

WHY: DO SOIL MICROBES MATTER?

BECAUSE: CROPS WOULD NOT GROW, AND PURIFICATION OF POLLUTANTS WOULD NOT TAKE PLACE

Microbes are central to all life on Earth due to their huge diversity in form and function. In soils, one teaspoon of topsoil contains around 1 billion individual microscopic cells and around 10,000 different species. These organisms have many tasks, and are central to crop fertility, purifying the environment from pollutants, regulating carbon storage stocks and production/consumption of many significant green house gases, such as methane and nitrous oxides. The economic valuation of soils is in a large part due to soil microbial populations which provide key soil functions. Future climate scenarios may affect microbial populations in soil with many potential consequences, from increased losses of soil carbon due to increased respiration, changes in soil borne greenhouse gas production/consumption and changes to important plant-soil feedbacks giving rise to soil fertility.

Microbes in soil ecosystems

- They cycle most major nutrients required for plant productivity e.g. Nitrogen, Phosphorus
- They protect plants from disease and are intimately associated with plant growth and productivity
- Different types produce and consume most types of major greenhouse gases e.g. Carbon Dioxide, Methane & Nitrous oxide
- They adapt to, and purify the environment, especially water, through degradation of pollutants e.g. removing explosives such as RDX

Microbes and climate change

- Bacteria recycle carbon in soils deposited by living and dead plants 'The Carbon Standing Stock'
- Whilst Plants are good CO₂ absorbers, it is activity by soil microbes that determines whether the carbon is stored underground or release back into the atmosphere where it contributes to climate change
- More than three times the carbon is stored in soil than in the atmosphere
- But increases in temperature are predicted to increase bacterial respiration and therefore increases in CO₂, methane into the atmosphere and so reduce carbon storage in soil





Microbial work at CEH

Despite the crucial role of microbes in food production and sustainability, carbon storage very little is known about their biodiversity, their functional roles and interactions within an ecosystem or even about the drivers that alter their population. To overcome this lack of knowledge, CEH was the first to devise and implement the next generation of DNA based monitoring methods to assess the microscopic microbial populations at the UK wide scale in order to understand basic concepts of what environmental factors distribute microbial populations and their functions. Through this work the UK now has the world's first 'next generation' DNA based monitoring network for bacteria, similar to those available for animals and plants. This work addresses fundamental concepts in microbial ecology it also provides the basis for next generation monitoring networks to understand and predict the effects of climate shifts.

Carried out as part of Countryside Survey, work at CEH has resulted in the first soil microbial map of the UK. It has shown that most soil bacteria belong to one of two lineages: alphaproteobacterial whose function associations include nitrogen fixation and acidobacterial whose function in soil is unknown. It has been suggested the ratio of these two main groups will be related to the nutrient status of the soil. Therefore it is necessary to measure bacterial biodiversity to understand the effects on soil functions and how that may be altered by shifts in composition.

The microbial work is part of a much larger research work on soils at CEH. It undertakes:

- 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 explore options for managing the soil.
- Risk assessment and Remediation strategies to solve complex environmental problems.

Future Impacts

The work understanding microbial distributions at a national level is an embryonic area of science. Yet it has the potential to improve our understanding of essential soils and ecosystem interactions. This could led to significant impact for:

- Food security: could soil microbial solutions result in an increase food production?
- Water security: could microbial solutions result in more effective water purification or land remediation?
- Climate change: understanding microbial effects will help reveal how soil carbon storage works and the balance of carbon use of bioenergy crops

Contact details

For more information please visit our web site at http://www.ceh.ac.uk/sci_programmes/SoilBiodiversityEcosystemFunction.html Or contact: Andrew Whiteley????