

The structure and function of soil microbial communities in contrasting biomes at The Eden Project,

The Eden Project is a unique global garden situated in a reclaimed Kaolinite quarry approximately 3 miles from St Austell, Cornwall. Eden is dominated by two steel-framed dome complexes, each of which emulates a biome, and is set among extensive outdoor gardens. The largest dome houses Eden's tropical rainforest biome, the second dome houses the Mediterranean biome while the outdoor gardens represent temperate environments. Together the biomes and gardens house a huge diversity of plant life and help to introduce the general public to the critical interdependencies between plants and people. Eden is fast becoming a unique resource for education and research towards a sustainable future.



CASE partner The Eden Project, Cornwall, is dominated by two biomes housing Mediterranean and tropical rainforest ecosystems, set among extensive outdoor gardens.

All of the environments at Eden are sustained by 85,000 tonnes of artificial soil, created from recycled mineral waste and composted green/bark wastes developed at the University of Reading. The soil has now been *in situ* and supporting complex plant communities for >15 years but surprisingly little is known about the identity or functional significance of the microbial communities also supported by the soil which in turn play a key role in maintaining the above-ground ecosystems.

This project will use the unique suite of environments available at Eden to explore the origins, diversity and functioning of microbial communities within synthetic soils using Eden's biomes and outdoor gardens, representative of globally important habitats. Soil microbial community responses to environmental stresses will be monitored through metagenomic analyses and reciprocal transplant experiments, alongside detailed lab experiments to elucidate microbial function in facilitating plant and therefore ecosystem establishment. These experiments will provide the student with expertise in a variety of desirable skills and techniques



The Tropical Rainforest and Mediterranean biomes at Eden are supported by just 38 cm of man-made topsoil. The microbial community structures and the role they play in maintaining the soil and plant health at Eden are unknown.

Objectives

1. Determine soil microbial community structure in rainforest, Mediterranean biomes, compared to each other and to those in natural soils.
2. Understand soil microbial dispersal patterns from surrounding native soil to Eden's man-made soils.
3. Examine the function of each soil microbial community in terms of carbon and nutrient cycling within each soil and evaluate their role in maintaining complex plant communities.
4. Identify soil microbial community responses to changes in soil, plant and abiotic environments.

Potential for High Impact Outcome

This project will provide new insights into soil ecology, particularly the role of soil microbes in establishing and maintaining plant communities on synthetic soils. It will help develop soil management strategies at Eden, aiming to reduce chemical inputs and improve sustainability of the systems. Further, thanks to the nature of the artificial soils developed and used at Eden, the findings from this PhD project will provide novel insights into the dispersal biology of soil microbes and provide unique opportunities for outreach work with the general public, highlighting the importance of the invisible worlds beneath the soil surface.

Training

The student will be supervised by Dr Katie Field, an ecophysiologicalist with special interests in functional diversity of plant-fungal symbioses and plant-soil interactions and Prof Urwin, professor in nematology, at the University of Leeds. The supervisory team is enhanced by close collaboration with external project partners Dr Thorunn Helgason (Univ. York) whose research focuses on structure and function of soil microbial communities and Dr Rachel Warmington, plant pathologist at CASE partner The Eden Project.

The student will acquire skills and become proficient in a variety of lab and field techniques. These include plant and soil physiology, isotope tracing, experimental design, ecosystem analysis, environmental genomics, and analysis of complex datasets using statistical models. The student will have the opportunity to attend and present their research at UK and international meetings throughout the PhD project, e.g. the British Ecological Society AGM and the International Conference on Mycorrhiza. These meetings will aid with dissemination of findings and develop the student's presentation skills while providing them with excellent networking opportunities to facilitate their career development. The Eden Project CASE partnership will provide unrivalled opportunities for public engagement and science communication.