Comments on “The Soil Survey as Paradigm-Based Science”

The soil-landscape paradigm is indeed the basis for soil survey (Hudson, 1992). As Hudson points out, the tacit nature of our knowledge of soil landscapes is a major source of inefficiency in soil survey. The following comments suggest some reasons why the soil-landscape paradigm has been neglected and adds to the possible solutions given in the article by Hudson.

One major reason why the soil-landscape paradigm has been neglected is that there is a competing and currently dominant paradigm — the taxonomy paradigm. That paradigm views soils as individuals (pedons or profiles are the individuals) that can be abstracted from their setting and joined in a branching, hierarchical classification system.

The taxonomy paradigm was originally developed for the study of organisms, and its success there prompted scientists to try it on soils. There are at least three major differences, however, between organisms and soils that limit the usefulness of the taxonomy paradigm for the latter:

1. The sequence of branching in the hierarchy has an objective basis for organisms (evolution), while in the case of soils this sequence is a matter of opinion (and perpetual disagreement).
2. Organisms transitional between taxa generally occur only at low taxonomic levels (between species and genera), while soils transitional between taxa occur at all levels.
3. Biological taxa are extremely information-rich in the sense that the amount of information needed to identify any taxon is small compared with the amount of information (on physiology, evolution, and agricultural use, for example) that can be associated with the taxon. In contrast, soil taxa are information-poor, because the information that can be associated with them barely exceeds that which is directly implied by their diagnostic properties.

To illustrate how the taxonomy paradigm currently rules in the world of soil genesis, morphology, and survey, I offer the following. Instruction on taxonomy usually fills a large part of college soil morphology and genesis courses and texts, while the soil-landscape paradigm, as Hudson’s article stated, is generally neglected. Taxonomy is also emphasized in Soil Conservation Service courses on basic soil survey and soil correlation. National Cooperative Soil Survey (NCSS) field reviews and soil survey manuscript editing in many cases are mainly a check on classification of soil pits and descriptions, rather than a check on the suitability of the soil-landscape models used. The entire soil information system used by the NCSS, including map unit names and descriptions and the soil information database, is organized around taxa. Finally, in my experience on field tours, soil scientists tend to discuss taxonomy more than soil-landscape relationships.

I believe that, for field soil science to really progress, we must make one of Kuhn’s (1970) paradigm shifts to the soil-landscape paradigm. One possible step would be to develop a hierarchical system of concrete soil-landscape units. (Concrete here means that the units are defined with reference to actual places, i.e., the properties of the units would be those of a specified area of land.) The basic unit would be the detailed mapping delineation, grouped (correlated) with similar delineations into soil-landscape units (Swanson, 1990a), and perhaps joined again into larger landscape or physiographic units (Swanson, 1990b).

It is significant that geologic formations — the paradigm for geologic mapping — are concrete units analogous to my suggested soil-landscape units. Although abstract rock classes (i.e., sandstone, granite — the geologic analogs of soil taxa) are used to describe formations, the formations are usually what is mapped, and they are the main repository of geologic information (Swanson, 1991). Application of the taxonomy paradigm to vegetation (another complex natural entity with some features analogous to soils) has also been questioned. Curtis (1959, p. 53) stated that plant communities cannot be taxonomically classified, even though plant species themselves can.

Although I feel that the soil taxonomy (Soil Survey Staff, 1992) is based on a borrowed paradigm not ideally suited to soils, it contains a wealth of useful information that could be extracted and used to name soils. I would advocate that a system of quantitatively defined, soil-naming adjectives be developed, largely from the taxonomy (e.g., mollic, andic, ustic, or coarse-loamy). To name a soil, as many adjectives as needed could be used in whatever order suits the purpose. A certain amount of information could be associated with these abstract adjectives; for example, vertic implies certain properties and management. The mass of detailed information on soil genesis, morphology, properties, use, and management, however, would be linked with concrete soil-landscape units rather than the abstract soil names.

Received 22 Dec. 1992.

DAVID K. SWANSON
USDA-SCS
1760 Westwood Way
Fairbanks, AK 99709

References