

35-year study shows combined approach can deliver more balanced ‘win-win’ solutions for grassland restoration

The results of a 35-year UK study shed new light on how grasslands can be restored for nature, the environment, and for farmers.

From richer biodiversity and benefits for pollinators, to carbon storage in soils, while balancing hay yields for grazing livestock, the study published in *Nature Communications* by researchers at Lancaster University and The University of Manchester, in collaboration with the Universities of Yale and Bergen, shows that using combinations of different restoration techniques can markedly enhance the restoration of grasslands.

Given many current grassland recovery projects typically only use one type of technique, or ‘intervention’, in attempts to deliver ecological benefits, the scientists behind the study hope their findings can help boost grassland restoration initiatives across the country and elsewhere,

Grasslands cover nearly 40% of the Earth’s land surface and serve as important global reservoirs of biodiversity. They also provide a host of other benefits to people, termed ecosystem services, including food production, water supply, carbon storage, soil nutrient cycling, and tourism. Yet these critical ecosystems are increasingly being degraded, especially by overgrazing, heavy use of fertilisers, and climate change. This is undermining their ability to support biodiversity, but also the delivery of key ecosystem services.

The team of scientists show that using single restoration interventions often leads to trade-offs among key grassland ecosystem services – for example the addition of low amounts of fertiliser boosted hay yields for livestock but suppressed plant diversity. Whereas the addition of a seed mix alone increased plant diversity and pollination, bringing value for nature conservation, but did not bring benefits for hay yield or soil carbon storage. They show that using a combination of different techniques delivers better, more balanced ecological benefits than relying on one single type of intervention.

The combined approach to grassland restoration boosted plant diversity, soil health, carbon storage, pollination, flower abundance, and forage production simultaneously, offering a clear path forward for sustainable land management.

The work was based on a long-term grassland restoration experiment set up in 1989 at Colt Park Meadows, in the Yorkshire Dales, northern England. The experiment included a range of commonly used grassland restoration interventions, including the addition of farmyard manure, low-level inorganic

fertiliser, a diverse seed mix, and a nitrogen-fixing red clover, which were tested individually and in all possible combinations. Over several years, the team measured 26 critical ecosystem functions related to hay yield, soil carbon storage, soil nutrient cycling, soil structure, water quality, pollinator visitation, and plant diversity.

Dr Shangshi Liu, the lead author of the paper from The University of Manchester and now based at Yale, said: *“Single solutions are rarely enough—we need landscapes that work on many levels: for climate, for people, and for nature. By layering complementary actions that target different components of the ecosystem, we can restore a broader suite of ecosystem functions—balancing trade-offs and minimising unintended consequences.”*

Professor Richard Bardgett who initiated the study and recently moved to Lancaster from The University of Manchester, said: *“These findings evidence the potential of combining interventions to boost the restoration of degraded grasslands. By combining interventions, such as adding more diverse plant seeds, small amounts of fertiliser, manure and red clover, we show that it is possible to have win-win solutions that balance yields for grazing as well as boosting biodiversity, carbon storage, and wildflower abundance. Though each combination will need to be tailored for specific sites. These findings represent a shift from conventional approaches that typically rely on single management interventions.*

“In doing so, they offer a blueprint for land managers and policymakers seeking to deliver multiple benefits from grassland restoration, which aligns the UN Decade on Ecosystem Restoration (2021–2030) that calls for integrated solutions to ecological degradation.”

The researchers also call for further experimentation across different climates and grassland types, alongside policy frameworks that incentivise grassland restoration. Programmes that currently support single interventions for grassland restoration could be restructured to favour integrated approaches that deliver broader ecological returns of benefit to a wider range of land users.

Ben Sykes, Director of the Ecological Continuity Trust (ECT), who work to secure long-term experiments such as Colt Park, said: *“The Colt Park Meadows long-term grassland restoration experiment, running since 1989, is one of many decades-long ecological field experiments (LTEs) across the UK that are linked via the ECT’s national register of experimental sites. These latest results from the Colt Park LTE help demonstrate the irreplaceable value of LTEs in providing the real-world scientific evidence needed to promote conservation, biodiversity restoration and future effective and sustainable land management.”*

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Image of the Colt Park Experiment by Richard Bardgett

