Effects of global warming on Antarctic soil microorganisms and associated functions

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Soil microorganisms are involved in all the major global biogeochemical cycles, but consequences of ongoing climate changes on these organisms and associated functions are mostly unknown. Antarctic terrestrial habitats are ideal testing grounds for the impacts of perturbation on soil microbes, and the ecosystem functions for which they are responsible. Indeed, the unusually harsh environmental conditions of terrestrial Antarctic habitats result in ecosystems with simplified trophic structures, where microbial processes are especially dominant as drivers of soil-borne nutrient cycling. The Antarctic Peninsula is one of the most rapidly warming regions in the world, yet few studies have addressed the potential impacts of global warming on soil microbes and associated nutrient-cycling functions inhabiting these simple and vulnerable environments.

The main objective of this thesis is to assess the effects of global warming on Antarctic soil-borne microorganisms and associated functions. This objective was pursued via three complementary experimental approaches:

1. A detailed description of the microbial communities, and their associated functions, inhabiting Antarctic terrestrial habitats along a latitudinal transect, as a proxy for long-term, large-scale climatic changes (Chapters 2-5).
2. A study of the short-term responses of soil microorganisms and associated functions to increasing temperature and altered freeze-thaw cycle frequency in controlled microcosm experiments (Chapter 6).
3. An assessment of the responses of soil microbial communities and functions in a field manipulation experiment involving three years of artificial enhancement of soil temperature warming using open-top chambers at three field locations (Chapter 7).

Such an integrated approach is thought to help overcome methodological, spatial and temporal limitations and to help discriminate between general and context-dependant responses of ecosystems to global warming.

Taken together, the results presented in this thesis suggest that global warming will have profound effects on Antarctic soil microorganisms and associated functions. The short-term effects will be highly variable and shaped by local environmental conditions, while in the longer-term, global warming will strongly affect soil microorganisms and nutrient-cycling functions, both directly and indirectly.

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