CEH SCIENCE AREAS

- Biosphere-Atmosphere Interactions
- Ecological Processes & Resilience
- Environmental Informatics
- Monitoring & Observation Systems
- Natural Capital
- Natural Hazards
- Pollution & Environmental Risk
- Soil
- Water Resources

SCIENCE AREA SUMMARY

SUSTAINABLE LAND MANAGEMENT

Delivering knowledge-based solutions to conserve and restore biodiversity, natural resources and ecosystem functions responsible for human wellbeing and livelihoods in semi-natural and intensively managed habitats.

Context

The human population is predicted to double to 9.4 billion by 2050. This, together with climate change, pollution and other environmental stresses, will have highly detrimental impacts on ecosystems and natural resources vital for human wellbeing and livelihoods. A key challenge is to develop knowledge-based, sustainable land management strategies to provide ample food, renewable energy and clean water whilst conserving biodiversity and enhancing beneficial ecosystem functions.

Our Research

Sustainable land management science in CEH aims to understand the threats to semi-natural and highly managed ecosystems, and their component resources. From this we will develop robust strategies to conserve these vital resources and increase their resilience to environmental change. In addition, we will develop practical approaches that can be applied at the field, farm and landscape to restore and enhance the beneficial ecosystem functions and services crucial for human wellbeing and livelihoods. We will achieve this through our long-term national monitoring of stocks and change in natural resources and capital, our deep understanding of ecosystem processes, and our expertise in manipulative experiments at the plot, field and landscape scales.

Research activity will include:

- understanding and quantifying the threats to semi-natural and managed ecosystems, building on Monitoring & Observing Systems and through long-term manipulative experiments.
- developing practical land management and restoration techniques to mitigate these threats, enhance resilience to environmental change, and support beneficial ecosystem functions and services, such as water purification and GHG storage.
- manipulating intensively managed grass and arable agro-ecosystems to protect, restore and enhance ecosystem functions that support food production, such as pollination and pest control ('ecological intensification').
- developing spatial models and decision-support tools for the design of future multi-functional landscapes to optimise land use and management to conserve biodiversity and enhance ecosystem functions and services.
- engaging with practitioners and the farming industry to develop new, innovative 'eco-intensive' farming systems that are practical and commercially viable.
- supporting future land management policies across Europe to meet the challenges of sustainable intensification and multi-functional land use.

Centre for Ecology & Hydrology
NATURAL ENVIRONMENT RESEARCH COUNCIL

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Science Excellence to Impact

1970s

1973: CEH develops first commercial wildflower seed mixes and practical guidance for habitat restoration on farmland and amenity areas.

1975: Re-introduction of Large Blue butterfly and landscape scale restoration of its habitat begins.

1980s

1986: CEH writes the 'Wildflower Handbook' for Department of Transport leading to wide scale planting of wildflowers on road verges across the UK.

1987: UK agri-environment schemes launched to support effective environmental management of farmland.

1990s

1992: New methods for large scale restoration developed e.g. M3 motorway extension at Twyford Down.

1999: Leading role in the Farm Scale Evaluations of genetically modified crops to assess their impacts on the environment.

2000s

2000: Buzz Project in collaboration with farming industry develops effective strategies to restore pollinator habitat on farmland.

2005: Hillesden Farm Research Platform demonstrates ecological intensification of food production.

2006: CEH leads interdisciplinary research showing farmer training improves delivery of agri-environment schemes.

2010s

2010: Operation Pollinator supports farmers in 14 EU countries to deliver over 10,000ha of multi-functional habitats.

2010-12: CEH leads integrated monitoring of flagship English and Welsh agri-environment schemes to assess their efficacy.

Photos: L to R: Marek Nowakowski; Shutterstock; H Lowther, CEH; Shutterstock

Future Research Objectives

Mitigating threats and enhancing beneficial ecosystem functions.

By 2019, we will have:

- *improved understanding of the role of semi-natural ecosystems in the delivery of ecosystem goods and services.*
- *developed and tested pro-active management and restoration strategies to increase the resilience of ecosystems to environmental threats and stressors, including eutrophication, climate change, and habitat fragmentation.*
- *provided farmers and policy makers with innovative management strategies to optimise beneficial ecosystem functions and services, and enhance their application across intensively managed ecosystems.*

Planning future multi-functional landscapes.

By 2019, we will have:

- *developed spatial models of spill-over and scaling of beneficial ecosystem processes at the farm and landscape scale.*
- *developed strategies for how landscape-scale restoration can increase permeability and connectivity to support species adaptation to climate change.*
- *constructed spatial decision-support tools to balance the various demands on limited land, with consideration of scenarios of future changes and their drivers, including environmental (e.g. climate change), economic (e.g. food production) and social (e.g. cultural services) factors.*

Understanding and quantifying threats to semi-natural and managed ecosystems.

By 2019, we will have:

- *undertaken large-scale experiments to measure the impacts of pesticides on pollinator populations.*
- *monitored and modelled the risk of nitrogen pollution from agricultural sources to ecosystems.*
- *mapped potential deficits and vulnerabilities of pollination and pest control services to environmental stress.*

'Ecological intensification' of food production.

By 2019, we will have:

- *developed novel strategies to enhance ecosystem functions within intensively managed landscapes required for crop production (e.g. pollination, pest control, nutrient cycling), and increase the resilience of these functions to environmental change.*
- *established farm-scale experimental platforms to quantify the practicality and benefits of these strategies on farm businesses and food production on commercial farms.*

Improved scientific evidence base for land management policies.

By 2019, we will have:

- *engaged with the farming industry to develop new, innovative 'eco-intensive' farming systems that are practical and commercially viable.*
- *supported future land management policies that meet the challenges of sustainable intensification and multi-functional land use.*

Photos - L to R - 1 & 2 Marek Nowakowski; 3 H Lowther, CEH

Partnerships

Since the mid-1990s, CEH has conducted innovative, multidisciplinary research on sustainable land management commissioned by policy makers (Defra, Natural England, Welsh Government), and, increasingly, the farming and food supply industries (e.g. Syngenta UK, Jordans Cereals, AGRII, Cotswold Seeds, Emorsgate Seeds). This has been delivered in long-term partnership with research institutes (Rothamsted Research), HEIs (e.g. Universities of Exeter, Reading and Bristol), NGOs (e.g. RSPB, Butterfly Conservation), and practitioners (Wildlife Farming Company).

Links with other CEH Science Areas

The Sustainable Land Management Science Area will also play a key role in supporting the delivery of objectives of other CEH Science Areas. Examples of likely important interactions are:

- Environmental Informatics - provision of interoperable data and knowledge to the wider academic, governmental and public communities.
- Monitoring & Observation Systems – national surveillance of the stocks and flow of habitats is vital for novel landscape planning and decision-support tools to deliver enhanced ecosystem services.
- Ecological Processes & Resilience – fundamental knowledge of complex ecosystem processes supporting food production is critical to enhancing these functions and increasing their resilience to environmental change.
- Natural Capital – identifying deficits and risks to natural capital will drive the development of strategies to protect and restore these resources.
- Soils – understanding key soil processes is fundamental for the development of effective strategies for restoration and enhancement of function.
- Biosphere-Atmosphere Interactions – mapping and modelling N pollution associated with intensive agriculture will be essential for developing and targeting effective mitigation strategies.

Contact

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Front cover photo - Marek Nowakowski