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Editorial

A synthesis of soil biodiversity and ecosystem functioning in Victoria Land, Antarctica

Since the 1970s, ecological research on the ice-free soils in Antarctica has exploded, drastically altering general perceptions about the diversity of life on this cold, dark and windy continent. In Victoria Land, Antarctica (70°30′S to 78°00S), where soil biota (microbes, protists, invertebrates) were once thought to be non-existent or rare, they are now recognized as widely distributed. It is these organisms with generally small biomass and limited diversity that are explored in the papers in this volume of *Soil Biology and Biochemistry*. In terms of the ecological functioning, many of the soils of Victoria Land represent end-members along a gradient of declining energetic and nutritional resources. These ecosystems are taxonomically and functionally simple, thus providing the opportunity for investigators to characterize the composition of soil communities more accurately and comprehensively than is normally the case for soils and to link soil species explicitly with ecosystem functioning. The collected papers in this volume demonstrate the relevance of Victoria Land soil ecosystems to understanding relationships between biodiversity and ecosystem functions fundamental to all soils. This issue of *Soil Biology and Biochemistry* represents a compilation and the first synthesis of recent soil ecological research in Victoria Land addressing these relationships. Building a synthesis of soils research across regions of Antarctica is especially critical as we seek to understand how the provision of ecosystem services by soils worldwide are affected by global change.

That global changes are affecting polar regions is no longer a contentious issue and because of their extreme environmental conditions, they are regarded as more sensitive indicators of environmental change—sentinels of change (Chapin et al., 2005a, b; ACIA, 2005). Of concern, however, is how these changes will affect biodiversity and the ecological processes mediated by soil organisms. A principal goal of this volume is to assess the current state of knowledge of controls over soil biodiversity in Victoria Land and to identify gaps in order to develop scenarios about the response of these systems to global changes (Wall, 2005). As presented, these papers provide a benchmark on soil ecosystems of Victoria Land. They call for a priority research agenda that will combine site-specific information, provide new data that is badly needed on taxa and ecosystem processes for Victoria Land and ice-free areas further south and inland, and that will compare responses of soil biodiversity and biogeochemical cycling to global changes through cross-continental Antarctic experiments. A consensus also arising from these papers is that the research agenda must be international, integrated, and multidisciplinary, involving soil scientists, biogeochemists, geologists, ecologists, taxonomists, modelers and others, if we are to observe responses to global change promptly.

As a result of the international commitment to Polar Science we now have considerable information to assemble on biodiversity in this region, such as current data on how many species are present, their biogeography, frequency of endemism, degree of interaction among species, the role some organisms play in carbon and nutrient cycling, and commonalities in the physical and chemical factors that determine distribution (see Adams et al., 2006; Barrett et al., 2006; Hogg et al., 2006; all in this volume). The National Science Foundation Office of Polar Programs funded an invited workshop and provided an opportunity for scientists to share insights gained from individual studies across Victoria Land, Antarctica. This workshop, ''The Synthesis of Soil Biodiversity and Ecosystem Functioning in Victoria Land, Antarctica'' held in April 2005 was the first international gathering of this community. Their research on soil ecosystems is a valuable contribution to global issues and 'hot topics' in biology, ranging from evolutionary biology to impacts of disturbance. The papers greatly improve our understanding of soil biodiversity and biogeography, foodweb structure and interactions, and terrestrial ecosystem processes. Furthermore, it is our intention that these papers will be an important contribution to the ecological literature on Antarctica and it is timely that they are published at the start of the International Polar Year (2007–08; http://www.ipy.org).

The participants identified priorities for future research in the soil ecosystems of the Victoria Land region. Among them were: the development or modification of analytical techniques capable of detecting low limits of ecosystem processes, expanded application of molecular (both phylogenetic and

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population genetic) and classical taxonomic methods, the determination of species active in ecosystem processes as opposed to those metabolically inactive, and the use of functional genes to distinguish the role of individual species in ecosystem processes (NRC Report, 2003). These priorities are deemed necessary if we are to establish and forecast how this region will respond to multiple impacts of global change. The collective result of this volume and the workshop is a collaborative agreement that there is a pressing need to address these priorities, sooner rather than later.

This landmark volume is due to the energies of many people. We thank all of the anonymous reviewers of the articles in this volume. We acknowledge Chris Frost, Breana Simmons, Patti Orth and Lily Hoffman for providing logistical support during the workshop. We thank Berry Lyons for facilitating discussions and providing much needed historical paleoecological and geochemical context as a basis for the workshop. We appreciate Polly Penhale's support in bringing this community together. We are especially grateful to David Coleman for hosting the meeting and editing this volume.

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Diana H. Wall
Natural Resource Ecology Laboratory & Department of Biology, Colorado State University, Fort Collins, CO 80523, USA
E-mail address: Diana@nrel.colostate.edu

Byron J. Adams
Microbiology & Molecular Biology Department, and Evolutionary Ecology Laboratories, Brigham Young University, 775 WIDB, Provo UT 84602, USA

John E. Barrett
Ross A. Virginia
Environmental Studies Program, Dartmouth College, Hanover, NH 03755, USA

David W. Hopkins
Scottish Crop Research Institute, Invergowrie, Dundee DD2 5DA, Scotland, UK