NatureScot
Scotland's Nature Agency

**SCIENTIFIC ADVISORY COMMITTEE**

**DISCUSSION PAPER**

**Horizon Scanning – Nature Restoration**

## Purpose

1. This is the regular horizon scanning item.
2. This report explores issues, challenges and opportunities for landscape scale nature restoration in a changing climate.

## Action

1. The SAC is invited to note the paper and comment on the three aspects set out in paragraph 35:
   * issues
   * challenges
   * opportunities.

## Preparation

1. The paper was written by Clive Mitchell and Brendan Turvey. It is sponsored by Eileen Stuart.

## Background

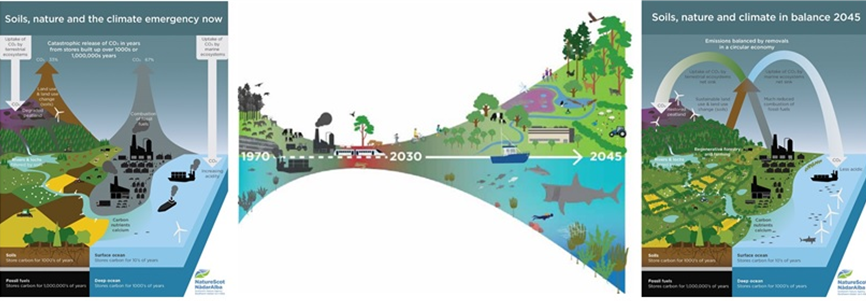
1. This paper is the regular thematic horizon scan for the Autumn SAC. This paper centres on nature restoration, to complement a major effort to synthesise the spatial priorities for landscape-scale restoration in Scotland. It reflects the shift in emphasis in the Corporate Plan from ‘*protect*’ to ‘*restore*’ and the need to identify clear priorities for restoration and resilience.
2. The Scottish Biodiversity Strategy (SBS) calls for the identification of 6 new landscape scale nature restoration areas by 2025, in addition to work on clusters of public land and other drivers such as Scottish Water’s catchment scale restoration to secure water supplies and avoid risks arising from a changing climate. The SBS also notes the urgent need to accelerate and scale up nature restoration.
3. Any restoration work undertaken will need to be resilient to climate risks. These risks arise on a warming trend to 2°C by the 2050s, but, importantly, are characterised by a more chaotic climate within and across years including extreme events and patterns of ‘unusual’ weather. Although it is important to understand average changes (e.g. warmer wetter winters, especially in the west; hotter drier summers, especially in the east), it is the extreme events and unusual patterns of weather that will mainly drive ecological change.

## Landscape Scale Nature Restoration

1. Landscape scale nature restoration recognises the need to restore nature at scale, especially in the context of a climate-nature emergency. This raises a number of questions such as: restoration to what point in the past; how will that be resilient to future change; restoration for what purpose; where; by what mechanism; whose role is it; when does it need to be done by; how much is enough?
2. The answers to these questions are not fixed, and any approach should be flexible and monitored to allow for adaptive learning as nature adapts to our changing climate. Some of our choices might be informed by the past, but all of them need to be resilient to the future. Timing is important and brings risks. For example, the need to act fast so that ecological systems have time to mature and be more resilient to climate risks; but, rapid deployment using imported seeds and stocks might introduce pests, pathogens and disease or weaken phenotypical resilience.
3. The paper is organised by the main questions in paragraph 8, noting that there are some overlaps and interdependencies.

## Restoration and baselines?

1. For many, nature restoration is about the past and concerns historical baselines, Now we need to look forwards and to plan for nature restoration which will be resilient in a turbulent future climate. This challenges the dominant ways of thinking in the conservation sector.
2. Contrasting approaches to current and potential future use of the land and sea are characterised in the infographics and table below.



|  |  |
| --- | --- |
| **People apart from nature** | **People a part of nature** |
| Arguably, mainly land sparing | Arguably, land sharing |
| Mainly for single benefits to maximise productivity and yield in the short term | Mainly for multiple benefits including public goods in the long term |
| Simpler, drier, less connected, nature poor – net source of ghg emissions | Complex, wetter, connected, nature rich – net sink for ghg emissions |
| Assumes a largely stable predictable climate | Assumes a more chaotic climate, within and across years |
| Managing for single (climate) risks | Building resilience to multiple cascading risks |
| Food/fibre/water vulnerable to losses arises from pests, pathogens, disease, floods, fires, drought | Food/fibre/water more resilient to pests, pathogens, disease, floods, fires, drought |
| Nature mainly in protected areas, nature networks, other effective conservation measures; ‘edges and hedges’ in agri-environment schemes – a positive climate feedback - about 30% of land and sea | Nature – all life everywhere – regulating key Earth systems through biogeochemical cycles in healthy soils and water – especially where less degraded – a negative climate feedback – 70-100% of land and sea |
| Climate an independent variable acting on a preferred state of nature | Climate-nature co-evolve |
| More resources reacting to events | More resources on preventative spend |
| Linear extractive economy separate from nature | Circular economy embedded in nature |
| Vulnerable landscapes? | Resilient landscapes? |

## Restoration and resilience?

1. Qualitatively, more resilient systems are characterised by diversity, complexity and connectivity at a range of scales. Ecological complexity can be defined as the number of components in a system and the number of connections among them, and includes structural heterogeneity, trophic interactions and functional diversity[[1]](#footnote-1). It can be assessed at the landscape scale, with metrics including β diversity, heterogeneity among habitat patches and connectivity at multiple scales.
2. Ecosystem functions, resilience and complexity are linked to system emergent properties. A key goal of restoration ecology therefore involves restoring complexity at multiple scales, in particular of individual ecosystems and across landscapes. NatureScot is working with UKRI [Restoring Resilient Landscapes](https://gtr.ukri.org/projects?ref=NE%2FV006444%2F1), which is starting to quantify some of the characteristics of resilient ecosystems.
3. Designing nature restoration to deliver that resilience will require a change in mindset from restoring nature to the past, to restoring nature which is resilient to the future, changing climate.

## Restoration for what purpose?

1. There are two main purposes for restoring nature:

* to help nature; and
* to help society and the economy, to mitigate and adapt to climate change.

The more widely nature is restored across all settings, the more these overlap.

1. Starting from where we are (see infographics and table above), restoring nature for itself is likely to be mainly publicly funded and concerned with protected areas (e.g. condition, 30x30, nature networks and other effective conservation measures). Increasingly, it may also include aspects of development (Positive Effects for Biodiversity) and support mechanisms for farming and forestry (public goods for public money).
2. Helping society and the economy to adapt to climate is likely to be more risk-based and involve a range of measures and markets, including nature finance through clear returns on investment and/or avoided costs. Examples include stabilising steep slopes above critical infrastructure (such as roads and railways) and enabling dynamic systems such as soft coastlines and rivers to be dynamic. The latter includes letting flood plains flood. Evidence emerging through the [Floodplain Meadows Partnership](https://floodplainmeadows.org.uk/content/floodplain-meadow-partnership-valuing-conserving-and-exploring-our-heritage) suggests that wetlands and floodplains play a disproportionately important role in biogeochemical cycles because silt arising from flood events both helps to ‘seal’ and store carbon in alluvial soils over time and rejuvenate the sequestration of atmospheric carbon into grasslands and their soils.
3. Well-designed market mechanisms may also enable ecological restoration, but if credits/ permits are traded there are concerns around permanence (including reversals or losses associated with climate risks) and where the responsibility for these lies. The latter is not straightforward if, for example, resilience/risk is linked to emergent features of complexity at a range of scales.
4. Recent events, such as storms Desmond (2015), Arwen, Malik (2021-22) and Babet (2023) illustrate the potential for significant losses arising from extreme events of unusual patterns of weather. In addition, [recent work](https://appliedecologistsblog.com/2023/09/26/drought-in-scotland-projections-affect-specialist-habitats-and-species/) suggests that severe drought (based on the 2018 event) will switch from a 1:20 year event today to 1:3 or 2:3 in the worst affected areas of the east coast by the 2040s.

## How?

1. In addition to detailed concerns about permanence and risk, there are wider long-running concerns about the potential for poorly designed markets and property rights to expand into, and over-exploit, hitherto untapped resources. Examples of water rights include the Dry West of the USA and Chile.
2. In terms of pace, there are concerns about the risk of introducing pests, pathogens, disease, reducing phenotypical resilience, depending on factors such as seed source; but also on the resilience of current stocks to climate risks, especially for long-lived species such as trees.
3. We are working closely with the Scottish Government, Scottish Land Commission and other agencies to consider how to shape the emerging nature finance market to address these risks.

## Identifying landscape priorities

1. We plan to use three approaches to identify the priorities for landscape scale nature restoration.

### Data led

1. Having built a new spatial dataset of restoration projects in our GIS system we will analyse this using existing datasets on peatland, woodland, protected areas and other factors to identify priority locations.

### Demand led

1. We intend to commission research in autumn 2024 to identify where there is demand for nature restoration to tackle other problems. For example, it will identify where nature restoration can best tackle flood risk or risks to infrastructure. By targeting restoration in these areas, we can deliver greater benefits per pound spent, demonstrate the multiple benefits of nature to communities and elected members and better attract alternative sources of finances from business and agencies who seek these outcomes. For example, by targeting nature restoration in drinking water catchments with long term pressures it’s more likely that Scottish Water will co fund work on the ground (see map in **annex 2**).

### Intelligence led

1. We will use the collective intelligence of NatureScot staff and colleagues in other agencies to target restoration activity at those landscapes where we think we can gain the most traction. For example, we can build on existing farm clusters to scale up and widen activity; and work with larger estates who are already managing deer numbers to support nature restoration.

## Who?

1. The wider the range of public, private, volunteer and community interests involved, the more likely the interventions will help to secure a Just Transition. Current approaches are generally resource-intensive (time and cost) – and innovation may be needed to ensure systems approaches can be both swift and just.
2. Land managers play a critical role. The Scottish Land Commission is currently working on a review of land governance in Scotland for net zero and resilience.
3. The new spatial dataset will include data on which agency or organisation is leading each project to provide greater clarity and accountability for delivery of nature restoration across Scotland.

## When?

1. In general, the sooner we start to restore nature at scale, the more time the interventions will have to develop emergent properties for complexity and resilience. Conversely, more delay will incur greater risk of failure, including from the effects of climate risks. Where evidence is lacking, adaptive learning approaches are likely to be needed especially for slow growing habitats and species.
2. These time lags are also problematic for some market-based opportunities, especially offsetting, where the emissions today will take many years to be removed by, for example, commitments to plant trees.
3. Nature restoration is not a one-off event, but requires ongoing management and the development of skills and capacity.

## Where?

1. A new post in NatureScot of ‘Nature restoration manager’ was created in May this year to lead a project, working closely with Scottish Government and other agencies, to identify where we most need to deliver nature restoration. By the end of 2024 it will deliver:

* An agreed list of priority restoration areas, with recommendations for 6 projects to be included in the SBS.
* A list of the ‘gaps’ where we need to do more nature restoration, which will be prioritised early in 2025.
* A new spatial dataset, which will facilitate GIS analysis and provide a ‘single source of truth’ on landscape scale restoration in Scotland (see emerging map of projects in **annex 1**).

## Recommendations and discussion

1. We would welcome recommendations from the SAC, based on the observations in previous paragraphs, on the questions below.

### Issues

* Is this the right approach (combining data, demand, intelligence) to the prioritisation of restoration projects (for nature, for people, for the economy)? Are there better ways of identifying priorities, supported by science?
* How can we best design landscapes for resilience? Has this paper captured the key principles, or does science identify other factors we should design into these projects, particularly in light of the need to adapt to a changing climate?

### Challenges

* How can we best build support for landscape scale nature restoration amongst a wider set of stakeholders, beyond the ‘usual suspects’? Are there new approaches to engagement and consensus building from the social sciences that we can draw from?

### Opportunities

* Can we learn more from approaches to nature restoration in other countries?
* What new approaches to modelling and monitoring can we use to better target nature restoration at the locations that will deliver the most benefits? And to inform adaptive approaches?

## Conclusion

1. Restoring nature at the pace and scale required is not going to be easy, and it is likely that some mistakes will be made. If we are risk averse, progress will be slow and benefits limited. An adaptive learning approach will help us to act and learn at the same time. This will also help us to move from being mainly reactive and opportunistic to being more targeted and proactive in identifying where we want to fund nature restoration.

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1. Bullock et al (2021) Future restoration should enhance ecological complexity and emergent properties at multiple scales, *Ecography*, 44: 1–11, doi: 10.1111/ecog.05780 [↑](#footnote-ref-1)