National Cooperative Soil Survey Newsletter

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Issue 59

In This Issue—

Editor's Note

Issues of this newsletter are available at 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 Pattie West, National Soil Survey Center, Lincoln, Nebraska. Phone—402-437-5334; FAX—402-437-5336; email—pattie.west@lin.usda.gov.

2012 NCSS Regional Conferences

The biennial National Cooperative Soil Survey (NCSS) Regional Conferences will be held this summer, in May and June. The dates and locations of the conferences are as follows:

South: Bowling Green, Kentucky—May 21–25, 2012
North Central: Lincoln, Nebraska—June 4–7, 2012
Northeast: Orono, Maine—June 18–21, 2012
West: Davis, California—June 25–28, 2012

The theme for the Southern conference is "Soil Survey for the Future—Continuing the Mission." Topics and speakers will address the issues involved in carrying on the mission of providing quality soils information to our users. A town hall meeting will be held to discuss the soil survey restructuring and to provide a forum for discussion on how the agency and cooperators will be affected. Also included in the conference is a 1-day field trip highlighting a unique NCSS effort in MLRA 120, Kentucky and Indiana Sandstone and Shale Hills and Valleys (fig. 1). The study sites consist of three pairs of watersheds under two different land uses: grassland and forest. The different paired watersheds have similar state factors of soil formation, with the exception of loess thickness. The study focuses on soil water movement through similar landscapes with various loess thicknesses and changes in soil properties under different land use. The field trip will also include a tour featuring ARS research on various methods of applying composted poultry litter and swine manure in areas of cropland and pastureland.

The North Central conference will be held on the East Campus of the

Figure 1.—This pastureland site in McLean County, Kentucky, is part of a tri-state (Illinois, Indiana, and Kentucky) soils system study. The project was established to study soil formation and ground water movement at various depths in loess-covered landscapes of pastureland and woodland.

University of Nebraska-Lincoln. Technical sessions and committee discussions will focus on challenging issues, including ecological site inventory and description, soil survey in urban and highly disturbed areas, and dynamic soil properties. A special feature of the conference will be the dedication of the Charles E. Kellogg Soil Survey Laboratory at the National Soil Survey Center. A highlight of the conference will be a field tour that will focus on the upland and flood-plain landscapes of southeastern Nebraska (fig. 2).

Figure 2.—An exposure of Peoria loess in southeastern Nebraska.

The Northeast conference, at the University of Maine in Orono, features a central theme of maximizing the value of soil survey. Presentations will range from the restructuring of the NRCS soil survey program to cutting-edge incorporation of spatial and laboratory data. The focus of the conference will include soil survey products ranging from the 3rd-order surveys in the remote North Woods to the high-intensity surveys of the consulting cooperators. A technical tour will provide a look at the soils and landscapes in the shadow of Maine's greatest mountain, Katahdin (fig. 3).

Figure 3.—Katahdin Mountain in Maine.

The theme of the Western conference is “It All Builds on Soil! Practical Applications of Soil Surveys for Land Management Decision-Making.” The conference will be held on the campus of the University of California-Davis. The topics will include a variety of contemporary issues affecting resource management. A field trip (fig. 4) exploring two sustainable farming operations will include opportunities to examine Entisols and Inceptisols on Holocene alluvial fans derived from the Coastal Range and Ultisols derived from Tertiary volcanic lahar. An intervening geomorphology stop will feature Plio-Pleistocene terraces as evidence of paleoclimatic depositional regimes and claypan/duripan subsoil morphology.

More details about all of the regional conferences and important registration information are available at www.soils.usda.gov. ■

Figure 4.—This view is typical of the landscape in the area included in the Western Regional NCSS Conference field trip.

Global Soil Partnership

By Jon Hempel, Director, National Soil Survey Center, Lincoln, Nebraska

I attended the Global Soil Partnership (GSP) workshop in Rome, Italy, during the week of March 19, 2012, as the representative for NRCS and the National Soil Survey Center, the chair of the International Union of Soil Science (IUSS) Universal Soil Classification Working Group, and the North American Node Leader for the GlobalSoilMap.net project. This workshop was a follow-up to the launch of the GSP in September 2011, which was attended by over 75 member countries.

The GSP was formed in response to an increasing world-wide demand on soil resources resulting from population increases, inappropriate practices for sustainability of the soil resource, and food security issues and in response to a need for adaptation to and mitigation of global climate change.

The vision of the GSP is the sustainable and productive use of the world's soil resources and sustainable agricultural production, and the mission is to support and facilitate joint efforts towards sustainable management of soil resources for food security and climate change adaptation and mitigation.

The GSP is sponsored by the Food and Agriculture Organization (FAO) of the United Nations. The GSP aims to provide coordination at the country level for Five Pillars of action relating to the soil resource and its best use and management. The Five Pillars include the following areas of focus:

- harmonization and establishment of guidelines and standards of methods, measurements, and indicators;
- strengthening of soils data and information;
- promoting targeted soil research and development;
- promoting sustainable management of soil resources; and
- encouraging investment, policy, and technical cooperation in soils.

This event was opened by a series of round-table discussions on the status and needs of Global Soil Information and included keynote presentations from representatives of the FAO, the Bill and Melinda Gates Foundation, the European Commission, the International Plant Nutrition Institute, the International Rice Institute, and the African Soil Science Society. All of these presentations focused on the need for stronger soils information to support important societal and environmental issues the world is currently facing.

The workshop consisted of a series of presentations by scientists from around the world on useful methodologies for producing soils data and information. Many of the presentations were geared towards development of the e-SOTER, which is the European Union's Soil and Terrain Database. There were also several presentations on the progress and development of data for the GlobalSoilMap.net project. My presentations related to our progress in producing soil property data to meet the GlobalSoilMap.net standards and specifications across North America and the progress of the IUSS Universal Soil Classification Working Group.

The last day of the workshop focused on discussions relating to the way forward for producing global soil information (ideas to action) and how to strengthen the GSP pillar of action—strengthening of soils data and information.

There was a consensus among the attendees that there is a need to provide updated soils information on a global basis. It was decided that, in the short term, the Harmonized World Soil Database (HWSD) would be updated to provide this data and that countries that have not contributed in the past would be asked to provide soils data to complete coverage for the globe. Australia, Canada, and the United States will be asked to provide information from their existing soils databases in an effort to fill major gaps within this database.

Plans for longer term solutions to providing soils data on a global basis will be developed by a team from the FAO regions. The following individuals make up the team that will work on this FAO plan:

Africa: Martin Yemefack
Middle East/North Africa (MENA): Rachid Moussadek
Asia: Ganlin Zhang
Europe: Rainer Baritz
North America: Jon Hempel
Latin America and Caribbean Group (GRULAC): Aracely Castro
Oceania/Pacific: Neil McKenzie
Secretary: Ronald Vargas

This group will be responsible for developing a Terms of Reference (TOR) document to support the concept of providing global soils information. The TOR will include the following information:

- Scope and reporting of global soil health (translating primary soils information into functions and capacities)
- Links between soils information and end users
- Global issues; what scales can/should this pillar address (subsidiary principle)?
- Governance/organizational structure
- Data infrastructure
    - Primary and spatial soil data products (required accuracy and methods)
- Technical capacity
    - Technology transfer, filling country-level gaps
- Global monitoring/experimental network
- Stepwise action from status to trends
- Archives/reference standards

Once the TOR document is complete, and after a period of consultation, it will be submitted to the Intergovernmental Panel for FAO, who will vote on accepting the plan for institutionalization. Once the plan has been accepted, we can move forward with the full support of the FAO member nations to implement a project that will provide consistent soils data for the global community. It is my hope that the GlobalSoilMap.net processes, procedures, standards, and specifications will be a part of the final document. ■

View from the terrace at the FAO. Note the Circus Maximus in the foreground and the Roman Forum and Coliseum in the background.

Sod and SOC: Homestead National Monument of America

By Susan B. Southard, national liaison to the National Park Service, Natural Resources Conservation Service, National Soil Survey Center

Homestead National Monument of America is a small National Park Service (NPS) property in southeastern Nebraska. Homestead is set in the rolling agricultural fields near Beatrice, Nebraska, not far from the National Soil Survey Center in Lincoln. It provides a visual link to the landscape that early settlers would have encountered as they moved west during the era of the Homestead Act of 1862. The tallgrass prairie and riparian lowland bur oak forest of Homestead present an opportunity to learn about a diverse range of habitats and species and provide a protected and documented classroom for ecological site development and environmental education.

In the past, the prairie area had been heavily used for agriculture and grazing. The NPS decided to restore this area to tallgrass prairie to minimize soil erosion and to provide a visual link to the environment encountered by early settlers. The prairie restoration was accomplished through a combination of seeding a mix of native grasses, installing native plant plugs, and transplanting sod from local areas of unplowed prairie. Management of exotic species has involved mowing, selective herbicide application, and, beginning in 1970, prescribed burning on a regular basis.

Today, the species composition of the tallgrass prairie at Homestead resembles that of pre-settlement times (fig. 1). Dominant species include big bluestem, little bluestem, Indiangrass, switchgrass, goldenrod, field pussytoes, and leadplant. Interspersed in the prairie are thickets of shrubby species, such as sumac, wild plum, and dogwood,

Figure 1.—View of the restored tallgrass prairie in an area of Judson silt loam, 2 to 6 percent slopes. Judson soils are Cumulic Hapludolls and formed in noncalcareous loess. Visible in the background is the Homestead National Monument of America Heritage Center. (Photo courtesy of Jeff Taylor)

that provide habitat for birds and other small animals. Small areas of the park, such as an old school site, were never plowed. Despite heavy use for nearly a century as the school playground, the site contains the most diverse assemblage of species found in the park.

The NPS has also studied the bur oak (*Quercus macrocarpa*) riparian forest that is mapped as a channeled area of Nodaway silt loam in the Cub Creek corridor (fig. 2). The idea was to restore the landscape to one used by transient hunters

Figure 2.—Nodaway silt loam, channeled, occasionally flooded, is mapped along Cub Creek and is part of the bur oak lowland ecosystem. Nodaway soils are Mollic Udifluvents. (Photo courtesy of Jeff Taylor)

before the area was populated by sedentary farmers. Restoration can be difficult to accomplish, since no reference states exist upon which to model the restoration pathway. Despite the many changes to the environment within the last 140 years, the current extent and density of the forest on Cub Creek probably exceed those of the original forest prior to European settlement, primarily as a result of fire suppression. The NPS has in place a forest management plan that focuses on reintroducing fire and desirable plant species to the forest (Rolfsmeier, 2007).

In preparing a special soil survey document for the NPS, calculations based on SSURGO data show that the Kennebec soil, where it is mapped in Homestead, has the highest content of soil organic carbon (SOC) of all Mollisols that occur in NPS properties nationwide. Kennebec is a Cumulic Hapludoll mapped in toeslope positions adjacent to the Cub Creek corridor. The Kennebec soil has 55 to 65 kilograms of SOC computed on a whole soil basis to 2 meters. For reference, 100 kg/m^2 of SOC is not unusual for a Histosol, whereas 2 kg/m^2 is typical of an Aridisol. Using a conversion of 4.4515 to change kg/m^2 to tons/acre, the Kennebec sequesters 265 tons of carbon per acre.

Assuming a total of 6,000 board feet in a 2,000-square-foot house and 1 pound of carbon (C) per board foot, the wood framing of a house contains 3 tons of C. Thus, in 1 acre of Kennebec soil, a carbon content equivalent to that in 88 single-family homes is stored below ground. The dense grass roots, which incorporate and sequester organic carbon at depth in the soil, held sod bricks together as homesteaders cut them from the native prairie for building their historical sod homes (fig. 3).

This type of information in the recently compiled soil survey of Homestead National Monument (fig. 4) is one more tool that can help park managers piece together and explain to park visitors the restored Homestead they see today. It also highlights the environmental significance of the soil beneath the landscape.

Reference:

Rolfsmeier, Steven B. 2007. High Plains Herbarium, Chadron State College. Homestead National Monument of America Bur Oak Forest Restoration Plan: Reference Condition and Management Considerations. Accessed March 26, 2012. http://www.nps.gov/home/naturescience/loader.cfm?csModule=security/getfile&PageID=168507

Credits:

Figures 1 through 3 used with permission, courtesy of Jeff Taylor, AP Environmental Science Instructor, Flagstaff High School, Flagstaff, Arizona. ■

Figure 3.—Pondering what life would be like living in a house constructed of Kennebec silt loam. (Photo courtesy of Jeff Taylor)

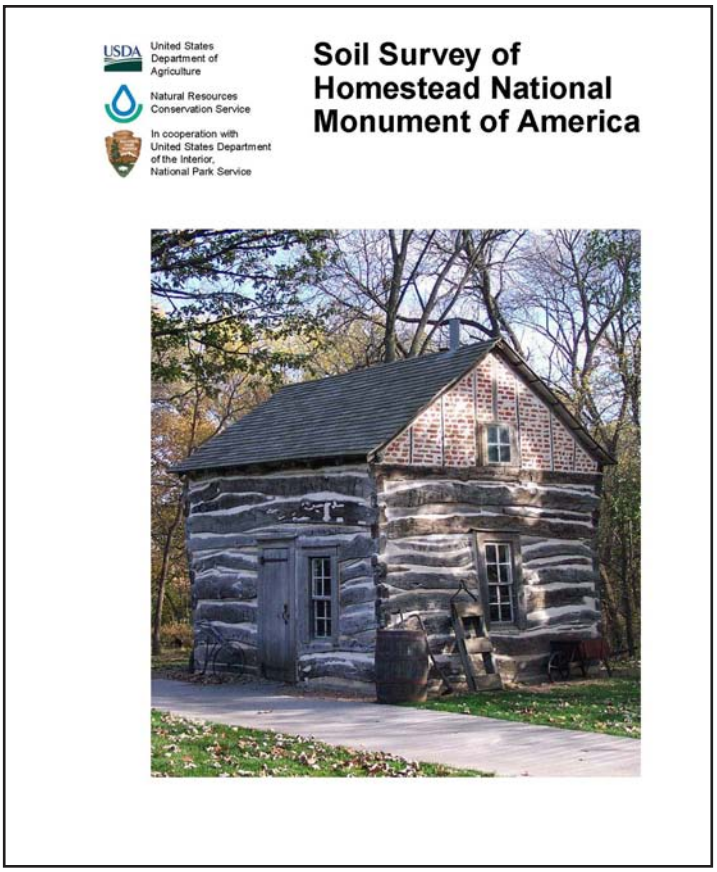


Figure 4.—The recently compiled soil survey of Homestead National Monument features a cover image of the Palmer-Epard cabin built in 1867 on Wymore silty clay loam. Wymore soils are Aquertic Argiudolls.

ARS-NRCS Cooperative Projects Will Emphasize Ecological Site Concepts

From Soil Science Division, "Weekly Report," February 29, 2012

The USDA-Agricultural Research Service Jornada Experimental Range has made a major commitment to collaborate with and support NRCS in the development and application of ecological site concepts. The Jornada objectives for the 2012–2017 project period are to (1) develop ecological site classifications for rangeland conservation specific to MLRAs in the western United States; (2) evaluate effectiveness of shrub management practices based upon ecological site delineations; (3) improve techniques, including remote sensing methodologies, for rangeland monitoring and assessment applicable to landscapes within MLRAs; (4) evaluate livestock management practices suitable for conserving and restoring ecological sites; and (5) develop predictions of climate-driven vegetation state changes. This commitment on the part of the Jornada and ARS means that substantial effort will go toward collaborating with NRCS and other agencies and institutions in developing the underlying theoretical basis for the ecological site classification system and for the application of new tools to improve the use of ecological sites in the decision-making process for land management policies, programs, and practices. ■

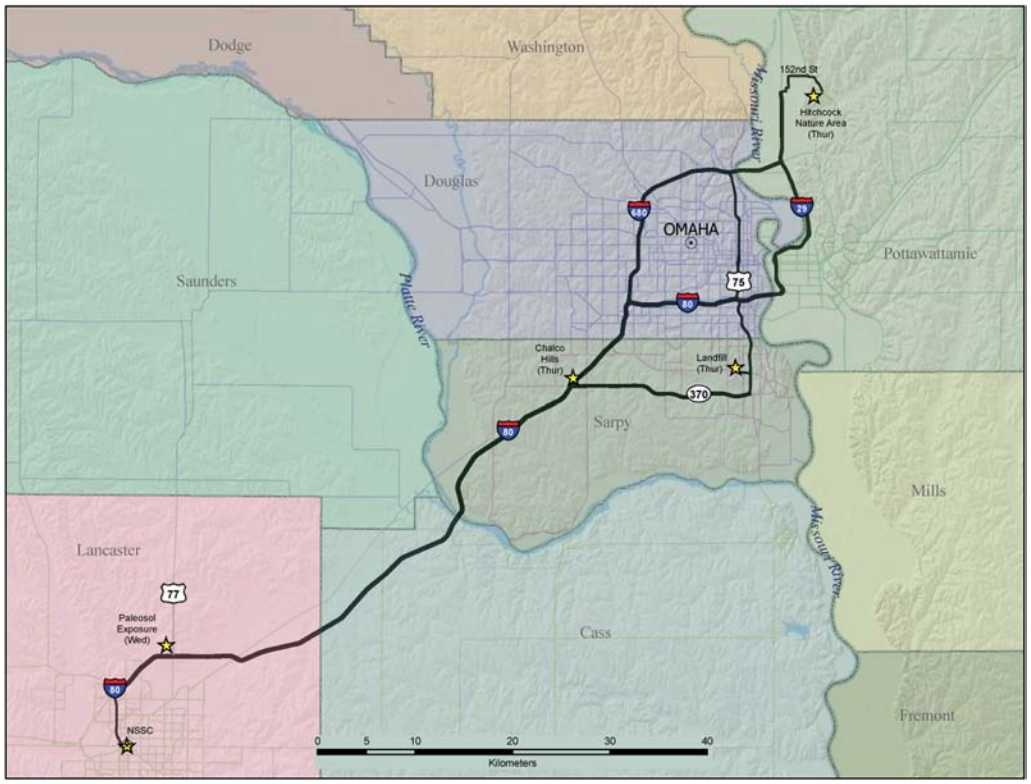
4th International Conference on Soil Classification, June 11–14, 2012

The 4th International Conference on Soil Classification, sponsored by the International Union of Soil Scientists (IUSS), will be held in Lincoln, Nebraska, June 11–14, 2012.

The conference provides an excellent opportunity to learn about soil classification issues on an international scale, hear from soil scientists from other countries, and explore various soil classification systems, such as Soil Taxonomy and the World Reference Base.

The conference continues the discussion on soil classification issues started in Gödölõ, Hungary (2001), Petrozavodsk, Russia (2004), and Santiago, Chile (2008). Specific attention will be paid to the harmonization of criteria for diagnostic horizons and features of soils in agricultural and urban areas and discussion on development of the concepts of a newly proposed Universal Soil Classification System. The conference is planned to include 2½ days of oral and poster presentations and a full-day tour and field workshop. Field activities include a half-day visit to a 5-meter vertical exposure of soil development in materials dating from the Late Wisconsinan and deposits of pre-Illinoian till. The day-long tour on June 14 includes stops in the Loess Hills at the Hitchcock Nature Center in western Iowa, discussion of flood-plain soils along the Missouri River, anthropogenic soil development and classification, and examples of pedogenic processes in loess and till deposits in eastern Nebraska.

The conference is open to all interested individuals. For more information and registration details, check out the following link: http://clic.cses.vt.edu/IUSS1.4/Conf_Soil_Classification_2012/IUSS_Conf_Soil_Classification_2012_A1.html ■



IUSS tour route

Baylor University Scientists Use Kellogg Soil Survey Laboratory Data To Evaluate Paleosols and Paleoclimates

Submitted by Gary Stinchcomb, Ph.D. candidate, Department of Geology, Baylor University

The Natural Resources Conservation Service (NRCS) recently made available a high-quality database of soil characterization and whole-soil geochemical data for more than 1,500 pedons that span the USA. This database is extremely valuable for paleopedological studies, which rely heavily on the use of contemporary soil characterization and whole-soil geochemical data. Specifically, these NRCS soil survey resources serve the needs of paleopedologists, who reconstruct ancient climate and soil systems using models to relate modern physical and chemical soil characterization data, whole-soil geochemical data, and climate parameters. However, the (paleo)pedologist currently faces a "data overload" problem resulting from the wide availability of a number of global and continental-based soil geochemical databases. The overwhelming nature of the available data makes model construction difficult and time consuming. The emerging field of data analytics addresses the overload problem by providing a systematic process for data acquisition, cleaning, initial analysis, and main analysis. We used a data analytics approach to construct the Baylor University Paleosol Informatics Cloud (BU-PIC). The BU-PIC uniquely combines: (1) NRCS pedon data, (2) PRISM-based climate parameters, (3) NLCD land-cover attributes, and (4) published paleosol data. This aggregation of data will allow paleopedologists to upload standardized geochemical data and test and refine soil-derived paleoclimate proxies and paleopedotransfer functions. Although BU-PIC development is in the initial stages of data cleaning, early analysis shows promising results. For example, variations in the chemical index of alteration minus potassium (CIA-K) for forested Alfisols explain roughly 80 percent of the variance in mean annual precipitation (fig. 1). Also, whole-soil weight % Fe_2O_3 explains approximately 76 percent of the variance in % Fe_d (pedogenic iron) in 4,000 soil horizons from more than 1,500 pedons. These preliminary models may be useful for paleopedologists interested in reconstructing paleo-precipitation or determining the amount of pedogenic iron within a rock paleosol. The continued success of BU-PIC relies heavily on: (1) the exceptional quality of soil chemical data collected and provided by the Kellogg Soil Survey Laboratory and (2) building rapport with modern soil scientists while seeking their consultation during the developmental stages. ■

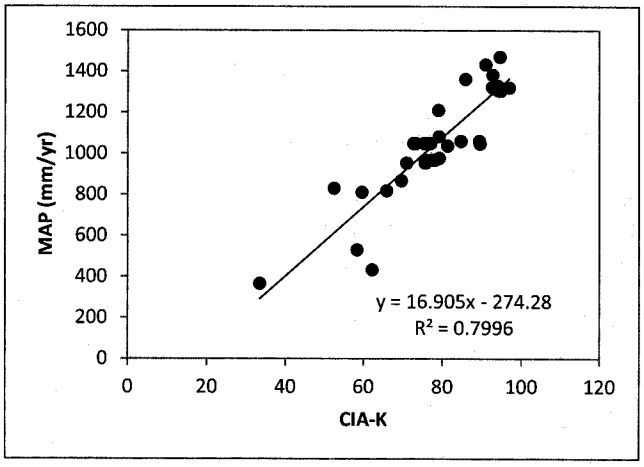
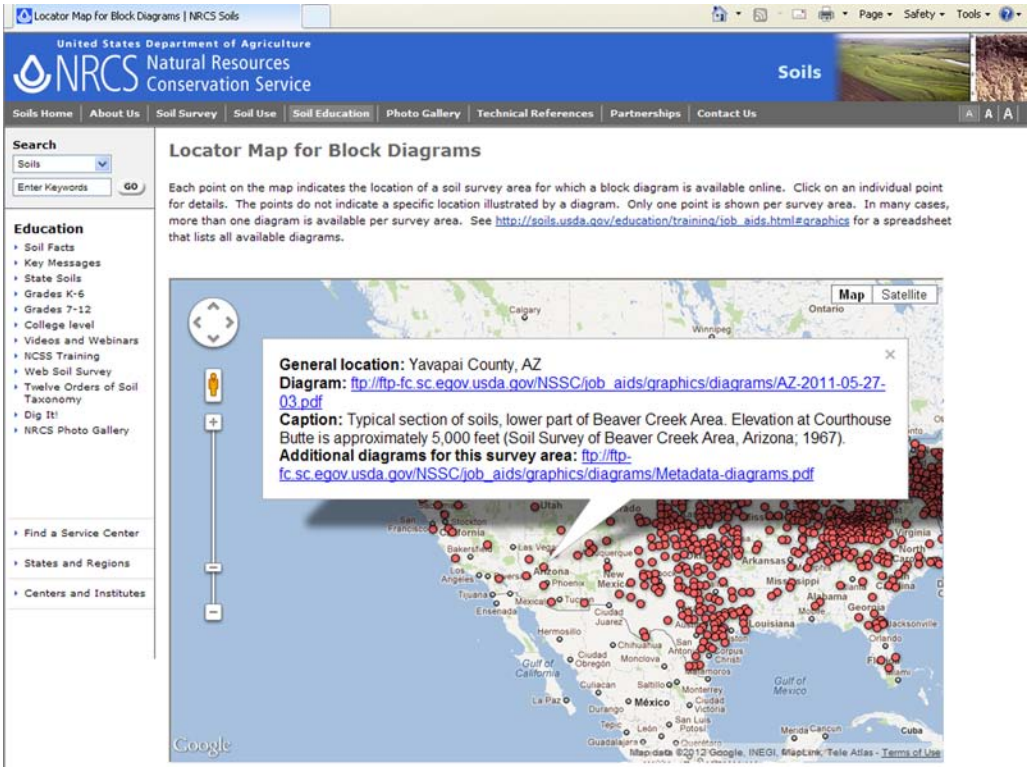
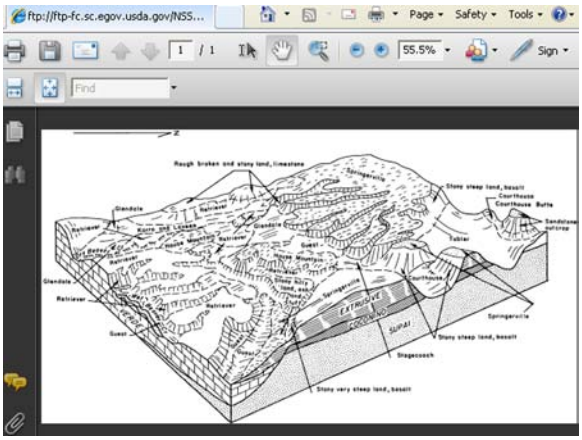


Figure 1.—The relationship between the chemical index of alteration minus potassium (CIA-K) vs. mean annual precipitation (MAP) measured in mm/yr for forested Alfisols (n=34). (Graphic courtesy of Kimberley Kuijper)

Locator Map Available for Block Diagrams

An interactive locator map is now available for the Soil Science Division's online collection of block diagrams (http://soils.usda.gov/education/training/block_diagrams_map.html). The map is based on the technology of Google Maps. It provides the location of each survey area for which at least one block diagram is available in the collection. Clicking on a designated point on the map brings up a link to one of the diagrams for the survey area and a description of the diagram. Over 3,350 diagrams are now available. The diagrams are mainly reproductions from published surveys and are indexed in a searchable spreadsheet. Most of the diagrams illustrate relationships among soil, landscape, and geologic materials. The spreadsheet is available online at http://soils.usda.gov/education/training/job_aids.html#graphics. The locator map was prepared by Aaron Achen, editor, MO-15, with the assistance of Tammy Umholtz and Paul Finnell, National Soil Survey Center. ■





Dr. Goro Uehara, Professor of Soils, University of Hawaii, 1928–2012

By Susan B. Southard, soil scientist, National Soil Survey Center

A few years ago, before I took my present position with NRCS, I was the soil data quality specialist for the State of Hawaii. When I look back on that experience, I feel so honored to have known Dr. Goro Uehara, who died on January 2, 2012. I am honored that he carved out time and participated in some of our soil survey field reviews on the Island of Hawaii. He was a very courteous man, and he seemed ageless. It was amazing how clean and immaculate he could be after we all had climbed a pali or stomped through a tree fern rain forest.

Dr. Uehara was born in Hawi Camp 17 on the North Kohala coast of the Island of Hawaii on November 7, 1928. He graduated from the University of Hawaii at Manoa with a degree in agriculture in 1951 and then served his country during the Korean War. Upon his honorable discharge from the U.S. Army in 1953, Dr. Uehara went back to the University of Hawaii, where he earned his master's degree in soil science in 1956. Three years later, he completed a Ph.D. in soil science at Michigan State University. He returned to the University of Hawaii and spent the rest of his career (more than 50 years) as a faculty member in the College of Tropical Agriculture and Human Resources, where he taught classes, directed research, and served as an advisor and mentor to a large and diverse group of undergraduate and graduate students from throughout the world.

Left to right: Russ Yost, Goro Uehara, and Gordon Bigelow, professors at the University of Hawaii, and Bob Gavenda and Tom Galiato, graduate students. Photo taken in March 1989 on Oahu. (Photo courtesy of Bob Gavenda)

His research included the mineralogy, chemistry, and physics of soils with variable charge clays. An early milestone was his book, *The Mineralogy, Chemistry, and Physics of Tropical Soils with Variable Charge Clays*, published in 1981. He was a strong supporter of the U.S. system of soil taxonomy and was one of the major contributors to the development of classification methods and criteria for tropical and volcanic soils.

Dr. Uehara was appointed by President William Clinton to serve as a member of the Board for International Food and Agricultural Development, and he served as science liaison advisor for the U.S. Agency for International Development (USAID)

to the International Institute for Tropical Agriculture. He also served as a member of a USAID panel to review the research agenda for the International Board for Soils Research and Agricultural Management and to review and evaluate the performance of the International Fertilizer Development Center. He served as president and member of the Board of Directors for the International Consortium for Agricultural Systems Application (ICASA), a nonprofit organization based in Honolulu. He was a lead scientist with the following international projects supported by USAID: the Benchmark Soils Project (1974–1983), the International Benchmark Sites Network for Agrotechnology Transfer (IBSNAT) Project (1983–1993), and the TropSoils Project/Soil Management CRSP (1984–2007); he also secured a technical assistance and capacity building grant for East Timor (2003–2006). His latest research program (2006–2011) focused on investigating the feasibility of producing clean, renewable energy in the tropics.

Dr. Uehara had many other honors, awards, and accomplishments not mentioned here. In my view, a lasting legacy that attests to his character is the Carolyn and Goro Uehara Scholarship for Women in Agriculture that he established at the University of Hawaii to improve educational opportunities for women in agricultural science and technology. ■

Dr. B.L. Allen, Texas Tech University, 1923–2012

By Dr. Susan M. Casby-Horton, adjunct professor, Texas Tech University

The loss of a teacher, or colleague, or mentor, or friend can be difficult, but the loss of one individual who embodied these four identities is really tough.

Dr. B.L. Allen did not willingly discuss his birth date and year and did not offer up his age. He was born on August 11, 1923, in Hillsboro, Texas, and he died at the age of 88 on Saturday, March 24, 2012. He was raised in Hillsboro and served in the U.S. Army from 1943 to 1946 in the South Pacific and Philippines. After World War II, he attended Texas Tech University and received his Bachelor of Science degree in agronomy (soils option) in 1948. Following that, he received both his Master of Science and Ph.D. (in 1959) from Michigan State University majoring in soil science (geology minor). While completing his graduate studies, Dr. Allen also served as an instructor and assistant professor of agriculture at Eastern New Mexico University

(ENMU) in Portales from 1948 to 1950 and again from 1951 to 1957. His New Mexico employment provided the funds necessary to complete his graduate education at Michigan State University. Some of his ENMU students assisted him in collecting soil samples from the widespread basalt outcrops in northeastern New Mexico for his dissertation, “A mineralogical study of soils developed on Tertiary and Recent lava flows in northeastern New Mexico.”

Dr. Allen taught soil science courses at Texas Tech for almost 50 years. From 1991 to 2003, he served as the Rockwell Professor of Soil Science at Texas Tech University. He was an ASA and SSSA Fellow, and along with his numerous publications, book chapters, and presentations, he was honored with several prestigious awards, including the Soil Science Education Award and Soil Science Distinguished Service Award (both conferred by the Soil Science Society of America). He coached the Texas Tech Soils Judging Team for 40 years and led them to five National Collegiate Soil Judging Championships. Dr. Allen was most especially the consummate field soil scientist, and he instilled his curiosity and passion in all of us who had the good fortune to work with him.

Dr. Allen was foremost a soil scientist, a deeply religious individual, and—most importantly—a good man. He was always interested to hear from colleagues and former students, and he took a genuine interest in their accomplishments. He kept in touch with many former graduate students by phone and mail, but he had not yet graduated to using email as a communication tool.

Dr. Allen’s roommate at Michigan State University was Dr. Goro Uehara, internationally acclaimed for his work on tropical soils. Dr. Uehara died in Hawaii on January 2, 2012. For years, Dr. Allen and Dr. Uehara would room together when they attended the Soil Science Society of America annual meetings. At every meeting, Dr. Allen would host a “happy hour” for his current and former students in his hotel room. After several hours of conversation and libations, Dr. Allen would send us packing and he (and Dr. Uehara) would reclaim their hotel space. So if you are so inclined, lift a glass of Scotch in Dr. Allen’s direction and savor the memories.

Dr. Allen’s memorial service was held on Saturday, March 31, 2012, at Saint Paul’s-on-the-Plains Episcopal Church in Lubbock. Interment was in the Dallas-Fort Worth National Cemetery alongside fellow veterans. ■

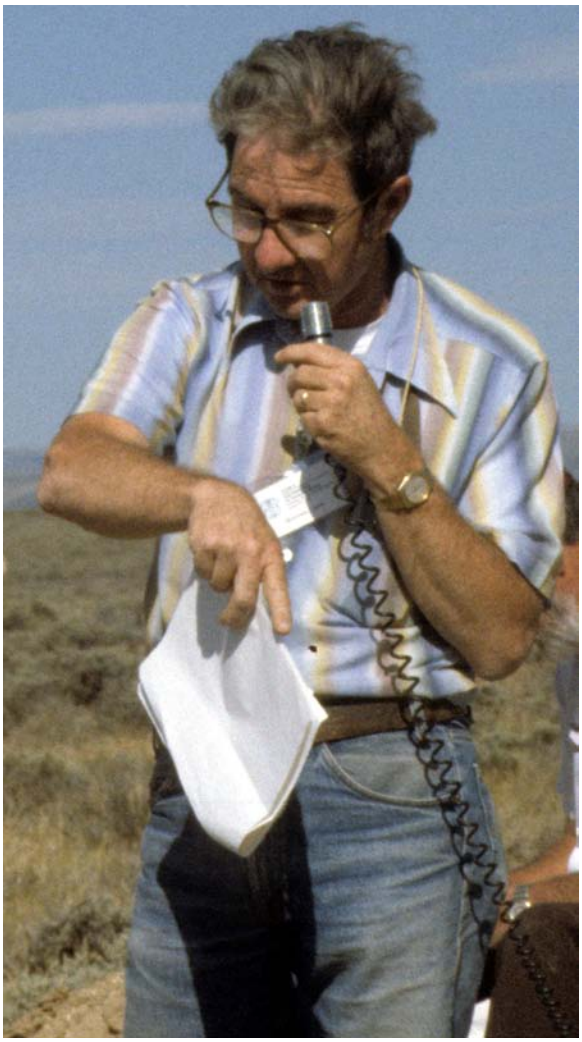
Dr. Warren Lynn, National Soil Survey Center, 1935–2012

Warren Clark Lynn died on March 18, 2012. Dr. Lynn worked as a soil scientist in the Soil Survey Laboratory at the National Soil Survey Center in Lincoln, Nebraska, from 1963 until his retirement in 2004; he also worked as a volunteer after his retirement. His research specialty was clay mineralogy, and he taught a course in that subject in the Geology Department at the University of Nebraska-Lincoln for 6 years. He traveled frequently and sampled soils in many locations in the United States, Puerto Rico, the Virgin Islands, and several foreign countries. He especially enjoyed working at middle school and high school science bowl competitions in Nebraska.

Dr. Lynn grew up in Wichita, Kansas. He graduated with honors in technical agronomy from Kansas State University in 1957 and completed a master’s degree there in 1958. He received his Ph.D. in soil science from the University of California at Davis in 1964. He was inducted into several honorary societies, including Gamma Sigma Delta, an agriculture honorary, and Sigma Xi, a scientific honorary.

Warren served in the U.S. Army from 1958 to 1960. He had a scientific classification and was assigned to the Army Chemical Center in Maryland. Most of his service time was spent on a classified project in Arizona and California.

His contributions to soil science were significant, and he achieved a world-class reputation in the study of clay mineralogy and of other minerals. He co-authored a chapter in the Soil Science Society of America's publication, *Minerals in Soil Environments*, entitled "Carbonate, Halide, Sulfate, and Sulfide Minerals." Warren developed very precise field procedures, which are still used by the National Soil Survey Center. He brought to the laboratory both precision and rigor, and his work



contributed greatly to the creation of an important reference collection of thousands of soil samples from around the world.

Dr. Robert Ahrens, former director of the National Soil Survey Center, describes a typical experience in working with Warren:

> Warren accompanied several U.S. soil scientists and two Canadians on a 2-week soil characterization trip through the Northwest Territory, Yukon, and Alaska in preparation for an international field trip for permafrost-affected soils. The trip was quite fun, and we broadened our experiences. But at the same time it was arduous, and with the constant daylight our biological clocks became rather skewed. In fact, one evening we arrived at a sample

site at 10:00 p.m. and proceeded to dig a pit and describe and sample the soil because we didn't feel tired, at least when we started. During the trip Warren was always the true energetic scientist. He proceeded to dig not just pits, but trenches—first on this mound, then on that shoulder. He was digging here and there at every opportunity in his attempt to discover the relationship between the depth to permafrost and topography. His energy and interest in discovery were an inspiration to all of us. Toward the end of the trip, we were all rather weary and perhaps a little cranky. But not Warren. He was always the kind gentleman of the bunch, and always a true scientist.

Robert B. Grossman and Wiley D. Nettleton, resource soil scientists, retired, also contributed to this article. ■