CEH SCIENCE AREAS

- Biosphere-Atmosphere Interactions
- Environmental Informatics
- Monitoring & Observation Systems
- Natural Capital
- Natural Hazards
- Pollution & Environmental Risk
- Soil
- Sustainable Land Management
- Water Resources

SCIENCE AREA SUMMARY

ECOLOGICAL PROCESSES & RESILIENCE

Advancing and applying understanding of ecological and socio-ecological processes and resilience to the challenges of global environmental change.

Context

Biodiversity, ecosystem services and the benefits to society that flow from them are increasingly threatened by habitat loss and fragmentation, climate change, over-exploitation of natural capital, pests, diseases, invasive alien species and other drivers of global environmental change. An effective response to these interacting threats requires a better understanding of ecological processes, particularly those that affect the resilience of species and ecosystems.

Our Research

We will identify early warnings of change, tipping points, and the characteristics of species, communities and ecosystems that underpin ecological resilience. To do this, we will combine long-term datasets and use citizen science, models and experimental systems to examine the impacts of single and multiple drivers, including socio-economic drivers, on populations, species and ecosystems. These studies will encompass freshwater, marine, urban and terrestrial ecosystems and their interfaces.

The drivers of change studied will include land-use change, climate change, air pollution, the spread of invasive alien species and emerging drivers such as marine renewable development and threats to food security. Our research will focus on developing policy responses to these drivers by providing fundamental ecological understanding for other Science Areas, particularly Sustainable Land Management and Natural Capital. Our research will also involve early and ongoing engagement with decision-makers and other stakeholders, including transdisciplinary research on trade-offs and conflicts.

Research activity will include:

- detecting early warnings of regime shifts and tipping points in marine, freshwater and terrestrial ecosystems and understanding the mechanisms behind these changes.
- quantifying the interacting effects of multiple socio-economic drivers, environmental pressures and intrinsic mechanisms, such as density dependence, on the resilience of species and ecosystems.
- identifying which ecological structures and processes confer resilience to individual and multiple interacting threats, particularly for those involving trophic relationships, and attributes, such as diversity at different biological scales.
- analysing the socio-ecological processes that create biodiversity conflicts, including the role of human behaviour.
- applying knowledge of ecological and socio-ecological processes to the sustainable management of natural systems, particularly through the engineering of resilience to future environmental change.

Centre for Ecology & Hydrology
NATURAL ENVIRONMENT RESEARCH COUNCIL

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Science Excellence to Impact

1945

1945: Surveillance monitoring of Cumbrian Lakes begins.


Wastwater, one of the Cumbrian lakes

1960s


Monitoring on Loch Leven

1968: Surveillance monitoring of Loch Leven begins.

1970s

1976: Isle of May monitoring of seabirds starts.

1976: UK Butterfly Monitoring Scheme commences, in partnership with Butterfly Conservation.

1990s

1995: PROTECH model developed, allowing assessment of lake ecosystem responses to environmental change.

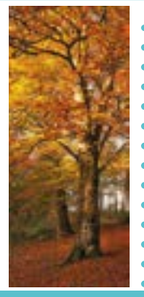
1998: Climate change experiments established in vulnerable upland habitats.

1999: CEH's seabird research integral to European Union (EU) decision-making on North Sea sandeel fishery closure.

2000s

2000: UK Phenology Network established, in partnership with the Woodland Trust.

2000s: Analyses of global extinction rates of plants, birds, butterflies published.



2005: CEH leads a European consortium to develop DAISIE, European inventory of invasive alien species.

2009: CEH leads the development of the first Defra biodiversity indicator for invasive alien species.

2010s

2010: CEH leads a consortium of UK institutions and universities, to publish a comprehensive assessment of shifts in the biological seasons, building on our long-term monitoring of freshwater, marine and terrestrial ecosystems.

2013: Forty years of Loch Leven data published on CEH Information Gateway and made publicly available on data.gov.uk

2013: CEH undertakes first estimations of population consequences for seabirds of displacement from offshore wind farms, which are being used directly in consenting decisions.

Future Research Objectives

To detect early warnings of regime shifts and tipping points in marine, freshwater and terrestrial ecosystems.

By 2019, we will have:

- *developed and tested new statistical methods for detecting early warnings of ecosystem regime shifts in observational systems.*
- *developed models and experimental systems to identify tipping points and early warnings of change in ecosystems.*

To understand how socio-economic drivers, environmental pressures and intrinsic mechanisms interact to affect ecosystem resilience.

By 2019, we will have:

- *quantified the resilience of selected plant and animal communities to interactive effects of environmental pressures.*
- *explored the linkage between above and below-ground diversity, and the role this plays in the resilience of plant communities to climate change.*
- *identified the plant and animal species that have the greatest potential as indicators of climate change in the UK.*

To identify which ecological structures and attributes confer resilience.

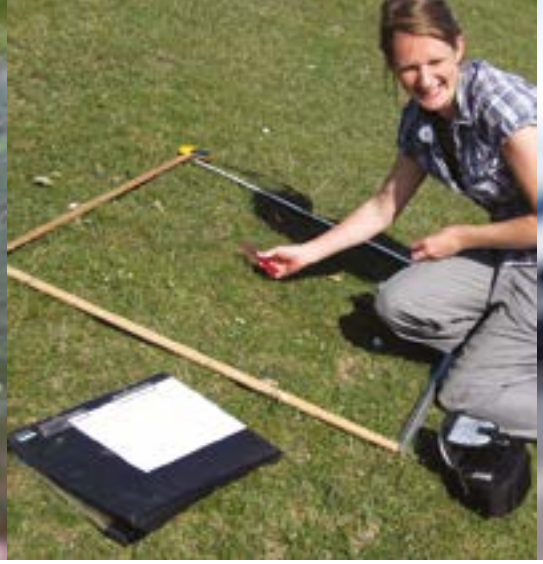
By 2019, we will have:

- *quantified the links between biodiversity and resilience to invasion by pests across a range of ecosystems.*
- *linked time-series data from different trophic levels to assess the degree of synchrony of species interactions, and test the relative strength of top-down and bottom-up processes influencing the structure and dynamics of food webs.*
- *explored the linkage between the function and diversity of microbial communities in a range of habitats and the resilience of these communities to environmental stressors.*

To apply ecological and socio-ecological knowledge to the sustainable management of natural systems.

By 2019, we will have:

- *assessed the impact of strategies to adapt to climate change in forestry on the composition and functioning of their associated communities.*
- *assessed the use of geo-engineering as a eutrophication management tool for engineering ecological resilience in lakes.*
- *developed guidance on biodiversity conflict management principles and tested it regionally.*



Photos L to R: R Broughton, CEH; Helen Roy, CEH; Ross Newham

Partnerships

Our research on ecological processes and resilience is built on over 40 years of experience, much of it in collaboration with others. Our key strengths are our collective breadth of expertise on different ecosystem components and processes, and the data collected across temperate, tropical and arctic ecosystems, such as the Isle of May monitoring of seabirds started in the 1970s and the monitoring of lake ecosystems started in the 1940s. This Science Area will therefore foster existing and new collaborations with universities and research institutes in the UK and internationally, including our partners in the ALTER-Net and PEER networks. Although we have expertise on both ecological and social sciences, we will implement interdisciplinary research mainly in partnership with social scientists elsewhere. We will continue to participate in interdisciplinary assessments, including those coordinated by the new Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES).

Photo - Martin Sharman

Contact

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