Meeting Reviews

Soil and Sediments: Linkages to New Research

The Scientific Committee on Problems of the Environment, SCOPE, convened a workshop sponsored by The Ministry of Agriculture, Natural Resources Management and Fisheries of The Netherlands and anonymous donors.

The SCOPE Committee on Soil and Sediment Biodiversity and Ecosystem Functioning, chaired by Diana Wall Freckman, Colorado State University, USA and aided by co-chairs Margaret Palmer, University of Maryland, USA (Freshwater Sediments), Lijbert Brussaard, Agricultural University, The Netherlands (Soils), and T. Henry Blackburn, Aarhus University, Denmark (Marine Sediments), met for the first workshop in late April 1997 in Wageningen, Holland. The 40 experts from 15 countries, representing taxonomists, ecologists, and biogeochemists working in the domains of soils, freshwater sediments, and marine sediments, spent almost a week summarizing the status of knowledge on biodiversity in relation to functioning in "their" ecosystems, and identifying similarities in taxa and functions and gaps in knowledge preventing a synthesis across these domains. SCOPE was the first integrative workshop bringing together scientists from these three domains and the first to emphasize the functional significance of specific organisms and taxa to ecosystem processes and the ecosystem services they represent.

A common basis of the meeting was our collective scientific knowledge of the organisms that supply many of the critical ecosystem services such as clean water, soil fertility, biocontrol for crops, and decay of organic matter. A recent study showed that these services contribute to global value for natural services of U.S.$33–48 trillion a year. The biota are affected by changes in land use practices, pollution of soils with connecting effects on streams and oceans, groundwater contamination, and their activities impact food supply (fisheries, agricultural crops) and ecosystem health. Many of these human-induced effects on our environment are studied in isolation (as black boxes in models, or as research topics such as groundwater and watershed biogeochemistry) from the diversity of organisms that provide the essential ecosystem services upon which society depends. In addition, there are few research projects linking soil–freshwater–marine biodiversity and ecosystem functioning.

Participants quickly realized that:

a) Soil, freshwater, and marine sediments are interconnected by similarities in ecosystem processes, biogeochemistry, and the types of functions performed by the diversity of biota, many of which occur across all three domains.

b) Though many of the processes were similar, important terminology used by the participants differed among the domains. For example, soil ecosystem engineers share many functional characteristics with bioturbators in aquatic and marine sediments.

c) Similar methods are lacking for sampling biota across the three domains, or even within a domain. It is also unclear how spatial scaling issues will differ across the domains, a critical issue in linking biota to large-scale processes and global change.

d) Most of the taxonomic descriptions of organisms in these domains have been from developed countries or in nearshore shallow waters of oceans, leaving our knowledge of global biodiversity and ecosystem functioning poorly known.

e) Linkages of knowledge across the three domains would increase our understanding of how disturbances affect subsurface biodiversity and functioning, and, in turn, how these impacts of disturbance influence above-surface ecosystem function. The implications for sustainable agriculture and forestry are large.

f) A major effort is recommended to improve our communication and understanding of the biodiversity of soils and sediments. The linkage of the soil and sediments as a research and synthesis effort will provide more information and a broader understanding of our planet on a global scale than traditional studies of each domain alone.

Here are a few topics that were among the priorities:

Training.—(1) Systematics and taxonomic expertise on biodiversity within and across domains should be expanded globally and organized through a biodiversity informatics approach, and user-friendly identification aids for key taxa should be developed to facilitate global biodiversity assessments.

Research.—(2) A multidisciplinary approach to research should be encouraged between systematists and ecologists to provide information on: (a) feedback mechanisms connecting above- and belowsurface species, (b) important taxa in bioremediation of pollutants within and across domains, (c) which organisms are pests that, with disturbance, could affect soil and sediment functioning, and (d) the role of these species in global processes, such as atmospheric trace gas production and consumption.

Syntheses.—(3) Data on subsurface herbivory across domains has not been synthesized. We need to determine how disturbance and/or dispersal of these biota can impact primary productivity and organic matter decomposition. (4) Biogeochemical and food web models are needed across domains to examine the similarities and differences in functions and the roles of the taxa in controlling these functions, and to predict consequences of disturbance to the habitat.

Policy.—(5) The taxa in soils and sediments perform vital functions for humans. The biodiversity in soils and sediments is responsible for bioremediation, soil fertility, clean harbors, and a productive agriculture. Research and synthesis across domains that connect the organisms in soils and sediments is a new approach to land and water management. Benefits from this approach will broaden approaches to bioremediation, land use, and environmental management, with benefits to near-shore habitats and marine harbors, wetlands, and soils.

The documents resulting from the meeting will be published in *Ambio* early next year. Additional workshops will be forthcoming and topics will be based on priorities set by participants.

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Ecology and Management of Subdivided Animal Populations

A workshop sponsored by Mission pour la Science et la Technologie, Embassy of France, Washington, D.C., and Patuxent Wildlife Research Center, U.S. Geological Survey, Biological Resources Division. Organized by J. D. Nichols, J.-D. Lebreton, and T. Boulinier, and held at The National Wildlife Visitor Center, Patuxent Wildlife Research Center, Laurel, Maryland, 14–16 January 1997.

The increasing subdivision of the earth's habitats by humans has led to substantial interest in the ecology and management of subdivided animal populations. Conservation biology as a whole has been strongly influenced by studies of the dynamics of subdivided populations, and of the dynamics of metapopulations in the broad sense. For instance Hanski and Gilpin (1991:13) emphasize that the well-known SLOSS (Single Large or Several Small) controversy over the design of nature reserves is "fundamentally a metapopulation question." Theoretical work on the dynamics of subdivided populations carried out over the last one to two decades has produced many interesting models and associated inferences (see, for example, from the genetical and evolutionary point of view the review by Harrison and Hastings 1996). Empirical research conducted over this same period has led to suggestive associations between habitat subdivision and the characteristics of corresponding animal populations and communities, especially with an outburst of experimental approaches. However, as emphasized by Kareiva (1990), there has been inadequate integration of theory and empirical results, especially because most models have neglected habitat heterogeneity (Hanski 1991), a key feature (as shown by many empirical studies). Moreover, the relationship of spatial dynamics to population regulation is still poorly understood, although it is a key issue from a conservation biology perspective because regulation is a major determinant of population resilience and persistence. Indeed, "whether regulation is typically achieved by local stabilizing mechanisms or via metapopulation dynamics remains to be determined," (Murdoch 1994:271).

Recent developments in theory, estimation methodology, and multisite empirical research should combine to permit integration of theory and empirical results in the very near future. Recent theoretical work has included source–sink models (Pulliam and Danielson 1991), patch-dynamic models (see, e.g., Verboom et al. 1991), and multisite projection matrices (Lebreton 1996). Such models have been developed in discrete time and space, matching the treatment of these variables in most empirical work with vertebrates. Recent statistical research has produced methods for estimating and modeling location-specific movement and survival probabilities using capture–recapture/resighting data from multiple study locations (Hestbeck et al. 1991). Recent empirical studies have included the simultaneous sampling of marked animals at multiple locations for use with these multisite estimation methods (Conroy et al. 1996). Scientists in France and the United States have been active participants in the recent development of theoretical, statistical, methodological, and empirical approaches to the dynamics of subdivided animal populations. This workshop provided a means to stimulate interaction and collaboration among French and United States scientists working on this topic. The objective of the workshop was to discuss recent and ongoing theoretical, methodological, and empirical research on the ecology and management of subdivided animal populations to better integrate future efforts. Integration should lead to increased understanding of subdivided animal populations and corresponding increases in the ability to manage such populations.

The workshop included presentations by 10 invited speakers, with designated periods for group discussion following each presentation. Andre Dhondt participated as an invited discussant.