Nature without precedent

'Novel ecosystems' – where human influence has radically changed the species present – are the new normal, writes **Roman Goergen**. These transformed landscapes present a new quandary for conservationists: what should we try to save?

A series of steep red mounds rise dramatically from the rolling landscape of West Lothian, between Glasgow and Edinburgh in Scotland. The bings, as they are known locally, are the legacy of the oil shale industry of the 19th century.

This landscape was once written off as lifeless waste. But over time, Nature has arrived on the spoil heaps in unfamiliar ways.

Natural birch woodland and wild flowers push up through the rose-tinted gravel. Orchids including early purple (*Orchis mascula*) and broad-leaved helleborine (*Epipactis helleborine*) appear on the slopes, and mosses like brown shield-moss (*Buxbaumia aphylla*) and lichens such as the snow lichen *Stereocaulon saxatile* cling to the shadier banks. More than 350 plant species have been recorded here, including some that are rare in this area. These include kidney vetch (*Anthyllis vulneraria*), melancholy thistle (*Cirsium helenioides*) and common bird's-foot trefoil (*Lotus corniculatus*).

Skylarks and yellowhammers nest in the mosaic of grasses, while hares and badgers find refuge among the hills.

Just a handful of Scotland's bings are officially protected, despite this recent ecological richness. Greendykes, Faucheldean and Westwood Bing (known as 'the five sisters') are scheduled monuments. Most remain outside the national conservation framework, however. They do not fit the traditional image of what Nature should look like – nor do they resemble the lost landscapes they replaced.

What's happening in West Lothian is not unique. A similar process can be seen the world over. Landscapes have been transformed through industry past and present, new species have been introduced, and of course climate breakdown is already taking effect.

Researchers are observing dramatic changes to biodiversity – the living community – as a result. The term 'novel ecosystems' has been adopted by many ecologists. Even some of the world's best-known Nature reserves fall into the category: the old boundaries of 'natural' no longer apply.

More than half of the Earth's land surface now hosts living communities with no historical precedent. This has been shown through global mapping efforts, including work by the Center for Ecological Dynamics in a Novel Biosphere (ECONOVO) at Aarhus University in Denmark.

The researchers divided the land around the world into a grid and analysed how much each region has changed. They observed the spread of new plant species, the disappearance of large mammals, and the shifts in the regional climate. The area was marked as ecologically novel when one measure passed a specific threshold. They concluded that 58% of land falls into this category. What began as exceptional has become the new normal.

This has serious consequences for conservation. Anna Walentowitz is a biogeographer at the University of Bayreuth in Germany. She explains that human influence has had a profound impact on biodiversity – even in remote areas such as the Galápagos Islands. "There are hardly any places left on Earth where human impact hasn't left a mark," she says. Even long-standing conservation projects cannot claim to be able to preserve Nature in a 'pristine' condition.

The three main forces behind this shift are climate breakdown, the disappearance of large animals, and the continued spread of invasive species. These drivers rarely act on the landscape alone, but instead reinforce one another. A warming climate can make a habitat newly available to non-native plants. The loss of a species that acted as a seed disperser will stress the native plants further. The original ecological network unravels.

Nowhere is this transformation more striking than on the Hawaiian island of O'ahu. The native birds that evolved to disperse native seeds have mostly vanished from the island. They have been replaced by species such as the warbling white-eye. These non-native birds also spread seeds but prefer non-native plants – resulting in species like guava thriving while many native plants struggle to reproduce.

Jeferson Vizentin-Bugoni is a professor of ecology at the Universidade Federal de Pelotas in Brazil who specialises in island ecosystems and species interactions. The birds and plants introduced to O'ahu keep the ecosystem active, he explains, but also result in significant transformations. The same functions may be reproduced – such as seed spreading. However, the species that are unique to the island are replaced by more common 'generalists' who also exist in other parts of the world.

This change comes at a price, as restoring native diversity

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becomes much harder, and some evolutionary lineages are lost for good. Vizentin-Bugoni explains: "O'ahu serves as a kind of crystal ball, offering a glimpse into the future of ecosystems globally if current rates of species extinction and biological invasion continue."

The question now is how conservationists should respond to these shifting realities. Some scientists warn that the language we use matters. Carolina Murcia of the University of Florida studies tropical ecological restoration and conservation restoration. She argues that using the term 'novel ecosystems' risks making the degraded state of the landscape sound appealing – and may discourage efforts to repair and restore. "The word 'novel' conveys a sense that this is a desirable state, when it is often the result of mismanagement or degradation," she says.

Some researchers have argued for a more flexible, step-by-step approach, instead of drawing hard lines between 'natural' and 'novel' landscapes. The United Nations' principle of a continuum of ecosystem restoration treats damaged landscapes as existing along a spectrum. The definition used requires a different response, from limiting further harm, to partial recovery, to full ecological restoration where possible. In this view, every move toward greater ecological function matters – whether in a city park, in a farm field, or on an abandoned industrial site.

Jens-Christian Svenning, the director of ECONOVO at Aarhus University, is a global expert on ecosystem change. He observes that these wild but changed ecosystems are "unlikely to ever go back to how they were before", no matter how much people intervene.

Svenning's university colleague Matthew Kerr is the lead author of the global novelty mapping study. Kerr concludes: "Restoration needs to shift to have a positive view of novelty and change the planning outcomes appropriately... Just assuming protection will continue to act as it does now is short-sighted."

The ecologists have advanced the RAD model: resist, accept, direct. "In some places, we may resist change and

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try to keep or restore historical conditions," Svenning explains. "But in many others, it makes more sense to accept or even direct change and actively guide these ecosystems toward new forms of diversity and function." This can include trophic rewilding, where large herbivores are reintroduced to shape landscapes and slow the spread of invasive plants.

The pragmatic approach is a new kind of responsibility rather than a form of surrender, argues Eric Higgs, a restoration ecologist at the University of Victoria, Canada. "For profoundly and irreversibly changed environments, practical unrestorability became the hallmark of what a novel ecosystem is," he explains. "But that does not mean they are worthless. It's about making space for new kinds of Nature and valuing the diversity and function they offer."

The main challenge now, he argues, is to educate the public and policymakers about the value and worthiness of novel ecosystems, of Nature without precedent. This can mean that historical reference points are no longer suitable. It becomes increasingly important within our changed conditions to value and foster diversity and function.

Higgs recalls working on a restoration project on an island near Victoria where there were no detailed records of the original state. The goal of creating new forms of biological richness and valuable habitats was adopted, even where this required embracing substantial change. "I see this as a forward-looking form of restoration. Many people are now beginning to understand restoration in this way," he says. Novel ecosystems are surprising.

They can – and should – be valued and protected. R

Roman Goergen is a journalist reporting on natural sciences, biology and ecology. He moved to London in 2021 after spending more than a decade in Southern Africa and continues to focus on international conservation issues.

"If we truly put a value on biodiversity, we would live in a really, really different world."

Clover Hogan, founder of Force of Nature, quoted in Rob Hopkins' Ministry of Imagination *manifesto, published in 2024*