Translational Science Partnerships: Key to Environmental Stewardship

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Key to enhancing the societal relevance of ecological knowledge is effective relationship building among scientists, ecosystem managers, and policymakers to create translational science partnerships that have sufficient capacity to address the mounting environmental challenges that confront human society. The Millennium Ecosystem Assessment, the National Research Council's (2009) *New Biology for the 21st Century*, and the National Science Foundation's Advisory Committee for Environmental Research and Education Report provide compelling arguments for greater integration of science within social organizations and policies in order to promote environmental stewardship. Translational science has been adopted by the medical sciences to more effectively disseminate and apply scientific knowledge to improve human life. Although specific definitions of *translational science* are numerous and varied, the term has multidisciplinary problem solving at its core—a goal that is central to ecological science. In contrast, ecological research institutions, including universities, have been less effective in translating ecological knowledge into action compared with the medical sciences. Less effective knowledge translation implies that various obstacles exist to limit the recognition and to impede the development of translational science partnerships that are essential to the dissemination and application of ecological knowledge in social organizations.

A recently completed assessment of the effectiveness of the US Department of Agriculture's (USDA) ecosystem-management programs, which affect 188 million hectares of privately owned rangelands in the United States, provides a unique case study to identify both the major obstacles and potential solutions for the development of translational science partnerships. This project engaged 30 USDA technical specialists and national program staff members and 40 scientists over a four-year period to complete an unprecedented integration of science, management, and policy knowledge within the 60-year history of the rangeland profession. This assessment highlighted five major obstacles, of varying transparency, to the development of translational partnerships and three categories of solutions that may inform the development of translational science in ecology.

The first major obstacle is the potential for competing agendas and motivations that may interfere with the development of trust among stakeholders in aspiring partnerships. The USDA assessment was initiated by the Office of Management and Budget to ascertain the societal benefits derived from federal expenditures on ecosystem management. Consequently, many USDA personnel were focused on scientific validation of the existing conservation programs, whereas research scientists emphasized the incorporation of contemporary scientific knowledge within these programs. These subtle distinctions, in an otherwise common agenda, can create an underlying tension or overt conflict that must be recognized and managed to strengthen emerging partnerships.

Second, uncertainties exist regarding the appropriate procedures to prioritize and integrate scientific and experiential knowledge. Each stakeholder group holds their information source in the highest regard and is less familiar with those of other stakeholders. This issue is compounded by the use of distinct styles of inquiry in science and management that generate unique knowledge sources that can prove difficult to integrate. Science emphasizes hypotheses testing, usually through highly regulated manipulation of a small number of ecological variables at relatively small scales over short time frames, to develop a process-based understanding of ecosystem structure and function. In contrast, managers often obtain experiential knowledge by observing qualitative indicators across large and frequently diverse landscapes to devise management rules of thumb that are based on the successes and failures of management actions and policy recommendations. Knowledge integration proved to be especially challenging in this assessment, because science and management or policy had operated with surprisingly minimal interaction throughout the history of the rangeland profession such that these two knowledge sources had diverged and become embedded within their respective social organizations.

Third, scientific knowledge often lacks sufficient context for successful application to ecosystem management and policy, because these actions occur within complex adaptive systems characterized by ecological, economic, and cultural components that collectively determine system responses and management outcomes. Research programs have, until recently, been focused primarily on ecological—and, to a lesser extent, economic—components to guide management and policy recommendations. It is not surprising that this assessment identified the limited understanding of human goals and values regarding ecosystem management as the most significant knowledge gap and called for greater involvement of social scientists in future research.

Fourth, involvement in translational partnerships is rarely recognized or encouraged by the respective social organizations, and when it is undertaken, it is often relegated to secondary status by its being added to existing high-priority responsibilities. Academic institutions are beginning to recognize the value of *boundary spanners*—individuals who create shared meaning among organizations by relationship building—but these individuals are often self-motivated and