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Dynamic Soil Properties

By Daniel F. Wallace, State Resource Inventory
 Coordinator, Natural Resources Conservation
 Service, State Office, Athens, Georgia.

Soil is so basic to our NRCS mission that the agency began its existence named the Soil Conservation Service. Understanding soil is essential to our success in conservation and has been so for a very long time (McDonald, 1941; Lowdermilk, 1953).

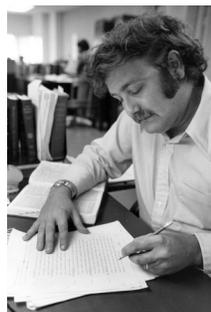
The properties of a soil can be viewed as either inherent or dynamic. Examples of inherent properties are slope, profile horizons, texture, color, structure, bulk density, cation-exchange capacity, and mineralogy. Examples of dynamic soil properties are pH; plant nutrient concentrations, including nitrogen (N), phosphorus (P), potassium (K), and micronutrients; organic C; aggregate stability; earthworm populations; moisture content; soil temperature; and compaction. Soil classification and mapping have concentrated on inherent properties. Dynamic soil properties are of primary concern to the soil conservationist because they respond to management changes.

Inherent properties are used to classify the soil. Soil Taxonomy is a system of classifying soils on the basis of inherent properties (Soil Survey Staff, 1999). Soil orders are the broadest groups of soils in this system (fig. 1). Georgia has representatives of eight of those orders (table 1). Dynamic properties were explicitly downgraded in Soil Taxonomy. In *The Guy Smith Interviews*, Smith, a central figure in creating Soil Taxonomy, says:

It has been suggested that properties of surface soil horizons be used as soil family criteria to enhance interpretive values. But no, I can see no way that can be done economically. The physical

Editor's Note

Issues of this newsletter are available on the World Wide Web (<http://soils.usda.gov/>). Under Quick Access, click on NCSS, then on Newsletters, and then on the desired issue number.



You are invited to submit stories for this newsletter to Stanley Anderson, National Soil Survey Center, Lincoln, Nebraska. Phone—402-437-5357; FAX—402-437-5336; email—stan.anderson@lin.usda.gov.



Figure 1.—Ultisols are the most common of the taxonomic soil orders in Georgia. Examples of Ultisols are Cecil and Tifton soils (www.soils.usda.gov).

and chemical properties of the plow layer, admittedly are critical to the growth of plants, and yet they can vary enormously from one system of management to another on what is essentially the same kind of soil.

Even at the inherent scale, however, soil is still changing, especially during catastrophic events, such as the intensive cultivation of piedmont soils during the cotton era. Gullies were a rampant problem during that time. In South Carolina, a gully site has been preserved as a research station—the Calhoun Experimental Forest (fig. 2). If one considers the examples of inherent properties identified earlier, it is clear that slope, profile horizons, texture, color, structure, bulk density, and cation-exchange capacity have all been changed drastically in the area affected by the gully. In fact, gullying has gone so far as to change the soil orders. A moderately sloping, highly weathered

Table 1.—Soil Orders Mapped in Georgia

<i>Soil Taxonomy Order</i>	<i>Number of GA Series in Order</i>
Ultisols	205
Inceptisols	48
Alfisols	27
Entisols	26
Spodosols	13
Histosols	4
Mollisols	3

(USDA, NRCS, OSDs)



Figure 2.—A Calhoun gully in the 1950s (<http://calhoun.env.duke.edu/view>).

formation of residuum (an Ultisol) has been transformed into unstable, highly sloping parent material unaffected by soil formation. This process can be stabilized, but it would not be reversed without extremely expensive remediation measures that may prove unsuccessful. A threshold has been crossed and a transition made from one set of inherent properties to another—from the soil order Ultisol to the soil order Entisol. The Calhoun Experimental Forest and in fact the whole soil conservation effort in the Southeast have stabilized the process in most places (fig. 3).

One of the most enlightening studies of this process is Stanley Trimble's 1974 publication *Man-Induced Soil Erosion on the Southern Piedmont, 1700–1970*. The bulk of this publication is a careful cataloguing of the history of erosive land uses from the time of European settlement to 1970. His block diagrams of pre-, during- and post-erosive land use show the processes of inherent soil transformations (fig. 4). The erosion on upland fields affects the slopes below with gullies and the bottomlands further downslope with accumulating sediments. Both these changes amount to catastrophic transformations from one soil order to another.

While the inherent soil property changes are the most visible and dramatic, they affect the least of the area in figure 4. The dynamic properties of the bulk of the area are changing as well. In fact, the solution to gullying occurs for the most part not in the gully itself but in the uphill fields that are the source of the destructive water creating the gully. The problem is vegetative cover, the extent of which is drastically reduced in the upland cotton fields. In turn, the infiltration rate, a dynamic property, in the upland soil is reduced to such an extent that water runoff overwhelms the resistance to erosion of the soil

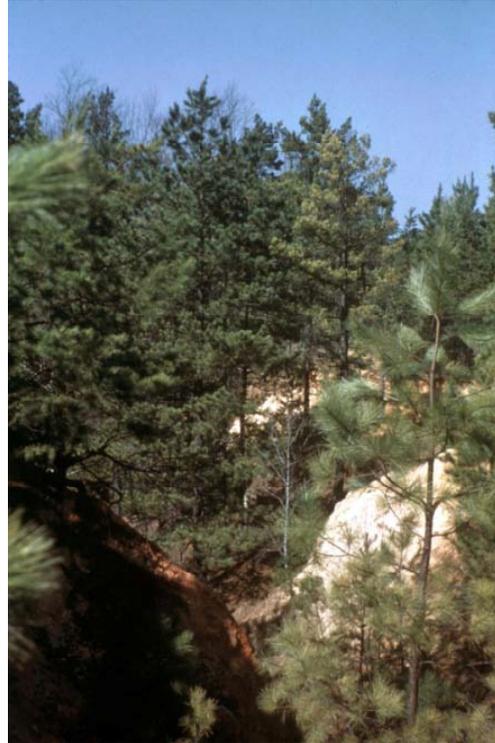


Figure 3.—A Calhoun gully stabilized (<http://calhoun.env.duke.edu/view>).

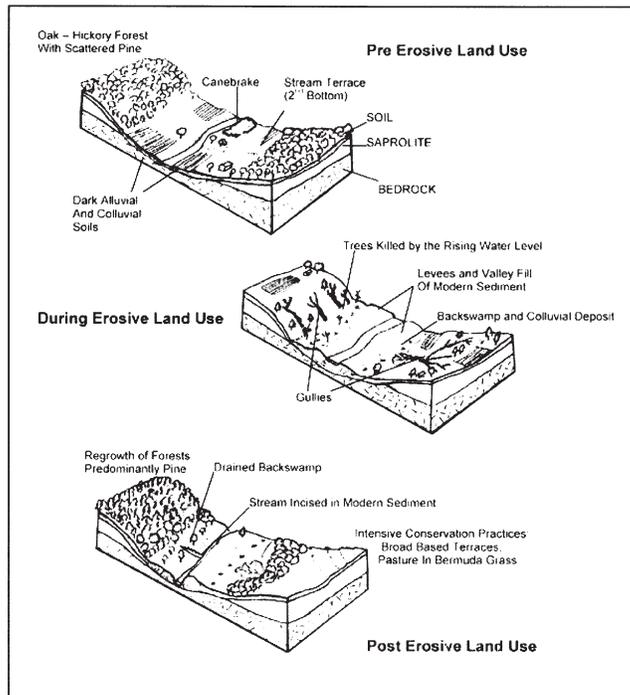


Figure 4.—Catastrophic disturbance alters inherent soil properties. (After Trimble, 1974.)

actually in the gully location. The solution is an increase in the infiltration rate. This is accomplished by increasing the vegetative cover, such as that of the Bermuda pasture illustrated in figure 4, and reducing the runoff velocity on the terraces, such as those illustrated in figure 4.

It is thus the soil's dynamic properties, and their response to management and conservation practices, that often determine success or failure in conservation. Do we understand them well enough to succeed? If we do not, it is not for lack of effort. Even the most wildly fluctuating properties—temperature and gas flux—have been intensively studied in research stations of the USDA Agricultural Research Service (USDA-ARS) and in universities. These studies are bearing fruit as climate change becomes a concern. Carbon sequestration in soil will likely play a big role in mitigation of rising atmospheric CO₂ concentrations. These studies, however, are intensive, not extensive. To be useful in advising individual landowners, our understanding must be ready to deal with the whole broad range of dynamic properties possible. In addition to the breadth of possibilities, our understanding must be deep enough to make reliable predictions.

Some soils will simply never be candidates for carbon sequestration because of their inherent properties. For example, Georgia's Lakeland soil is an extremely sandy substance. Air readily circulates through all portions of the soil where carbon might accumulate as organic matter. Organic matter constantly exposed to air decomposes rapidly. Examination of the tables of the soil survey of Johnson and Laurens Counties reveals that the Lakeland soil has less than 1 percent organic matter and the Chastain soil has a possible 2 to 6 percent organic matter (table 2). These soils are intermixed across Johnson and Laurens Counties. It makes a big difference to know which soil we are on when we undertake to advise a landowner.

Unlike the Lakeland soil, the Chastain soil would be a good candidate for carbon sequestration. If a landowner in an area with 2 percent organic matter wanted to make organic matter a priority, we could reliably tell him he could target a 4 percent increase. Perhaps it would depend on whether the landowner was trying to build organic matter in a crop field, a pasture, or a forest. That's a big perhaps! As a rule of thumb, cropland is likely to accumulate the least amount of organic matter in the soil, but even this is not an ironclad prediction. What if the landowner was using a no-till system with extensive cover cropping? Recall Guy Smith's comment about excluding the properties of surface horizons from interpretations; the science is simply not there to make a prediction about possible differences in the accumulation of organic matter among these land uses. Nor was it intended to be—the time and expense were too much for the initial soil survey. The soil scientists had enough to do trying to understand inherent soil properties! One last point about inherent properties: the Chastain and Lakeland soils actually are unlikely to be used as cropland, thus indicating that inherent soil properties are an accepted fact among Georgia's landowning public. Table 2 also lists two of the soils likely to be used for agronomic purposes—Faceville and Orangeburg soils. Their differences are more subtle, but they are differences nonetheless.

Table 2.—Representative Properties of Four Soil Series

<i>Soil Series</i>	<i>% Organic Matter</i>	<i>Surface Permeability</i>	<i>Moist Bulk Density</i>	<i>pH</i>
Chastain	2–6	0.06–0.2 in/hr	1.20–1.40 g/cc	4.5–6.0
Faceville	.5–2	6.0–20 in/hr	1.40–1.65 g/cc	4.5–5.5
Orangeburg	.5–2	2.0–6.0 in/hr	1.35–1.55 g/cc	4.5–5.5
Lakeland	<1	6.0–20 in/hr	1.35–1.65 g/cc	4.5–5.5

Here this rambling dissertation reaches its point. There is important science to do in this arena of subtle differences: science in the public interest and science that furthers conservation. Note the four representative properties in table 2. Advocates for dynamic soil properties propose to focus on the variation of the four representative properties *within* a soil type. The variation *between* soil types is nonnegotiable. Permeability is an inherent soil property. No one could make a Chastain soil achieve the 20 in/hr surface permeability the Lakeland soil can achieve. By increasing the content of organic matter, however, one could take a Chastain soil from 0.06 in/hr to 0.2 in/hr. This change may or may not be desirable. In the case of the Lakeland soil, *decreasing* surface permeability is more likely to achieve worthwhile agronomic goals. There is likewise considerable variation in all the properties in table 2. The desirability of any given value depends on the goals of the landowner; however, we must be able to understand what is achievable and how it can be achieved if we are to advise landowners on methods for changing their soil towards their goals. Soil survey has given us the framework to understand inherent properties—the variation between soils in table 2. Systematic investigation of the variation within soil types—the dynamic soil properties—logically follows understanding inherent properties.

What does understanding dynamic properties mean in practice? This can be best illustrated by returning to the Trimble diagram (fig. 4). Of interest here is post-erosive land use. A modern conservationist will recognize that the conservation practices and management changes depicted in figure 4 as means to control the erosion are somewhat limited. Basically there are four conservation or management practices depicted: reforestation, pasture planting, terraces, and drainage. Why so few? The reasons for the few management options are similar to why soil survey concentrated on inherent properties. The priority for conservationists at the time of Trimble's publication was still stabilization, almost like medical "triage." They needed reliably effective and fairly simple methods. These four fit that bill. Just as soil survey has grown and matured to a new stage in its existence, so too has conservation moved on from broad, sweeping practices that are as reliable as the dawn. Trimble's four practices are unlikely to meet all the expectations of a landowner.

Figure 5 shows the modern conservationist's viewpoint. What additional goals can we expect from our hypothetical landowner? First, the land uses chosen in figure 4 are not very lucrative; some more profitable uses of the land will probably be desired. Second, terraces have grown to be incompatible with modern farming equipment; some other method of decreasing runoff velocity will probably be desired. Third, our

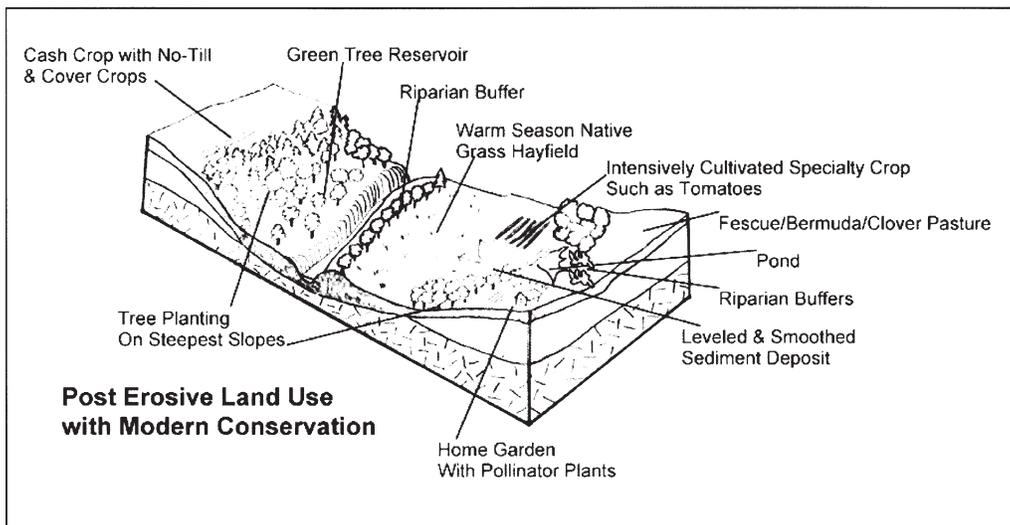


Figure 5.—Modern conservation treatment of an eroded landscape. (After Trimble, 1974.)

landowner will probably desire opportunities for recreation in some areas. The modern conservationist would recommend that the most productive land be used for high-value crops. That land occurs on the upland on the left and the stream terrace. No-tillage and cover cropping will be recommended to reduce runoff velocity. A pond serves as a floodwater-retarding structure and as an opportunity for recreation. A motivated conservationist will make more recommendations, ones based on recent wildlife and water-quality science. Examples are a green tree reservoir for duck hunting (and wetland environmental benefits), riparian buffers on the main and vulnerable streams, leveling and smoothing of the sediment deposit to facilitate the use of haying equipment, and some pollinator plants in the home garden.

These recommendations are a long way from the immediate stabilization suite offered in the 1970s. Some of them reflect our name and mission change from Soil Conservation Service to Natural Resources Conservation Service. Many of the practices have justifications based on wildlife, water-quality, or wetland benefits. Also, some of them are rare feats in the career of a conservationist. Rarely did I have the opportunity to recommend placement of land uses, such as the crop fields shown in figure 5. This is not to say that I never made such a recommendation or that conservationists should not look for opportunities to do so. The opportunities I had to make such recommendations resulted in some of my most successful plans. Land use placement is an opportunity that does not occur often and is a delicate decision in the life of a property requiring a high degree of trust between a conservationist and a landowner. Finally, taken as a whole, this would be a very expensive plan.

Our increasing understanding of soil is behind a lot of the difference between the plan represented by figure 4 and the one represented by figure 5. The two main recommendations in figure 5—the placement of the crop fields—reflect the nature of the underlying soil. For the main field, the soil is on a broad flat upland that will respond positively to standard agronomic management. For intense cultivation, the stream terrace is unlikely to erode or be flooded and has some native fertility. All the other practices reflect basic soil considerations as well—tree planting on steep slopes, a green tree reservoir on wetlands, a pond dam in a nicely defined valley with adequate watershed from upstream soils—all these are soil considerations. So, one can see that soils play a big role in design considerations for land management. Those considerations would be inherent soil properties, and they arise from a truly impressive effort on the part of NRCS soil scientists to help us understand the soil. What could dynamic properties contribute? If the inherent properties helped in design preparation, dynamic properties will help with the operation. When it comes time to choose the trees to plant, can NRCS help with a rich diversity of species well suited to the site? Not as things stand, but if we pursue dynamic soil properties, that will be a major interpretation—Ecological Site Descriptions. If there are soil disease problems in the no-till field, could we easily step into the field and diagnose the soil condition responsible? Not as things stand, but if we pursue dynamic soil properties, organic matter and soil biota will be our stock in trade. If runoff from the bermuda fields becomes excessive and the soil droughty, will we be ready? Not as things stand, but if we pursue dynamic soil properties, we will understand compaction well enough to make successful recommendations. Dynamic soil properties are well worth our consideration.

Dynamic soil properties affect initiatives involving soil quality, Ecological Site Descriptions (including NRI Grazing Land On-Site Studies), and soil comparison studies. Soil quality has raised awareness of the distinction between inherent and dynamic properties and focuses on management recommendations to improve soil quality (USDA, NRCS, Soil Quality). Ecological Site Descriptions attempt to meld plant and soil science in state and transition models (USDA, NRCS, ESIS; Bestlemeyer et al., 2008). Soil comparison studies use state and transition models to understand soil change, which is dynamic soil properties in action (USDA, NRCS, 2008).

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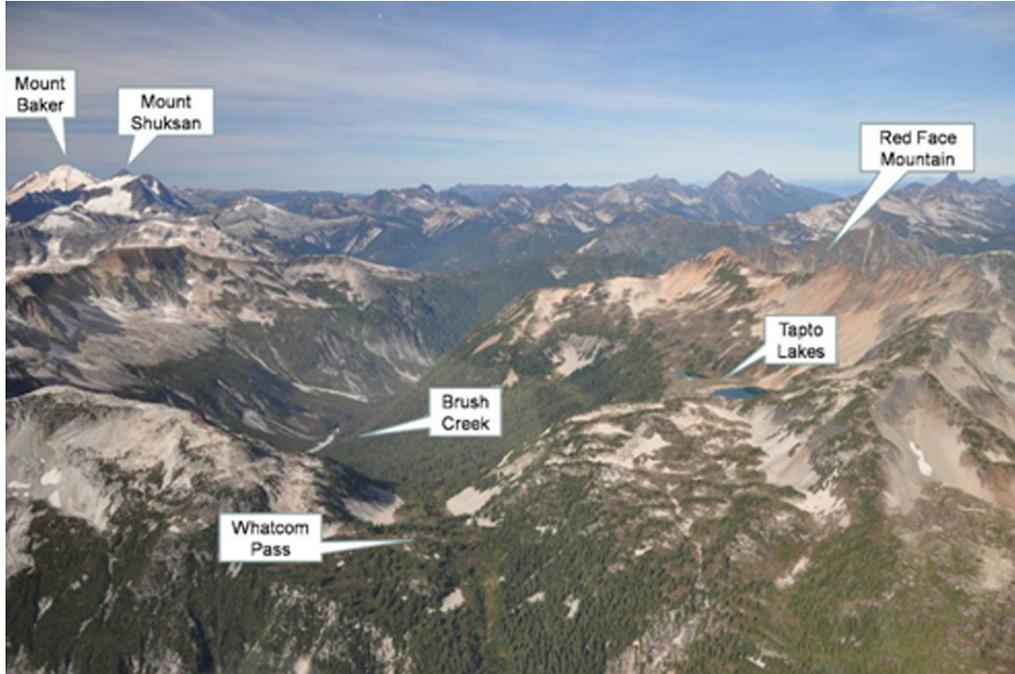
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Initial Mapping of North Cascades National Park Completed

From Soil Survey Division, "Weekly Report," April 27, 2011.

SSURGO data for the initial mapping of the 700,000-acre North Cascades National Park Complex in Washington was posted this month to the Web Soil Survey and Soil Data Mart. The NRCS-NPS interagency agreement for soil mapping was managed by Ron Myhrum, retired Washington State Soil Scientist; Chad McGrath, Pacific Northwest MO Leader in Portland; and Pete Biggam, NPS Soils Program Leader. Susan Southard, NSSC soil scientist and liaison to the NPS, has been assisting the field crew and MO in delivering final data products to the NPS.

Mike Regan, Soil Data Quality Specialist from the Pacific Northwest MO, prepared the final correlation document, which was signed by Brad Duncan, the current acting State Soil Scientist for Washington. The park soil survey was led by Toby Rodgers, NRCS project leader, MLRA Soil Survey Project Office in Mt. Vernon, Washington. Assisting Toby were NRCS soil scientists Crystal Briggs and Philip Roberts, NRCS forester Kathy Smith, MLRA Soil Survey Leader Bruce Lindsay, and NPS physical



Aerial view of the North Cascades National Park, looking west. Whatcom Pass is in the foreground, and Mount Baker, of the Cascade Range, is on the extreme left.

scientist Sharon Brady. Washington NRCS staff and the NPS used a GIS soil mapping model developed by Washington State University called the Remote Area Soil Proxy (RASP) to help map remote areas of the park that had minimal to no soil information and limited access. Results of the model were combined with traditional mapping techniques to develop the final products. The establishment of numerous soil series with this project creates a foundation for continued first-over mapping of the Olympic and Cascade Mountains MLRA in Washington, including upcoming soil mapping of 1.3 million acres of Federal land in Mount Rainier and Olympic National Parks. ■

Iraqi Soil Scientist Technical Exchange

Expanded from Soil Survey Division, "Weekly Report," April 27, 2011.

The National Soil Survey Center hosted an Iraqi Soil Scientist Training and Technical Exchange Session in Lincoln, Nebraska, April 18-29, 2011. The session was sponsored by the Foreign Agriculture Service, the NRCS Soil Survey Division, and the National Soil Survey Center. Expenses for the 10 Iraqi scientists and engineers with expertise in soil science, hydrology, and agricultural engineering were covered by Cochran Fellowships. Topics on the agenda during the first part of the exchange included:

- remote sensing and spatial analysis;
- soil geomorphology;
- soil morphology and classification;
- soil salinity and sodicity, including use of geophysical tools for field identification and mapping;
- dynamic soil properties;
- Web Soil Survey and other soil survey software applications;



- 1 - Hassan Hameed Gatiea, Expert, National Center for Water Resources Management
- 2 - Raouf Maarouf Elias, Chief Agricultural Engineer, National Center for Water Resources Management
- 3 - Abdul Jabbar Challob Hasan, Department Head of Marine Geology, Marine Science Center, Univ. of Basra
- 4 - Hamed Flayh Salman, Chief Agricultural Engineer, National Center for Water Resources Management
- 5 - Abdul Khalik Saleh Naima, Director of Soil Science Department, State Board for Agricultural Research
- 6 - Kasim Ahmed Saliem, Senior Researcher, State Board for Agricultural Research
- 7 - Ahmed Salih Mhaimed, Head of Soil And Water Department, College of Agriculture, Baghdad University
- 8 - Ahmed Adnan Ahmed, Senior Researcher, State Board for Agricultural Research
- 9 - Tareq Salim Saleem, Senior Chief Researcher, State Board for Agricultural Research
- 10 - Ayad Ghazi Rasheed, Research Assistant, Ministry of Science & Technology



Iraqi scientists and engineers on the first and last days of the session in Nebraska.

- analysis and aggregation of pedon data;
- soil survey interpretations;
- ecological site descriptions; and
- soil sustainability and health.



From left to right, Raof Maarof Elias, Hassan Hameed Gatiea, and Ahmed Salih Mhaimed on a tour of a Nebraska farm.

The visitors toured the Soil Survey and Soil Mechanics Laboratories, were provided an opportunity to classify and interpret data from Iraq soils, and participated in field trips that focused on soil-landscape relationships, map unit design, EMI for salinity mapping, measurement of soil hydraulic properties, soil health, and dynamic soil properties. A number of seminars on a variety of topics were presented by the Iraqi scientists, NSSC staff, and others. We hope that further collaboration and technical exchange can be developed and fostered as part of the U.S. assistance to Iraq.

One of the field trips, to two farms in Seward County, Nebraska, on April 26, 2011, is described in a story in the Lincoln Journal Star, posted April 29, 2011 (http://journalstar.com/news/local/article_84419f90-660c-5174-8ebe-0fc2d10769cb.html). ■

Ecological Site Presentations Given to State Resource Conservationists

From Soil Survey Division, "Weekly Report," May 11, 2011.

Mike Kucera, Agronomist for the NSSC Soil Ecology Branch, gave a presentation at a meeting of Western State Resource Conservationists (SRCs) at the West National Technology Support Center (NTSC) in Portland, Oregon. Previously, he was able to join teleconferences of the Eastern and Central SRCs, sponsored by their respective NTSCs.

For each meeting or teleconference, Mike provided a basic overview of the Ecological Site Description (ESD) Acceleration effort and its importance. He reviewed a draft workflow describing roles of SSRA and S&T staffs and an action plan of major

activities of the Soil Ecology Branch, in conjunction with NTSC and state specialists, including standard writing and training efforts.

Most importantly, Mike was afforded the opportunity to obtain input from the SRCs on communication preferences, training needs, and other items important to them. The entire Soil Ecology Branch is working to maintain good communication with the SRCs, NTSCs, State Soil Scientists, and MO Leaders to ensure ongoing progress in the ESD Acceleration. ■

New Web Page Developed for Soils Research

From Soil Survey Division, "Weekly Report," May 18, 2011, with additions by Rebecca Burt and Pattie West.

Considerable information regarding soil science and the soil survey program and covering a wide range of topics has been developed over the years by NRCS research scientists, the National Soil Survey Laboratories, and field staff. A new source for locating information on current National Soil Survey Center research projects, recent publications, abstracts, and posters and presentations is currently being developed by a team of research soil scientists from the Soil Survey Research and Laboratory Staff; Tammy Umholtz, visual information specialist, Soil Business Systems; and Pattie West, editor, Soil Survey Standards. This Web site will also provide a complete compilation of past and current research projects and products of the USDA NRCS Soil Survey Division. The research and research-related products are grouped by topic (e.g., geomorphology, soil genesis, and classification; soil and water quality; and soil change).

Examples of publications by current NSSC research soil scientists are:

- "Loss of alkaline earth elements by runoff for agricultural watersheds" by M.A. Elrashidi, D. Hammer, M.D. Mays, C. Seybold, and S.D. Peaslee
- "Geochemistry in the modern soil survey program: Environmental monitoring and assessment" by M.A. Wilson, R. Burt, S.J. Indorante, A.B. Jenkins, J.V. Chiaretti, M.G. Ulmer, and J.M. Scheyer
- "Hydrology of soils and deep regolith: A nexus between soil geography, ecosystem function, and land management" by P.J. Schoeneberger and D.A. Wysocki
- "Ground-penetrating radar soil suitability map of the conterminous United States" by J.A. Doolittle, F.E. Minzenmayer, S.W. Waltman, E.C. Benham, J.W. Tuttle, and S. Peaslee
- "Changes in the organization and institutions of agricultural knowledge, science, and technology and consequences for development and sustainability goals" by R. Burt
- "Use of terrain attributes as a tool to explore the interaction of vertic soils and surface hydrology in south Texas playa wetland systems" by A.F. Parker, P.R. Owens, Z. Libohova, X.B. Wu, L.P. Wilding, and S.A. Archer

In addition, with the help of retired research soil scientist W.D. Nettleton, past research publications, Soil Survey Investigations Reports (SSIRs), and other scientific documents and materials (dating as far back as 1930) will be listed by topical area on this Web site. The following are just a few examples of these past publications:

- "Genesis and hardening of laterite in soils" by L.T. Alexander and J.G. Cady
- "Vertisol genesis in a humid climate of the Coastal Plain of Texas" by L.C. Nordt, L.P. Wilding, W.C. Lynn, and C.C. Crawford

- “Morphology of the argillic horizon in desert soils of southern New Mexico” by L.H. Gile and R.B. Grossman

The NSSC research Web page is a work in progress and can currently be accessed via <http://soils.usda.gov/survey/> (see “Research and Research-Related Activities” under “Laboratory Data and Research”). ■



Kerry Arroues with Hall of Fame Wood Block.

Carbon Sampling Equipment Toll

Email from Kerry Arroues, MLRA Soil Survey Leader, Hanford, California, June 29, 2011.

Hello folks and fellow Carbon Sojourners,

Yesterday, after sampling a carbon site way upriver above Pine Flat Reservoir, Bry Schmidt and I ceremoniously retired a Hall of Fame Wood Block. This block of wood has survived many different conditions and many brutal beatings with a 3 lb. jack-sledge. The final number of blows that this spunky chunk of wood survived may be legendary. The best estimate is 6,800 hits. See calculation below:

34 Sites X 5 Pits per site X 4 Avg. B.D. Samples per site X 10 Avg. Blows with 3 lb. jack-sledge = 6,800 HITS.

Has anyone ever beat this record? Oh and Kit, spare me the joke about which is the block of wood.

Thanks,

Kerry Arroues ■

Newsletter and Web Site and Meeting Announcement

Dear fellow classifiers:

This email is to announce three items of interest, from me and Vice-chair Pavel Krasilnikov.

1) The first IUSS Commission 1.4 Soil Classification Newsletter (http://clic.cses.vt.edu/IUSS1.4/IUSS_SoilClassification_Newsletters.htm).

2) The new IUSS Commission 1.4 Soil Classification Web site (<http://clic.cses.vt.edu/IUSS1.4/>).

3) The first announcement of the 2012 International Soil Classification Meeting, 11-14 June, 2012 (http://clic.cses.vt.edu/IUSS1.4/Conf_Soil_Classification_2012/).

Please spread this information to other soil scientists, your work organizations, professional organizations, in newsletters, through any listserv you feel is appropriate. This is not spam, but we respect the rights of email recipients if you do not wish to forward. If anyone wants to be added to this list, please tell them to send an email request to: soilclassification@gmail.com.

Sincerely,

Dr. John M. Galbraith
239 Smyth Hall (0404)
Blacksburg, VA 24061 ■

Latest Web Soil Survey (2.3) Launched

By Linda Greene, ACES enrollee, Natural Resources Conservation Service, National Soil Survey Center, Lincoln, Nebraska.

Version 2.3 of the popular Web Soil Survey (WSS) was recently launched by the USDA, Natural Resources Conservation Service (NRCS), and can be accessed at <http://websoilsurvey.nrcs.usda.gov>. The Web-based program provides anyone with computer access a wealth of soils information. Soil maps and descriptions of soil properties and interpretations can help visitors to WSS make good land-use decisions. The Web site, originally introduced in August 2005, continues to be improved with new enhancements and features that meet the needs of its growing customer base, now numbered in the several millions.

A new feature in version 2.3 is the ability to import a Shapefile boundary to be used when an Area of Interest (AOI) is established. The size limit, however, remains at 10,000 acres for display purposes. Also, the new version provides the user the ability to export an AOI boundary from WSS for use in other applications.

Another new feature allows the user to bookmark an AOI in WSS so that he or she can return to it later. Also, the user can embed AOI coordinates in a URL to open WSS and the set AOI. So, getting to your prime destination is now easier and quicker.

Another feature of convenience is the availability of Quick Navigation by street address for U.S. Territories. New options for latitude and longitude data entry also are available in Quick Navigation. Also, with the release of version 2.3, WSS is now compatible with IE9 and Firefox 5 browsers.

These are just some of the major enhancements added to the latest version of WSS. More enhancements are planned for future releases.

Also, an updated version of the Web Soil Survey brochure has been printed and is ready for distribution. To place an order, contact Linda Greene at LindaM.Greene@lin.usda.gov or Carol Fisk at Carol.Fisk@lin.usda.gov with a requested quantity and the

delivery address. In addition, the latest brochure will be posted as a PDF file available for downloading if you prefer to print your own. This year the latest WSS brochure was translated into Spanish. This translation also is available as a PDF file for downloading. Both PDF files are located at <http://soils.usda.gov/survey>. The Spanish version is not available for distribution in quantity, but you can print the desired number by using the downloadable PDF file. Call Linda Greene at 402-437-5879 if you have any questions. ■

Soil Survey Modernizes Communication with E-book Technology

By Shawn McVey, Soil Scientist, USDA, NRCS, National Soil Survey Center (NSSC), Lincoln, Nebraska.

E-readers improve readability by making reading convenient. The NSSC recognizes that society is moving towards greater use of e-readers and, following up on requests for this format, has released the 11th Edition of the *Keys to Soil Taxonomy* in e-book format (ftp://ftp-fc.sc.egov.usda.gov/NSSC/Soil_Taxonomy/keys/ebook/Keys_to_Soil_Taxonomy_11th_Edition.pdf). Producing hard copy publications is expensive, and eliminating paper copies or reducing their number will save resources. One e-reader can hold all of our technical references and have them available at your fingertips. E-readers take up very little room when you are traveling or doing field work. Many of them make it easy to take notes, highlight text, and search for key words so you can find information quickly. The new format is sure to be a hit with college students interested in soil science and soil survey. Additional NCSS technical references and MO regional guidance documents are being considered for release in e-book format as a way to improve the delivery of technology and science. The ease and convenience of having all of our references on one device will increase the use of information contained in our bulkier documents, and increased use will improve the consistency and quality of our soil survey information. ■

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