people at the heart of biodiversity policy

13	13. Public awareness, understanding and support for conservation	Proportion of people highly engaged with the issue of biodiversity loss	A1
14	14. Taking action for the natural environment	Conservation volunteering	A2
		Wildlife gardening	-
15	15. Funding for biodiversity	Public sector expenditure on biodiversity in England	E2a
		Non-governmental organisation expenditure on biodiversity in the UK	E2b
16	16. Integrating biodiversity considerations into local decision making	Local sites under positive conservation management	-
17	17. Global biodiversity impacts of UK consumption	Under development	A4

### Theme 3. Reducing environmental pressures

18	18. Climate change impacts	Timing of biological events: Spring Index	B4
19	19. Trends in pressures on biodiversity: pollution	Area affected by acidity	B5a(i)
		Area affected by nitrogen deposition	B5a(ii)
		Marine pollution: combined input of hazardous substances	B5b
20	20. Trends in pressures on biodiversity: invasive species in Great Britain	Freshwater species	B6a
		Marine (coastal) species	B6b
		Terrestrial species	B6c
21	21. Trends in pressures on biodiversity: surface water body status	Percentage of surface water bodies in 'High' or 'Good' ecological status	B7

22	22. Agricultural and forest area in environmental management schemes	Area of land under higher-level or targeted agri-environment schemes	B1a
		Percentage of woodland certified as sustainably managed	B1b
23	23. Sustainable fisheries: fish stocks harvested within safe limits	Percentage of UK fish stocks harvested sustainably	B2a
		Percentage of UK fish stocks with biomass at full reproductive capacity	B2b

#### Theme 4. Improving knowledge

24	24. Biodiversity data for decision making	Cumulative number of records in the National Biodiversity Network	E1a
		Number of publicly accessible records at 1km <sup>2</sup> resolution or better	E1b

In England there is another suite of indicators called the England Natural Environment Indicators (ENEI), which specifically tracked progress on targets set in the 2011 Natural Environment White Paper. The ENEIs have some overlap with both the England Biodiversity 2020 Indicators and the UK Biodiversity Indicators, but there are also some considerable differences mainly resulting from the wider scope of the ENEIs. Considering only the biodiversity-related indicators in the ENEIs, there are none that are not also represented in the other two suites. Some of these indicators are likely to be incorporated to track progress following adoption of the new biodiversity targets under the Environment Bill.

## Wales

The Nature Recovery Action Plan outlines the Welsh Government's commitment to track change and trends by monitoring two indicators that have been outlined under the Well-being of Future Generations (Wales) Act 2015: Indicator 43: Areas of healthy ecosystems in Wales, and Indicator 44: Status of biological diversity in Wales.<sup>73</sup> These are currently being developed and form part of a larger set of 46 national indicators that measure progress towards the achievement of the Well-being goals.<sup>74</sup>

The State of Natural Resources Report (SoNaRR) in Wales provides evidence for the future development of the two indicators. The report was first published in 2016 and a second assessment was published in 2020.<sup>56,57</sup> SoNaRR assesses the extent to which sustainable management of natural

resources is being achieved, and links the resilience of Welsh natural resources to the well-being of the people of Wales.<sup>57</sup> Under the Environment (Wales) Act, Natural Resources Wales (NRW) and other public bodies are required to seek to maintain and enhance biodiversity and promote the resilience of ecosystems.

SoNaRR defines ecosystem resilience as “the capacity of ecosystems to deal with disturbances, either by resisting them, recovering from them, or adapting to them, whilst retaining their ability to deliver services and benefits now and in the future”.<sup>57</sup> The report recognises five attributes of ecosystem resilience (referred to as the DECCA Framework), which provide a framework for considering the state of ecosystem resilience in Wales<sup>75</sup>:

- **Diversity** of genes, species, habitats and landscapes. Indicator 44 under the Well-being of Future Generations (Wales) Act 2015: ‘Status of biological diversity in Wales’, sits within this attribute of resilience. Indicator 44 could be based on an indicator of species abundance and species distribution, the feasibility of which is being explored at a UK level.
- **Extent** of habitats or species. Indicator 43 under the Well-being of Future Generations (Wales) Act 2015: ‘Areas of healthy ecosystems in Wales’, sits within this attribute of resilience and is likely to be based on a measure such as the total area of semi-natural habitats in Wales.
- **Condition** of ecosystems. The term condition is used to make a link to how a habitat is managed, what inputs are applied, what is taken from it, and how it is influenced by the management of the surrounding land.
- **Connectivity** or the movement within and between ecosystems. SoNaRR states that connectivity usually applies to the movement of organisms: from foraging or migration of individuals, through dispersal of seeds and genes, to the major shifts of species’ populations to adjust to a changing climate.<sup>57</sup> It can also refer to movement within natural processes, for example, cycling of water and nutrients between different components of a landscape.
- **Adaptability** or the ability to adapt to change (partly synonymous with resilience).

## Scotland

NatureScot have developed a suite of 22 indicators (Table 3) with the Scottish Environment Protection Agency, Marine Scotland and Scottish Forestry to monitor progress against the aims of the Scottish Biodiversity Strategy.<sup>7,8</sup> The indicators are split into two groups; one measuring the state of biodiversity for species, habitats and ecosystems selected as typical of Scotland and the other measuring the level of engagement of Scotland’s people with biodiversity.<sup>46</sup> These are reported every 3 years in a report to the Scottish Parliament outlining progress against the Strategy, although a number of the indicators have been archived and not updated for several years (see Table 3).<sup>76</sup>

There are a number of indicators in the Scottish biodiversity indicator suite that are not represented in the UK Biodiversity Indicator suite, for example the indicators on the condition of notified species and habitats (S10 and S11), which take into account the condition of species and habitats that are important to Scotland. Many of the groups of species in Scotland's biodiversity indicator suite including moths, otters, freshwater macroinvertebrates, marine plankton, and estuarine fish, are also not represented in the UK suite.

**Table 3. The Scotland Biodiversity Indicator suite**

State indicators	
S1	Status of UK Biodiversity Action Plan (UK BAP) priority species (archived 2008)
S2	Status of UK Biodiversity Action Plan (UK BAP) priority habitats (archived 2008)
S3	Abundance of terrestrial breeding birds
S4	Abundance of wintering waterbirds
S5	The numbers and breeding success of seabirds
S6	Vascular plant diversity (archived 2007)
S7	Woodland diversity (archived 1999)
S8	Terrestrial insect abundance: Butterflies
S9	Terrestrial insect abundance: Moths
S10	Condition of notified species
S11	Condition of notified habitats
S12	Status of otters in freshwater habitats (archived 2004)
S13	Freshwater macroinvertebrate diversity (archived 2008)
S14	Marine plankton (archived 2010)
S15	Estuarine fish (archived 2005)
S16	Proportion of commercially exploited fish stocks which are at full reproductive capacity
S17	Non-native species: Terrestrial freshwater and marine environments (archived 2001)
Engagement indicators	
E1	Attitudes to biodiversity
E2	Extent and composition of greenspace (archived 2015)
E3	Visits to the outdoors
E4	Involvement in biodiversity conservation
E5	Membership of biodiversity non-governmental organisations (NGOs)



Scotland also has a suite of ecosystem health indicators (Table 4), which provide a measure of the status of ecosystems through a combination of three inter-related elements:

**Condition of components:** how far the component of the ecosystem is from a 'good' state.

**Function:** the extent to which ecosystems retain their natural function and so have the capacity to deliver a range of benefits.

**Sustainability or resilience:** the extent to which the health of ecosystems (and their capacity to deliver benefits) can be sustained under human and environmental pressures, including climate change.

Ecosystem health is a complex concept, the definition of which is widely debated among researchers.<sup>77,78</sup> IPBES uses the term 'ecosystem health' to describe the condition of an ecosystem, by analogy with human health, but highlight that there is no universally accepted benchmark for a healthy ecosystem. Rather, the apparent health status of an ecosystem can vary, depending upon which metrics are used to assess it, and which societal aspirations are driving the assessment.<sup>78</sup>

Plans to expand the biodiversity indicator suite to include new indicators in ecosystem health were outlined in the Scottish Biodiversity Strategy.<sup>8</sup> A number of these ecosystem health indicators were also used to assess progress in the delivery of the Scottish Biodiversity Strategy in the most recent progress report to Parliament.<sup>76</sup> The ecosystem health indicators cover some broader and more complex concepts of biodiversity including habitat connectivity, which measures how well species can move from one habitat patch to another based on their dispersal abilities and the nature of the intervening land.<sup>79</sup> Ecosystem Health Indicator 14, assesses how the link between bryophyte (the group of plants containing mosses and liverworts) records and their habitat preferences (levels of soil nitrogen and summer temperature) changes over time.<sup>80,81</sup> Research has suggested that indicators linking species occurrences to environmental drivers are more informative than those that just rely on species occurrence data.<sup>82</sup>

An experimental indicator to show changes in marine and terrestrial biodiversity in Scotland has recently been developed.<sup>35</sup> The indicator is based on trends in the occupancy and abundance of native species in Scotland (in total trends of 3,049 species are used in the report, from all regions and habitats, and including Scotland's seas within the Exclusive Economic Zone (EEZ: up to 200 nautical miles from the Scottish coast). The trends in abundance (for 583 species) come from a range of established monitoring schemes, and trends in occupancy (2,466 species) from analyses of biological records held by the Biological Records Centre.<sup>35</sup>

**Table 4. Scotland's Ecosystem Health Indicators**

Condition indicators	
1	Land cover
2	Protected nature sites
3	Forests
4	Farming and nature
5	Species diversity - bird populations
6	Freshwater
7	Soil carbon
Function indicators	
8	Connectivity
9	Acid nitrogen pollution
Resilience indicators	
10	Habitat restoration
11	Invasive non-native species
12	Climate change adaptation
13	Soil sealing
14	Bryophyte nitrogen
	Bryophyte summer temperature

Finally, NatureScot has also recently developed an indicator for the genetic diversity of wild species. A list of 26 species of socio-economic importance in Scotland have been selected for inclusion in the assessment of genetic diversity. A scorecard method is applied to these species, which uses structured expert opinion assessments to assess risks to the conservation of genetic diversity. This indicator was developed to address the CBD's Aichi Target 13, which focuses on the conservation of genetic diversity and has been included as a proposed indicator for post-2020 CBD reporting. Scotland is currently the only UK nation with an indicator for the genetic diversity of wild species.

## Northern Ireland

The Department of Agriculture, Environment and Rural Affairs has developed indicators to monitor progress towards the Biodiversity Strategy for Northern Ireland to 2020.<sup>6</sup> There are eight indicators made up of ten measures (Table 4). They are part of a larger suite of environmental indicators that are reported yearly in the Environmental Statistics Report.<sup>83</sup>

The Northern Ireland Biodiversity Indicator suite is relatively restricted compared to the other national and UK indicator suites. Four out of the eight Northern Ireland Indicators focus on the area, condition and management of protected areas and their features. Out of the remaining four indicators, two are further area-based measures (the area of Northern Ireland agri-environment schemes under agreements, which is similar to indicator B1a in the UK suite, and the area of new forest and woodland plantings). The remaining two indicators are bird indicators, which are common across the national and UK biodiversity indicator suites, however, in the Northern Ireland indicators, specific measures for farmland, woodland, seabirds and wintering waterbirds are not considered.

**Table 5. The Northern Ireland Biodiversity and Land Indicators**

The indicators are from a larger set covering other aspects of the environment. Only those listed specifically as ‘Biodiversity and Land Indicators’ are included in the table.

Indicator	Measure(s)
Nature conservation designations	Area of nature conservation designations
	Areas of Special Scientific Interest (ASSI)
	Special Areas of Conservation (SACs), Special Protection Areas (SPAs) and Ramsar Sites
Nature conservation ASSI	Condition of features within Areas of Special Scientific Interest (ASSI)
Terrestrial protected sites under favourable management	Terrestrial protected sites under favourable management
Marine protected sites under favourable management	Marine protected sites under favourable management
Wild birds	Change to wild bird populations in Northern Ireland
Wetland birds	Wetland bird populations in Northern Ireland
Sustainable land management	Northern Ireland agri-environment schemes, area under agreements
Area of woodland	Area of new forest and woodland plantings

## STRENGTHS AND WEAKNESSES OF UK INDICATORS

The current suites of indicators adopted by the UK and different nations have their strengths and weaknesses.

The representation of species, habitats and facets of biodiversity in headline biodiversity indicators at the UK and country level varies between the suites of indicators. This may be due to several reasons outlined in the section above on selection of indicators. The variety of indicators within the UK and national suites can cause confusion and make it difficult to compare progress across the nations. However, each country is required to measure against the same focal areas (based on the targets in international agreements), which ensures some degree of consistency between nations.<sup>59,84</sup>

Coverage of all groups of species within a suite of indicators is not possible, but effective biodiversity indicators will give a good indication of how other facets of biodiversity are faring without having to directly measure every element.<sup>12,39</sup>

Although vertebrates are not comprehensively covered across the different suites, they are represented in most national suites, as well as in the UK suite, mainly by birds. Invertebrates are mainly represented by butterflies (UK, England and Scotland) and moths (Scotland only) ([PB036](#)). Birds, butterflies, and moths are generally considered to be good biodiversity indicators as they are relatively well-studied groups of species across the UK. There are long-term monitoring programmes associated with these groups of species, meaning the drivers of change in the populations are better understood for these groups than for others.<sup>12,36,49,50</sup> Despite the benefits of using these groups of species as indicators, there is little direct evidence on how the changes in their populations over time and space correspond with changes in other groups of species.<sup>12,40,49</sup>

Plants are poorly represented compared to animals and species groups that are shown to play key ecological roles (such as fungi), and microbes are not represented at all. Freshwater and marine species are poorly represented in comparison to terrestrial species.

A lot of species and habitat surveillance and monitoring occurs outside of these suites of national indicators such as the data collected by the Local Environmental Record Centres and the National Biodiversity Network.<sup>85,86</sup> Although the indicators produced by this extra monitoring do not contribute

to the UK or national suites, they can be important sources of evidence for other purposes such as scientific ecological research, engagement, and campaigning by organisations such as local planning authorities, Wildlife Trusts, Non-Governmental Organisations and wildlife charities.

Genetic diversity is mainly represented by domestic animals and plants, except in Scotland, where an indicator for the genetic diversity of wild species has recently been developed. Domestic species are only a small proportion of UK biodiversity and are highly selectively bred for use in agriculture therefore the usefulness of many of the current genetic diversity indicators is debated.<sup>67</sup>

Both Wales and Scotland are developing or have recently developed indicators for some more complex concepts surrounding biodiversity such as ecosystem resilience or ecosystem health. These concepts are more difficult to quantify than the state of a species or species group, which may explain why there are fewer indicators measuring this area of biodiversity. However, developing indicators for concepts such as ecosystem resilience or ecosystem health is important when considering the ultimate aims of the CBD and national biodiversity strategies, which encompass all levels of biodiversity from genes to ecosystems.

The Group on Earth Observations Biodiversity Observation Network (a partner organisation to the CBD) have recently proposed a set of Essential Biodiversity Variables (EBVs) – key components to effectively evaluate the state of biodiversity ([PN644](#)).<sup>87,88</sup> These EBVs may help determine how gaps in the UK and national indicator suites, particularly indicators assessing ecosystem functioning and ecosystem structure, can be filled either by existing indicators, or by developing new indicators, perhaps making use of advances in remote sensing of ecosystems.<sup>89</sup>

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