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Exploring the carbon sequestration potential of rewilding in the UK

Summary

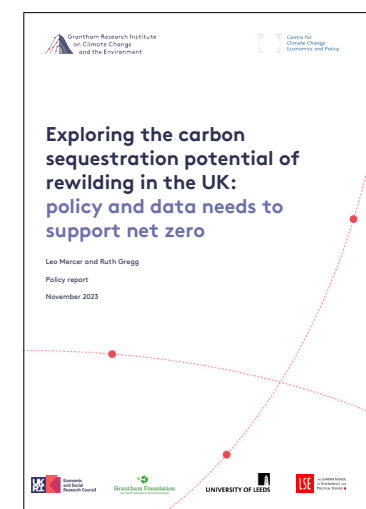
- Rewilding is an approach to nature restoration that recognises the intrinsic value of nature and wild spaces when restoring degraded ecosystems, leading to the establishment of natural ecological processes at scale, and ultimately supporting ecosystems to become self-sustaining, self-organising and resilient.
- UK environmental strategy and policy focuses on sustainable land use and nature restoration, with the position on subsidy payments for farmers and land managers post-Brexit taking a 'public money for public goods' approach. However, rewilding does not explicitly feature in new agri-environmental policy developments in any UK region.
- When sited appropriately, rewilding can support achievement of the UK's net zero target through contributions to carbon sequestration and emissions reduction, while also aiming to achieve wider environmental and societal benefits.
- Current evidence gaps mean the full spectrum of rewilding transitions are not represented in national greenhouse gas abatement plans. Greater understanding of the interaction between rewilding and wider ecosystem service delivery is needed.
- Some habitats (woodland or peatland) that develop at defined steps within a rewilding transition are represented in the UK's Greenhouse Gas Inventory. Land use change at local authority level is estimated probabilistically using spatially disaggregated and other survey data.
- Carbon flux data for successional habitats such as species-rich grassland, heathland, scrub and scattered forest, along with coastal sea grass and salt marsh, are not yet of sufficient quality to be included in the Inventory or in other net zero pathways.
- This evidence gap can be filled using satellite data, drone and radar applications to better clarify and monitor the role of rewilding within net zero once this role has been directly observed and measured.
- The challenge for policymakers and regulators is to understand the efficacy and benefits of nature-based solutions such as rewilding, including addressing both biodiversity loss and climate change, in order to develop effective incentives for landowners to deliver on UK statutory targets such as net zero by 2050.



Policy briefs provide analysis on topical issues, presenting specific recommendations to inform ongoing policy debates. Drawing on the Grantham Research Institute's expertise, they summarise either our research findings or the state of knowledge about a particular issue.

This policy brief was written by
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Introduction

Rewilding has often been wedged into a binary land use paradigm, where land is understood to be used solely for productive uses (e.g. agriculture) or put aside for nature, with none or very little overlap. Land use decisions in the UK must balance competing demands across nature restoration and sequestration, food and energy production, or housing and infrastructure development. These are highly context-dependent and require consideration of needs at the local or regional scale. Acknowledging these issues, the objective of this policy brief is to better understand how rewilding is understood in relation to the legislated net zero target, and what evidential or policy constraints might be limiting the contribution of rewilding to decreasing greenhouse gas emissions and reporting on reduction targets in the UK.

Rewilding, nature-based solutions and carbon sequestration

Rewilding is increasingly being used to address both biodiversity loss and climate change, while also aiming to achieve a range of wider environmental and societal benefits.

As a nature-based solution (NbS), rewilding offers the potential for high-integrity greenhouse gas removal to help meet the UK's net zero target via sequestration and storage of carbon dioxide from the atmosphere in vegetation, soils and sediments, as well as providing benefits for local biodiversity and communities (UNEP, 2022).

Although rewilding is conceptually aligned with NbS – which aim to improve the sustainability of ecosystems while enhancing benefits and resilience for humans and biodiversity – it is distinct from other NbS in that it prioritises the intrinsic value of wildness, rather than specifically using nature to address societal challenges.

Rewilding as an umbrella term can include a range of conservation activities, from unassisted vegetation colonisation on former agricultural land, to translocation of regionally or functionally extinct species to restore trophic networks (Schulte to Bühne, et al. 2022). There remains debate among rewilding stakeholders about what – in both ecological and philosophical terms – can constitute a rewilding project.

While there is a degree of overlap between rewilding and nature restoration, the latter aims to make improvements within a defined trajectory of transition and space, often within a specific ecological community or 'habitat', whereas rewilding interventions seek to support the healthy functioning and resilience of an entire ecosystem, generally at a larger scale.

Further, rewilding does not target a desired 'end state' or explicitly safeguard existing taxonomic precedent: instead, it focuses on present and future ecosystem functioning and resilience while aiming for minimal to no ongoing management over the long term.

Defining rewilding can be difficult: indeed, Hayward et al. [2019] identify 14 definitions. It can be interpreted as a continuum, a binary state or an open-ended process.

Box 1. Terminology

This policy brief is based on a report that was guided by two roundtable discussions convened in early and mid-2023, for which we co-designed the following non-exhaustive definition of **rewilding** (while acknowledging the definition's limitations):

Rewilding is an approach to **large-scale nature restoration and conservation** that aims to increase the integration of natural ecological processes into managed and/or degraded landscapes.

Key principles can include protecting and reintroducing **keystone species**, removing invasive species, ending damaging practices, and **restoring degraded landscapes**. There are proponents of active and passive rewilding approaches. Some practitioners see benefits in continued human intervention in landscapes that are 'rewilded' or undergoing a rewilding transition such as **managed grazing or active management** to support desirable habitat assemblages and the species that depend on them. For others, the goal is to move towards the **removal of anthropogenic influences** entirely and in doing so support ecosystems to become self-sustaining.

To be considered successful, rewilding should not be introduced without engagement and support from **local communities**, and where possible should be designed to deliver **socioeconomic and environmental benefits** simultaneously.

Rewilding as a response to the nature and climate crises

The nature crisis and climate change are interrelated, and advocates of rewilding assert the approach can address both crises simultaneously, while increasing the resilience and transformative capacity of nature (Schulte to Bühne, et al. 2022).

Nature is already being affected by climate change but can contribute to carbon sequestration if managed and protected appropriately (Girardin et al., 2021). However, at present, there are few data on the greenhouse gas sequestration dynamics from rewilded land (Sandom et al., 2019). Similarly, nature can be a source of carbon emissions if it is not adequately protected.

The following summarises the benefits offered by rewilding in terms of ecosystem and biodiversity health, building the resilience of landscapes to severe weather events, and providing recreation opportunities and amenity benefits in rewilded areas.

Climate mitigation

Grassland. If a proportion of the large areas of converted grassland (currently used for livestock grazing) in the UK's broadleaf forest biome were reforested, there would be a likely increase in net carbon sequestration. Creation of species-rich grassland and floodplain meadows offer potential to build soil carbon stocks on sites that have been degraded through primary production.

Peatland. Peatlands comprise about 10% of Britain's land area. Restoring peatland by raising water levels, promoting appropriate vegetation cover and reducing grazing pressure could abate the 17.3 million tonnes of CO₂ equivalent emitted during 2021 within the UK's Land Use, Land Use Change and Forestry and Agriculture reporting sectors (UK Centre for Ecology and Hydrology, pers. comm.).

Coastal habitats. Restoration of coastal habitats such as saltmarsh and seagrass can capture significant amounts of carbon via vegetation and depositional processes, and also provide wider benefits for flood risk management, biodiversity, tourism and fisheries.

Successional habitats. Species-rich grassland, heathland and other more early successional habitats generally store more carbon than under intensive agriculture, and can be created and maintained (often in a mosaic) by lower-intensity grazing systems, with or without introducing large predators.

Climate adaptation and resilience

Wildfires. Rewilding increases ecological complexity and contributes to mixed landscapes with wetter areas, uneven species age class and composition, reducing the risk of wildfires (Wang et al., 2023). This is most pronounced where large herbivores disrupt contiguous vegetation cover through biomass consumption, creating a more complex, heterogenous ecosystem that is more resilient to the spread of wildfire (Malhi et al., 2022).



Scottish peatland.
Photo: K Brembo, Unsplash

Flooding. Increasing woodland cover and other above-ground biomass results in greater absorption and less water runoff from land, which can reduce downstream flood risk (Jepson and Schepers, 2016). Rewetting wetlands and peatlands can support increased water retention and slow water flow. Similar benefits are achieved with the re-naturalisation of river channels. Flood protection can also be achieved through reintroducing beavers, which provide natural flood management (Puttock et al., 2021).

Other ecosystem services. Other adaptive benefits from rewilding include water purification, improved soil health and pollination.

Rural economic development

Tourism. Rewilding can attract visitors who are interested in experiencing nature and wildlife, which supports and diversifies rural economics (Rewilding Britain, 2019).

Other economic development. New rural businesses can develop and leverage the environmental benefits of rewilding to boost on-farm income and provide employment in nature tourism, accommodation and artisanal farm products (Tree, 2018).

Challenges to the uptake of rewilding in the UK

Monitoring, reporting and verification

The UK's Greenhouse Gas Inventory is the formal reporting tool at the national scale of emission sources and sinks to the United Nations Framework Convention on Climate Change (UNFCCC). The inclusion of actions within the Inventory must adhere to the guidance of the Intergovernmental Panel on Climate Change and be attributable to specific anthropogenic activities leading to emissions reductions or sequestration (removals) that are additional to business-as-usual scenarios.

Measuring greenhouse gas flux at the local scale to capture discrete land use changes such as rewilding is not possible to do for national emissions reporting. Currently, probabilistic 'bottom-up' estimates that rely on a range of spatial and survey data sources (e.g. emissions at a local authority scale) are used to estimate local land use change.



“Flood protection can be achieved through reintroducing beavers, which provide natural flood management.”

*The first beaver dam to have been constructed in the wild in Scotland in the last 400 years.
Photo: Patrick Mackie, geograph.org*

Data gaps

The evidence base for greenhouse gas sequestration potential under rewilding is currently limited and must be strengthened for it to be a credible land use option to mitigate climate change and arrest nature decline.

Robust, long-term datasets derived from rewilding projects are scant. This is compounded by the fact that the definition of rewilding can encompass a wide range of land use states, transitions and outcomes, such as re-naturalisation of rivers, coastal realignment, or wilder grazing systems that create a mosaic of early and later successional habitats.

The evidence gaps mean the potential contribution rewilding can make to meeting net zero is subject to a high level of uncertainty and it is not accounted for in the UK's Greenhouse Gas Inventory, whereas conventional abatement approaches in the industrial and energy sectors can be readily modelled and are included.

Lack of precise definition

The wide range of definitions relating to rewilding, and its commonalities/differences with nature restoration and/or habitat management, makes assigning current and potential abatement to specific land use change under rewilding extremely difficult.

To integrate rewilding into the Greenhouse Gas Inventory for UNFCCC reporting and net zero considerations, it is crucial to have a precise definition of rewilding, backed by robust emission factors and activity data. The International Union for Conservation of Nature (IUCN) has commissioned a new working group to co-develop a new definition, which is expected to be introduced by summer 2025.

Incentives and skills development for landlords

Policy in UK administrations is misaligned with the needs of rewilding processes. A greater emphasis needs to be placed on raising awareness of post-Common Agricultural Policy (CAP) subsidies and the roll out of skills development programmes to ensure land managers understand and can fully engage with these schemes in order to leverage maximum benefits for climate and nature.

The misalignment of incentives potentially creates challenges between landlords and tenants, who may have opposing views on how land should be managed. Land managers are hesitant to move early in making changes to their management systems, given policy uncertainties.

A land use framework pilot, supported by the UK's Geospatial Commission, has indicated that land managers and stakeholders favour restoration of degraded habitats and creating new habitats, but need support to understand where in the landscape carbon is stored and lost, and which carbon management interventions are most effective in light of new agri-environmental subsidies (HM Government, 2023).



*Heathland at Chobham National Nature Reserve, Surrey.
Photo: Walter Bonnici, Unsplash*

Local community acceptance

Concern has been expressed by rural communities about rewilding projects where there is a perception that they have been developed without broad consultation and community buy-in (Wynne-Jones et al., 2018).

Some of the public view rewilding as favouring, or being best suited to, larger, well-capitalised landowners. There are also risks and trade-offs associated with rewilding within broader food system goals, especially regarding emissions leakage (where food production is displaced to jurisdictions with higher emissions intensity) within the food system.

Deep engagement in rural areas is essential, given the diversity of rewilding approaches, and need for more research on social preferences, perspectives and local impacts of rewilding transitions. Environmental benefits are better understood, but further research is needed on social aspects and the economic and cultural impacts of rewilding transitions in land use.

Uncertain outcomes and timescales

Though rewilding, and NbS more broadly, can help address both the biodiversity and climate crises, the sequestration it provides will deliver a relatively small (though important) proportion of the emissions reduction required for the UK to meet net zero, with the bulk coming from decarbonisation of the wider economy.

Looking to 2100, Bradfer-Lawrence et al. (2021) highlight the modest contribution to the UK's net zero target from peatland restoration and woodland and saltmarsh creation, even under ambitious land availability and landowner uptake scenarios. Girardin et al. (2021) consider NbS from a global perspective, stating that they will have real but limited mitigation benefits for climate approaches in the short term. And Mikołajczak et al. (2022) pull together England-specific evidence that implies costs and benefits to farmers and land managers from introducing herbivores and carnivores, and other spillover effects (such as vegetation encroachment on boundaries or changes to local landscape).

Both roundtables that informed this work considered the importance of recognising that landscape recovery takes time, and, when viewed purely through a sequestration lens, results may be discouraging for landowners and policymakers. It was further noted that rewilding should not be seen as a panacea for net zero or biodiversity restoration: while it has its place in nature and landscape restoration efforts, given the emphasis on supporting natural autonomy outcomes are far from certain in terms of net gains for net zero and biodiversity on human timescales, as rewilding responses are highly contingent on baseline ecological health and the degree of intervention within the strategy.

Many rewilding projects place emphasis on natural colonisation in pursuit of resilient self-sufficient ecosystems. However, the outcomes of such 'interventions' cannot be accurately predicted for reporting purposes.

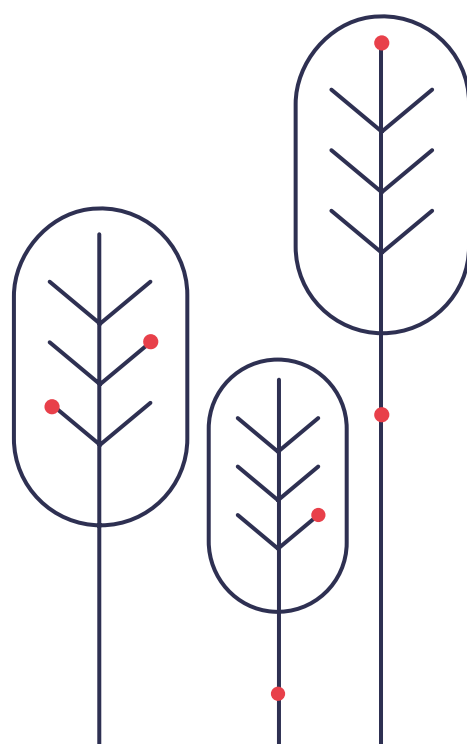
These unknowns create substantial challenges for policymakers attempting to incentivise rewilding in pursuit of net zero, given that there is no 'end goal' and little regional or biota-specific data to measure progress against, or reward.

“Deep engagement in rural areas is essential, given the diversity of rewilding approaches, and need for more research on social preferences, perspectives and local impacts of rewilding transitions.”

Policy recommendations

- Policymakers should support work to improve the evidence base relating to carbon flux from rewilded land, as current gaps are limiting the representation of rewilding within decarbonisation and greenhouse gas removal strategies for the agricultural and land use sectors.
- The Government should consider using the definition of rewilding currently being set out by expert communities including the IUCN Rewilding Working Group (expected by summer 2025), if it proves appropriate. The Government and conservation agencies should then develop region- and habitat-specific guidance to reflect landscape responses to rewilding interventions.
- Central government and the devolved administrations should increase the level of detail in existing Greenhouse Gas Inventory categories to reflect the real impacts of land use change that result from ecosystem restoration and conservation approaches. This would then support the reporting of actions aligned with rewilding.
- Central government and the devolved administrations should clarify to landowners what tools are appropriate for determining natural capital baselines. They should also consider the merits of nominating or creating an organisation to capture and manage carbon and greenhouse gas flux data (alongside wider socioeconomic and ecological data) from nature restoration projects, including those that follow rewilding principles.
- Central government and the devolved administrations should continue to fund case study and longitudinal research in the UK to improve the evidence base for rewilding, at project and landscape scale, assessing the net benefits of, and trade-offs between, delivery of ecosystem services such as carbon sequestration, landscape resilience and nature restoration. Successional habitats should be prioritised, given the evidence gaps that currently exist. These gaps can be filled using satellite data, drone and radar applications to better clarify and monitor the role of rewilding within net zero once this role has been directly observed and measured.
- The Government needs to ensure that access to rewilding incentives is fair and supports a just transition in rural communities, including recognising the importance of continued food production. Administering agencies should remove obstacles to accessing environmental improvement incentives encountered by smallholders, tenant farmers and larger landowners, and provide funding for skills development and knowledge exchange, to maximise the uptake of post-CAP subsidies by these groups.
- Central government and the devolved administrations should incentivise rewilding, including by promoting connectivity across all landscape types where appropriate, not just the uplands. The Environmental Land Management Scheme and devolved administrations' post-CAP frameworks should address this through supporting regenerative and nature-friendly farming and connectivity of 'wild' places.

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Conclusion

Rewilding, as an NbS, can address both biodiversity and climate challenges, including through improved land complexity and resilience. The sequestration provided will deliver the critical emissions reductions and carbon removal required for the UK to meet net zero, along with nature benefits, even though the bulk of reductions will come from decarbonising the wider economy.

However, the evidence gaps described above mean that the current and future potential contribution rewilding can make to meeting net zero is subject to a high level of uncertainty, hence the strong need to address these gaps effectively and quickly.

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