MANAGING OUR SOILS FOR A SUSTAINABLE FUTURE

WHY: SHOULD WE CONSERVE AND MANAGE OUR SOILS?

BECAUSE: IT TAKES 10,000 YEARS TO CREATE A SOIL BUT ONLY 10 YEARS TO DESTROY IT

- Soils are critical for life, yet are vulnerable to pollution and unsustainable exploitation
- Soils store 10 billion tonnes of the UK's terrestrial carbon and play an important role in modulating the greenhouse gas cycles which control our climate
- Soils provide the nutrients and water to grow our food and they regulate floods and droughts
- Biologically, soil organisms recycle nutrients, clean our waste and water and provide a biodiverse resource for medical, industrial and agricultural economies
- The diversity, and often conflicting services, provided by soils demands an integrated, multidisciplinary approach to their understanding and management

"A nation that destroys its soils destroys itself"

F.D. Roosevelt, 1937

CEH
Centre for Ecology & Hydrology
NATURAL ENVIRONMENT RESEARCH COUNCIL

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SIX KEY SOIL RESEARCH AREAS AT CEH

Soils and changing climate

Climate change research is established in CEH science strategy. Understanding how soils respond to a changing climate is of fundamental importance.

CEH's role

- Quantifying changes in soil structure and function in response to climate change and climate extremes
- Modelling impacts of extremes of drought or high temperature on soils
- Improving understanding of the soil processes involved in land surface-atmosphere feedbacks

Natural capital and ecosystem services

Soil contributes to the provision of a wide range of ecosystem services. The area of natural capital and ecosystem services is still an emerging science.

CEH's role

- Determining landscape-scale linkages between soil and the provision of ecosystem services such as climate regulation, water filtration and storage, and the maintenance of biodiversity
- Delivering ecosystem models incorporating current knowledge of soils to improve predictions for change in biodiversity and ecosystem functions
- Framework development - mapping, quantifying and valuing the provision of services or functions

Soil contamination, risk assessment and remediation

The UK has a legacy of contamination that needs to be addressed.

CEH's role

- Monitoring large-scale inputs of potentially hazardous contaminants and pathogens (e.g. sewage sludge, manures, industrial wastes) on soils and determining their retention, transport and potential impact on human health and food production
- Producing UK risk maps for soil contamination by metals, soil acidification and nitrogen enrichment, including sensitivity and vulnerability analysis
- Identifying indicators and predicting recovery time from nitrogen enrichment
- Developing new physiological and functional biomarkers, metagenomic and toxicogenomic tools to quantify pollutant impacts on soil communities to support sustainable soil management

Managing land and water to protect the soil resource

Water is vital. We must ensure enough for consumption and ecological requirements, while too much leads to flooding.

CEH's role

- Measuring how changing catchment/ riparian land management affects the condition of freshwater ecosystems and the function of soils
- Assessing available soil and water resources in a changing world based on long-term scenarios of climate, land use and demographic change
- Quantifying impacts of changing urban, peri-urban and rural land use (including energy crops) on soil function and services, e.g. water storage and reducing flood risk
- Identifying and quantifying sources, fluxes and pathways of water, chemicals and sediments including runoff and leaching from soils

Biodiversity, distribution and importance of soil organisms

Surprisingly, little is known about the biogeography and vulnerability of soil organisms, particularly microbes.

CEH's role

- Mapping the distribution and activity of soil organisms
- Identifying key functional groups, and the range of taxa, essential for maintaining ecosystem services
- Developing tools to enable prediction of below-ground biodiversity, e.g. molecular taxonomy
- Quantifying thresholds and predicting impact of above-ground perturbation on soil food webs and ecosystem function

Soil organic matter and carbon

A wide range of research is undertaken at CEH to address the critical question of what drives changes in organic matter and carbon stock.

CEH's role

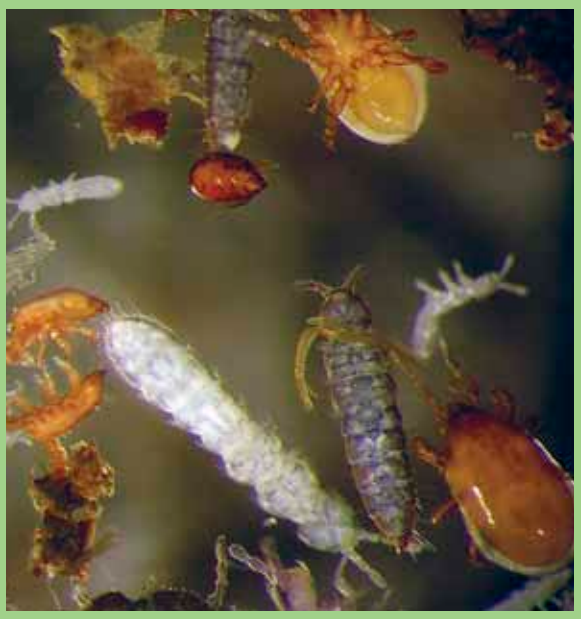
- Quantifying catchment-scale carbon budgets and fluxes at key research sites
- Determining changes in soil carbon held in different soils and in different regions of the UK, and attributing causes of change over the last 30 years
- Contributing to the UK soil carbon map
- Inventory of changes in carbon fluxes due to current UK land use
- Improving modelling of carbon to enable rates of change to be forecast and to inform mitigation measures

Using new technology to improve our understanding

Embracing and applying new technologies is vital to modern science.

CEH's role

- CEH is continually developing and testing technologies for environmental application, ranging from remote telemetry systems, sensor networks and geophysical mapping to gene discrimination techniques in the laboratory
- Using an integrated approach, CEH applies cutting-edge technology to understand complex and emergent properties of the soil resource



CEH is working on many projects applying new knowledge and new solutions to address complex changes facing our earth systems.

CEH's multi-disciplinery, integrated research delivers unique solutions for managing our soils.

- **Monitoring** across Britain to observe how soils are changing and understand why
- **Experimentation** relating soil biodiversity to function and measuring the services they deliver
- **Modelling** to predict how soils may change in the future and exploring options for managing the soil
- **Risk assessment and remediation** strategies to solve complex environmental problems

FUTURE CHALLENGES

- Multi-disciplinary expertise and novel technologies are essential to address questions from the gene to a global scale
- Identifying the thresholds for soil functions and the ecosystem services they provide
- Developing new monitoring approaches to protect our soil natural capital
- Helping society prioritise, conserve and manage soils to deliver multiple functions across whole landscapes

DELIVERING IMPACT

- CEH delivers and coordinates the UK Countryside Survey, including the UK Land Cover Map, and coordinates the UK Environmental Change Network that provides detailed ground-based ecosystem assessments of the stock and change in our soils including stored carbon, organisms and pollutants
- CEH develops acclaimed models including the Joint UK Land Environment Simulator (JULES) that links soil processes such as soil moisture with atmospheric processes and climate models
- CEH is commissioned by DECC to report annually on inventories and projections of UK greenhouse gas emissions by sources and removals by sinks due to land use, land use change and forestry
- CEH led the soil section of Defra's Review of Transboundary Air Pollution (RoTAP). The review focuses on the main chemicals causing acid deposition, eutrophication, ground-level ozone and heavy metal pollution in the UK and their impact on soils and their function
- CEH published the first national survey of the distribution and diversity of soil meso and microbiota across our landscape

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