

Initial recommendations of the Monitoring and Evidence Expert Group for Wales.

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Author(s): **C. Davies, D. Lloyd, K. Stothard, S. Spode, J. Skates, K. Wade, D. Allen, T. Hatton-Ellis, M. Camplin, R. Lucas, J. Bailey, K. Medcalf, C. Cheffings, J. Davies, R. Price, A. Rowe, S. Smart, R. MacDonald-Lofts, J. Hawley, A. Smith, M. MacDonald, F. Burns, K. Boughey, D. Hill, M. Rhydderch, H. York.**

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Glossary

- AHTEG – Ad hoc technical expert group
- AONB – Area of Outstanding Natural Beauty / National Landscape
- BBNP - Bannau Brycheiniog National Park
- CBD - Convention on Biological Diversity
- CMS – Convention on Migratory Species
- CS – Citizen Science
- CSM - Common Standards Monitoring
- DECCA – Diversity, Extent, Connectivity, Condition, Adaptability
- Defra - Department for Environment, Food and Rural Affairs
- ECN - Environmental Change Network
- eNGOs – environmental non-governmental organisation
- ERAMMP - Environment and Rural Affairs Monitoring & Modelling Programme
- FAO – Food and Agriculture Organisation
- FCS - Favourable Conservation Status
- GBF – Global Biodiversity Framework

MarClim – Marine Biodiversity and Climate Change
MBA – Marine Biological Association
MHWESG - Milford Haven Waterway Environmental Surveillance Group
IUCN - International Union for the Conservation of Nature
JNCC – Joint Nature Conservation Committee
LCCS - Land Cover Classification System
LERC – Local Environmental Records Centre
NaCE – Natural Capital and Ecosystem Resilience
MCC - Minister for Climate Change
MCCIP - Marine Climate Change Impacts Partnership
MCZ - Marine Conservation Zone
MEPCA - Management Effectiveness of Protected and Conserved Areas
MPA - Marine Protected Area
NBN – National Biodiversity Network
NBMP - National Bat Monitoring Programme
NFI – National Forest Inventory
NNR – National Nature Reserve
NRW – Natural Resources Wales
OECM – Other effective area-based conservation measure
OSPAR - Oslo and Paris Convention for the Protection of the Marine Environment of the North-East Atlantic
PAME - Protected Area Management Effectiveness
PA - Protected area
NREA – Nature Recovery Exemplar Area
SSSI – Site of Special Scientific Interest
SPA - Special Protection Area
SAC - Special Area of Conservation
SuMMeR - Sustainable management of UK marine resources
TePoP – Terrestrial Partnership of Partnerships
TSDA – Terrestrial Surveillance and Development
UKBMS - UK Butterfly Monitoring Scheme
UKMMAS - UK Marine Monitoring and Assessment Strategy
WFD – Water Framework Directive

Executive summary

To support nature's recovery, the Welsh Government's Biodiversity Deep Dive developed a set of collective actions. The 30 by 30 target was chosen as a strategic focus to consider where and how action could be accelerated thereby conserving and effectively managing at least 30% of our land, freshwater, and seas for biodiversity by 2030. It is one of a number of targets which form part of the Global Biodiversity Framework (GBF).

Effective and affordable monitoring and evidence frameworks are vital to track our progress towards both the 30 by 30 target and the longer-term nature positive ambition. They underpin decision making, to enable an adaptive management approach which is necessary to deliver resilient ecosystems able to adapt to wider pressures such as climate change. These frameworks need to be informed by an appraisal of data needs, building on existing good practice and data sets, and identifying what is needed in the future. Also creating opportunities for better collaboration, an increased role for citizen science and making better use of technological advances.

The Deep Dive monitoring and evidence expert group (the group) was established in May 2023 in response to the recommendations from the 2022 Biodiversity Deep Dive.

The group met monthly to:

- Develop and adapt monitoring and evidence frameworks to measure progress towards the 30 by 30 target and guide prioritisation of action;
- Continue the work needed to establish robust and appropriate monitoring and evidence frameworks for 30 by 30 and wider nature recovery targets, building on those that are already in place.

Membership was drawn from Welsh Government, agencies, academia, eNGOs, and National Park Authorities, bringing together key areas of technical expertise, policy work and delivery.

The report reflects the views of the expert group and outlines the progress towards the monitoring and evidence recommendation in the Deep Dive. The group's work was undertaken under the following seven themes:

- Understanding and reviewing current monitoring in Wales,
- Defining the monitoring components of the 30 by 30 target (target three of the GBF),
- Developing a monitoring framework,
- Identifying evidence sources and gaps,
- Identifying development needs,
- Considering options for delivery,
- Identifying recommendations and next steps.

The report explores the themes discussed, progress made to date and emerging recommendations, followed by next steps.

An initial starting point for work was to understand the wide array of monitoring being undertaken in Wales to help inform the approach to the 30 by 30 target and identify opportunities.

The group explored a range of conceptual models to ensure any framework had the potential to address evidence needs at a range of scales whilst having regard to Sustainable Management of Natural Resources (SMNR) principles and the drivers and pressures impacting the environment.

A range of potential metrics were selected based on their potential measurability, precision, consistency, and sensitivity. They were split into three areas, each with a specific role to play in evaluation:

- **Delivery** – ensuring we are clear over achievement of target three.
- **Tracking** – providing a clear map of progress in delivery across a range of aspects of target three.
- **Outcome Assurance** – ensuring that outcomes are producing the desired impact.

Issues and evidence challenges were identified which would impact delivery, these require further development work before costed options can be produced.

The priority development areas include the following:

- *evidence generation* using both traditional and innovative approaches.
- *evidence collation and sharing*. Key to success is the development, implementation and maintenance of robust evidence platforms.
- a robust yet simple mechanism is needed for evaluation of *effective management* applied across both protected areas and Other Effective Area-based Conservation Measures (OECMs) to encompass the potentially large diversity of management approaches.
- given the wide range of potential partners who will need to work collaboratively, effective *governance* through clear roles and responsibilities needs to be established.
- additional *resources* and realignment of current resources will be necessary to support delivery of this work.

The group sets out in Table 1 the recommended monitoring framework to evaluate target three and in Table 2 the recommended evidence sources required for delivery of target three. The suggested metrics may have differing implications across the environmental domains, not only as a result of the way ecological processes work in different environments but also as a result of the history of evidence collection in these environments.

Monitoring framework recommendations

Table 1: Recommended monitoring framework to evaluate delivery of target 3.

Type of metric	Metric for protected areas and OECMs	Data source	Application
Delivery	Area of land and freshwater which satisfy the inclusion criteria. Area of sea which satisfy the inclusion criteria.	Data infrastructure development and implementation is required.	A measure of delivery of the 30% target, showing what proportion of Wales across land, freshwater, sea now meeting the inclusion criteria as a protected area or OECM under effective management.
Tracking	Protected area classed as effectively managed and the area on a pathway to effective management. OECM area data classed as effectively managed and the area on a pathway to effective management.	Data infrastructure development and implementation is required depending on the outcomes of the case study exercise.	A tracking measure showing the area of both protected area and OECMs which are either now included in the delivery target as a result of achieving effective management or are on a pathway to delivering effective management.
	Connectivity in freshwater, terrestrial and marine environments.	To be developed – this will depend on the nature of the metrics used.	A tracking measure showing the changes to connectivity as the inclusion of areas for target three develops.
	Ecosystem representation.	To be developed.	A tracking measure exploring how the representation of ecosystems in target three evolves as implementation develops. To be implemented only if a suitable measure can be identified.
Outcomes	Welsh level Biodiversity and Ecosystem integrity	A potential combination of UK level biodiversity surveillance scheme data where Welsh level trends are available, plus further biodiversity or ecosystem function data. All needing development work.	An assurance measure to explore how wider biodiversity is changing as the implementation of 30 by 30 develops. To be further developed following Earth Observation work.

Evidence framework recommendations

Table 2: Recommended evidence sources required for delivery of target 3.

Type of metric	Metric for protected areas and OECMs	Evidence source
Delivery	Area of land and freshwater which satisfy the inclusion criteria. Area of sea which satisfy the inclusion criteria.	Evidence on the type of site (protected areas, OECM) and its area which satisfy the criteria for inclusion.
Tracking	Protected area classed as effectively managed and the area on a pathway to effective management. OECM area data classed as effectively managed and the area on a pathway to effective management.	Evidence on the effective management of protected areas or OECMs, including: • The type and governance arrangements for the area. • The conservation objectives for the area. • The implementation of management measures for the area. • The extent, nature, suitability and frequency of the monitoring undertaken for the area. • The extent of achievement of the conservation objectives. • The level of confidence in the assessment of achievement of conservation objectives.
	Connectivity	To be confirmed - Pending agreement on the measurement of connectivity.
	Ecosystem representation	To be confirmed - Pending agreement on the measurement of representation.
Outcome	Welsh level Biodiversity and Ecosystem integrity.	UK level biodiversity surveillance scheme data where Welsh level trends are available plus clarified evidence needs following further development work around ecosystem function or integrity linked to Earth Observation developments.

Establishing a community of practice to build collaboration and oversee and coordinate delivery of the workstreams would support implementation of the framework. The group developed key principles to inform the next stages in delivery. It is hoped these principles together with the recommended framework, development areas and proposed collaborations will contribute to the route map for 2030.

Delivery principles

During discussions a number of emerging principles were noted and are summarised below.

- Engaging with and delivery through others:
There is a clear social aspect to the target and we need to ensure systems are in place to engage with others in effective and meaningful ways. Ensuring local communities & their skills and knowledge are able to be part of the process of identifying opportunities and directing delivery.
- Ensuring equitable governance:
Equitable governance as defined by the GBF will be embedded in every aspect of

representation, decision making and distribution that relates to the work of this group moving forwards.

- Sharing enabling data:

Adequate, effective data availability is key to enabling both informed delivery on the ground and national level planning. Ensuring the FAIR principles are adopted in our data is key i.e. findability, accessibility, interoperability, and reusability. In some cases, this will need to be supported by subject matter experts to enable effective use.

- Tracking progress:

Delivering ecosystem change can take time, be complex and is often challenging. Given such issues we will need to ensure our metrics are sensitive enough to start to demonstrate early change to help map and understand progress. Such tracking will also enable the communication of the route to delivery.

- Understanding baselines:

To understand how we are progressing there is a need to have a clear understanding of our baseline against which we can track progress.

- Being realistic over delivery:

There is a collective recognition that delivery needs to sit within tight fiscal constraints together with the practical time constraints associated with the work. However, delivery is not cost neutral and appropriate resourcing will be necessary.

- Recognising target three as part of a suite of targets:

Given the suite of targets set down under the GBF, it is sensible not to regard target three in isolation but as part of a wider series of targets each focussing on different aspects of action or outcome aiming at achievement of the 2050 vision.

Background

The Kunming-Montreal Global Biodiversity Framework (GBF) was adopted during the fifteenth meeting of the Conference of the Parties (COP15) of the United Nations Convention on Biological Diversity (CBD) following a four-year consultation and negotiation process. It sets out an ambitious pathway to reach the global vision of a world living in harmony with nature by 2050 as well as 4 goals for 2050 and 23 targets for 2030. Further details of the GBF monitoring framework which is comprised of a set of agreed indicators for tracking progress towards the goals and targets of the framework is included in Annex 1.

Target three (Fig 1), widely referred to as the 30 by 30 target, aims to ensure that at least 30% of land, freshwater and seas are effectively conserved and managed by 2030 as a key part of the overall mission to halt and reverse biodiversity loss.

In Wales, the Senedd declared a nature emergency in 2021 to help drive positive action towards tackling the joint nature and climate crises.

Ensure and enable that by 2030 at least 30 per cent of terrestrial and inland water areas, and of marine and coastal areas, especially areas of particular importance for biodiversity and ecosystem functions and services, are effectively conserved and managed through ecologically representative, well-connected and equitably governed systems of protected areas and other effective area-based conservation measures, recognizing indigenous and traditional territories, where applicable, and integrated into wider landscapes, seascapes and the ocean, while ensuring that any sustainable use, where appropriate in such areas, is fully consistent with conservation outcomes, recognizing and respecting the rights of indigenous peoples and local communities, including over their traditional territories.

Figure 1: Global Biodiversity Framework target three

Biodiversity Deep Dive

The Minister for Climate Change (MCC) publicly announced support for the 30 by 30 target and commenced a biodiversity deep dive focussing on how Wales can effectively implement the CBD target to effectively conserve and manage 30% of land and sea by 2030. The objective of the biodiversity deep dive is “to develop a set of collective actions we (in Wales) can take immediately to support meaningful delivery of the CBD 30 by 30 goal, recognising the capabilities we have in Wales and reflecting our duties and approach under the Wellbeing of Future Generations and Environment (Wales) Acts.”

A small core group of critical thinkers led by the Minister was formed by Welsh Government. The group were supported by expert subgroups on marine, designated landscapes, land management, and monitoring. The group focused on addressing the 30 by 30 target by addressing the following questions:

- How can the existing protected site network (Sites of Special Scientific Interest (SSSIs), National Nature Reserves (NNRs), Special Areas of Conservation (SACs), Special Protection Areas (SPAs) and Ramsar sites) be effectively managed for nature?
- How do we enable National Parks and Areas of Outstanding Natural Beauty to deliver landscape scale biodiversity and ecosystem enhancement across their areas?
- How do we ensure that our protected sites are well connected and integrated into the wider land and seascapes? Considering the role of the future Sustainable Farming Scheme, non-statutory sites, and other opportunities in reversing the decline in biodiversity.
- What vehicles, such as Nature Recovery Exemplar Areas, could be used to expand the current designations to include areas which are of particular importance for biodiversity and its contribution to people?
- How do we ensure that our protected sites are well connected and integrated into the wider land and seascapes?
- How and who do we best engage and collaborate with to help us achieve our target and address the nature crisis?
- How do we deliver a programme of action over the next decade?

The recommendations of the deep dive were published in 2022 ([Welsh Government Written Statement: Biodiversity Deep Dive \(3 October 2022\)](#)). These recommendations included:

Recommendation 7: Develop and adapt monitoring and evidence frameworks to measure progress towards the 30 by 30 target and guide prioritisation of action.

“Effective monitoring is needed if we are to chart progress towards delivering 30 by 30. It will also underpin decision making to enable an adaptive management approach required to deliver resilient ecosystems which are able to adapt to wider pressures such as climate change. To achieve this, we will appraise our data needs, building on existing data sets and good practice and identifying future needs. We will create opportunities for better collaboration, an increased role for citizen science and make better use of technological advances. I will set up an expert group to provide advice on how best to achieve this.”

The recommendation outlined the need to take immediate action to **‘Establish a monitoring and evidence task group to continue the work needed to establish robust and appropriate monitoring and evidence frameworks for 30 by 30 and wider nature recovery targets, building on those that are already in place.’**

Establishing the expert group.

In early 2023 work commenced on the establishment of the expert group with membership drawn from agencies, academia, consultancies, eNGOs and National Park Authorities. These represented key areas of technical expertise, policy and delivery. The final membership of the group is listed in Annex 2.

A provisional outline for the group was also developed, focussed on the request to:

- Develop and adapt monitoring and evidence frameworks to measure progress towards the 30 by 30 target and guide prioritisation of action.
- Continue the work needed to establish robust and appropriate monitoring and evidence frameworks for 30 by 30 and wider nature recovery targets, building on those that are already in place.

The above frameworks were seen as vital to track progress towards both the 30 by 30 goal and the longer-term nature positive ambitions of the GBF. However, they must prove themselves to be not only efficient but also affordable. The development of these frameworks should be guided by a thorough assessment of data requirements, drawing from established best practices and existing datasets, while also pinpointing the data needs for the future.

The key requested outputs were:

- A report (including reporting after 6 months) to Welsh Government and the core Biodiversity Deep Dive Group.
- Monitoring and reporting/evidence frameworks
- A mechanism for long-term collaboration

Key interdependencies

Given the range of policy initiatives, the wider context of the GBF and other recommendations coming out of the deep dive, a number of dependencies were also identified which the group would need to take account of during their work. Key dependencies were:

- The work of the 'Other Effective Area Based Conservation Measures (OECM) and Nature Recovery Exemplar Area (NREA) expert Group' established in response to the deep dive recommendations.
- The work of the Designated Landscapes expert group again established in response to the deep dive recommendations.
- Development of Nature Recovery Targets for Wales.
- GBF indicator development at a UK level ([JNCC: GBF overview](#)).
- The suite of wider targets established under the GBF.
- Nature Recovery Action Plan refresh.

Outline programme

The first phase of the working group took place as a series of monthly meetings which concluded in December 2023. It is proposed that a second phase, as outlined in next steps, is now undertaken building on recommendations of the most effective way forward.

The programme for the first phase identified the following key topics for discussion, however these evolved as meetings progressed to address a number of themes:

- Establish what the monitoring and reporting requirements are for target three
- Consider the wider monitoring and reporting requirements of Other Effective Area Based Conservation Measures and Nature Recovery Exemplar Areas
- How could this be delivered?
- Innovation and collaboration

- Affordability and funding
- Wider evidence requirements

Terms of reference

Initial meetings enabled a terms of reference to be agreed together with the ways of working (Annex 3). The background and issues associated with the GBF and the deep dive were also explored together with clarification of any areas of uncertainty. Subsequent meeting then addressed the core themes and challenges for delivery.

Theme 1: Reviewing current monitoring in Wales.

There is a wide array of evidence programmes of relevance to Wales, led by individual bodies or collaborative ventures involving eNGOs, agencies and academia. These provide a major evidence base supporting policy, reporting and site interventions.

Understanding the range of monitoring and innovation activities relevant to target three is a valuable first step in developing our approaches and identifying opportunities. Overall monitoring (in its broadest sense) in Wales is deemed to cover the following core areas:

- **Agri-environmental assessment:** To evaluate agri-environmental support in Wales the Welsh Government has implemented the Environment and Rural Affairs Monitoring and Modelling Programme ([ERAMMP website](#)).
- **Biodiversity stock and trend:** Principally through a series of citizen science led surveillance programmes overseen by JNCC ([JNCC: Overview of surveillance schemes](#)). Collecting data on a range of key indicators to support UK and Welsh level reporting of trends for a range of indicator species.
- **Protected site common standards monitoring:** A limited programme of feature condition monitoring of a range of notified and qualifying species and habitats on protected sites (SSSI, SAC, SPA) led by NRW ([NRW: Protected sites baseline assessments](#)).
- **Other site and landscape monitoring:** driven by eNGOs, local authorities (as a result of Section 6 duties, well-being plans and local nature recovery action plans), research bodies or National Parks with specific interests in sites under their management or a focus of their interest e.g. National Forest Inventory (NFI) covering 1500 plots in Wales (10% of the total in GB) on a 5-year rolling programme.
- **Water quality and ecology monitoring:** A large range of monitoring activities across both the freshwater and marine environments often focussed on assessment of the state of aquatic ecosystems.

In addition to such specific programmes, the generation of a large range of less structured data also takes place often as a result of citizen science activities, with data feeding into schemes and societies, Local Environmental Record Centres (LERCs) and the National Biodiversity Network (NBN).

As the potential scope was large, the areas of current or emerging activity considered to be most relevant were subject to more detailed discussion by the expert group. A range of specific topics were explored in this context:

- JNCC work on earth observation monitoring initiatives ([JNCC: EO overview](#)).
- Collaborative work being undertaken as part of the Terrestrial Surveillance Development and Analysis (TSDA) contract ([JNCC: TSDA overview](#)).
- Operational monitoring being undertaken by NRW across terrestrial, freshwater and marine environments (Annex 4).
- Monitoring approaches for a National Park – Bannau Brycheiniog National Park (BBNP).
- Welsh Government monitoring under the Environment and Rural Affairs Monitoring and Modelling Programme ([ERAMMP website](#)).
- Remote sensing innovation being undertaken by the Living Wales Programme ([Living Wales portal](#)).

Theme 2: Defining the monitoring components of target three.

Target three is a complex target incorporating several elements, each of which may have evidence and monitoring implications. To ensure the range of aspects were addressed it was necessary to break the target down into a number of key components amenable to measurement and reporting:

Key aspects of target three which were deemed of potential relevance to monitoring:

- 30 per cent of terrestrial and inland water areas, and of marine and coastal areas.
- Areas of particular importance for biodiversity and ecosystem functions and services.
- Effectively conserved and managed protected areas and OECMS.
- Being ecologically representative.
- Being well-connected.
- Being equitably governed.
- Under sustainable use consistent with conservation objectives.
- Respecting the rights of indigenous peoples and local communities.

Once the key aspects had been identified it was then necessary to ensure there were robust definitions for key terms. This was an iterative process as the nature of the definitions evolved as the potential monitoring implications were explored.

Conceptual model for selecting potential measurable components of target three

Given the range of potential metrics which could comprise target three, a framework for selecting potential metrics was required taking into account factors such as a metric's potential measurability, precision, consistency, and sensitivity.

An approach was adopted centred around an evaluation model informed by a number of scales (temporal, spatial and thematic) against which metrics were considered. These could also be cross referenced to the Welsh Sustainable Management of Natural Resources (SMNR) principles (Annex 5) and the Drivers, Pressures, State, Impact, Response (DPSIR) model (Annex 6) to provide context.

Evaluation model components

Evaluation models (Fig 2) provide a structured and systematic approach to assess the effectiveness and efficiency of an intervention, enabling informed decisions, delivery

improvements, and better outcomes. Whilst many models exist, the concepts of activities, outcomes and impacts remain common and key to designing evaluation. The implementation of 30 by 30 is seen as a major intervention in the Welsh environment and thus lends itself to such an evaluation approach.

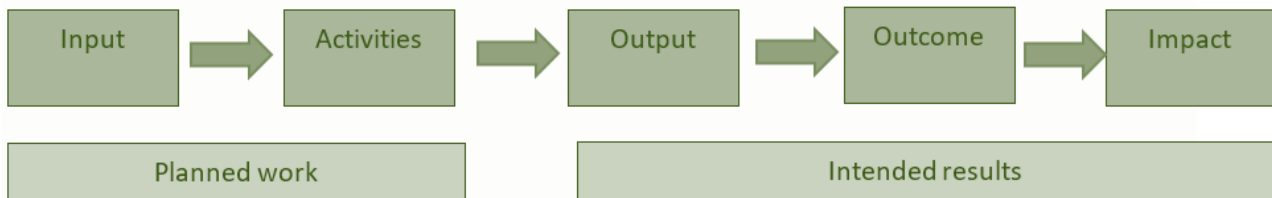


Figure 2: A standard evaluation model.

Temporal scale.

Metrics are needed to enable tracking of progress over time, encompassing short-, medium- or long-term changes (Fig 3). However, these requirements differ depending on the timeframe and their application. In the short-term information is needed to provide timely operational feedback to improve the speed and efficiency of ecosystem interventions. Other short and medium-term data is needed to enable continuous programme evaluation and feedback, helping improve the likelihood of achieving the longer-term ambitions around target three.

In the longer-term evidence will be needed to evaluate overall impacts of target three in terms of programme delivery and the links with other CBD targets where interdependencies may come into effect. The long-term perspective is also required due to the timescale over which we can expect ecosystem responses to be observed or measurable. Establishing suitable monitoring systems now is vital to ensure we can measure these future outcomes effectively.

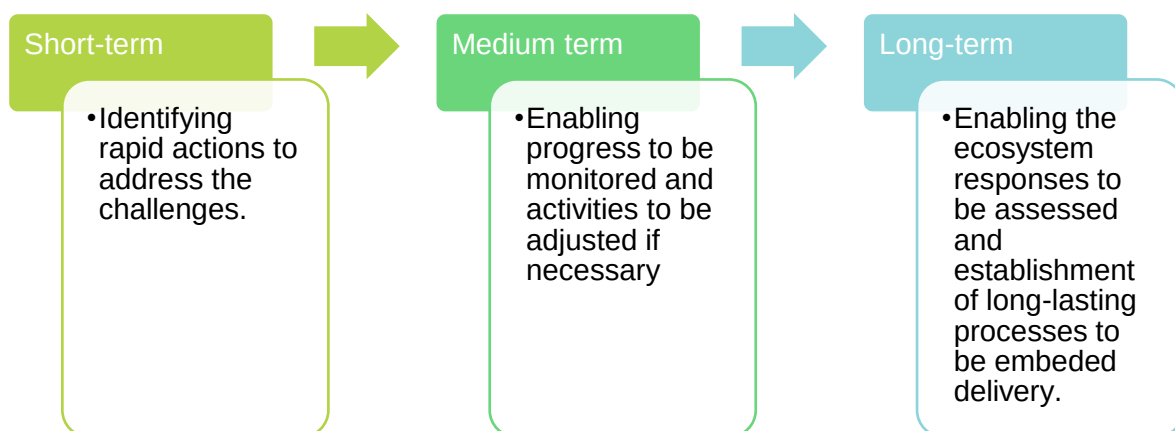


Figure 3: Key temporal aspects.

Spatial scale.

Given the ultimate ambition of the GBF (i.e. ‘a world living in harmony with nature’), the success of 30 by 30 interventions should be measurable at a range of spatial scales beyond just protected areas and OECMs. The impact of target three should extend outside the site boundaries of the areas contributing to the 30%, delivering change at both network and national scales.

Metrics will be required to take account of this range of spatial scales, collectively building a national picture of progress (Fig 4). These scales reflect some key identifiable aspects of target three and also offer a mechanism for gap analysis when reviewing the relevance of current evidence sources.

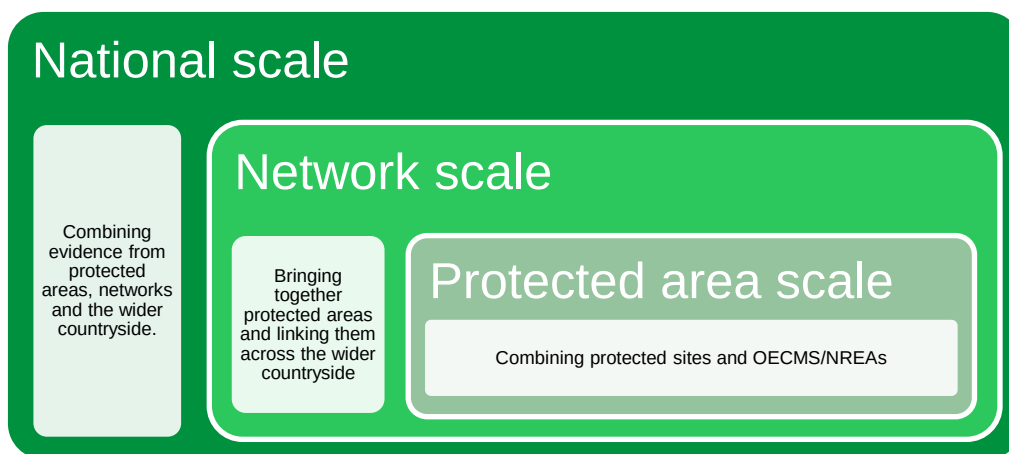


Figure 4: Key spatial scales of interest.

Thematic scale.

Ecological processes tend to work differently at different spatial scales for example competition tends to work at the local scale whilst speciation or broad climate induced range shifts tend to work at the larger biogeographic scale. Technology and observation systems also differ in their application at different scales both due to technical limitations (e.g. EO), or as a result of method design (e.g. phase II habitat mapping).

Such differences make it important to ensure that the right questions posed at different spatial scales take account of the different evidence streams and ecological processes relevant to that spatial scale. These then impact what we focus on in terms of data collection.

Theme 3: Developing a monitoring framework for target three.

Target three requires a monitoring framework to be in place that enables the continuous observation, measurement, and analysis of various aspects of delivery. Its primary purpose will be to ensure that target three implementation and progress is measured efficiently, effectively, and securely by tracking key performance indicators (KPIs) and metrics.

Key components of a monitoring framework should ideally include:

- **Clarity over the question posed:** To develop any monitoring framework it is important to be clear over the key questions which need to be answered.
- **Data Collection:** The framework identifies the evidence required from a range of relevant sources for use in evaluation of the process.
- **Data Aggregation:** Aggregation helps in summarising data across different dimensions and time intervals, making it easier to identify trends and anomalies. The collected data should be able to be aggregated and retained to provide a high-level view of delivery.
- **Visualization:** The monitoring framework should enable an effective visualization of delivery, allowing stakeholders to grasp the current state, trends, and potential issues.
- **Analysis and Insights:** The monitoring framework should provide opportunity for in-depth analysis of data to identify patterns, trends, and root causes of issues. This analysis can help optimize delivery, troubleshoot problems, and plan for capacity upgrades through adaptive management.
- **Scalability and Customization:** A robust monitoring framework should be scalable to accommodate growing systems and customisable to fit the specific needs of stakeholders. This includes the ability to add new data sources, KPIs, and alerts as requirements evolve.
- **Integration:** The monitoring frameworks should provide the opportunity to integrate with other platforms and GBF indicators, to report at a range of scales from international to local.
- **Proportionality:** The level of evidence required by the framework to support progress should be sufficient but not onerous in terms of level of detail and range of components. Maximising the resources available for informed, well-directed evidence led interventions.
- **Effective collaboration:** Cooperation and commitments from a wide range of stakeholders for achievement of the target are needed as part of framework development. This can extend into synchronisation of monitoring and reporting activities for improved efficiency and effective use of limited resources.
- **Technology and innovation transfer:** Given the evidence and resource challenges, effective innovation will be necessary to improve the efficiency and ability to deliver shared goals within any framework.

Framework development

Workshops were initially used to scope out a range of possible metrics and issues associated with them. Two questions were posed:

- Across each of the key terms in target three what does this imply in terms of metrics and the evidence needs?
- For each spatial scale (national, network, and protected area) provide metrics you think may well be potentially relevant to evaluate the elements required for target three together with possible evidence sources.

Members were asked to consider the likelihood of suggested metrics demonstrating a response in the short/medium and long-term.

Further iterative discussion then refined the metrics until a potential range of monitorable aspects were identified. Given time pressures, detailed exploration of all potential metrics was not possible. As a result, the range of metrics have been divided into those recommended as options to take forward and those potentially of interest but requiring a more substantial evaluation before taking forward (Table 1). Development and discussions around the framework also highlighted a range of development areas, definitions, and key questions which required further input.

The provisional metrics framework was split into three components, each with a specific role to play in target three:

Components of the monitoring framework:

- **Delivery** – ensuring we are clear over achievement of the target.
- **Tracking** - providing a clear map of progress in delivery across a range of aspects of target three.
- **Assurance** – ensuring that outcomes are delivering the desired impact.

Table 1: Draft target three framework.

Target 3 aspect	Potential metric	Sub-component	Rationale
Delivery component			
Area contributing to 30%	30% of land (incl. freshwater) and 30% of marine.	% contribution by area from protected sites % contribution by area from OECMs.	This delivery measure will enable Wales to communicate and report on delivery. The fundamental aspect of target three is the establishment of areas of particular importance for biodiversity and ecosystem functions and services, which are effectively conserved and managed through ecologically representative, well-connected, and equitably governed systems of protected areas and OECMs. Establishing clear quantifiable rules for determining whether a site can contribute to 30 by 30 is fundamental to monitoring delivery. The supporting metrics identify a range of evidence which will inform this selection. It will also be necessary to understand any inclusion criteria adopted by other countries or used for international reporting such as the role of management effectiveness as a determinant for inclusion.
Tracking components – Activities which will help us track more detailed progress in delivery of the 30%.			
Effective management	% effectively managed.	% by area effectively managed on protected sites and OECMs (assessed separately). % by area of OECMs and protected sites on a pathway to effective management.	Establishing that an area is under effective management is considered a key criterion for inclusion of a site in the overall assessment of the 30% target. To understand the levels of effective management for sites in Wales we will need to understand both the area considered to be under effective management together with those sites which may not yet be included in the 30% target but are considered to be on a pathway to achieving this. Periodic tracking will help

			inform policy and the targeting of interventions to support progress.
How well connected	Index of connectivity for the 30% network.	Index of connectivity.	Whilst target three does not establish a level of connectivity required for sites contributing to the 30%, it recognises that connectivity is an important aspect of site establishment and contributes to the resilience of ecosystems. As the contribution of both protected areas and OECMs to the 30% target develops it will be important to understand how connectivity evolves. This may help inform the targeting of interventions and site selection at a range of scales to help improve the overall connectivity of the network.
Equitable governance and recognizing and respecting local communities	Degree to which being delivered across protected sites and OECMs.	N/A	Equitable governance is seen as a cross cutting theme relevant to the selection and management of sites deemed to form part of the 30% target. Understanding how well governance functions and how well local communities are engaged with developments as part of these processes is potentially important. Whilst initially proposed as a potential metric, after further discussion equitable governance was made an underpinning principle (see Annex 9 for a discussion on equitable governance).
<u>Potential interest*</u> - Ecological representation	How representative is the network of Welsh ecosystems?	tbc	As selection of protected areas and OECMs for inclusion develops, biases may emerge in the contribution of different ecosystems to the overall network of sites. Understanding such biases may help inform policy and the targeting of interventions or designations to address underrepresented ecosystems or aspects of Welsh biodiversity. The causes of bias could also then be fed into the screening criteria for sites selected for 30 by 30 inclusion.
Assurance component (outcomes)			
Biodiversity impact	National level evidence that there is a change in biodiversity occupancy, trend, function and services at a Welsh national level.		Whilst the exact aspects of biodiversity which we will want to record are currently uncertain, as the area of Wales containing protected areas and OECMs which are effectively managed and well connected grows, it is anticipated that there will be wider benefits across Wales in terms of biodiversity, ecosystem services, and functions. Understanding how the wider Welsh biodiversity picture changes as target three is implemented will provide valuable insights. It is also recognised that measurement of biodiversity impact need not be designed to specifically attribute change to delivery of the 30% area target.

<u>Potential interest*</u> - Landscape/ecosystem level integration	Extent of landscape/sea scape linking to the protected area/OECM network.	Degree on land, Degree in marine.	The contribution of the 30% network to biodiversity, ecosystems and services across the wider landscape is a desirable outcome for the Welsh environment. How successful this outcome is may not only be a result of the area coverage but the spatial nature of protected areas and OECMs and how well this links to the wider countryside across Wales. Such a measure of integration may have a role to play in evaluating policy and understanding how well any new sites (contributing to 30 by 30) are contributing to some optimal vision of a connected network.
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(* metric was identified as of potential interest but not a priority metric for initial development)

Three priority topic areas were selected for additional work to be undertaken by specialists in parallel with the evidence monitoring group meetings. These were as follows:

Effective management evaluation

The assessment of management effectiveness is seen as a key area for development given the need to address the greater diversity of management systems in place when considering OECMS in addition to the more familiar protected sites (i.e. SSSI, SAC, SPA). The IUCN recognise the diversity of protected areas means one system of assessment is unlikely to fit all circumstances and needs to be tailored to the management systems in place. However, management effectiveness evaluation does have a range of common elements and processes that can form the basis of an assessment system (Fig 5).

Evaluation is seen as more than just an assessment of activities and outcomes but an assessment of the extent to which management is protecting values and achieving goals and objectives. It is seen as encompassing elements of governance, design and planning.

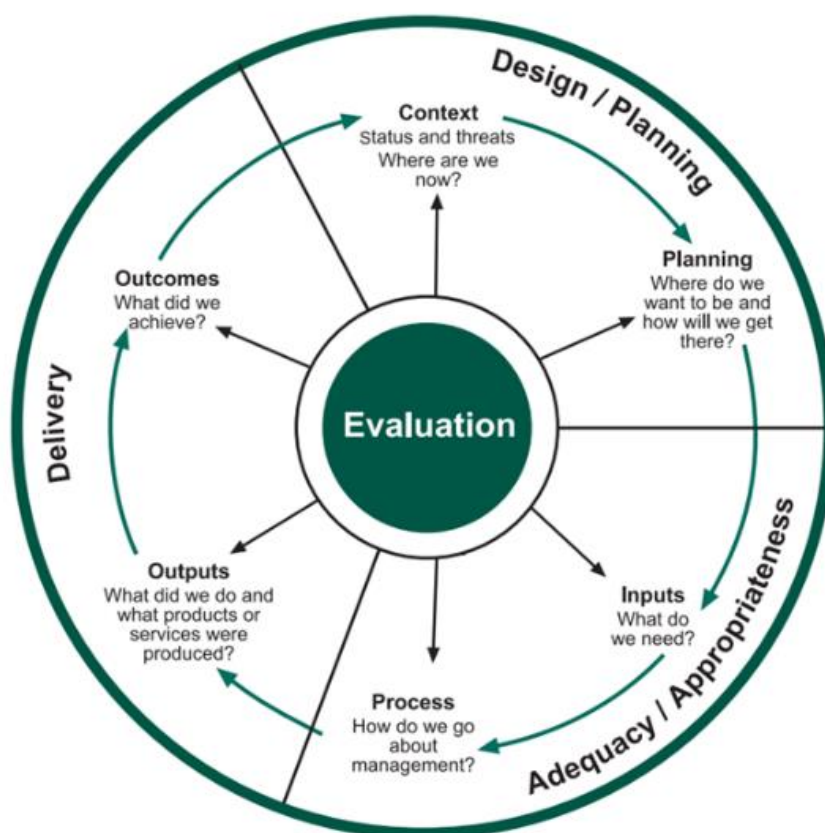


Figure 5: The IUCN evaluation model (Hockings et al. 2006).

On land and sea protected sites are generally supported by a range of management steps and processes involving management statements, conservation objectives, management plans and management agreements. These are supported by an element of compliance monitoring and more limited condition monitoring.

OECMS may potentially not be supported by the same range of documentation or systems as for protected sites. Any assessment processes need to accommodate such differences but enable a common effective and achievable mechanism to evaluate delivery across the board.

Next steps for management effectiveness evaluation

The evaluation of management effectiveness is an active development area at national and international levels. Whilst this group did not have the resources to undertake a full review of approaches, it was noted JNCC/Defra were already working on the topic looking at the current range of options (e.g., IUCN Green List Standard, Management Effectiveness Tracking Tool, Integrated Management Effectiveness Tool) and had developed a recommended indicator.

The work by JNCC to date has led to the development of the [Management Effectiveness of Protected and Conserved Areas](#) (MEPCA) Indicator. An administratively light approach to evaluation adopted as a complementary indicator under the GBF monitoring framework. See Annex 7 for further details.

Given the timescale to make recommendations and the continuing refinement of the MEPCA indicator guidance, the group recommends the testing of the metric using a series of Welsh case studies across protected areas and OECMs to explore application, reporting, and handling of the evidence required to support assessments in comparison with a range of other approaches.

The role of innovation in delivery of target three metrics

Embracing technological developments could provide a more cost effective and efficient way to address the evidence requirement emerging from target three. They offer the potential of improving the temporal and spatial resolution of monitoring regimes or data or both and increasing the range of environmental variables monitored.

Such technological developments are potentially wide ranging but include the use of remote sensing systems such as drones, passive acoustic monitors, sonar, hydro acoustic monitors, and earth observation systems. Other technologies also include the development of eDNA approaches for environmental sampling across land, water, and air.

As such new technologies develop, they bring with them new and increasing data flows which require new analytical approaches and decision-making mechanisms. In addition, they bring challenges around data storage, processing, integration, analysis, modelling, plus organisational skills and capacity. Work is also required to test the new data products (including 'ground-truthing' with existing monitoring regimes) to verify their accuracy and reliability.

Earth observation (EO) was seen by the group as having particular cross cutting potential for a number of target three metrics (i.e. connectivity, effectiveness evaluation, and landscape level assurance) in addition to wider potential relevance to a range of GBF targets.

There are three key emerging questions that EO has potential to help answer:

- 1) How can EO data, in combination with contextual information and modelling, help us better understand and quantify the health/function of ecological networks, protected sites and OECMs in terms of their achievement of conservation outcomes at the national scale?
- 2) How can EO data and derived products help inform the understanding of protected area performance at the site level and target interventions at the site, local or network level?
- 3) What is the potential cross cutting role for EO data in supporting the range of GBF targets?

Next steps for Earth Observation development.

Given the potential role EO can play in addressing the requirements and ambitions of 30 by 30. The group recommended a workstream should be established to undertake

targeted demonstrations (e.g., test cases) and exploration of Earth observation data to provide real examples of where these can make the most effective contribution towards 30 by 30 targets.

Equitable governance

Equitable governance and respect of local communities were two aspects of target three requiring specific skill areas. Additional technical input was delivered via a behavioural science specialist joining the expert group and working with a sub-set of members developing the thinking around the topic area (see Annex 9).

Equitable governance in the context of monitoring and evidence refers to the fair and just use of data, surveillance, and evidentiary support in the decision-making processes within organisations, governments, and communities.

The group recognised the definition of equitable governance used by the Global Biodiversity Framework (see Table 2).

Table 2: Equitable governance as defined by the Global Biodiversity Framework.

Equity: recognition	1. Recognition and respect for the rights of all relevant actors
	2. Recognition and respect for all relevant actors and their knowledge
Equity: procedure	3. Full and effective participation of all relevant actors in decision making
	4. Transparency, information sharing and accountability for actions and inactions
	5. Access to justice, including effective dispute resolution processes
	6. Fair and effective law enforcement
Equity: distribution	7. Effective measures for mitigation of negative impacts on communities
	8. Benefits equitably shared among relevant actors
Other	9. Achievement of conservation and other objectives
	10. Effective coordination and collaboration between actors, sectors and levels

The group recommends that a general principle be stated with regard to equitable governance that demonstrates its commitment to embed it fully in the work of target three as it moves forwards. This could take the form of accepting accountability for upholding the following suggested principle:

‘Equitable Governance as defined by the Global Biodiversity Framework will be embedded in every aspect of representation, decision making and distribution that relates to the work of this group moving forwards.’

The suggested measure of whether this principle is being upheld is to ensure that it is clearly referenced and reflected in approaches, frameworks, decisions and actions moving forwards associated with this overall work and to check periodically that this is the case.

Theme 4: Identifying evidence sources and gaps.

Given a broad consensus on the core components of the framework, mapping of evidence sources was required to confirm availability or identify potential gaps. Discussions also provided an opportunity to explore novel approaches and sense check the emerging view. Given uncertainty over resources and the areas identified as requiring further development, the evidence implications for each metric are highlighted below (Table 3).

Table 3: Evidence requirements to support target three evaluation.

Work area	Evidence implication
Monitoring framework – Delivery metric: <u>30 by30</u>	Evidence will be required on: • Area of land which satisfies the inclusion criteria for both protected areas and OECMs. • Area of sea which satisfies the inclusion criteria for both protected areas and OECMs.
Monitoring framework – tracking metric: <u>Effective management</u>	Depending on final decisions over adoption of the MEPCA assessment method, evidence could be required on: • The type and governance arrangements for the area in question. • The conservation objectives for the areas under consideration for inclusion. • The implementation of management measures for the areas under consideration for inclusion. • The extent, nature, suitability, and frequency of the monitoring undertaken for the relevant area. • The extent of achievement of the conservation objectives for the area. • The level of confidence in the assessment of achievement of conservation objectives. Note evaluation of best approach will be finalised when a series of comparative case studies are run in the workstream mentioned below.
Monitoring framework – tracking metric: <u>Connectivity</u>	• Spatial data on the distribution of areas for inclusion necessary to support calculation of a connectivity index (note – index methodology yet to be determined under the evidence generation workstream proposed below).
Monitoring framework – tracking metric: <u>Ecosystem representation</u>	• Development of a measure of representation required before evidence requirements can be determined (note – methodology yet to be determined under the evidence generation workstream proposed below).
Monitoring framework – assurance metric:	The exact approach will need further development under the evidence generation workstream mentioned below. However potential evidence

<u>Biodiversity and Ecosystem integrity</u>	sources addressing biodiversity change at a range of spatial scales include: • Welsh level trends currently generated from a range of UK biodiversity surveillance schemes e.g. Breeding Bird Survey, Butterfly monitoring scheme or National Bat Monitoring Programme. • Integrated data sets combining structured and unstructured data addressing trajectories of change within and outside the 30% network of sites. • Site level condition assessments. In addition (under the EO workstream): Exploration of EO and modelled approaches for ecosystem function or health at a range of spatial scales is required before clarification of evidence needs will be possible.
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Theme 5: Identifying development areas.

The evidence challenges arising from delivery of target three are significant and take many forms across the collection, management, quality assurance, analysis, and communication of results. However, exploration of the potential metrics and how delivery could be implemented has revealed several major areas of work which will require further development:

Evidence generation

The evidence required to support the tracking and reporting of delivery of 30 by 30 covers a range of scales and data types. The evidence will also be required from a range of stakeholders to ensure it addresses the range of metrics. Some areas of current data collection will also require bolstering as they may not be of sufficient intensity or scope to service emerging needs. Given the resource implications, innovative methods will be essential to integrate approaches and sources of evidence, enabling reporting in cases where limited resources hinder the implementation of conventional approaches.

Development is needed to:

- Establish a coordination mechanism to ensure evidence generation is coordinated across bodies and areas.
- Explore key innovation areas and, where viable, implement.
- Explore how, and where, evidence integration can improve efficiency and impact.
- Establish a mechanism to identify emerging evidence gaps which may become an impediment to delivery and reporting of 30 by 30.
- Investigate approaches to biodiversity, ecosystem integration, connectivity, and representation as potential target three metrics. Defining the specific questions which need addressing, the relevant methods together with the evidence implications and potential roles in delivery.

- Quantify the resources needed to bridge identified gaps in evidence generation.

Evidence collation and sharing

In order to report on delivery of 30 by 30 the right evidence of the right quality needs to be collected, analysed, and communicated in an effective way. Such mechanisms allow both the progress to be understood at a range of scales for policy evaluation and the engagement of communities and stakeholders in delivery of effectively managed protected areas and OECMs.

The development, implementation, and maintenance of robust evidence platforms is key to successful delivery. Such platforms will need to accommodate the needs of the range of stakeholders from government and NGOs through to local communities. Whilst substantial work has already been accomplished via a range of bodies such as LERCs and Local Nature Partnerships, further development will be needed to address the new evidence needs via:

- Understanding the broad stakeholder needs over 30 by 30.
- Creating a data infrastructure to house the additional critical data required for reporting. Building on existing practice where possible.
- Creating mechanisms to communicate progress and gaps in an effective way.
- Securing the resources necessary for the establishment and long-term maintenance of any data platforms.

Earth observation

Earth observation is emerging as a key innovation area with the potential to address a number of evidence gaps. However, work will be required to understand the role EO can play in delivery at a range of spatial scales, and to what level of detail, required for the recommended target three metrics.

Development is needed to:

- Establish a series of case studies to demonstrate application and relative strengths and weaknesses.
- Determine the uncertainties arising from the incorporation of EO data into metric tracking.
- Establish a mechanism to ensure the range of stakeholders are able to access and usefully interpret EO data.
- Develop a mechanism for integration of EO data into currently used evidence streams.
- Ensure data flows are resourced for the long-term.

Effective management

Effective management is a key concept within 30 by 30 and represents a new approach when applied across both protected areas and OECMs. As evaluation will need to encompass the potentially large diversity of management approaches expected for OECMs, a robust but simple mechanism will be required which is serviceable for ongoing cycles of assessment.

Development is needed to:

- Create a suite of case studies illustrating how the proposed MEPCA assessment process works for a range of stakeholders.
- Agree roles, responsibilities, and resourcing for assessment cycles.
- Agree the mechanism for assessment and the nature of any required audit trails.

Governance

Throughout discussions the need to clearly establish roles and responsibilities for delivery and evaluation of 30 by 30 has become evident, particularly given the wide range of potential partners who will need to work collaboratively to ensure 30 by 30 is delivered. How can delivery responsibility be shared across other sectors? How will the Section 6 biodiversity duty, Well-being indicators and Local Nature Recovery Action Plan reporting support this process?

Resourcing

Whilst the fiscal challenges facing delivery have permeated discussions, it has been recognised that shifts in resourcing, or additional resources, will be necessary to support delivery. The extent of resources required will depend on the delivery options adopted and the potential of securing alternative finance.

Theme 6: Options for delivery.

The choice of delivery option will play a pivotal role in the speed, efficiency, and probability of success for the delivery of target three, especially in the light of the financial challenges currently faced.

However, given the ongoing development work required to specify more precisely the approaches and evidence implications for a range of metrics, it has not been possible to produce a series of costed options at this time. It is however evident that current resources, the way they are formulated, and the associated data flows mean we would not be able to deliver the assessment of metric three progress based on current practice and resources. Ongoing work of this group and associated workstreams should enable the development of more specific options.

Options development will need to address a number of key aspects both in terms of development and implementation planning (Table 4).

Table 4: Key activities to be addressed for option development.

Work area	Recommended activity
Delivery metric: <u>30 by 30</u>	Delivery across workstreams required together with introduction of relevant tools and implementation planning.
Tracking metric: <u>Effective management</u>	Effective management workstream delivery required.

Tracking metric: <u>Connectivity</u>	Evidence Generation and EO Workstream delivery required.
Tracking metric: <u>Ecosystem representation</u>	Evidence Generation Workstream delivery required.
Assurance metric: <u>Biodiversity and Ecosystem integrity</u>	Evidence Generation and EO workstream delivery required.
Delivery Tools:	
Data infrastructure	Evidence collation and sharing workstream delivery required together with input from other workstreams over data flows.
Reporting infrastructure and process	Evidence collation and sharing workstream delivery required together with input from other workstreams and Welsh Government over data flows and reporting approach.
Human infrastructure	Resources for each reportable component required for: • Collection of data • Collation of data • Quality assurance • Data analysis and reporting • Handling communications
Implementation planning:	
Communications	Detailed comms planning required with stakeholder engagement.
Engagement	Wider engagement and outreach actively required as part of a planned comms programme and on an ongoing basis.
Collaboration	Establish a long-term collaboration working group to support implementation and evaluation of target three delivery.

Theme 7: Recommendations and next steps.

The monitoring and evaluation expert group have worked at pace to explore, identify, and recommend key aspects for evaluation of target three delivery (Table 5), and the associated evidence implications (Table 6). This has enabled the identification of several priority development areas which will need to be carried forward into the next phase of the work.

During the course of discussions around the evidence and monitoring frameworks a number of key principles were identified which should inform the implementation of the next stages in target three work. It is hoped these principles together with the recommended framework, development areas, and proposed collaborations will contribute to the route map for 2030.

Delivery principles

During discussions a number of emerging principles were noted and are summarised below.

- **Engaging with and delivery through others:**

There is a clear social aspect to the target and we need to ensure systems are in place to engage with others in effective and meaningful ways. Ensuring local communities & their skills and knowledge are able to be part of the process of identifying opportunities and directing delivery.

- **Ensuring equitable governance:**

Equitable governance as defined by the GBF will be embedded in every aspect of representation, decision making and distribution that relates to the work of this group moving forwards.

- **Sharing enabling data:**

Adequate, effective data availability is key to enabling both informed delivery on the ground and national level planning. Ensuring the FAIR principles are adopted in our data is key i.e. findability, accessibility, interoperability, and reusability. In some cases, this will need to be supported by subject matter experts to enable effective use.

- **Tracking progress:**

Delivering ecosystem change can take time, be complex and is often challenging. Given such issues we will need to ensure our metrics are sensitive enough to start to demonstrate early change to help map and understand progress. Such tracking will also enable the communication of the route to delivery.

- **Understanding baselines:**

To understand how we are progressing there is a need to have a clear understanding of our baseline against which we can track progress.

- **Being realistic over delivery:**

There is a collective recognition that delivery needs to sit within tight fiscal constraints together with the practical time constraints associated with the work. However, delivery is not cost neutral and appropriate resourcing will be necessary.

- **Recognising target three as part of a suite of targets:**

Given the suite of targets set down under the GBF, it is sensible not to regard target three in isolation but as part of a wider series of targets each focussing on different aspects of action or outcome aiming at achievement of the 2050 vision.

Monitoring framework recommendations.

Table 5: Recommended Monitoring Framework to evaluate delivery of target three.

Type of metric	Metric for protected areas and OECMs	Data source	Application
Delivery	Area of land and freshwater which satisfy the inclusion criteria. Area of sea which satisfy the inclusion criteria.	Data infrastructure development and implementation is required.	A measure of delivery of the 30% target, showing what proportion of Wales across land/sea now meeting the inclusion criteria as a PA or OECM under effective management.
Tracking	Protected area classed as effectively managed and the area on a pathway to effective management. OECM area data classed as effectively managed and the area on a pathway to effective management.	Data infrastructure development and implementation is required depending on the outcomes of the case study exercise.	A tracking measure showing the area of both PA and OECMs which are either now included in the delivery target as a result of achieving effective management or are on a pathway to delivering effective management.
	Connectivity in freshwater, terrestrial and marine environments.	To be developed – this will depend on the nature of the metrics used.	A tracking measure showing the changes to connectivity as the inclusion of areas for target three develops.
	Ecosystem representation	To be developed	A tracking measure exploring how the representation of ecosystems in target three evolves as implementation develops. To be implemented only if a suitable

			measure can be identified.
Outcomes	Welsh level Biodiversity and Ecosystem integrity	A potential combination of UK level biodiversity surveillance scheme data where Welsh level trends are available, plus further biodiversity or ecosystem function data. All needing development work.	An assurance measure to explore how wider biodiversity is changing as the implementation of 30 by 30 develops. To be further developed following EO work.

Evidence framework recommendations

Table 6: Recommended Evidence sources required for delivery of target three.

Type of metric	Metric for protected areas and OECMs	Evidence source
Delivery	Area of land and freshwater which satisfy the inclusion criteria. Area of sea which satisfy the inclusion criteria.	Evidence on the type of site (PA, OECM) and its area which satisfy the criteria for inclusion.
Tracking	Protected area classed as effectively managed and the area on a pathway to effective management. OECM area data classed as effectively managed and the area on a pathway to effective management.	Evidence on the effective management of PA or OECMs, including: • The type and governance arrangements for the area. • The conservation objectives for the area. • The implementation of management measures for the area. • The extent, nature, suitability and frequency of the monitoring undertaken for the area. • The extent of achievement of the conservation objectives. • The level of confidence in the assessment of achievement of conservation objectives.
	Connectivity	To be confirmed - Pending agreement on the measurement of connectivity.
	Ecosystem representation	To be confirmed - Pending agreement on the measurement of representation.
Outcome	Welsh level Biodiversity and Ecosystem integrity.	UK level biodiversity surveillance scheme data where Welsh level trends are available plus clarified evidence needs following further development work around ecosystem function or integrity linked to EO developments.

The implications for different environmental domains

The suggested metrics may have differing implications across the environmental domains, not only as a result of the way ecological processes work in different environments but also as a result of the history of evidence collection in these environments.

Terrestrial Environment

Adapting the way evidence is collected and used in the terrestrial sphere is critical to accommodate the suggested metrics. Historical challenges in resourcing traditional protected site monitoring have resulted in substantial evidence gaps. These resource challenges will be ongoing and so place even greater pressure on a move to more cost effective, sustainable approaches at the scale required to support the 30 by 30 agenda.

Unlike the focus on assessing good ecological status in aquatic environments, historically, there has been less emphasis on evaluating ecosystem health in terrestrial environments. Traditionally metrics include favourable conservation status and condition, these focus on individual species/habitats rather than broader measures of ecosystem health. This approach underscores the need to develop new approaches to assessment of terrestrial biodiversity outcomes and ecosystem integrity.

Despite these challenges the terrestrial environment also benefits from a well-established tradition of volunteer-based citizen science for evidence collection, involving a wide range of stakeholders e.g. JNCC based surveillance schemes. This presents an opportunity to foster an enhanced community of practice to support the 30 by 30 agenda.

Freshwater Environment

In freshwaters, there is a reasonably good evidence base assessing different aspects of the freshwater environment, with the result that a much stronger basis for assessment against 30 by 30 criteria exists compared to the terrestrial environment. In particular, a good evidence base exists for river and lake protected areas.

There is nevertheless uneven coverage of the freshwater resource, reflecting past and existing legislative and policy priorities. Whereas data on water quality and ecosystem health is a major strength of the freshwater evidence base, there is much less structured evidence of the extent of freshwater habitats and their physical health (an important driver of biodiversity). Very little monitoring data of any kind exists for some types of freshwater ecosystem such as ponds, springs, and headwaters. Opportunities for use of remote sensed data are also somewhat different in freshwaters. For example, satellite data may be difficult to utilise due to the small size of many freshwater habitats, but other technologies not available in the terrestrial environment are available, such as fish counters and sondes.

The connectivity of freshwaters also differs strongly from terrestrial organisms. Whereas terrestrial ecosystems can often be assessed on a grid basis, freshwaters require a catchment-focussed assessment, reflecting the travel of water, sediment, and the migration route along them for many animals and plants. Lateral connectivity is also

important, as linkages to floodplains and riparian woodlands, meadows, and wetlands are crucial for ecosystem function in freshwaters. These factors will need to be integrated into measures of freshwater connectivity.

Citizen science is less well developed in freshwaters than in the terrestrial environment, but schemes such as the Riverfly Partnership do exist and could potentially be developed into surveillance programmes. There is also considerable scope for LERCs to work with anglers to increase the number of records of fish and other freshwater biota.

Marine Environment

Marine areas have a mixed evidence base. Offshore areas generally have sparse data as most evidence has been gathered close to shore (within a mile or so). This tends to reflect the distribution of human pressure on the marine environment (through risk-based prioritisation) as well as the logistical difficulties and costs associated with evidence gathering offshore or in deeper waters. Integration of delivery to meet a range of drivers means that marine evidence typically supports both the generation of wider ecosystem health metrics as well as focussed assessments of protected habitats and species.

The effort required to gather evidence in the marine environment means that spatial coverage and replication can be quite limited, even the use of remote sensing methods is spatially constrained by the platform (vessel) or observable area in a 3D environment (EO is limited to shores, clear shallow waters and the sea surface). However, temporal replication is quite reasonable in several evidence areas, providing a good baseline for observing and understanding future changes.

The mobile nature of marine waters, and its use for material transport and species movement and dispersion requires a different type of connectivity consideration to that of the land but similar in some respects to that of rivers. Active movement of marine species is important, but passive use of currents and tidal streams can create a high dependency on the health of upstream areas and the integrity of water transport processes between habitats.

As for terrestrial habitats, there is a long history of volunteer-based citizen science in the marine environment. Intertidal habitats have been the traditional focus, but the advent of recreational diving and organised programmes such as SeaSearch have spread the effort offshore. However, volunteer programmes are affected by the high cost and logistical difficulties of working in the marine environment and so remain quite limited, mostly shore based, and well below the scale of that found terrestrially.

Next steps.

Over the course of 2023 the group has explored the types of monitoring undertaken across Wales, identified the key aspects of target three and made a series of recommendations for metrics to support 30 by 30 delivery focussed on delivery, tracking and outcome monitoring.

Given the limited time available and topic complexity, it was not possible to resolve a range of issues or investigate a range of development areas in detail. These challenges have informed the proposed next steps.

Establishing development and delivery workstreams:

A series of workstreams have been identified which will need to be established to carry forward the work of the expert group. These groups should cover:

- Evidence specification and generation.
- Collaboration and data sharing.
- Innovation.
- Effective management.
- Governance.
- Resourcing.

Whilst membership may be built from the existing group membership other contributors may be required as the work of delivering 30 by 30 progresses.

Establishing a community of practice:

To oversee and coordinate delivery of the workstreams and build the wider collaboration necessary to support implementation, the establishment of a community of practice is recommended. The monitoring and evidence expert group is considered to be best placed to build this through ongoing work in 2024. As we move forward into the next phase, the group proposes to meet every 3-4 months, with intersessional working groups established to take forward the workstreams. Liaison with other UK countries will also be necessary to share best practice and approaches.

The group recognises that several evidence workstreams have synergies with the Deep Dive OECM and NREA Expert Group and the Deep Dive Designated Landscapes Expert Group. A joint meeting will be held in April to take discussions forward.

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Definitions

The delivery of target three involves use of a number of key terms, these have specific definitions in the context of the work as follows:

Other effective area-based conservation measure (OECMs): A definition was agreed at the 14th Conference of Parties of the Convention on Biological Diversity in 2018:

"A geographically defined area other than a Protected Area, which is governed and managed in ways that achieve positive and sustained long-term outcomes for the in-situ conservation of biodiversity, with associated ecosystem functions and services and where applicable, cultural, spiritual, socio-economic, and other locally relevant values." See: <https://biodiversity.europa.eu/europes-biodiversity/protected-areas/other-effective-area-based-conservation-measures>.

Protected areas (PA): For the purposes of 30 by 30 protected areas are deemed to include SSSIs, SPAs, SACs and NNRs. This broadly aligns with the IUCN Protected Area Categories IV - Habitat/Species Management Areas, although a few are of Category I – Strict Nature Reserve (Dudley, 2008). As many protected area designations overlay one another most area-based considerations are focussed on the underpinning SSSI designations as a unit of focus.

The area of land and sea in Wales: We will assess 30% collectively for land and freshwater as a proportion of the land mass from the political boundary of Wales down to the mean low water mark.

For the marine environment (which we consider includes coastal) we will calculate 30% as a proportion of the marine area from mean low water springs to the territorial water limit for Wales.

Appendices

Annex 1: Monitoring and reporting overview of Wales.

International reporting

The UK is a signatory to a number of international commitments to protect biodiversity, including the Convention on Biological Diversity (CBD), the Bern Convention, the Ramsar Convention, the Convention on Migratory Species (CMS), the OSPAR Convention, and the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). These conventions require signatories to report on their progress towards achieving the targets and goals that have been set. For the UK, this requires an integrated response which covers the four countries.

Convention of Biological Diversity reporting

Parties to the CBD are required to submit national reports to the Conference of the Parties on measures taken for the implementation of the Convention and their effectiveness in meeting the objectives of the Convention.

The [CBD 6th National Report](#) focused on work by Parties to achieve the 20 [Aichi Targets](#) in the Strategic Plan for Biodiversity 2011-2020. For the UK, JNCC (on behalf of Defra and the devolved administrations) was responsible for collation and assessment of evidence from around the UK, its Overseas Territories and Crown Dependencies including

contributions from government, statutory nature conservation bodies and the wider stakeholder community. The final report was submitted to the CBD Secretariat on the 11 March 2019.

The Kunming-Montreal Global Biodiversity Framework

The GBF is accompanied by a detailed [monitoring framework](#) comprised of a set of agreed indicators for tracking progress towards the goals and targets of the Framework. The monitoring framework includes headline indicators which are recommended for national, regional, and global monitoring, and more detailed component and complementary indicators. The monitoring framework will provide information on how the world is faring in terms of achieving the goals and targets of the framework. The COP have established an [ad hoc technical expert group \(AHTEG\)](#) to provide guidance on the further development and operationalization of the monitoring framework.

The [monitoring framework](#) for the GBF identifies the following indicators for target three (Fig 1):

Headline indicators:

3.1 Coverage of protected areas and OECMs

Component indicators:

- Protected area coverage of key biodiversity areas
- Protected Area Management Effectiveness (PAME)
- ProtConn
- Protected Area Connectedness Index (PARC-Connectedness)
- Red List of Ecosystems Connectivity Indicator (in development)
- The number of protected areas that have completed a site-level assessment of governance and equity (SAGE)
- Species Protection Index

Complementary indicators:

- Protected area downgrading, downsizing and degazettement (PD)
- Status of key biodiversity areas
- IUCN Green List of Protected and Conserved Areas
- Number of hectares of UNESCO designated sites (natural and mixed World Heritage sites and Biosphere Reserves)
- Protected area and OECM management effectiveness (MEPCA) indicator
- Protected Area Isolation Index (PAI)
- Protected Areas Network metric (ProNet)
- Extent to which protected areas and other effective area based conservation measures (OECMs) cover Key Biodiversity Areas that are important for migratory species
- Coverage of Protected areas and OECMs and traditional territories (by governance type)
- Ramsar Management Effectiveness Tracking Tool (RMETT)
- Percentage of biosphere reserves that have a positive conservation outcome and effective management
- Extent of indigenous peoples and local communities' lands that have some form of recognition
- Species Protection Index
- Number of countries implementing national legislation, policies or other measures regarding free, prior and informed consent related to conservation
- Red List of Ecosystems
- Proportion of terrestrial, freshwater and marine ecological regions which are conserved by protected areas or other effective area-based conservation measures

Figure 1: Indicators for target three.

Domestic (Wales) reporting

State of Natural Resources Report (SoNaRR)

The Environment Wales Act states that NRW must prepare a report containing its assessment of the state of natural resources in relation to Wales which amongst other things must set out:

- An assessment of the extent to which the sustainable management of natural resources is being achieved.
- An assessment of biodiversity.
- What NRW considers to be the main trends and factors that are affecting and are likely to affect the state of natural resource.
- Any aspects about which NRW considers it does not have sufficient information to make an assessment.

The report forms an important evidence base for Welsh Ministers to consider in the preparation of the Natural Resources Policy. It must also be taken into account in the review of National Park and AONB Management Plans by those relevant authorities. It also works alongside the Nature Recovery Action Plan which is Wales' biodiversity strategy and action plan setting out how the existing CBD targets are being met. The first report was published in 2016 with the most recent one published in 2020.

Habitats Regulations 9A reporting

Habitats Regulations 9A reporting (previously reported via Habitats Directive Article 17 and Article 12 Birds Directive) is retained under the EU Withdrawal Act 2018. Reporting requires the assessment of the favourable conservation status of a range species and habitats at the Welsh level by NRW on behalf of Welsh Government. Reporting takes place every six years with the first report due in 2026.

The evidence and reports created will inform SoNaRR and be used to compile a UK composite report.

Area Statements

The seven Area Statements produced by NRW is a collaborative response to the [Natural Resources Policy, published by the Welsh Government in 2017](#), which sets out the key challenges and opportunities for the sustainable management of Wales' natural resources into the future.

Each Area Statement outlines the key challenges facing that particular locality, what we can all do to meet those challenges, and how we can better manage our natural resources for the benefit of future generations. They will be updated regularly and improved year-on-year as we engage with more people, gather new evidence, put forward ideas, and work across boundaries to create opportunities.

Annex 2 – Group membership.

Chair: Ceri Davies - Executive Director Evidence, Policy and Permitting, Natural Resources Wales

Members:

Karen Stothard – Welsh Government
Steve Spode – Welsh Government
James Skates – Welsh Government
Kate Wade - Welsh Government
Dylan Lloyd - Natural Resources Wales
Dr. David Allen – Natural Resources Wales
Dr. Tristan Hatton-Ellis – Natural Resources Wales
Dr. Mike Camplin – Natural Resources Wales
Prof. Richard Lucas – Aberystwyth University
Dr. Joseph Bailey – British Ecological Society
Dr. Katie Medcalf – Environment systems
Dr. Chris Cheffings – JNCC
Dr. Jonathan Davies – BBNP
Rebecca Price - BBNP
Adam Rowe – LERC Wales
Dr. Simon Smart – CEH
Rebecca MacDonald-Lofts / Jenny Hawley – Wales Environment Link
Annie Smith – RSPB
Michael MacDonald – RSPB
Fiona Burns – RSPB
Dr. Katherine Boughey – Bat Conservation Trust
Deborah Hill – Swansea Council

Observers:

Prof. Steve Ormerod – Chair of the OECM and NREA Expert Group / Cardiff University
Howard Davies – Chair of the Designated Landscapes Expert Group
Holly York - Natural Resources Wales

Annex 3 – Terms of reference.

Status

The Monitoring and Evidence Expert Group reports to the Core Biodiversity Deep Dive Group.

Purpose

Focused on Recommendation 7 of the Biodiversity Deep Dive 'Develop and adapt monitoring and evidence frameworks to measure progress towards 30 by 30 target and guide prioritisation of action' the principal purpose of the group is to take forward:

- the work needed to establish a robust and appropriate monitoring and evidence frameworks for 30 by 30 and wider nature recovery targets, building on those already in place.

Effective and affordable monitoring and evidence frameworks are vital if we are to track our progress towards both the 30 by 30 goal and the longer-term nature positive ambition. These frameworks need to be informed by an appraisal of data needs, building on existing good practice and data sets, and identifying what is needed in future.

The group will undertake this work with reference to the targets contained within the post 2020 Global Biodiversity Framework, especially target three which seeks to:

‘Ensure and enable that by 2030 **at least 30 per cent** of terrestrial, inland water, and of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem functions and services, are **effectively conserved and managed** through **ecologically representative, well-connected and equitably governed systems of protected areas and other effective area-based conservation measures**, recognizing indigenous and traditional territories, where applicable, and **integrated into wider landscapes**, seascapes and the ocean, while ensuring that any sustainable use, where appropriate in such areas, is fully consistent with conservation outcomes, recognizing and respecting the rights of indigenous peoples and local communities, including over their traditional territories.’

The remit of the group is to:

1. Provide an evidence framework for Wales which will enable evaluation of 30 by 30 and beyond. Clarifying the role monitoring has within the wider evidence framework and the roles various spatial components may play in contributing the required evidence e.g., OECMs.

Such a framework will need to plan for monitoring and target-setting which addresses the key objectives of 30 by 30 in Wales and that provides a rounded evaluation of outcomes in relation to a set of habitats, species, and ecosystem metrics at a range of appropriate scales as required to support policy.

Given that outcomes may take many years (beyond 2030) to become apparent, the group may need to develop a range of evaluations that include a variety of indicator types allowing progress to be tracked over short, medium and long-term timescales with respect to actions, inputs, outputs.

2. Clarify the required evidence to support both national 30 by 30 reporting desires but aligned with data required for international reporting.
3. Map out the evidence contributions which could come from a range of stakeholders involved in evidence generation.
4. Recommend any additional costed monitoring activities which will be required to fulfil reporting obligations.
5. Ensure alignment with other Biodiversity Deep Dive activities, including those relating to Protected Sites, Designated Landscapes monitoring and financing.

6. Establish a forum for reviewing and coordinating relevant monitoring undertaken by different organisations, and to facilitate joint or complementary approaches to analysis and evaluation.

This section should be read in conjunction with the wider Monitoring and Evidence work plan.

Membership of the group

The chair of the group is appointed by the Minister of Climate Change and should be a member of the Core Biodiversity Deep Dive Group.

The appointed chair is Ceri Davies, Executive Director for Evidence, Policy and Permitting, Natural Resources Wales with secretariat provided by the Wales Biodiversity Partnership Support Team.

Members should have sufficient expertise, knowledge, and capacity to allow rapid and robust development of the outcomes. Additional specialist expertise may be brought in as and when required.

Ways of Working

These will be aligned to the Five Ways of Working outlined within the Wellbeing of Future Generations Act.

- Work collaboratively across organisations, and with other stakeholders and sub-groups.
- In proposing future actions and solutions, take account of relevant evidence and/or identify any key evidence gaps in respect of uncertainties.
- Seek to achieve integrated long-term solutions and take account of the short-, medium- and long-term consequences of actions.
- Work with integrity and respectfully challenge each other to consider how we can do things differently/better.
- All outputs and recommendations from this group should be justified by reference to a sound evidence base or draw attention to the limitations of the evidence where this not available.

Meeting arrangements (incl. timing)

- Meetings will be held online using Teams or on occasion, face to face.
- Meetings - a forward schedule of meetings will be agreed and should fit with the reporting deadlines and schedules of the Core Biodiversity Deep Dive Group.
- Proposed agenda items and papers should be sent to the Chair and Secretariat one week prior to the meeting.
- The Secretariat will circulate the draft minutes within two weeks of the meeting.
- The group will maintain a risks and issues log to feed into the Core Deep Dive Group.
- Any decisions or issues the group cannot resolve should be escalated to the Core Deep Dive Group.

Communications and Reporting

- The chair will report to the Core Biodiversity Deep Dive Group on a quarterly basis, and feed into the six-monthly reporting schedule.

- The group will look to communicate outputs with relevant parties.
- Engagement with a range of stakeholders who may be considered as part of any monitoring and evidence process will be critical in due course.

Annex 4 – Monitoring being undertaken in Natural Resources Wales.

Terrestrial Biodiversity monitoring in Natural Resources Wales.

NRW's terrestrial monitoring strategy focusses on species and habitats of conservation interest (principally notified and/or qualifying 'features') on protected sites (SAC, SPA and SSSIs) across Wales.

Within these protected sites, approximately 3,000 terrestrial features are in scope for assessment. Features are selected for a range of reasons based on rarity, threat, or uniqueness. The frequency with which certain feature types have been notified varies considerably, with the majority of features occurring at very low frequency. Estimates in 2020 suggest 634 terrestrial feature types (comprising 1795 features) occur less than 25 times across Wales. This represents a major proportion of features. In contrast only three feature types occur more than 100 times, these are marshy grassland, neutral grassland, and semi-natural woodland.

The 2020 Protected site baseline assessment project demonstrated that only 15% of terrestrial biodiversity features were classed as favourable, with 29% unfavourable and 55% unknown.

NRW seeks to deliver terrestrial monitoring of these sites and features through a series of core evidence programmes.

Programme 1: Protected sites monitoring programme.

The program enables the updating of the national condition picture through a targeted risk-based approach for features of monitoring interest within SACs, SPAs, and SSSIs. The monitoring effort is focused on areas where technical and logistical factors allow for effective delivery and brings together various types of evidence to assess the likely condition of the feature. Additional site-based data is collected only when existing evidence is considered inadequate. This risk-based approach includes:

- Conducting light touch assessments of the condition of individual features using pre-existing information on their status, pressures, and interventions through desk-based assessments.
- Conducting field assessments of condition targeted at high priority features when the available pre-existing data is insufficient to make an assessment.
- Provides a wholistic condition reporting process at national and local scales.

The primary purpose of this program is to continuously update the evidence state, enabling more comprehensive reporting of feature condition at national and regional scales. While it

also supports local interventions and other local priorities, its role in this regard is more limited.

Programme 2: Local investigations programme

This programme enables improved management interventions and support of local initiatives. Activities range from habitat surveys, support of site notifications and working with others to deliver monitoring. The data generated as part of the programme also supports the national sites programme either directly through generating condition assessments or indirectly by bolstering the desk assessments. The program primarily focuses on the following:

- Addressing operational issues at the local level through place-based responses, such as investigations or land management agreements.
- Providing baseline mapping and survey services for place-based notification work.
- Conducting comprehensive assessments of features, which includes defining conservation objectives, collecting, and analysing data, and interpreting the findings.
- Assessment of site condition for NRW plans or projects requiring planning permission, Environmental Impact Assessment (EIA) and/or permitting, such as forestry operations, metal mine remediation, or NNR works.

Programme 3: Surveillance programme

Surveillance evidence is generated by both NRW and others working at a range of spatial scales across a number of environmental indicators, the majority with a significant component of citizen science delivery. For NRW the surveillance programme encompasses:

- Support of critical national surveillance programmes - to provide wider environmental evidence to be utilised in protected site assessment work e.g., Environmental Change Network (ECN), National Bat Monitoring Programme (NBMP), UK Butterfly Monitoring Scheme (UKBMS).
- Direct support of citizen science surveillance programme delivery.

Programme 4: Support and development programme

The expansion of NRW's monitoring service to encompass all features within protected sites has brought to light substantial gaps in our understanding of individual features, both in terms of their ecology and the suitability of current monitoring methods. This expansion has also underscored the necessity of incorporating a wider array of evidence sources into the assessment process.

These changes also require significant support, training, and quality assurance to ensure proposed new approaches are working appropriately. The support program addresses various issues, including:

- Technical development- this involves testing new monitoring techniques and promoting innovation in areas where gaps have been identified.
- Staff development- this encompasses enhancing habitat and species-related skills, undertaking successional planning, and providing training on technical equipment and data management.

Monitoring Approaches

The monitoring methods applied to protected sites are diverse, however, the current delivery programmes result in three broad methodological themes:

Condition assessment methods

Feature condition monitoring based on common standards monitoring (an agreed UK approach), employs an interpretive framework that emphasizes reporting condition using a predetermined set of categories for species and habitat types.

Features are prioritised based on the risk of condition change or the operational urgency for site intervention. Assessments are conducted using desk assessments, brief site checks, or more comprehensive surveys, depending on the available evidence and the specific feature type. Within NRW, condition assessments are accompanied by a confidence rating to provide an indication of the reliability of the assessment.

Baseline surveying

Baseline surveys encompass a wide range of activities from habitat mapping to species counts. Such activities enable management planning to commence and allow baselines to be developed where sites are newly notified.

Enabling site management

Effective management requires information on the location, condition, ecology, and pressures acting on key species and habitats. Local investigations provide the flexibility to concentrate monitoring efforts on crucial questions related to site management priorities. This information is then used to support state-dependent decision making as well as to evaluate the outcomes of interventions.

Outputs

Given resource limitations the extent of monitoring in NRW is very limited. In 2022 the desk and field-based approaches of the National Programme determined the condition of 44 features (previously classed as of unknown condition), with varying levels of confidence. This represents only approximately 2.5% of the features identified as requiring condition assessment.

The management support focus of the local investigations programme in 2022 led to 57 investigations across a range of sites and feature types covering activities from baseline surveys, brief site checks through to more detailed condition assessments.

Relevance to GBF target three

Target three contains several potentially measurable aspects, with the evaluation of management effectiveness being the most relevant to NRW's terrestrial monitoring.

The value and relevance of monitoring is expressed through a variety of mechanisms:

- Support of state-dependent decision making – enabling interventions to be adjusted in response to the state of the target species or habitat.
- Evaluating the outcomes of management interventions.

- Communicating the results of management interventions to stakeholders and local communities.
- Ensuring efficient targeting of investments in site management.

UK and international work on the evaluation of management effectiveness breaks evaluation into several components centred around design, adequacy, appropriateness, and delivery.

NRW protected site work (covering monitoring and management) has the potential to directly align with several of these parameters for evaluating management effectiveness. (Table 1).

Table 1: Broad metrics required to evaluate management effectiveness.

Metric	Notes on NRW relevance
Is management information on the protected or conserved area available?	NRW has information available on the availability of management plans, conservation objectives and governance arrangements. Broader information is also available providing the underpinning approach to site selection and notification.
Are management measures implemented for the area to achieve its objectives for conservation?	NRW has collated information on management measures / actions. These could be available and tracked to monitor which have been acted upon.
Does monitoring take place which helps to assess progress towards achieving conservation outcomes?	NRW does undertake monitoring to determine progress towards conservation outcomes. However, questions remain over the frequency and spatial scale of the activity.
Is the area achieving its conservation outcomes?	NRW's monitoring collects data to allow progress towards achievement of ecological conservation outcomes to be assessed. The monitoring however largely focusses on determining the condition state of the feature rather than the trajectory of response to management i.e. generally report favourable/unfavourable categories rather than unfavourable: recovering or declining etc. Collecting sufficient data to infer trajectory of change is more costly and thus collected in only limited circumstances.
What is the level of confidence in the data used to assess progress towards outcomes?	NRW's evidence is structured and assessed in a manner which enables an auditable confidence rating to be applied to the monitoring evaluation.
Confidence in achievement of conservation outcomes	In NRW monitoring focusses on the assessment of a range of features found on a site rather than the assessment of the overall state of a site. Collated evidence for all the features on a site would then allow an overall evaluation of the degree to which a site is achieving positive conservation outcomes. Targeting assessments to those features driving site management could also provide a general level of information for management outcomes.

Freshwater Biodiversity monitoring in Natural Resources Wales

NRW's freshwater monitoring strategy focusses on:

1. Ecological and water quality monitoring for the Water Framework Directive (WFD)
2. Habitats and species of conservation interest (principally notified and/or qualifying 'features') on protected sites (SAC and SSSIs) across Wales.
3. Flow gauging
4. Local Investigations programme
5. Specific surveillance programmes
6. Project level monitoring, to evaluate the success of actions

Freshwater monitoring is generally carried out following specific protocols to ensure a consistent monitoring approach and to enable data to be comparable in a wide range of contexts. NRW monitoring staff are trained in the relevant sampling and analysis techniques. Most freshwater monitoring is carried out in-house, but some more specialised work is contracted out.

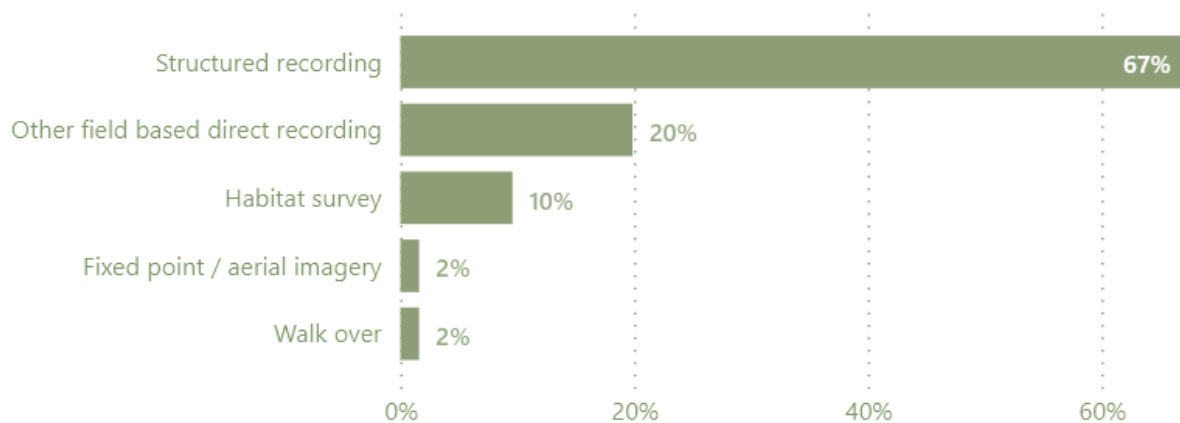


Figure 1: Methods used in freshwater data collection (NRW, 2020)

Structured recording (Fig 1) is the most important source of freshwater data for condition assessments.

Due to the inherently hazardous nature of the freshwater environment, there is less scope for Citizen Science (CS) methods than in terrestrial, but there are nevertheless examples of successful freshwater CS methods and projects such as the Riverfly Partnership. NRW's freshwater data are stored on an internal database that can be interrogated to answer different questions, and includes previous data inherited from legacy bodies.

NRW's use of freshwater data is highly modular, with individual datasets being used for different purposes so far as is practicable. For example, most of the WFD Ecological Classification monitoring data and tools are also used to some extent in Common Standards Monitoring (CSM). This approach maximises efficiencies among different programmes.

Decisions on which locations to monitor are taken using a standardised risk-based approach across Wales. Although this allows resources to be targeted where they are most needed, it also means that the available data do not necessarily reflect national trends.

Freshwater monitoring data has major implications for Wales. As well as the gauging station network, used to assess flood risk and flow in our rivers, nutrient data from the monitoring network has been important in informing nutrient management data on SAC rivers. Salmon data has also recently been used to estimate catchment level extinction risk for Atlantic salmon, driving a significant policy response (Fig 2).

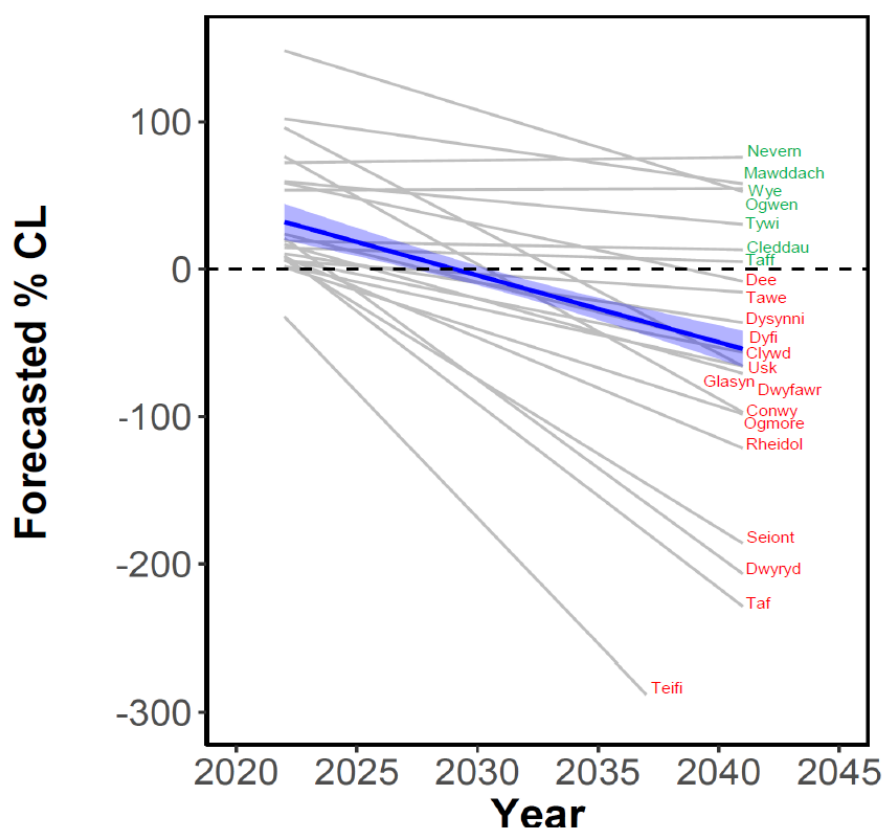


Figure 2: Projected salmon populations in Wales to 2045 based on population trends between 1990 and 2021. Source: Milner and Garcia de Leaniz 2023

Programme 1: Water Framework Directive Monitoring

WFD monitoring is the mainstay of NRW's monitoring programme in freshwaters and consists of a combination of water quality monitoring and biological monitoring. Water quality work focusses mainly on nutrients and acidity, with smaller programmes working on other pollutants such as pesticides and metals. Biological monitoring assesses various aspects of the freshwater environment (known as quality elements), predominantly invertebrates, diatoms, aquatic plants, and fish.

Programme 2: Protected sites monitoring programme.

The programme enables the updating of the national condition picture through a targeted approach for features of monitoring interest within SACs, SPAs, and SSSIs. 115 SSSIs and 25 SACs have one or more freshwater features, though many of these overlap (Fig 3).

Indicative condition results for broad feature categories

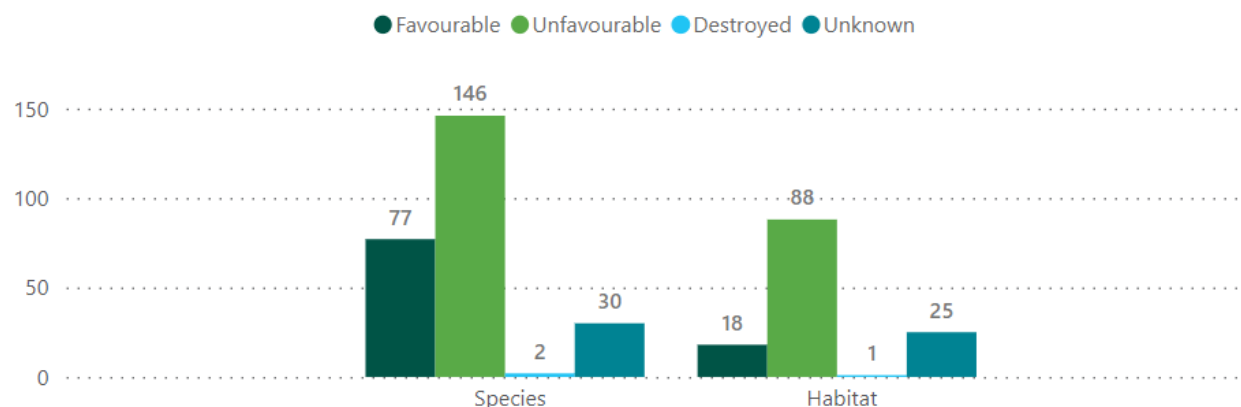


Figure 3: Baseline condition of freshwater protected site features ([NRW, 2020](#)).

The monitoring effort is focused on areas where the highest priority features occur, and where pressures are considered likely to be greatest based on previous monitoring results or a priori criteria (Fig 4). The monitoring programme is integrated with WFD work to maximise efficiencies, and analysis tools are increasingly automated to reduce data analysis time.

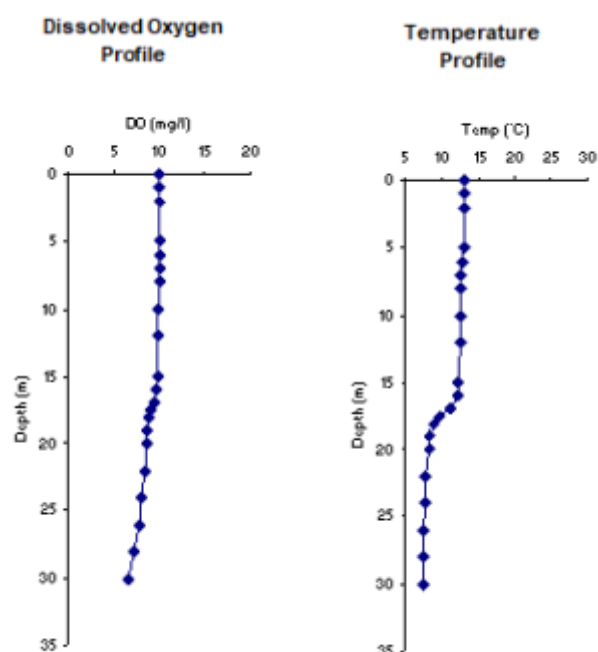


Figure 4: Dissolved Oxygen and Temperature Profiles from Llyn Cwellyn in 2018, indicating favourable condition for Arctic charr (Goldsmith et al. 2019).

The primary purpose of this programme is to (i) continuously update the evidence state, enabling more comprehensive statutory and non-statutory reporting of feature condition at national and regional scales and (ii) support local interventions, restoration project development and other priorities. In the last 5 years, project funding worth over £20 million has been committed to restoration of Welsh rivers: these projects could not have been evidenced without the protected sites monitoring programme.

Programme 3: Flow gauging

Flow gauging occurs at a series of stations covering all the main rivers in Wales (Fig 5). The data are collected via a telemetry system that serves as a means of measuring river levels, used for water resources monitoring, flood warning, regulation of abstraction and discharge permits, and for assessment of protected site condition (Fig 6). The data are stored on a National Flow Archive that is highly relevant for assessing long-term trends in response to climate change.

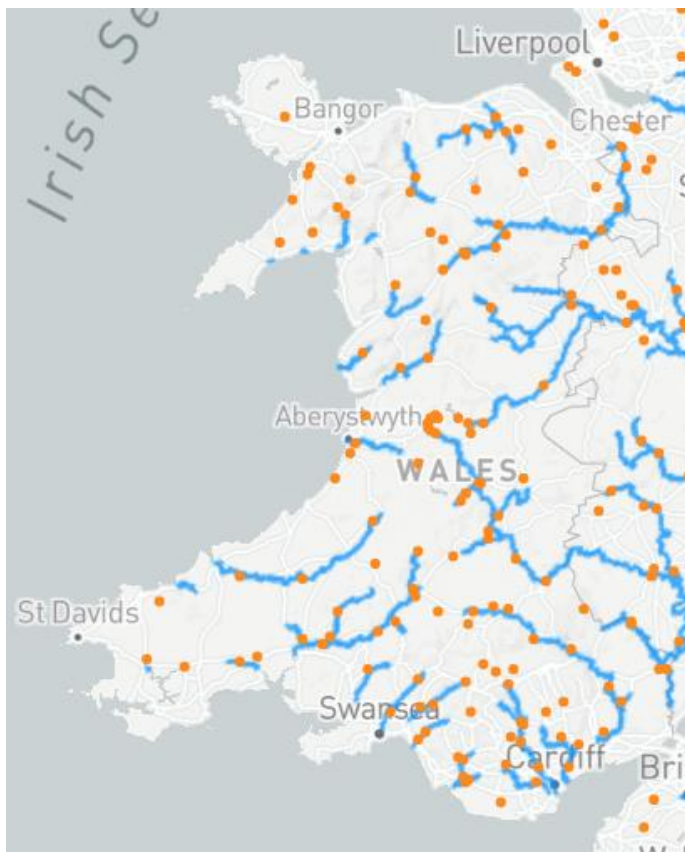


Figure 5: Map of past and present NRW gauging locations in Wales available on the [UKCEH National River Flow Archive](#).

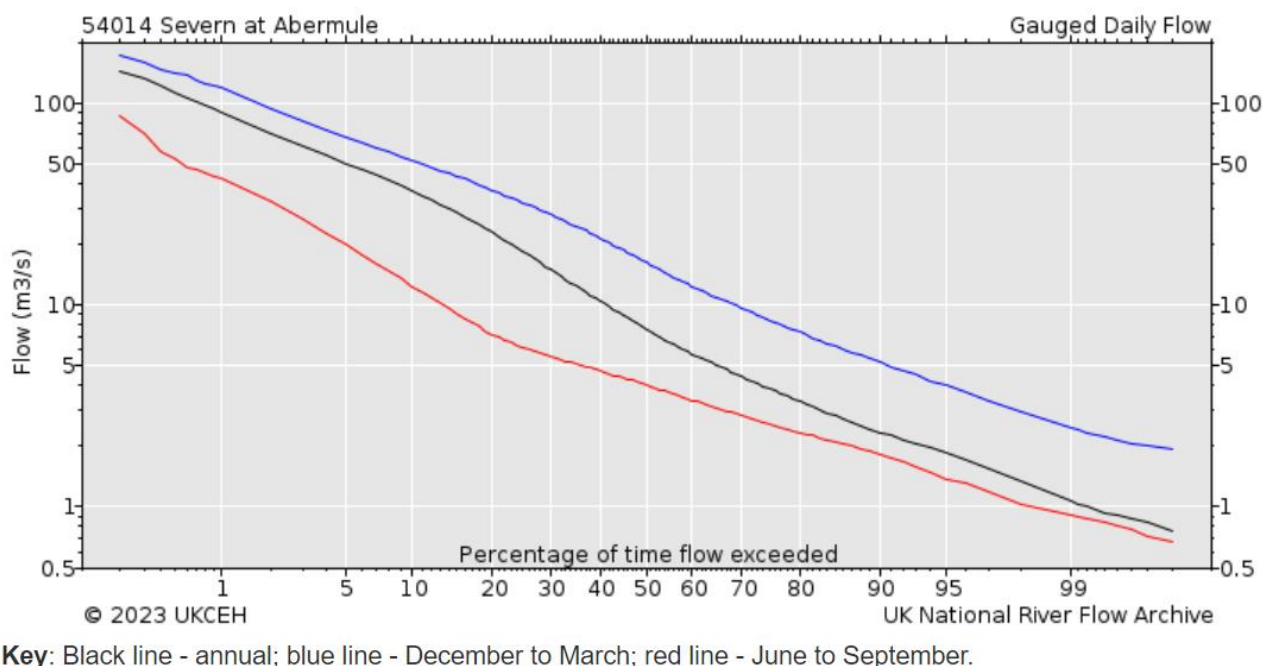


Figure 6: Flow duration curve for the River Severn at Abermule ([UKCEH National River Flow Archive](#))

Programme 4: Local investigations programme

This programme enables improved management interventions, addressing pollution and support of local initiatives. Activities range from habitat surveys, support of site notifications and working with others to deliver monitoring. The data generated may also support the protected sites programme either directly through generating condition assessments or indirectly via provision of additional data for site assessments. The program primarily focuses on the following:

- Addressing operational issues at the local level through place-based responses, such as investigations.
- Providing baseline mapping and survey services for place-based notification work.
- Conducting comprehensive assessments of features, which includes defining conservation objectives, collecting, and analysing data, and interpreting the findings.
- Assessment of site condition for NRW plans or projects requiring planning permission, EIA and/or permitting, such as forestry operations, metal mine remediation, or NNR works.

Programme 5: Surveillance programmes

Surveillance evidence is generated by both NRW and others working at a range of spatial scales across a number of environmental indicators. For NRW the surveillance programme encompasses support of critical national surveillance programmes - to provide wider environmental evidence to be utilised in pressure management and policy development (Fig 7) e.g., Environmental Change Network, Uplands Waters Monitoring Network, Salmon Index Rivers.

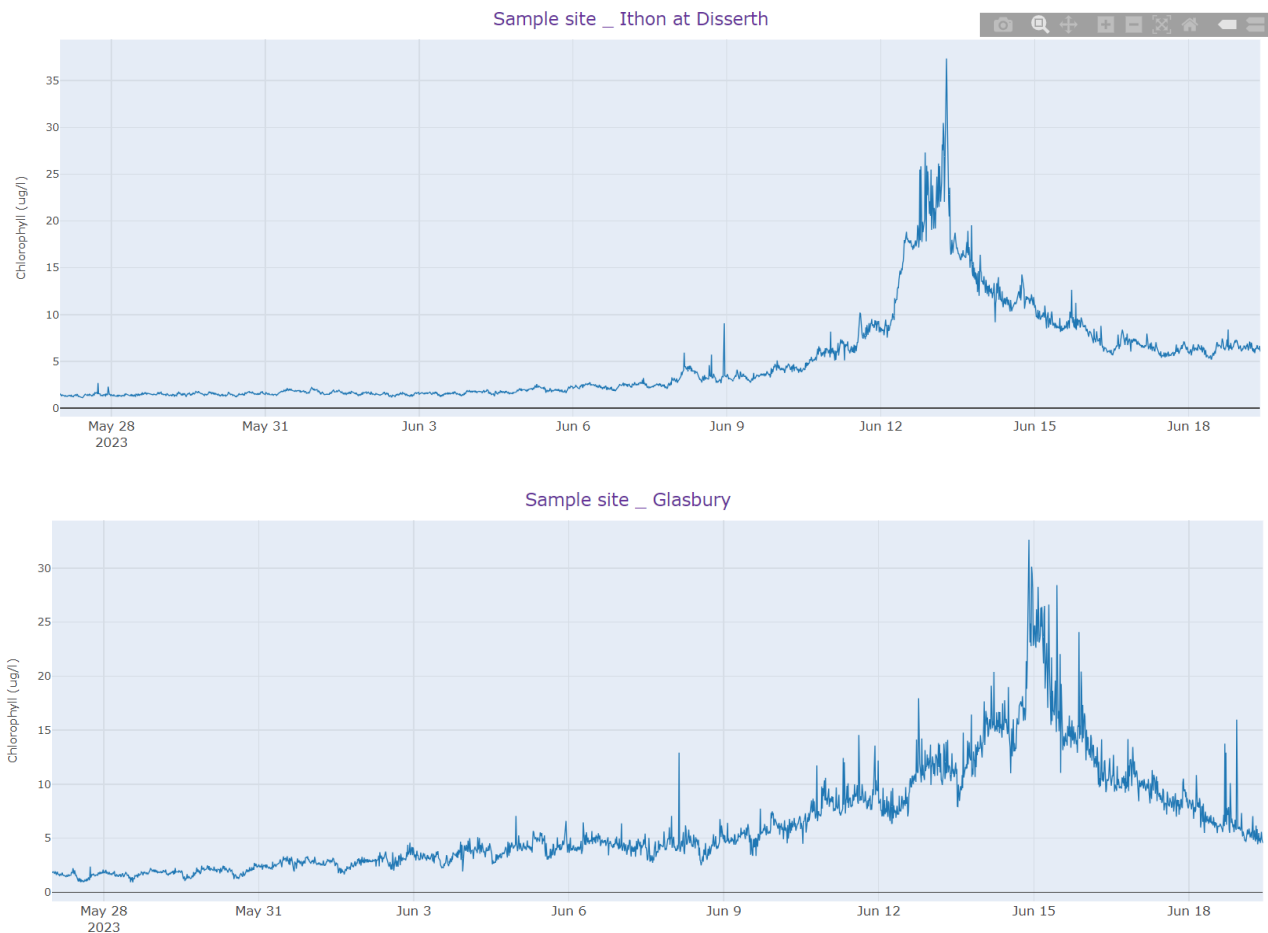


Figure 7: Surveillance of short-term chlorophyll concentrations measured using NRW sondes at two locations in the River Wye.

Programme 6: Project delivery monitoring

The large freshwater restoration projects currently being delivered by NRW each have their own specific monitoring programme, targeted at assessing the effectiveness of project actions in relation to project objectives. As these cannot necessarily be assessed using existing monitoring methods and/or the existing network, innovative or bespoke methods are often required.

Support and development programme

The introduction of a range of specific freshwater restoration projects and the drive for innovation has placed additional emphasis on development and support work e.g. introduction and testing of Sonds as surveillance technology. This expansion has also underscored the necessity of incorporating a wider array of evidence sources into the assessment process.

These changes require significant support, training, and quality assurance to ensure proposed new approaches are working appropriately. The freshwater support work addresses various issues, including:

- Technical development - this involves testing new monitoring techniques and promoting innovation in areas where gaps have been identified.
- Staff development - this encompasses enhancing habitat and species-related skills, undertaking successional planning, and providing training on technical equipment and data management.

NRW is also currently undertaking a water quality monitoring review, which is evaluating the ability of NRW's existing water sampling networks to meet current and future evidence needs, and then to implement changes where appropriate. The current phase of the project is determining the desired future network design and the strengths, weaknesses, and relative efficiency of different levels of randomisation and stratification options.

Outputs

Coverage of freshwater habitats and species up to 2020 is generally good, though the Covid pandemic resulted in a significant disruption to delivery of the programme. The water quality and flow aspects tend to be better covered compared with ecology. In 2020, the condition of 86% of freshwater features was reported on, with 14% being classed as unknown, although some of this was using rolled over data for the ecology aspects. Evidence quality was also generally considered to be good. Key gaps in freshwater monitoring are available data to update SSSI and SAC feature assessments, river morphology and extent, condition, and connectivity of ponds.

WFD is reported on against a statutory timetable every 3 years and reported on Water Watch Wales (see [NRW: Water Watch Wales](#)). However, not all water bodies are necessarily monitored over this time, with lack of resources often leading to some results being 'rolled forward' from previous assessments.

Looking forward, there is an emerging lack of capacity for freshwater monitoring in NRW. Monitoring programmes need to be planned well in advance so that appropriately trained

staff can be allocated at the correct time of year (since most monitoring work can only be carried out within defined windows), and therefore work is best carried out by permanent staff. This does not make monitoring well placed to take advantage of short-term resource availability such as in-year funding.

Relevance to GBF target three

Freshwater monitoring has potentially two main areas of relevance to target three, the first relates to a wider understanding of freshwater ecosystem health and the second, as with other areas of NRW's protected site monitoring work, to the evaluation of management effectiveness.

Given the national scale of freshwater sampling being undertaken for some programmes e.g. WFD and surveillance programmes, freshwater evidence has the potential to contribute to a national wider understanding of freshwater ecosystem health across catchments.

The value and relevance of monitoring for assessment of management effectiveness is expressed through a variety of mechanisms:

- Support of state-dependent decision making – enabling interventions to be adjusted in response to the state of the target species or habitat.
- Evaluating the outcomes of management interventions.
- Communicating the results of management interventions to stakeholders and local communities.
- Ensuring efficient targeting of investments in site management.

UK and international work on the evaluation of management effectiveness breaks evaluation into several components centred around design, adequacy, appropriateness, and delivery.

As with NRW's other areas of protected site work, work on freshwater sites (covering monitoring **and** management) has the potential to directly align with several of the criteria for evaluating management effectiveness (Table 1).

Table 1: Broad metrics required to evaluate management effectiveness.

Metric	Notes on NRW relevance
Is management information on the protected or conserved area available?	NRW has information available on the availability of management plans, conservation objectives and governance arrangements. Broader information is also available providing the underpinning approach to site selection and notification.
Are management measures implemented for the area to achieve its objectives for conservation?	NRW has collated information on management measures / actions. These could be available and tracked to monitor which have been acted upon.
Does monitoring take place which helps to assess progress towards achieving conservation outcomes?	NRW does undertake monitoring to determine progress towards conservation outcomes. However, questions remain over the frequency and spatial scale of the activity.
Is the area achieving its conservation outcomes?	NRW's monitoring collects data to allow progress towards achievement of ecological conservation outcomes to be assessed. The monitoring however largely focusses on determining the condition state of the feature rather than the trajectory of response to management i.e. generally report

	favourable/unfavourable categories rather than unfavourable: recovering or declining etc.
What is the level of confidence in the data used to assess progress towards outcomes?	NRW's evidence is structured and assessed in a manner which enables a confidence rating to be applied to the monitoring evaluation.
Confidence in achievement of conservation outcomes	In NRW monitoring focusses on the assessment of a range of features found on a site rather than the assessment of the overall state of a site. Collated evidence for all the features on a site would then allow an overall evaluation of the degree to which a site is achieving positive conservation outcomes. Targeting assessments to those features driving site management could also provide a general level of information for management outcomes.

Marine biodiversity monitoring in Natural Resource Wales

There are many drivers for undertaking marine monitoring in Wales. In general, they can be summarised as a need to gather evidence to:

- Assess and report the condition of habitats and species of conservation importance, including those safeguarded by our national and international marine protected areas (MPAs).
- Assess and report the environmental status of the wider marine environment.
- Inform the management of our MPAs and the wider marine environment.

The wider UK context

NRW's marine monitoring forms part of a wider UK strategic approach to assessing the state of our seas.

Safeguarding our Seas (2002) set out a vision for 'clean, healthy, safe, productive, and biologically diverse oceans and seas' and started a process which changed the UK's approach to monitoring and assessment of our seas. It led to the publication of Charting Progress, the first integrated assessment of our seas, in 2005 (UKMMAS 2005). This provided a baseline for the state of our marine environment and recommended the development of a UK Marine Monitoring and Assessment Strategy (UKMMAS), which has now been in place for around 15 years. Its work is primarily delivered through a suite of supporting Evidence Groups, and the UKMMAS community, of which NRW forms part, has over 40 members including marine agencies, research institutes, universities, environmental organisations, and industries.

In July 2010 the UKMMAS community published Charting Progress 2. This assessment of the state of UK seas was based on robust, peer-reviewed evidence and described progress since 2005 towards achieving the UK vision (UKMMAS 2010). Since then, and following the Government Commentary on Charting Progress 2, the UKMMAS community has taken a leading role in the development of monitoring indicators and the assessment of monitoring data required for reporting as part of the UK Marine Strategy (UKMS).

In 2016, as part of UKMMAS, the JNCC and the Country Nature Conservation Bodies (including NRW) developed a UK Integrated Marine Biodiversity Monitoring Strategy.

UKMMAS also plays an important technical oversight role for several of the key UK marine monitoring programmes such as those delivered by NRW.

Natural Resources Wales Marine Monitoring Programme

Within Wales

NRW's current marine monitoring programme is predominantly driven by the requirements of:

- The Water Environment (Water Framework Directive) (England & Wales) Regulations 2017.
- The Conservation of Habitats and Species Regulations 2017.
- The Marine and Coastal Access Act 2009.

The programme largely comprises:

- Marine Protected Area (MPA) Monitoring - Designated habitats and species features of SACs, SPAs, Marine Conservation Zones (MCZ), and SSSI.
- Water Framework Directive (WFD) Monitoring - Ecological and water quality monitoring of WFD marine 'quality elements'.

It also includes aspects that help deliver specific national programmes of work (e.g. Clean Safe Seas Environmental Monitoring Programme - [CSEMP](#)), or that contribute to partnership working (e.g. Marine Biodiversity and Climate Change - [MarClim](#)). Within Wales the programme also informs wider marine evidence needs, supporting marine planning, management, and regulatory functions for NRW, Welsh Government and their partners.

Monitoring of the Welsh MPAs has been ongoing since 2001 for SACs, and since the 1980's at Skomer Marine Conservation Zone.

Integration

Whilst NRW's marine monitoring is focussed on MPAs and WFD waterbodies, it delivers a strategic programme of marine monitoring to meet the requirements of many UK and Wales level drivers. Where possible, partnership working, monitoring methods, field logistics, assessments and reporting processes have been aligned in order to reduce duplication of effort and improve consistency. This helps ensure a prioritised and efficient approach, 'collecting once, and using many times'.

What do we monitor

- Biological (e.g. species, communities, population dynamics).
- Chemical (e.g. salinity, nutrients, metals, hydrocarbons, pesticides).
- Physical (e.g. temperature, depth, topography, sediment structure, meteorology).

NRW delivers its marine monitoring through a combination of inhouse and contracted out work. A service level agreement with the Environment Agency provides use of a coastal survey vessel for 16 days each month, delivering much of NRW's water quality and seabed sediment sampling requirements.

NRW's marine monitoring programme has been spilt into topic areas which are described below.

Work area 1: Marine Protected Areas monitoring.

The main purpose of MPA monitoring is to determine the condition of each site's protected features and to provide evidence to inform site management. It typically follows common standards monitoring approaches, ensuring consistent and comparable data over time.

Due to resource constraints, only a few of the MPA's have targeted monitoring - most work occurs within Skomer MCZ and five of the marine SACs. Some other MPAs get incidental monitoring, due to overlaps in designation (intertidal areas of SAC are also SSSIs or where there is monitoring for other purposes (e.g. WFD monitoring). WFD monitoring provides significant support to evaluating the condition of MPA features.

NRW's marine monitoring is limited to nearshore waters, within 12nm of the coast. Offshore areas are the responsibility of JNCC who deliver this work on behalf of Welsh Government. E.g. [Croker Slabs SAC](#). Highly mobile species such as birds and marine mammals are typically monitored through national programmes of surveillance (Small Cetacean Abundance in the North Sea ([SCANS](#)), Wetland Bird Survey ([WeBS](#)), Seabird Monitoring Programme ([SMP](#))), but where they aggregate inshore, they may be monitored by NRW (e.g. seal pupping, seabird breeding sites, 'resident' bottlenose dolphins).

Monitoring of the Welsh MPAs has been ongoing since around 2001 for SACs, and since the 1980's at Skomer MCZ. Skomer's marine monitoring programme forms one of the longest running in the UK, and its [surveillance data](#) provides a key point of comparison for changes observed elsewhere (Lock et al. 2022).

To monitor the varied habitats and species of the marine environment, a wide range of monitoring methods are employed. Remote sensing approaches such as aerial imagery and various types of sonar provide broadscale data. Remote sampling such as drop-down video/stills and grab sampling enable detailed community data to be gathered without directly accessing the seabed. In situ recording and sample taking is undertaken by NRW staff intertidally on foot or subtidally whilst diving. In situ recording often comprises, or is supported by, image acquisition, allowing data to be extracted later when time on site is limited (e.g. whilst underwater). Species such as birds and marine mammals each have their own methodology for deriving key population dynamics data. Whilst Earth Observation data enables evaluation of several sea surface parameters, nearshore observations are often confounded by low resolution and the presence of land. Consequently, many near shore monitoring sites have their own fixed autonomous devices that log metrics such as seabed temperature and salinity.

Work area 2: Water Framework Directive Transitional and Coastal waters monitoring.

WFD Transitional and Coastal waters (TraC) comprise transitional (estuarine) waterbodies (WBs) and coastal waterbodies out to 1nm from baselines. WFD 'quality elements' of some waterbodies ('surveillance' WBs) are monitored cyclically to provide an indication of

general health at a Wales level. Other waterbodies ('operational' WBs) are monitored only when elements they support are at risk of deterioration or failure to achieve 'Good' or better status. As there is insufficient resource to monitor all operational waterbodies considered at risk, a prioritisation process is used to select those where risk is highest.

Monitoring approaches for WFD are similar to those for MPA monitoring, though subtidal monitoring is limited to sediment invertebrates. The WFD programme includes a significant water quality component which provides support for MPA assessments. WFD methods are standardised across the UK (and EU) and there has been an extensive programme of indicator development and intercalibration across countries.

WFD waterbodies are assessed every three years and outputs from this classification process are published on WaterWatch Wales. Where a waterbody is failing, investigation may be initiated, which may result in further investigative monitoring.

Work area 3: Partnerships

NRW often works with, or supports, partners in delivering monitoring related work, whether it be field work, investigatory studies, or marine research to improve understanding. A few examples:

Marine Biodiversity and Climate Change (MarClim)

NRW partner with the Marine Biological Association (MBA) to help deliver this project within Wales. It comprises rocky shore monitoring with a focus on climate change indicators. Field work is integrated with our current rocky shore monitoring and the data informs MarClim inputs to Marine Climate Change Impacts Partnership ([MCCIP](#)) reports as well as NRW's MPA feature condition assessments. The MarClim project, now running for many years, has the most spatio-temporally extensive time-series of rocky intertidal systems globally.

Milford Haven Waterway Environmental Surveillance Group (MHWESG)

The [MHWESG](#) is a collaborative group of industry, statutory bodies, and others with an interest in the environmental quality of the Milford Haven Waterway (MHW) in Pembrokeshire. It is part of the MHWESG's purpose to provide high quality environmental information to enable members, other bodies and industry working in and adjacent to the MHW, to contribute to the maintenance, enhancement, and safeguard of the MHW's rich and diverse marine environment. MHWESG contracts out project work to collect field data, collate and analyse data and to provide interpretive reports. NRW (including its legacy bodies) has been a partner since the group's inception in 1992. The estuary is important for its wildlife, industry, and national infrastructure, and the group's outputs provide key information for ensuring sustainable management. NRW maintain an active role within the group and have ensured that its monitoring activities are integrated with our own statutory obligations to avoid duplication of effort.

Sustainable management of UK marine resources (SuMMeR) PhD Studentship

Through its monitoring work, NRW has strong links with academia and has supported multiple research projects and PhD studentships. For many years NRW's marine monitoring team has also hosted a higher education apprenticeship post. NRW is currently

supporting a SuMMER PhD studentship with Bangor University's School of Ocean Sciences, investigating "The effect of anchoring disturbance on seabed ecosystems." Large ship anchoring occurs in several of our SACs, particularly in Liverpool Bay and St Bride's Bay, Pembrokeshire. Monitoring data gathered by NRW (shipping activity, sediment invertebrates) will help support the work. Outputs will help determine the significance of impacts and inform the necessity for, and type of, any management.

Work area 4: Investigations

When monitoring indicates there is a problem, we need to investigate.

Where protected sites or waterbodies are failing to meet their environmental standards, or there is a recognised decline, an investigation is initiated. The purpose of the investigation is to confirm that there is a failure or decline and if so, to determine the reasons. The outputs of the investigation inform the establishment or modification of management measures for bringing the waterbody or protected site back into good status/condition or to restore it to its original status/condition.

Since 2018, 38 investigations of WFD TraC failures have been undertaken, most relating to excessive nutrients and their effects in Welsh estuaries.

There are currently 5 ongoing investigations into MPA feature condition failures, which include declines in maerl, horse mussels, sandbank invertebrates, herring, and sponges. These are currently resourced through the [Nature Networks programme](#) as there is insufficient resource within the team to deliver them.

Work area 5: Local investigations programme

When monitoring indicates there is a problem, we investigate to confirm the issue and, if possible, determine the cause so that any necessary management measures can be identified. This may require the gathering of further evidence which is initiated through a local field investigation. Data may be required to confirm a failure where confidence is low, or to help pinpoint the cause of the failure (e.g. detailed sampling within a catchment to determine the primary sources of nutrient input).

Some examples of field work initiated to support investigations include:

- Nutrient sampling within and adjacent to some coastal lagoons to confirm high levels and identify potential routes of entry.
- Monitoring of bait digging activity, its intensity, frequency, and distribution to inform impact assessment and potential management.
- Sidescan, drop down video and sediment invertebrate sampling to help determine levels of impact from ship anchoring.
- Installation of a turbidity logger to help inform an investigation into the decline of maerl in Milford Haven, silt deposition and reduced light being potential impact pathways.

Work area 6: Development and innovation

It is important for NRW to keep abreast of new approaches to delivering monitoring work. This allows us to improve the quality and volume of the evidence we collect and the efficiency with which it is acquired. Use and development of new analytical approaches allow us to extract new insights from data already gathered. NRW have been at the forefront of method development for both WFD and MPA monitoring and assessment approaches and continue to provide advice on the development of new UK marine indicators.

Oversight of evolving technologies, such as use of mobile devices, Autonomous Underwater Vehicles (AUV's) and Unmanned Aerial Vehicles (UAV's), is maintained and potential uses are tested where appropriate. Collection and analysis of imagery is an essential component of NRW's marine monitoring. Improved image capture equipment is utilised where possible and the potential for image analysis through machine learning has been considered. NRW maintain an active presence on UK groups involved in considering and advising on use of new approaches and technologies (e.g. [UKMMAS Evidence Groups: The Big Picture](#)).

Work area 7: Other evidence needs

Support for other work areas

As part of its monitoring work, NRW also supports the collection of data to help meet other priority evidence needs such as baseline survey, investigatory work, invasive non-native species (INNS), and regulatory compliance.

Environmental Impact Assessment

NRW marine monitoring work includes providing EIA support in the event of a marine pollution incident, such as the rail diesel spill and fire at Llangennech, Carmarthenshire in 2020. NRW chair the Wales Pollution response in emergencies: Marine Impact Assessment and monitoring ([PREMIAM](#)) Coordination Cell and staff are trained in incident response and survey methods such as the Shoreline Clean-up Assessment Technique ([Maritime and Coastguard Agency: SCAT](#)).

Work area 8: Analysis and assessment

NRW analyse and assess the monitoring data it gathers in order to generate useful information. In the marine environment, determining whether the environment is achieving the desired quality is usually based on either the use of well researched environmental thresholds (e.g. Environmental Quality Standards (EQS)) or indicators of environmental (typically anthropogenic) impact or stress.

For WFD, NRW use a suite of well recognised approaches (tools) for determining the status of each WFD waterbodies' quality elements. For example: for macrobenthic invertebrates, the Infaunal Quality Index ([WFD: IQI](#)) incorporates taxonomic diversity and evenness and proportions of sensitive and opportunistic taxa (each compared to minimally disturbed reference conditions) to derive an Ecological Quality Ratio.

For MPAs, data is assessed against a suite of performance indicators in order to determine feature condition. A combination of statistical analysis, analytical tools and set standards are used to determine whether the performance indicator standards are met.

Quality assurance and quality control measures are applied to data prior to assessment and then to the assessment results. NRW subscribes to the NE Atlantic Marine Biological Analytical Quality Control ([NMBAQC](#)) scheme which provides training in taxonomy and recording approaches as well as quality control of marine sediment laboratory analysis.

Work area 9: Reporting

NRW's monitoring data and assessments support a wide range of national and international reporting requirements (e.g. OSPAR, BERN, UKMS, SoNaRR, WFD, Habitats Directive/Regulations). These may be coordinated by NRW or at a UK level through JNCC or UKMMAS.

NRW also reports on the marine monitoring activity it undertakes and the results of data analyses and assessments. These are often published as [NRW marine and coastal evidence reports](#).

Outputs

The combination of MPA, WFD and partnership monitoring provides a wide spatial spread of monitored locations across Welsh waters but with a near shore bias. The bias itself is probably not a bad thing as most pressures occur near or on shore, though the sparsity of some types of monitoring activity away from the shoreline is a concern.

Resource constraints mean that there are WFD waterbodies at risk that are not, or have not, been monitored for the at-risk elements. WFD monitoring levels are just sufficient to provide data confident classification results for those elements at 'highest' risk.

MPA monitoring is the most impacted by limited resources. With relatively low staff numbers for a Wales wide programme, and more costly logistics to access sites at sea, it relies heavily on its delivery budget. With a reduction of over 30% in programme budget since 2012, (> 50% in real terms), only a small proportion of MPAs are monitored. Less than 5% of marine MPA features are monitored adequately, about 17% partially. Spatial and temporal replication in our MPA monitoring is at or close to the lowest limit of acceptability. Condition reporting confidence overall is moderate to poor, though where there is data gathered, it is of good quality and support sound conclusions.

Relevance to GBF target three

Marine monitoring has potentially two main areas of relevance to target three, the first relates to a wider understanding of marine ecosystem health and the second, as with other areas of NRW's protected site monitoring work, to the evaluation of management effectiveness.

Given the national scale of marine monitoring being undertaken by NRW and others, marine evidence already contributes to a national understanding of marine ecosystem health (e.g. through the UK Marine Strategy).

The value and relevance of monitoring for assessment of management effectiveness is expressed through a variety of mechanisms:

- Support of state-dependent decision making – enabling interventions to be adjusted in response to the state of the target species or habitat.
- Evaluating the outcomes of management interventions.
- Communicating the results of management interventions to stakeholders and local communities.
- Ensuring efficient targeting of investments in site management.

UK and international work on the evaluation of management effectiveness breaks evaluation into several components centred around design, adequacy, appropriateness, and delivery.

As with NRW's other areas of protected site work, work on marine sites (covering monitoring **and** management) has the potential to directly align with several of the criteria for evaluating management effectiveness. (Table 1).

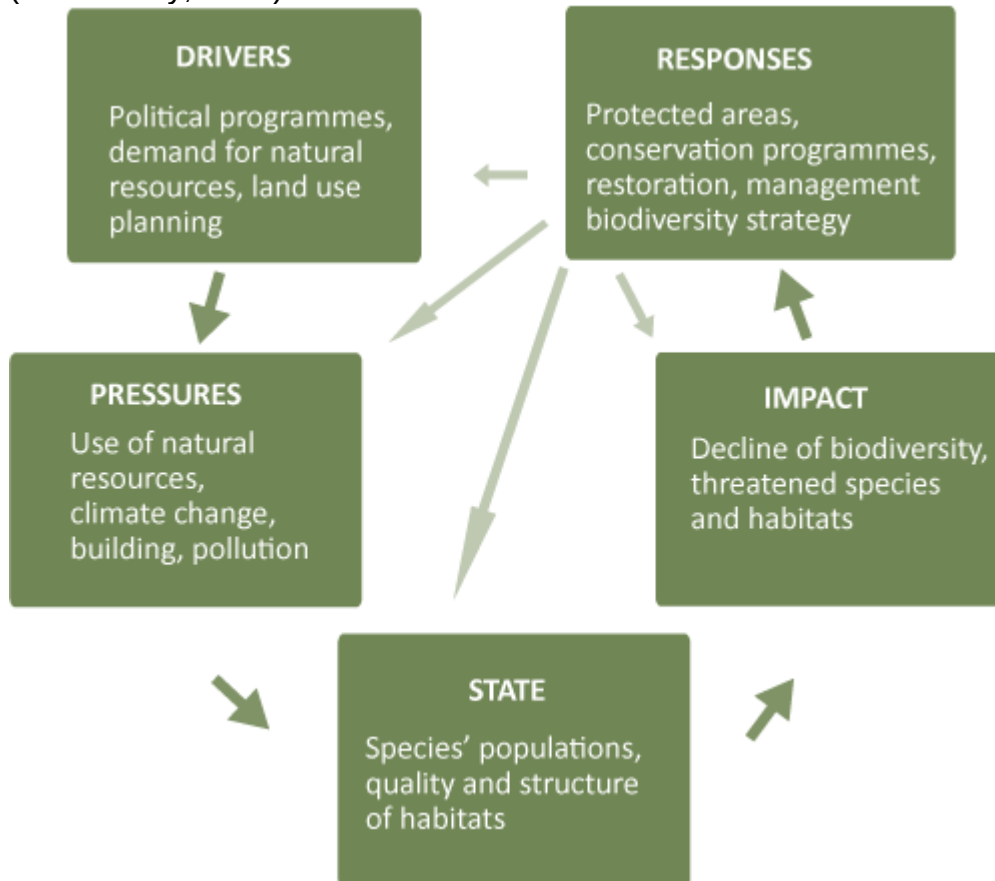
Table 1: Broad metrics required to evaluate management effectiveness.

Metric	Notes on NRW relevance
Is management information on the protected or conserved area available?	NRW has information available on the availability of management plans, conservation objectives and governance arrangements. Broader information is also available providing the underpinning approach to site selection and notification.
Are management measures implemented for the area to achieve its objectives for conservation?	NRW has collated information on management measures / actions. These could be available and tracked to monitor which have been acted upon.
Does monitoring take place which helps to assess progress towards achieving conservation outcomes?	NRW does undertake monitoring to determine progress towards conservation outcomes. However questions remain over the frequency and spatial scale of the activity.
Is the area achieving its conservation outcomes?	NRW's monitoring collects data to allow progress towards achievement of ecological conservation outcomes to be assessed. The monitoring however largely focusses on determining the condition state of the feature rather than the trajectory of response to management i.e. generally report favourable/unfavourable categories rather than unfavourable: recovering or declining etc.
What is the level of confidence in the data used to assess progress towards outcomes?	NRW's evidence is structured and assessed in a manner which enables a confidence rating to be applied to the monitoring evaluation.
Confidence in achievement of conservation outcomes	In NRW monitoring focusses on the assessment of a range of features found on a site rather than the assessment of the overall state of a site. Collated evidence for all the features on a site would then allow an overall evaluation of the degree to which a site is achieving positive conservation outcomes. Targeting assessments to those features driving site management could also provide a general level of information for management outcomes.

Annex 5 – Sustainable Management of Natural Resources (SMNR) principles. (Source: [NRW SMNR](#))

Principles of sustainable management of natural resources		
	Adaptive management	manage adaptively by planning, monitoring, reviewing and where appropriate, changing action
	Scale	consider the appropriate spatial scale for action
	Collaboration and engagement	promote and engage in collaboration and cooperation
	Public Participation	make appropriate arrangements for public participation in decision-making
	Evidence	take account of all relevant evidence, and gather evidence in respect of uncertainties
	Multiple benefits	take account of the benefits and intrinsic value of natural resources and ecosystems
	Long term	take account of the short, medium and long term consequences of actions
	Preventative action	take action to prevent significant damage to ecosystems
	Building resilience	take account of the resilience of ecosystems, in particular the following aspects: (i) diversity between and within ecosystems; (ii) the connections between and within ecosystems; (iii) the scale of ecosystems; (iv) the condition of ecosystems (including their structure and functioning); (v) the adaptability of ecosystems

Annex 6 – Drivers, Pressures, State, Impact, Response (DPSIR) model. (Biodiversity, 2014)



Annex 7 – Effective Management Evaluation.

Effective management evaluation

The assessment of management effectiveness is seen as a key area for development given the need to address the greater diversity of management systems in place when considering OECMS in addition to the more familiar protected sites (i.e. SSSI, SAC and SPA). The IUCN recognise the diversity of protected areas means one system of assessment is unlikely to fit all circumstances and needs to be tailored to the management systems in place. However, management effectiveness evaluation does have a range of common elements and processes that can form the basis of an assessment system.

Evaluation is seen as more than just an assessment of activities and outcomes but an assessment of the extent to which management is protecting values and achieving goals and objectives. It is seen as encompassing elements of governance, design, and planning.

On land and sea protected sites are generally supported by a range of management steps and processes involving management statements, conservation objectives, management

plans and management agreements. These are supported by an element of compliance monitoring and more limited condition monitoring.

OECMS may potentially not be supported by the same range of documentation or systems as for protected sites. Any assessment processes need to accommodate such differences but enable a common effective and achievable mechanism to evaluate delivery across the board.

Proposed approach

The evaluation of management effectiveness is an active development area at national and international levels. Whilst the expert monitoring group did not have the resources to undertake a full review of approaches, it was noted JNCC/Defra were already working on the topic looking at the current range of options (e.g., IUCN Green List Standard, Management Effectiveness Tracking Tool, Integrated Management Effectiveness Tool) and had developed a recommended indicator.

The work by JNCC to date has led to the development of the Management Effectiveness of Protected and Conserved Areas (MEPCA) Indicator ([JNCC MEPCA Development](#), 2023). An administratively light approach to evaluation adopted as a complementary indicator under the GBF monitoring framework.

Pending further testing and the final publication of guidance (to be published by March 2024), the adoption of this approach was recommended as a preliminary approach for evaluation in Wales.

Core elements of MEPCA:

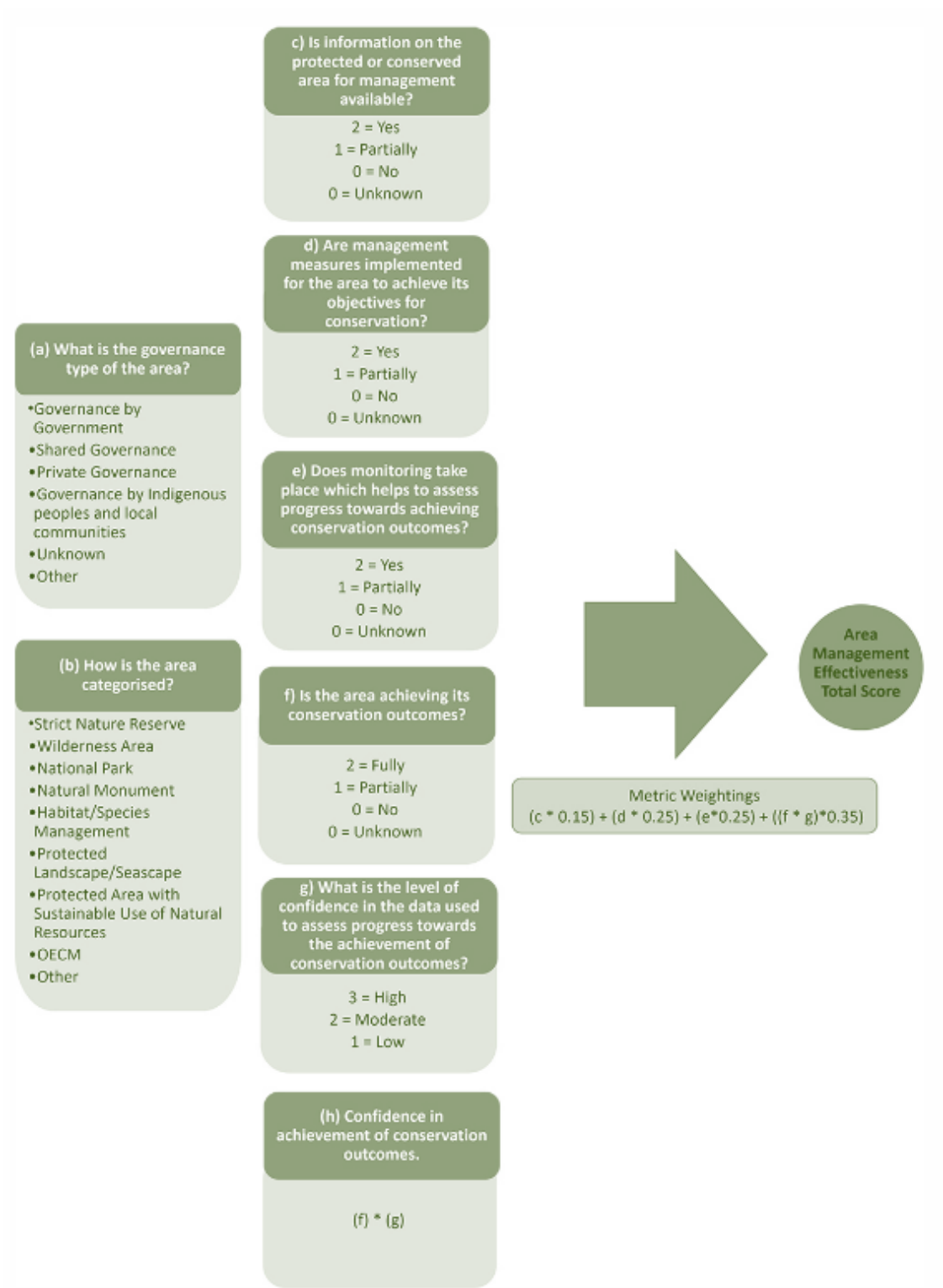
- A simple assessment system designed to accommodate a diversity of site management systems across protected sites and OECMS. Data providers should have different options available based on their level of capacity, availability of information and the level of detail they are willing/able to share.
- A standard simple set of questions supported by definitions and guidance which limit the reporting burden on data providers.
- Designed to feed data into the GBF reporting mechanism ([Protected Planet: World Database on Protected Areas](#)).
- Accommodates different levels of evidence used to support assessments.
- Captures consideration of uncertainty in evidence.

The MEPCA framework:

The metric uses a set of questions (Fig 2: a-h below), with scored responses that are then weighted to produce an overall management effectiveness score. The areas evaluated are designed to reflect the dimensions of good (including equitable) governance, sound design and planning, and effective management¹.

¹ Recognized by CBD Decision CBD/COP/DEC/XIII/2, <https://www.cbd.int/doc/decisions/cop-13/cop-13-dec-02-en.pdf>

Figure 2: MEPCA scoring approach (JNCC, 2023).



How does MEPCA address the evidence needs?

- The proportion of protected areas (SAC, SPA and SSSI) under effective management.
Once a value is defined which enables a score to be converted to a category (i.e., if the site is effectively managed), then the metric would enable reporting of this proportion.
- The proportion of protected areas not currently under effective management but on a pathway to achieving effective management.
Changes to the scoring will allow tracking of improvements in delivery over time – enabling ‘improving,’ ‘deteriorating’ or ‘stable’ type categories to be determined.
- The proportion of OECMs under effective management.
As with protected areas, OECM reporting would be possible.
- The proportion of candidate OECMs not currently under effective management but on a pathway to achieving effective management.
As with protected areas, OECM reporting would be possible

Next steps for management effectiveness evaluation:

Given the timescale to make recommendations and the continuing refinement of the MEPCA indicator guidance. The group recommended the testing of the metric via a series of Welsh case studies to explore application, resource implications, reporting, and handling of the evidence required to support assessments in comparison with a range of other approaches.

Annex 8 – The potential role of Earth Observation in delivery of target three metrics.

EO was seen as having cross cutting potential for a number of metrics (connectivity, effectiveness evaluation and landscape level assurance).

Earth observation (EO) data have considerable potential to support plans and actions towards the GBF targets. Both airborne and spaceborne sensors have been in operation for many decades (increasing in number and frequency of observations since the 1950s) and have provided data at local to global scales at spatial resolutions ranging from less than 1 m to over 1 km. The frequency of acquisitions is variable but has generally been greater (typically sub-daily) for coarser and least for moderate to fine spatial resolution sensors. However, multiple sensors of the same or similar type (e.g. Copernicus Sentinel-series, CubeSats) are increasingly providing weekly to near daily observations at submeter resolution.

These EO sensors operate in different regions of the electromagnetic spectrum and hence have capacity to interrogate environments in two and/or three-dimensions. Of particular relevance to 30 by 30 are optical sensors, including those mounted on drones, which record sunlight reflected from surfaces and provide information on the surface materials as well as change (e.g., in health and dynamics). When captured in stereo, these data can be used to generate three-dimensional surfaces of land covers. Radio Detection and Ranging (Radar), which operates across a range of frequencies, is also important as this sensor type provides cloud-free observations and information on the geometry, moisture content, and size of landscape components and surface elevations. Light detection and ranging (LIDAR) measures the time and hence distance of light transmission and can quantify, with high fidelity, terrain surface elevation and the vertical and horizontal distribution of materials (including vegetation). Whilst data from individual sensors alone can be useful, the capacity to quantitatively describe the varying states and dynamics of environments is increased substantially when they are used in combination.

In terms of GBF target three, there are three key emerging questions that EO has potential to help answer:

- 4) How can EO data, in combination with contextual information and modelling, help us better understand and quantify the health/function of ecological networks, protected sites and Other Effective area-based Conservation Measures (OECMs) in terms of their achievement of conservation outcomes at the national scale?
- 5) How can EO data and derived products help inform the understanding of protected area performance at the site level and target interventions at the site, local or network level?
- 6) What is the potential cross cutting role for EO data in supporting the range of GBF targets?

Biodiversity

Distributions, abundance, and richness

For Wales, most assessments of biodiversity have historically been based on field surveys by experts/semi-experts or observations contributed by volunteers (e.g. using apps such as iNaturalist). The volunteer based national surveillance programmes led by JNCC are a major contributor to the understanding of Welsh and UK trends across a range of biodiversity interests. Other data sets are collated through non-governmental organisations (NGOs) or Local Environmental Record Centres (LERCs) and stored and hosted in centralised archives (e.g. the [National Biodiversity Network Atlas](#)).

Over the past decades, habitat, and species assessments (primarily of flora) have largely been undertaken using field surveys, with resulting mapping undertaken by referencing these observations to primarily manual delineations from very high-resolution imagery (primarily aerial photography). Through this effort, Wales has acquired extensive records of biodiversity over extended periods of time.

In addition, mapping and recording of biodiversity (including plants, birds and pollinators) has also been carried out on a sample basis within 300 1 km squares across Wales as part of the Glastir Monitoring and Evaluation Program (GMEP), set up in 2013-2016, with this repeated under the auspices of the Environment and Rural Affairs Monitoring and Modelling Programme (ERAMMP) over the last four years. These campaigns have provided data on species presence and abundance, excluding the rarest species, with detailed records having a high locational accuracy allowing these to be referenced to specific areas (e.g. individual habitats).

Environmental states

At the protected site level, and primarily through ground observations, Common Standards Monitoring' (CMS) assesses the condition of a specific species or habitat feature in terms of a range of indicators (e.g. extent, population, structure, composition) with reference to a desired state so as to provide a common, UK-level approach. However, the condition of many protected sites across Wales is unknown as some recent assessments or updates have not been undertaken.

At a national level, the Favourable Conservation Status (FCS) approach has been established as a means of assessing whether species and habitats, as an integral and functioning component of ecosystems, are being maintained in the long-term. These FCS assessments take account of a number of variables (e.g. range, extent, structure/function, future prospects) assessed against a set of reference values, with these again determined largely at the ground level.

Connectivity and biodiversity

The semi-natural elements of the Welsh landscape have become highly fragmented, with this impacting on biodiversity and movement of species. To address the need for assessing connectivity (past, current and future), Priority Ecological Networks (PENs) have been developed for a number of Welsh habitats with these allowing priorities for habitat retention and maximise connectivity between different habitat types and areas to be established. These also allow planning of actions that could be put in place to retain biodiversity and increase the resilience of protected sites as well as OECMs. PENs have yet to be developed for the full range of habitats in Wales (e.g. freshwater).

Temporal aspects

A limitation of many products relating to habitats is that the temporal dynamics within and between years is not well represented (if at all) and there is limited or no capacity to detect and quantify the change. This is principally due to the increased level and type of evidence required to quantify temporal change compared to assessments of range and state. Biodiversity across landscapes varies over multiple temporal scales, and this can be in response to temporal changes in the extent and/or condition of habitats driven by human and/or natural pressures (including climatic fluctuation). Within these habitats, temporal variations in species also occur. For example, many fauna species are resident, whilst others (e.g. bird, insects) migrate (e.g. to overwinter), and some species only become apparent at certain times of the year (e.g. early emerging butterflies and fungi). Often these habitats act as staging posts along migration pathways, which can include those between the UK and Ireland as well as more globally. Hence, the role of different habitats will change depending on whether they are used for feeding, breeding and/or roosting for

fauna or provide a temporary or permanent niche for flora. Over longer timescales, climate change-induced shifts in the range and condition of both species and their supporting habitats are anticipated (and are already evident) and these need to be addressed when planning for biodiversity conservation and recovery.

Earth observations

Environmental descriptors, land cover and habitats

Earth observations are commonly used for retrieving or classifying environmental descriptors (e.g. vegetation height or plant species composition), which alone can be used for assessing biodiversity. Many can be retrieved or classified from Earth observation data and, particularly when associated with defined units (e.g. m, %, time) or categories (e.g. species codes), can be combined to construct and describe land covers using well-established taxonomies. A notable example of these is the Food and Agriculture Organisation (FAO) Land Cover Classification System (LCCS), where environmental descriptors can be defined as those that are overarching or essential. Overarching descriptors are used to define broad land covers (agriculture, semi-natural vegetation and artificial and natural bare surfaces and water) and include the fractional cover of photosynthetic or non-photosynthetic vegetation (%), water hydroperiod (time) or classified urban extent (e.g. from radar). Essential descriptors are required to generate, in part or fully, the FAO LCCS classes (approximately 12,000 in total, with each having biophysical meaning). These include lifeform (woody, herbaceous), leaf type (broadleaf/evergreen), vegetation phenology (deciduous, evergreen), and annual water hydroperiod. Once defined and mapped, more detail can be added by integrating what are termed here as additional descriptors, with examples being above ground biomass, crop type, dominant species or community and contextual information such as peat depth, geology, and soil acidity. These additional descriptors often provide the information needed to translate land cover to habitat maps. Whilst EO data can be a primary source, other datasets can be included such as those generated through fauna or flora species distribution models or hydrological models.

Many descriptors, singularly or in combination, can also be associated directly with biodiversity, particularly where species have specialised requirements, although more generalised distributions are less easy to discern. For example, flora and fauna can be associated with (as examples) bracken, gorse, broadleaved woodland, or open water, which are habitats that are directly translated from land cover. However, often additional information is needed (e.g. biomass as one indicator of the condition of habitats, including over time-varying periods), to better understand how biodiversity is distributed. Other descriptors have more indirect but important links with biodiversity, with these including Net Primary Productivity (NPP), which has a strong unimodal relationship with plant species richness (which forms one component of biodiversity) and potential modellable links to soil function, carbon, and health. Descriptors relevant to biodiversity can further be generated through spatially explicit models that predict distributions and abundance of individual or groups of species, genera, or habits (e.g. frugivores) or representations of these (e.g. heatmaps summarising species richness). When effectively parameterised and evaluated, such models can be used to identify how biodiversity, in its various forms, might move into new habitats however temporary, or those that have been restored following

previous losses. Collectively, this information can be used to populate calculators for biodiversity in the past and future under a range of scenarios, establishing whether there have been declines or increases in populations or these have remained stable.

If a strict condition that all environmental descriptors have predefined units or categories is maintained, maps of land cover (and also change) can be generated from these across space and time. This presents considerable advantages as land cover and change information can be obtained and scaled from environmental descriptors observed or sensed on the ground (e.g. by cameras or ground-based lidar), or retrieved/classified from drones, aircraft or spacecraft sensors operating across a range of modes (optical, lidar, radar or thermal). Furthermore, assessments can be undertaken (if data are available) in the past, present and future, noting that the earliest useable satellite observations are generally regarded as those acquired by the Landsat series of sensors (from the mid-1970s onwards) although aerial photographs are also a useful source of information.

Change

Over decades, both from the ground and remotely, multiple approaches to classifying and describing change have been proposed and/or used. However, these often focus on one or several natural events or processes or human activities and rarely consider those that may occur sequentially or simultaneously including historically. For this reason, more consistent frameworks are required. A relevant framework developed to address this limitation is the Evidence Based Change Framework and Global Change Taxonomy, which builds on the Driver-Pressure-State-Impacts-Response (DPSIR) framework (Fig 1) and lists 77 impact and 144 pressure classes that give 248 'impact (pressure)' classes when combined. Each of these can be discerned from changes in states (which directly link to Environmental Descriptors) and hence can be mapped using evidence including that obtained from EO data or other spatial datasets.

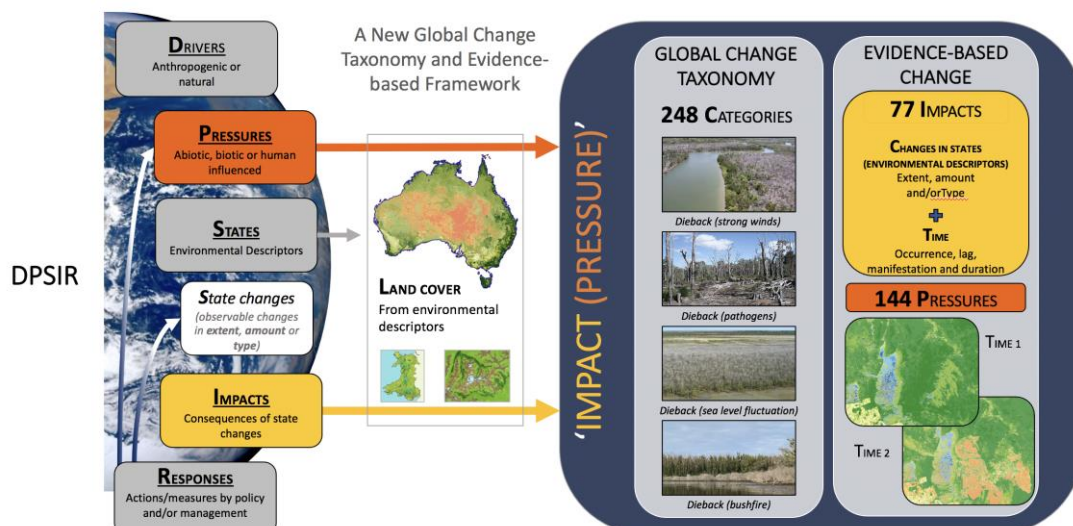


Figure 1. The Global Change Taxonomy and Evidence Based Change Framework that builds on the Driver-Pressure-State-Impacts-Response (DPSIR) framework.

Relevance to Wales

Past and current assessments of habitats

The capacity to generate consistent datasets on land cover, habitats and change across the Welsh landscape provides a valuable source of information for assessing past and present distributions of biodiversity. For 30 by 30, knowledge of the changing extent and condition of land covers and habitats over at least the past 40 years, including sub-annually, is desirable as this can inform where human activities or natural events and processes (including those associated with a changing climate) might have contributed to losses or gains in biodiversity. In this context, condition is a collective term for “quality that is benchmarked against a pre-determined goal or target and helps inform the level of concern implied by an impact on (i.e., a change in) the amount, extent and/or type of something, and is usually derived from a number of indicators rather than a single measure of change”.

Earth observation data uniquely allow changes in land cover and habitats to be observed and mapped over time-periods ranging from days to decades. The Copernicus Sentinel-1 and-2 sensor data are available from 2017 but there are cloud-free Landsat observations of all of Wales acquired on several dates as early as 1985 and these can be used to generate a reasonable baseline of land cover (and potentially habitats) for this year against which to assess change occurring in subsequent years. This period of satellite observation aligns broadly with that of the original Phase 1 Habitat Survey and so there is potential to evaluate this effort in the context of satellite observations.

Relationships with biodiversity

Earth observations have rarely been used to support the assessment of biodiversity, largely because most flora and fauna cannot be directly observed in remotely sensed imagery. However, there is capacity to associate mapped classes with elements of biodiversity (e.g. bracken) but also to spatially estimate/model the distribution of species or communities across the national landscape and, over time, to broadly capture distribution, abundance, and diversity at different scales (e.g. alpha, beta, gamma). In particular, environmental descriptors can provide input to species distribution models (see Fig 2) that are informed by biodiversity records. In addition to mapping actual (current) and past distributions, these models can be used to generate maps of potential (future) distributions under different scenarios, thereby informing and contributing to rigorous and robust mapping of future landscapes and associated biodiversity (with explicit uncertainty levels). Importantly, several environmental descriptors combined can capture the changing structure (height and cover) and biomass of vegetation, with this providing three- and four-dimensional inputs to these models. Models might also be applied to better convey the changing nature of landscapes within and between years, including through descriptions of physical structure and diversity of structures, and how these impact on resident and/or migratory species.

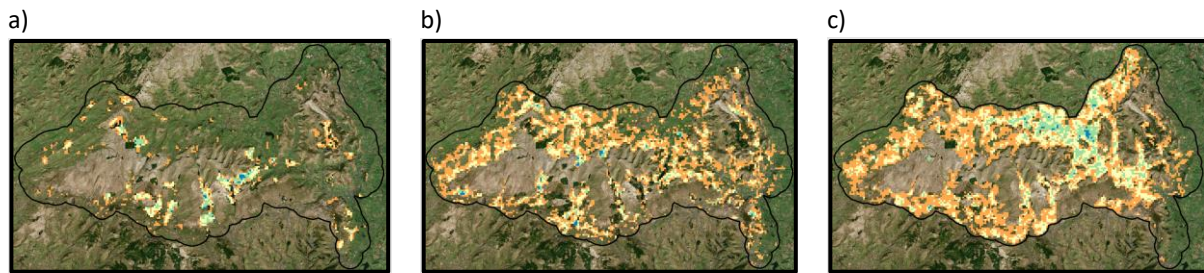


Figure 2. Predictions of a) Nightjar, b) Pied Flycatcher and c) Tawny Owl distributions generated using the MAXENT SDM with Living Wales' environmental descriptors as input.

Future landscapes

An option to facilitate further enhancement of biodiversity and promote recovery is to suggest ecologically plausible future landscapes that may be optimized for achieving 30 by 30 goals. This can be achieved by considering current states, imagining future landscapes, harmonising views to arrive at co-designed plans, estimating the value of these for people and nature (including biodiversity), assessing the realism of ambitions through reference to past change but also modelling, identifying risks (e.g. from climate change, pests, and disease) and assessing resilience. Many of these aspects can be addressed through EOs. Monitoring progress towards ambitions can then be undertaken and future changes (impacts and driving pressures) affecting progress better evaluated.

As well as addressing biodiversity, climate change mitigation and sustainable land management are key 30 by30 goals that are relevant to future targets and ambitions. National and international efforts are focusing on developing spatially explicit ecosystem service provision as well as economic and environmental accounting (e.g. through the European Environment Agency Natural Capital Accounting Practices and United Nations System on Economic and Environmental Accounts). In this regard, EO data can be used to support valuing of environments (e.g., in terms of carbon, vegetation condition, water quality) and associated decision-making, learning and policy development.

Current Earth Observation based mechanisms and capability for meeting 30 by 30 needs

The MEPCA Indicator Framework

One component of assessing progress towards achieving target three is the Management Effectiveness of Protected and Conserved Areas (MEPCA) Indicator framework, which has been proposed and is under consideration by Welsh Government. Within MEPCA, the following metrics (E, F and G) can be assessed using Earth observation data and derived products, either fully or in part:

Metric E ('Is ecological/environmental monitoring taking place?') in its entirety, by providing robust, replicable, and routine monitoring of habitat extent and condition (e.g. in terms of biomass, water hydroperiods, broad plant community composition), describing and quantifying change impacts and pressures over varying timeframes and measuring and monitoring conservation indicators.

Metrics F and G ('Is the site achieving its conservation objective?' 'What level of confidence is associated with achievement of conservation objectives?'), by providing environmental descriptors, land cover, habitat and change products with associated estimates of uncertainty. Where daily to weekly observations are provided, there is capacity to identify and monitor changes when (or close to when) they occur, highlight issues and problems when they arise (enabling faster responses to changes such as that associated with extreme weather events and recovery from these), track progress and assess and appropriately respond to risk (e.g. fire frequency and severity).

GMEP/ERAMMP

The Glastir Monitoring and Evaluation Programme (GMEP) and Environment and Rural Affairs Monitoring and Modelling Programme (ERAMMP) have collected and collated a large quantity of current and historical field-based data on species (flora and fauna), including from within 300 x 1 km Countryside Survey squares across Wales. The GMEP/ERAMMP data provide considerable scope for interpolating and upscaling a range of field-based indices of habitat condition, state and function and their use builds credibility and relevance to monitoring and modelling activities. In relation to EOs, they can be used to establish relationships with environmental descriptors and land cover obtained from airborne or spaceborne data as a basis for modelling the distribution of flora and fauna species and soils. The wealth of species-level records can also be used to explore novel measures of ecological complexity and evaluate resilience-relevant contributions (including diversity and condition) that can be linked to EOs and inform efforts towards increasing habitat connectivity in support of 30 by 30.

Welsh habitats have been subject to agri-environment scheme intervention going back to the first Environmentally Sensitive Areas in the mid-1980s. Using the combined power of habitat extent and condition models, a key deliverable within the ERAMMP program will be to try and quantify the impact of the most recent agri-environmental schemes and build in legacy scheme uptake, gaining discriminating power where evidence of longer scheme duration can be applied as an explanatory variable. This knowledge can inform whether land in agri-environment management has actually delivered desired ecological outcomes over varying lengths of time, particularly if used in conjunction with time-series of EOs. However, this is only likely to be possible for particular bundles of high uptake options whose aims and actions on the ground are sufficiently similar across schemes.

Living Wales

'Living Wales' was initiated in 2018 with the vision of routinely and consistently capturing the state and dynamics of Wales' landscape, in near real time, historically and into the future (over the long-term) through integration of primarily open EO data. 'Living Wales' has been a major developer of and contributor to 'Living Earth', a globally applicable system that constructs land cover maps from environmental descriptors retrieved or classified from Analysis Ready satellite Data (ARD), translates these to national habitat taxonomies directly from land cover or through reference to other descriptors (e.g. dominant species type) or contextual information (e.g. presence of deep peat, geology), and detects and describes change based on evidence. Throughout, 'Living Earth' has utilised and/or developed globally applicable frameworks for classifying land covers (i.e. Food and Agriculture Organisation (FAO) Land Cover Classification System (LCCS)) and

detecting, describing, mapping, and monitoring change (using the Global Change Taxonomy and Evidence-Based Change Framework). As part of 'Living Earth', 'Living Wales' has been implemented within the Welsh Data Cube (WDC), which provides access to the entire archive of Sentinel-1 radar and 2 optical data and derived products (i.e., derived environmental descriptors, land cover, habitat and change) from 2018 onwards and has capacity to bring in the Landsat archive given all images are available as ARD.

'Living Wales' is well suited to support the assessment of biodiversity in existing and proposed protected areas as well as the wider landscape. In particular:

- The FAO LCCS categories mapped by 'Living Wales' align with many habitat classes in national taxonomies, including the Phase 1 Habitat Taxonomy for Wales, noting that more detail and hence discrimination can be added by integrating often well-established contextual information (e.g. peat depth) as well as new or improved environmental descriptors.
- The existing maps of land covers and habitats provided through 'Living Wales' can be used to better explore and understand past and current connections between habitats within and outside such focus areas.
- Through the use of environmental descriptors and land cover/habitat maps generated from these, 'Living Wales' provides generic capacity for quantifying many conservation objective indicators and generating temporal estimates of habitat area (actual and proposed) for regions of interest selected by users (e.g. individual farms, protected areas (SSSIs) or individual or combinations of PENs) (Fig 3). These data can also be used to establish the temporal characteristics of best-state ecosystems and habitats.
- 'Living Wales' provides unique capacity to monitor annual, seasonal, and habitat-specific changes across landscapes and offers the opportunity to explore population-scale trends, dynamics and patterns and develop methods for monitoring in relation to single- or multispecies conservation planning or programs. For example, the spatial location of opportunistic niches (e.g. for nightjars on cleared forestry plantations) can be used to predict trends in habitat use.
- The products generated by 'Living Wales' can be used (through the WDC and also linking with other platforms) to establish whether past management and outcomes have been effective, inform future plans and policy decisions, and monitor progress towards ambitions over varying time frames (potentially daily to multi-annual depending on the availability of EO data).

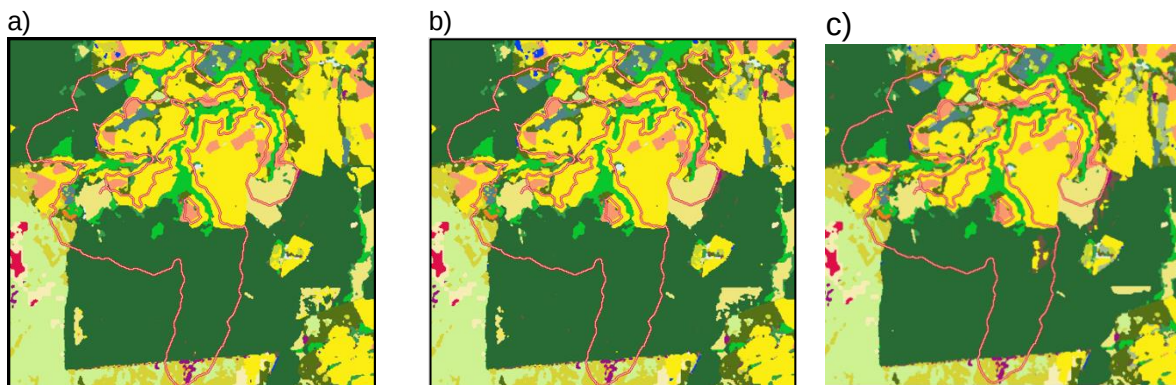


Figure 2. The *Living Wales* Habitat Map for a) 2020, b) 2021 and c) 2022 for north-eastern Brecon Beacons overlain with the PEN based on connectivity between woodland areas (dark green).

- The land cover, habitat and change maps generated by 'Living Wales' can also be used with field observations of soil and habitat condition and biodiversity (such as those generated by GMEP/ERAMMP) to develop models that hind- and forecast habitat-specific ecological indicators and spatio-temporal evaluation of landscapes. These can then contribute evidence on the past, current and potential presence in and use of habitats by species, thereby informing on the effectiveness of actual and proposed land management actions across Wales.
- 'Living Wales' also has a significant role to play in upscaling impact-state-response relationships derived from field observations, for example via testing whether effective management under AES has resulted in greater detectable reductions in measures of ecosystem function (e.g. Net Primary Production) compared to areas not subject to AES intervention of the same kind but where baseline habitat and condition have largely remained the same.
- 'Living Wales' is introducing new capacity to retrieve/classify or use environmental descriptors relevant to inland (freshwater), coastal (intertidal) and marine waters, including water surface, water columns and benthic environments, and provides a connection to change processes occurring on the terrestrial surface.

Other contributions and Earth Observation linked considerations

Very High Resolution (VHR) Imagery

Consultation with land managers in Wales has highlighted that, whilst national mapping (e.g. through 'Living Wales') is currently undertaken is at 10 m spatial resolution, the assessments of biodiversity, habitats (e.g. hedgerows, ditches) and change (e.g. stream erosion) need to be taken at finer spatial and temporal resolutions. This can be achieved by integrating the recent and previous national (1-2 m) lidar coverages as well as 3 m Planetscope and also other very high-resolution datasets (e.g. Worldview, Planet Skysat) provided that relevant environmental descriptors can be retrieved. Such information can still be represented (e.g. in 'Living Wales'), with information accessed and displayed in parallel to coarser resolution land cover, habitat and change products. However,

consideration needs to be given to the cost and viability of using these VHR data, noting that a substantive resource has already been funded.

In situ data

Citizen scientists can offer a valuable source of environmental records on fauna and flora species, including supporting the projection of trends such as priority species associated with the Well-being of Future Generations Indicator 44 (Status of biological diversity) in Wales. In general, only the location of a species by type is recorded and the capacity for recording land cover, habitats or change is often limited. By contrast, the Earthtrack app (developed as part of 'Living Earth') facilitates in situ recording of land cover, habitats (according to the Phase 1 Habitat taxonomy) and change (according to the FAO LCCS and Global Change Taxonomy) as well as plant species (dominance of up to three species through different strata as well as indicators). Data collected from Earthtrack are openly available (as and when acquired) and can be used to verify products generated from EO data. However, a combination of sampling strategies that are active (e.g. using randomised stratified sampling) and passive (e.g. ad hoc collection by volunteers) is needed noting that there may be issues with reliability and/or uneven spatial distribution of records. Moreover, some records require external information (e.g. contextual layers) and/or knowledge (e.g. context) that may be outside of the expertise of contributors.

Users

Engagement with a wide range of users on the use of EO with other datasets is considered an essential contribution to addressing and fulfilling 30 by 30 targets, which can be achieved by providing direct and open access to airborne and satellite sensor data, derived products and relevant tools (e.g., mobile applications), increasing capacity within open analytical systems to explore and process these data and analyse for specific focal areas, and generating timely and effective communication materials and avenues. An example relevant to Wales is ['Living Wales' Living Earth Hub](#) and the Earthtrack mobile application.

Conclusions and recommendations for Earth Observation development.

Earth observations can play a key role in informing on the changing states and dynamics of past landscapes and how these have impacted on the different facets of biodiversity. Furthermore, this information can be used to better understand where and how past activities or natural events or processes have benefited or been detrimental to biodiversity and hence inform future responses. These data also provide a unique opportunity to help address the requirements and ambitions of 30 by 30. In particular, once tested and validated they have the potential to:

- Establish the extent and condition of some habitats and via modelled relationships, do the same for some aspects of associated biodiversity. Over time, these products could inform on the health and function of ecological networks and protected sites as well as conservation outcomes from local to national scales.

- Furthermore, the success of otherwise of measures put in to protect and restore landscapes can be better evaluated, although reference to field observations will be needed.
- Earth observations can also play a key role in planning land management and assessing and evaluating policy, including that relevant to the GBF targets.

Recommendations for going forward need to be developed at future group meetings but one that is key is to undertake targeted demonstration (e.g., test cases) and exploration of EO data to provide real examples of where these can make the most effective contribution towards the 30 by 30 target.

Annex 9 – Enhancing biodiversity through equitable governance: A focus on GBF target three in Wales.

Introduction

The urgency to halt biodiversity loss globally has never been more critical. To address this challenge, the GBF has emerged as a beacon of hope, with specific targets designed to restore and safeguard the natural world. One pivotal component is target three, aiming for the conservation of 30% of terrestrial and marine areas by 2030. However, achieving this target effectively demands the integration of equitable governance (EG) across all planned activity. This paper explores the relationship between EG and evidence and monitoring for biodiversity conservation within the Welsh context, emphasising the transformative potential of EG in realigning societal interactions with nature.

Overview of equitable governance for evidence and monitoring

Equitable governance in the context of monitoring and evidence refers to the fair and just use of data, surveillance, and evidentiary support in the decision-making processes within organisations, governments, and communities.

Equitable governance transcends conventional governance frameworks by mandating fairness and inclusivity in decision-making processes. Within the context of biodiversity monitoring and evidence approaches, EG ensures that the impacts of such activity on all sectors of society, including indigenous and local communities, local stakeholders as well as the underrepresented.

This approach recognises the intrinsic link between human societies and natural ecosystems, advocating for an approach to evidence and monitoring that respects cultural, social, and ecological variance.

The intersection of equitable governance and GBF target three

For Wales, the application of EG in biodiversity conservation initiatives presents unique opportunities and challenges. The nation's rich cultural heritage, diverse landscapes and commitment to Wellbeing for Future Generations Act necessitate a tailored approach to evidence and monitoring to support target three. One that collaborates with and advocates

for all sections of society, respecting local, regional, and national ecological systems whilst seeking out opportunities to include wellbeing co-benefits for all.

Role of indigenous and local communities (evidence and monitoring)

The definitions surrounding 'indigenous' and 'local community' within the United Nations framework underscore the importance of self-identification and cultural continuity in conservation. For Wales, this means acknowledging the diverse socio-cultural makeup of the whole of its population and integrating this understanding into conservation strategies and the approaches to evidence and monitoring needed to drive and support change.

From an evidence and monitoring perspective, the group noted the increasingly important and growing contribution to achieving EG by the growing numbers of local communities who record and report their wildlife sightings. At present we have a baseline of 20 million biological records, but this is the tip of the iceberg for what is possible to achieve through a continued commitment to Citizen Science. The group also considered the value in the use of the phrase 'Community Science' as having more appeal to communities. Some ideas were suggested regarding the value of working in the space of Biocultural community protocols whereby local decision making is emphasised e.g. Local Nature Partnerships. Biocultural protocols are also 'internal' governance tools to regulate equitable benefit-sharing amongst communities and reduce conflicts associated with access and benefits sharing agreements.

Finally, the importance of recognising unsung contributions was voiced. For example, in Wales, there are instances where areas of high biodiversity are conserved by individuals outside of formal government programmes. Equitable governance necessitates acknowledging and incentivising these contributions, perhaps through a recognition system or alternative support mechanisms that validate the efforts of these dedicated conservators who wish to sit outside of formal systems. This approach respects the autonomy and expertise of local land stewards and acknowledges conservation efforts happening outside governmental purview.

What does good equitable governance look like with regards to evidence and monitoring?

Key components of equitable governance include:

- **Inclusivity:** Ensuring participation of all individuals, regardless of race, ethnicity, gender, sexual orientation, economic status, or other social identifiers in data collection where appropriate. This often means providing platforms for the voices that may have traditionally been silenced or ignored, thereby allowing for more representative decision-making.
- **Transparency:** Actions and decisions taken by governing bodies should where possible and appropriate be clear and accessible, so that people can understand what evidence is being collected and why. This helps to build trust within communities and ensures that actions are taken for the benefit of all.
- **Accountability:** Equitable governance requires mechanisms for accountability where leaders are answerable for their actions and there are clear repercussions for decisions or actions that can contribute to inequity in evidence and monitoring.

- **Responsiveness:** Policies and leadership should be responsive to the needs and concerns of all individuals, especially minority or marginalised groups. This requires ongoing dialogue and engagement with communities to understand where and how evidence and monitoring whether technical, social or both should be considered
- **Empowerment:** Providing individuals and communities with the resources, knowledge, and power they need to encourage participation in data collection, evidence generation, and monitoring where appropriate.
- **Collaboration and Partnership:** Working in collaboration with different stakeholders, groups, and communities ensures a multi-perspective approach to decision-making regarding evidence and monitoring.
- **Scaling and Local Engagement:** Equitable conservation operates at multiple scales and requires tools for understanding local areas from both ecological and cultural perspectives. Furthermore, incorporating what local communities value in their environments ensures that conservation efforts resonate with the cultural and natural heritage of the areas. This community-driven approach in delineating Other Effective Conservation Measures (OECMs) or protected areas can ensure conservation strategies that are locally relevant, accepted, and sustainable.
- **Continuous Assessment and Improvement:** Regularly evaluating policies and initiatives to see how effectively they are reducing disparities and then making necessary improvements. This involves collecting data, seeking feedback, and being willing to make changes for continued progress towards equity.

Equitable governance is essential for the sustainable management of natural resources as we work towards target three. Effective EG works to diminish feelings of disenfranchisement and creates systems that people feel are legitimate, fair, and representative of their needs and values.

What can happen without due consideration to equitable governance in evidence and monitoring?

- **Biases:** Equitable governance necessitates confronting inherent biases in data collection, analysis, and interpretation. These biases often occur due to disproportionate representation in data (like underrepresentation of certain demographic groups), subconscious prejudices of researchers, or societal stereotypes. Strategies for equitable governance include actively working to recognise these biases and implementing methods that neutralise the impact they have on conclusions and subsequent policy or decision-making.
- **Misinterpretation:** Facts and figures can be misrepresented or misunderstood, leading to decisions that propagate inequality rather than rectify it. Equitable governance involves rigorous checks and balances to ensure that data is interpreted correctly, taking into account the context and the complex realities of diverse populations. This includes peer reviews, consultation with stakeholders, and interdisciplinary approaches to interpretation to safeguard against misrepresentation.
- **Lack of Transparency:** In equitable governance, transparency is important in monitoring and evidence usage. Stakeholders need to understand how data was

gathered, analysed, and applied in decision-making processes. To support this, procedures and outcomes at every stage should be openly accessible and easily understandable, emphasising clear communication to ensure informed public discourse.

- **Exclusive Decision-Making:** Traditional decision-making structures can exclude marginalised voices, particularly in interpreting evidence and setting priorities. Equitable governance champions inclusive and participatory decision-making, ensuring that diverse perspectives are not only heard but are integral to the decision-making process. This approach recognizes that those affected by decisions provide invaluable insights into the appropriateness and fairness of policies.

In summary, EG with regards to monitoring and evidence is about instituting practices that ensure fairness, inclusivity, and appropriate transparency in how information is collected, analysed, and used. It requires a vigilant approach to recognising and mitigating biases, misinterpretations, and exclusivity in decision-making. This form of EG mandates a clear-sighted view of how data, in its various forms, influences policy and social norms and insists on accountability at all stages to prevent the perpetuation of inequality.

Cross-over with two other GBF targets

The following two targets were also included in the GBF to strengthen equity and local communities and indigenous people considerations across the framework. They really reflect the wider equality issues.

CBD: TARGET 22

Ensure the full, equitable, inclusive, effective and gender-responsive representation and participation in decision-making, and access to justice and information related to biodiversity by indigenous peoples and local communities, respecting their cultures and their rights over lands, territories, resources, and traditional knowledge, as well as by women and girls, children and youth, and persons with disabilities and ensure the full protection of environmental human rights defenders.

CBD: TARGET 23

Ensure gender equality in the implementation of the Framework through a gender-responsive approach, where all women and girls have equal opportunity and capacity to contribute to the three objectives of the Convention, including by recognizing their equal rights and access to land and natural resources and their full, equitable, meaningful and informed participation and leadership at all levels of action, engagement, policy and decision-making related to biodiversity.

Conclusion: Equitable governance as a catalyst for biodiversity conservation

In conclusion, the journey towards achieving target three in Wales is both a challenge and an opportunity to redefine societal relationships with nature through equitable governance. By prioritising equity, inclusivity, and justice in conservation strategies and the evidence needed to monitor, drive and support change, Wales can continue to build resilient ecological networks that respect cultural heritage, culture diversity and biodiversity. The

future of Wales' natural landscapes hinges on its ability to fully integrate equitable governance into its ambitions to achieve 30 by 30. Embracing Equitable governance within target three is not merely a strategic choice to encourage ethical participation and engagement with evidence and monitoring, it is a commitment to a sustainable and inclusive future for all life - human and ecological - in Wales.

Further information

[House of Lords Environment and Climate Change Committee: An extraordinary challenge: Restoring 30 per cent of our land and sea by 2030](#)

[Global Biodiversity Framework: equitable governance is key](#)

[UK Government: The People and Nature Survey](#)

[Union Island Environmental Alliance](#)

[International Institute of Environment and Development: Community Biocultural Protocols](#)

[United Nations: Who are indigenous peoples?](#)

[Welsh Government: National Survey for Wales](#)