A Striking Profile: Soil Ecological Knowledge in Restoration Management and Science

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Abstract
Available evidence suggests that research in terrestrial restoration ecology has been dominated by the engineering and botanical sciences. Because restoration science is a relatively young discipline in ecology, the theoretical framework for this discipline is under development and new theoretical offerings appear regularly in the literature. In reviewing this literature, we observed an absence of in-depth discussion of how soils, and in particular the ecology of soils, can be integrated into the developing theory of restoration science. These observations prompted us to assess the current role of soil ecological knowledge in restoration research and restoration practice. Although soils are universally regarded as critical to restoration success, and much research has included manipulations of soil variables, we found that better integration of soil ecological principles could still contribute much to the practice of ecosystem restoration. Here we offer four potential points of departure for increased dialog between restoration ecologists and soil ecologists. We hope to encourage the view that soil is a complex, heterogeneous, and vital entity and that adoption of this point of view can positively affect restoration efforts worldwide.

Key words: land use legacies, restoration, soil, soil ecology, soil fauna.

Background
Soil ecology blends knowledge of physical, chemical, and biological processes and properties to better understand and manage ecosystems, communities, and species’ functions and interactions. The interplay between aboveground and belowground structure and function holds great relevance to the maintenance of native biodiversity and viable ecosystems (Wardle 2002), so the marriage of restoration and soil ecological perspectives holds great promise. Indeed, restorationists have long appreciated the importance of soils, in spite of the fact that terrestrial restoration science has focused primarily on establishing aboveground plant communities. Here we discuss the current state of these interactions and attempt to identify areas where greater appreciation for the parallel interests of the two disciplines could advance both restoration successes and soil ecological knowledge.

In October 2005, an international group of soil ecologists gathered on the campus of the University of Georgia (UGA) to participate in a special symposium celebrating the retirement of Prof. David C. Coleman from the Institute of Ecology at UGA. During this symposium, several participants discovered a common interest in restoration ecology and decided to conduct a detailed evaluation of how the discipline of soil ecology had contributed to progress in the practice of Restoration Ecology. Toward this end, a small group met in Chicago at DePaul University for a workshop, and a half-day symposium was held at the Ecological Society of America meetings in Memphis (2006). These efforts helped the group to focus their questions and further demonstrated that the topic was of interest to a large number of individuals from a broad spectrum within the ecological research community. Momentum from these efforts ultimately led to the planning and execution of a larger conference on the subject of interfaces between soil ecology and restoration ecology held at DePaul University in Chicago, Illinois, U.S.A., from 18 to 20 December 2006. With more than 150 participants, the audience consisted of scientists, land managers, and restoration practitioners. The articles in this special section represent a substantial fraction of the presentations made at the conference in Chicago.

The workshop, symposium, and conference all were loosely organized around the basic question of whether or not Soil Ecology and Restoration Ecology were making full use of their accumulated wisdom to accomplish restoration goals. We retooled a question based on Bradshaw’s (1983) famous proposition: “If restoration is the acid test of ecology, what is the pH of our soils knowledge?” Most of the original organizers could be best described as soil ecologists (i.e., not restoration ecologists), and we proceeded with the possibly naïve view that in practice, restoration ecology employs a simplistic approach to soil (soil = medium for plant growth). We based this view on observations by Ruiz-Jean and Aide (2005) that success in