National Cooperative Soil Survey Newsletter

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Editor's Note

Issues of this newsletter are available at http://soils.usda.gov/. Under the Soil Survey tab, click on Partnerships, then on NCSS Newsletters, and then on the desired issue number.

You are invited to submit articles for this newsletter to Jenny Sutherland, National Soil Survey Center, Lincoln, Nebraska. Phone—(402) 437–5326; FAX—(402) 437–5336; email—jenny.sutherland@lin.usda.gov. ■

Preparations Begin for 2021 Conference

The path to the 2021 NCSS National Conference lies before us, as outlined in the Timeline of Activities in the newly revised NCSS bylaws. The bylaw revisions were accepted by the membership and will soon be published in the National Soil Survey Handbook, Part 602, Subpart B, Section 602.15 (https://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=41516.wba). An excerpt of the Timeline of Activities is given below.

Incoming committee chairs and vice-chairs should have received copies of the new bylaws from the Executive Services staff. Committees are open to new membership, and solicitations are going out via GovDelivery this month. Presentations and committee meeting notes from the 2019 Conference in Rhode Island are available on the Conference Agenda page.

Timeline of Activities

July 2019

Steering committee and committee chairs provide reports, including names of the new committee chairs and vice-chairs, to the Soil and Plant Science Division for posting on the NCSS website, and to the national conference liaisons for communication to the corresponding national or regional committees. Executive Services staff distribute bylaws to incoming committee chairs and vice-chairs.

August 2019

Soil and Plant Science Division publishes proceedings on conference websites. Committee chairs solicit new committee members through the NCSS.

October 2019

Committees convene to review objectives and charges as assigned based on prior conference proceedings and recommendations. Committees set meetings as needed to discuss and accomplish charges and to prepare reports for the intervening regional or national conferences.

The steering committee meets to review recommendations and assess further action.

March 2020

Committees submit mid-term report to the intervening regional or national conference committees; report is published on the NCSS website and in the NCSS newsletter.

June 2020

Conference steering committee begins holding planning meetings monthly, or more frequently if needed.

October 2020

Conference, including dates and location, is announced by posting on the NCSS website and sending information to member lists.

January 2021

Committees meet to review intervening meeting proceedings and begin drafting recommendations.

March 2021

Committee chairs submit draft reports to steering committee for distribution to NCSS members. Requests for new committee vice-chair nominations are solicited.

June 2021

Committee reports are presented during committee meetings. Report recommendations are submitted to the business meeting for discussion. Committee vice-chairs are chosen by the committees and names are submitted to the business meeting. ■

Cacao for Peace

The NRCS Soil and Plant Science Division (SPSD), Penn State University, and the International Center for Tropical Agriculture (CIAT) have been collaborating on the Cacao for Peace Project in Colombia for almost a year. This project aims to provide an alternative high-value crop to coca. It seeks to delineate suitable areas and site-specific management practices for optimal and sustainable cacao production. It will also identify high-yielding, drought-tolerant, disease-resistant, and high-quality cacao varieties.

Optimum cacao production occurs within a narrow range of tropical temperatures and requires moderate to high rainfall on very well drained soils. Project participants are investigating the suitability of the area for producing cacao with high-quality flavor for local consumption and for export markets. Another challenge to expanding cacao production in the region is the concern about cadmium (Cd) levels in cacao beans. The European Union recently passed new regulations on Cd levels in cacao and chocolate. As a result, the project will evaluate Cd levels in soil, foliage, and cacao beans.

The multidisciplinary team of soil scientists and plant geneticists are investigating limitations to profitable cacao operations in the Santa Marta region of Colombia. The

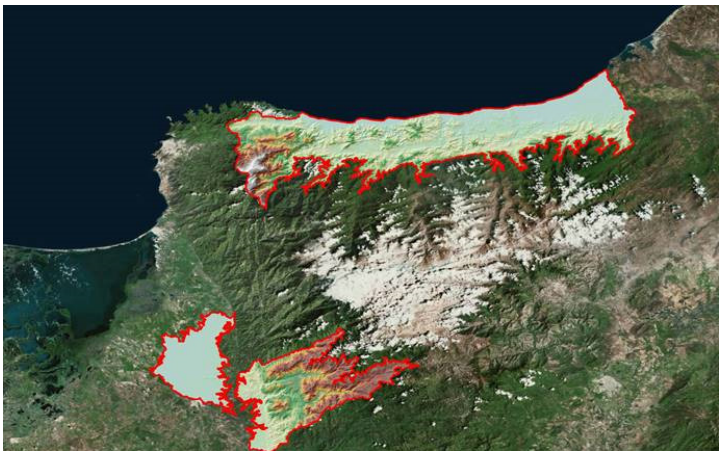

Figure 1.—Overall view of project area.

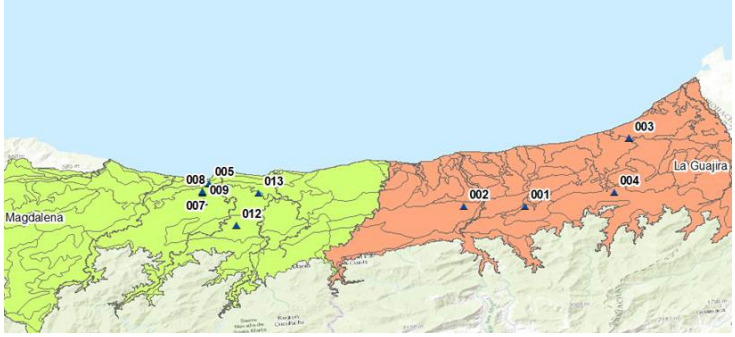

Figure 2.—Locations for detailed profile descriptions

soil scientists will produce more detailed soil maps delineating the different soil types and properties and their suitability and limitations for cacao production. The specific objectives are to map regional soil characteristics, soil moisture regimes, and cacao genetics. Data on typical soil characteristics (pH, texture, moisture and temperature regimes) are needed to develop a cacao suitability map. Cadmium levels in soils will be compared to cadmium accumulation in the beans of the various cacao varieties cultivated in the region. The project will also involve mapping the genetic diversity of cacao varieties in the project area to determine which varieties are high yielding, drought tolerant, and disease resistant and, possibly, excluders of Cd.

NRCS, Penn State University, and CIAT scientists and other collaborators participated in a field sampling campaign from March 17 to April 5, 2019. They collected soil and cacao pods and leaves for analyses in the project area in cooperation with the local cacao growers' association (FEDECACAO). The local soil scientists, botanists, and agronomists were trained on sampling protocols.

During the 3-week field campaign, approximately 28 farms were visited and 10 full pedons were described and sampled, resulting in a total of 414 soil samples and leaf and cacao pods samples from 193 cacao trees for genetic study and cadmium analysis. The field work included detailed landscape and soil profile descriptions as well as the collection of representative soil and vegetation samples for laboratory analyses.

Samples were collected, labeled, and shipped to the CIAT Soils Laboratory for analyses. Results of the soils analyses for the profiles are already being released by CIAT to the NRCS scientists for interpretation and for finalizing their profile descriptions

Figure 3.—Members of field sampling campaign explore the landscape and conduct soil investigations.

and quality control protocols. CIAT will continue to conduct the soil laboratory analyses, primarily physical and chemical properties (including cadmium), while Penn State will be responsible for foliar analyses and genetic sequencing for the various cacao varieties. Penn State will map the genetic diversity of cacao varieties in the project area to determine the best varieties.

Soil sample subsets will be sent to the Kellogg Soil Survey Laboratory (KSSL) for a suite of analyses with different methods (traditional, XRF, MIR). The analyses will be used to: (i) finalize the soil maps for regional planning and small farm management and (ii) develop interpretation and suitability ratings for cacao growing. In addition, work will continue on developing a web-based platform for delivering the data and the products, completing the training for the local soil scientists, and publishing the findings in a scientific journal and other reports.

Although the government of Colombia has made significant strides in mapping its soils, the map scale is typically inadequate for use by small scale farmers, who have only 1 to 3 hectares on average for farming. Plans are underway for the digital soil mapping training in Colombia. Soil information is needed to support management decisions related to soil water management, soil erosion control, and conservation planning for sustainable farming operations to help farmers grow cacao and other crops profitably.

Participants in Field Sampling Campaign:

CIAT: Mayesse da Silva, Javier Martin, Cesar Botero, Gerardo Gallego, Carlos Dorado
PSU: Mark Guiltinan, Siela Maximova, Patrick Drohan
Los Andes University: Daniel Estrada
NRCS: Zamir Libohova, Janella Cruz, Charles Lagoueyte, Giulio Ferruzzi
FEDECACAO: Juan Pablo ■

Kazakhstani Ag Representatives Visit NSSC and KSSL

A group of agricultural-sector scientists, producers, and managers from Kazakhstan visited the National Soil Survey Center and the Kellogg Soil Survey Laboratory (KSSL) on Friday, July 12. The group was visiting several locations in the United States and was sponsored by the U.S. Department of State's International Visitor Leadership Program and, in Lincoln, by the Lincoln Council for International Visitors. The group included representatives from the crop and animal production sectors. Before coming to Lincoln, they visited Washington, D.C.; Sacramento,

Richard Ferguson and Mike Pearson discuss particle-size analysis with Mr. Kairat Kunanbayev, Ms. Anastassiya Tuyakova, and Ms. Elena Bell, interpreter.

California; Madison, Wisconsin; and Freeport, Illinois. In Lincoln, in addition to the center and the KSSL, they visited specialists in animal science and water management at the University of Nebraska, local farmers, and other agricultural enterprises. During their visit to the KSSL they received an overview of the laboratory's operations, with special attention on their areas of interest, including the profile of sample submitters, the sampling and submission process, the scope of analyses, and the analytical technology used at the KSSL. The visitors included Mr. Zhan Dyussenov (Consultant, Kazgrowers Union), Mr. Kairat Kunanbayev (Head, Department of Soil Quality and Crop Production, Barayev Grain Research Institute), Mr. Nurbolat Makashev (Deputy Mayor, Office of the Mayor, Terenkol District), Mr. Altay Nazarbekov (Ph.D. Deputy Director for Innovation Animal Husbandry and Veterinary Science Center), Ms. Anastassiya Tuyakova (Director Kazagrobilim LLP), and Mr. Yerlan Zirkin (Director BeibarsAgro LLP). Aaron Achen and Curtis Monger facilitated the visit to the NSSC, and Richard Ferguson, Steve Monteith, and Mike Pearson met with the group in the KSSL. ■

International Delegation Visits the NRCS East National Technology Support Center

An international delegation from four different countries visited the NRCS East National Technology Support Center (ENTSC) in Greensboro, North Carolina, on July 15, 2019, to explore opportunities for technical assistance and collaboration. The visiting delegation consisted of four scientists from Cambodia, four from Ethiopia, and two from Guatemala and was accompanied by a facilitator from North Carolina Agricultural and Technical State University (NC A&T). This diverse group was selected from attendees at the recent meeting of the American Society of Biological Engineers. These scientists are actively involved in USAID and/or other U.S. foundations in their respective countries. The goal of the visit was to brainstorm and prioritize ways to

Dr. Manny Reyes (black shirt) and others listening and reacting during the discussions.

develop initiatives for natural resources conservation and identify potential partners in the initiatives, in countries like Cambodia, Vietnam, Thailand, Laos, and Myanmar in the Lower Mekong River Basin.

The Delegation Leader, Dr. Manny Reyes, is a research professor at the Kansas State University Sustainable Intensification Innovation Laboratory (SIIL) and was formerly professor of Biological Engineering for 23 years at NC A&T. He has a legacy of successful collaborations with the East NTSC. He has worked with Drs. Susan Andrews and Charles Kome on several funded projects, notably, the SANREM-CRSP project and the Soil Health Training for STEM students at NC A&T as well as Soil Health Training for high school teachers in the State of North Carolina.

NRCS staff participating at the meeting included Jeffrey Porter, national team leader for the Manure Management Team; Renee Leech, animal husbandry specialist; Hamid Farahani, water management engineer; Tibor Horvath, agronomist and nutrient management specialist at the ENTSC; and Charles Kome, soil scientist, Soil and Plant Science Division.

The visitors were interested in topics related, but not limited, to:

- Soil information systems and practical soil information delivery tools
- Nutrient management planning tools
- Enhancements of SWAT/APEX models for ongoing work within the Mekong River Basin
- Conservation agriculture machinery
- Climate change adaptation/mitigation research and application
- Climate change and soil health
- Conservation agriculture cropping systems
- Soil water management

In the ENTSC conference room, Jeff Porter welcomed the visitors and gave an overview of the center's mission. His opening remarks were followed by brief presentations on the phosphorus and nitrogen indices by Tibor Horvath, including a few weblinks and reference materials. Renee Leech led a discussion on biosecurity and food safety, and Dr. Hamid Farahani talked briefly about opportunities and innovations for improving soil water management.

Charles Kome shared information on recently completed and ongoing international activities, namely, the Haiti Natural Resources Conservation Initiative, the Pakistan Fertility and Soil Health project, and the ongoing Cacao for Peace Project in Colombia. He also emphasized the need to follow proper procedures in engaging NRCS scientists through the International Agriculture Program Office, since NRCS does not have international authority.

The meeting's organizer, Dr. Niroj Aryal (assistant professor of Biological Engineering at the College of Engineering, Department of Agriculture and Environmental Sciences, NC A&T), expressed her sincere appreciation to the NRCS staff for hosting the meeting with international visitors and thanked them for the interaction and the invaluable information shared with the visiting team members. She also expressed the hope that the exchange will help in extending NRCS's technological footprint beyond the U.S. borders. In response, Mr. Jeffrey Porter stated that it was pleasure for the NRCS team to work with the NC A&T team and the international visitors and expressed the hope that this may open some doors for continued collaboration in the future.

The international visitors have already met with or plan to meet potential partners at:

- ARS – Temple and Texas A&M University, regarding SWAT/APEX models (there is ongoing modeling of the Mekong River Basin using SWAT)
- ARS – Soil Dynamics Lab, regarding conservation agriculture machinery and climate change research and application
- ARS – Florence, regarding climate change and soil health research
- NRCS-ENTSC, regarding conservation agriculture cropping systems, irrigation, and soil survey
- USDA-FAS, Washington, DC

Dr. Reyes also invited everyone to the upcoming International SWAT-SEA 2019 conference in Siem Reap, Cambodia (https://swat.tamu.edu/conferences/sea/2019-cambodia/), October 24 to 26, 2019. ■

Mafic Wet Meadow Vegetation and Soils Data Collection

By Yogev Erez, Pathways intern, NRCS, Raleigh, North Carolina.

For 5 days in mid-July, a team of 3 botanists, 2 soil scientists, 1 ecologist, and 1 ecologist Pathways intern gathered vegetation and soils data in wet meadows in the Northern Piedmont (Major Land Resource Area 148). Data was gathered across southeastern Pennsylvania and northern Delaware on locations where soils were derived from diabase intrusions in the Triassic Basin, from mafic metamorphic rocks of the crystalline Piedmont uplands, as well as from dolomite. Locations were targeted for sampling, on both floodplain and slope wetlands, based on pre-sampling assessment that indicated a high likelihood of hydric conditions and high base saturation (high pH).

The trip organizers, Matt Duvall (ecological data quality specialist, NRCS Soil Survey Region 3) and Ephraim Zimmerman (ecologist and Natural Heritage Science Director, Western Pennsylvania Conservancy, Pennsylvania Natural Heritage Program), came together to answer a shared question: Is there a distinct vegetation community associated with wet mafic meadows in southeastern Pennsylvania? Dr. Will Ryan, a research botanist with Drexel University, and Janet Ebert, a well-known botanical consultant, have been trying to answer the same question.

Ryan and Ebert have been working in coordination with the Pennsylvania Natural Heritage Program to determine if the data justifies adding a new vegetation community to the National Vegetation Classification System. The data may be difficult to interpret, because even if such a vegetation community exists, its floristic and physiognomic

Figure 1.—Will Ryan, Ben Marshall, and Yogev Erez discussing the soil profile in a meadow on a confined flood plain.

attributes may not be expressed on every wet mafic site. The team points out that factors other than parent material can also shape vegetation community composition and structure. Past land use, current management practices, specific hydrologic features, and even chance events all contribute to the kinds and amounts of vegetation present on a site at any given point in time.

Before the trip, Matt Duvall compiled a list of potential “generalist” species that may occur on wet meadows in southeastern Pennsylvania, regardless of base status and potential “indicator” species that are thought to commonly grow on wet mafic sites. The two categories roughly correspond to two distinct placeholders for plant community phases in the (Provisional) Ecological Site Descriptions (ESDs) for Major Land Resource (MLRA) 148. Through further data collection and analysis, Matt hopes to be able to either confirm or invalidate the two phase concepts and eventually refine the floristic components of each.

The ultimate objective is to develop a more detailed state-and-transition model that accurately reflects the plant community dynamics that are possible on a wet mafic site. The model would help support the development of Approved-level ESDs on hydric sites in MLRA 148.

NRCS and the Pennsylvania Natural Heritage Program use different terminology and concepts and have different applications for the data. Nonetheless, a collaborative effort was extremely valuable for all involved. As the days went by, a

Figure 2.—Matt Duvall, Ben Marshall, and Yogev Erez discussing the soil profile in a headwater floodplain meadow.

Figure 3.—John Chibirka and Yogev Erez completing a soil profile description on a slope wetland meadow. All soil profiles were described from within a 10m x 10m vegetation inventory plot.

clearly symbiotic relationship began to develop between the botanists, ecologists, and soil scientists. The botanists explained that having the ability to make determinations about prior land use will likely be critical to interpreting the effect of parent material on vegetation community attributes for these sites. NRCS Soil Scientists Ben Marshall (soil survey office, Frederick, Maryland) and Jon Chibirka (regional soil scientist, Pennsylvania) were able to make inferences about the cultivation history of a site, make determinations about anthropogenic impacts on hydrology, identify recently deposited "legacy" sediments, and confirm parent materials and other soil-forming factors. These inferences will help inform any conclusions reached by both the Pennsylvania Natural Heritage Program and Dr. Will Ryan. Likewise, the NRCS ecologists and soil scientists were equally grateful to have the help of the botanists on site. Given the diversity of plant species found in southeastern Pennsylvania wet meadows, accurate data collection would have been impossible without their expertise. The collaborative effort also allowed for a more general exchange of knowledge about soils, plants, and soil-plant relationships. This diverse ensemble of scientists will likely call on one another again soon for help with both related and unrelated projects. ■

TSCAN Station to Serve the Iowa Tribe

In the Spring of 2019, Matalyn Stark and Dave Kohake, resource soil scientists from Manhattan, Kansas, assisted the Iowa Tribe of Kansas and Nebraska with the installation of a Tribal Soil Climate Analysis Network (TSCAN) site. The TSCAN station collects data on precipitation, wind speed, wind direction, soil moisture, soil temperature, relative humidity, and other important climatic data. The Iowa Tribe and the local community are using the data collected to assist them in making better informed agronomic decisions, such as when to irrigate and when to apply fertilizers and pesticides. The tribe grows corn, soybeans, winter wheat, and grain sorghum.

Figure 1.—Matalyn Stark, Alan Kelley, and Melvin Massey installing the air temperature/relative humidity sensor.

As part of the installation, a soil pit was backhoed and sampled for full characterization by the Kellogg Soil Survey Laboratory. Assisting with the sampling was Bruce Evans and Casey Latta, soil scientists from the soil survey office in Lincoln, Nebraska. The site location is in the northeast corner of Brown County, Kansas. This area of Kansas is covered by thick deposits of Peoria loess, which was deposited around the time of the Wisconsin glaciation. The soil sampled was a Monona, which classifies as a fine-silty, mixed, superactive, mesic Typic Hapludoll. Monona soils are very deep and well drained and formed in loess. These soils are very typical of the soil types that the Iowa Tribe is farming in this area.

The installation of the TSCAN tower and the equipment was done according to the most current version of the Tribal SCAN (TSCAN) Equipment Installation Manual. The local field office staff, consisting of Matt Sprick (supervisory district conservationist), Brad Grier (soil conservation technician), and Melvin Massey (soil conservation technician), assisted with the installation together with Alan Kelley of the Iowa Tribe. A hole was dug upslope from the soil pit location that was used for sampling. The tower base was placed in the hole so that one side faced true north. It was then leveled and

Figure 2.—Bruce Evans in the soil pit, sampling the Monona soil. The different soil horizons are laid out in the pans.

Figure 4.—Matalyn Stark finishing up the installation and wiring of the site.

surrounded by concrete, and the legs of the tower were ensured to be vertical. The tower was then attached to the tower base. A lightning rod was installed a few feet away, using a T-post driver. Fortunately, Monona soils are very easy to dig and work. The lightning rod went into the ground very smoothly. Another small soil pit was carefully dug upslope of the tower, and soil moisture sensors were installed at depths of 4, 8, and 20 inches. The other sensors were attached to the cross arms and mounted on the tower along with the data logger boxes. These boxes each hold a data logger and a battery. A solar panel was attached to the tower to charge the battery that powers the entire station. Once everything was in place, Matalyn Stark connected the wiring and completed the final touches on the installation. The site has been up and running since April of this year, collecting valuable information for the Iowa Tribe and the local community. ■

Understanding the Substratum in Conservation Planning

By Chance Robinson, NRCS soil scientist, Region 9, MLRA soil survey office, Stephenville, Texas.

NRCS soil scientists have an in-depth knowledge of soil physical, chemical, and biological properties across the land surface to a depth of 2 meters, information that is delivered in published soil surveys. However, to effectively predict and map soils at the near surface, scientists need to know what lies below 2 meters in the deeper substratum. Knowledge of the continuum of soil-to-substratum relationships creates a “window to the subsurface,” which can guide decision makers[1] in making more science-based and cost-effective decisions for the benefit of society and private working lands.

In north-central Texas, many producers want to manage their working lands to meet the needs of a profitable livestock operation while improving or maintaining fish and wildlife habitat. A successful grazing management plan requires adequate water sources in multiple paddocks so that livestock can be rotated across the entirety of the property and not allowed to overutilize resources near a water source. NRCS soil scientists assist conservation planners with onsite geotechnical investigations to design effective watering systems, which may include pond reservoir areas. A pond reservoir area requires the expense of excavating a “test pit” to determine if suitable material is available onsite for the pond. In some cases, this is a wasted expense because a pond reservoir is not feasible at the desired location.

NRCS soil scientists have knowledge of pedostratigraphy (soil and substratum horizons) and lithostratigraphy (deep substratum bedrock layers) that can assist producers in placing “test pits” in the most advantageous locations (fig. 2). In some cases, onsite investigations may prompt a producer to consider an alternative water source (ground water) rather than spending money to install a pond liner where there is no suitable onsite material.

Figure 1.—NRCS soil survey and Texas NRCS field office staff discuss the findings on this site for a pond reservoir.

Figure 1 shows NRCS soil survey staff and Texas NRCS field office staff discussing the capabilities and limitations of a potential site for a pond reservoir. The complex pedostratigraphy of this site presented several concerns for the design of a permanent water source. To make the onsite determination, Sidney Paulson (soil scientist in green hat) estimated clay content and plasticity while Carson Singleton (range management specialist) operated the bucket auger. Alan Deubler (soil scientist) described the morphology of the excavated soil horizons. Prior to arriving on site, the NRCS staff

Figure 2.—NRCS soil survey staff assisting Texas NRCS field office staff in assessing the potential of a marginal site for a pond reservoir.

downloaded site-specific information from Web Soil Survey[2]. Lee Gernentz (district technician) brought along Hamilton County's soil survey manuscript, which not only includes soil descriptions but also significant guest-author documentation about the area. The extra documentation is not currently available in Web Soil Survey.

Figure 2 shows another onsite investigation where NRCS soil survey staff assist Texas NRCS field office staff in assessing the potential of a marginal site for a pond reservoir. Shelby Hilbert (range management specialist in green hat) and land manager look on as Chance Robinson (soil scientist in straw hat) explains the alluvial gravel layer encountered at depth by Alan Deubler (soil scientist operating bucket auger).

The Stephenville MLRA Soil Survey Office has assisted the Lampasas NRCS Field Office with geotechnical onsite investigations for several years. These investigations assist the field office in making a more science-based and cost-effective recommendation to producers while also informing the NRCS sois staff of the needs for future updates that will improve the Soil Survey for conservation planning and the public at large.

[1] Wysocki, D.A., P.J. Schoeneberger, and H.E. LaGarry. 2005. Soil surveys: A window to the subsurface. Geoderma 126:167-180.

[2] Soil Survey Staff. Web Soil Survey. United States Department of Agriculture, Natural Resources Conservation Service. https://websoilsurvey.sc.egov.usda.gov/. ■

NRCS Assists the Natural Resources Conservation Academy

NRCS soil scientists staffed the 8th annual Natural Resources Conservation Academy (NRCA) held this summer at the University of Connecticut (UCONN). The mission of NRCA is to engage high school students in environmental science and to provide transformative learning opportunities for students to interact physically, intellectually, and creatively with local environments. Students participating in the NRCA are educated on a wide range of topics related to natural resources and the environment, including water, forestry, soil, fish and wildlife, landscape ecology, and habitat protection.

Figure 1.—NRCA students observe how water runs off or infiltrates through their soil samples during the rainfall simulator demonstration.

On hand to lead the students were NRCS Soil Scientists Jacob Isleib, Donald Parizek, and Debbie Surabian along with Garrett Beaulieu (NRCS soil scientist intern) and Anne McGraw (student

Figure 2.—NRCA students get dirty looking at soils in the field.

at Pennsylvania State University). Dawn Pettinelli, soil scientist from the UCONN Nutrient Analysis Laboratory, provided her expertise on invasive earthworms of Connecticut and explained how to texture soils and use the Munsell color chart.

The soil staff organized a variety of interactive activities to give high school students a hands-on approach to learning basic soil characteristics in the field and how soil relates to other natural resources. NRCA students used spades to collect soil samples in the field. Later in the day, the rainfall simulator was used to demonstrate the effects of soil infiltration and soil erosion on the samples. Students also learned the difference between mineral and organic soils, the five soil-forming factors, and how worms affect soils. Students walked away with a greater connection to and knowledge of soil, which anchors all life on Earth. ■

Young Kansans Learn About Soils

Soil scientists from Region 5 and the MLRA 73 Soil Survey Offices interacted with 160 ninth-grade students from Salina Central High School over 3 days at the Sternberg Museum in Hays, Kansas. Participating in hands-on experiments, the students learned about the basic properties of the soils and how important soil is to everyday life. Ryan Still talked about his job as an NRCS soil scientist and pointed out the soil properties that can be observed in a soil core.

Each talk began with a question for the group of students: “What do you eat that does not come from the soil?” The answer was usually “pizza.” Soil Scientist John Warner discussed the items on a pizza and described how each came from the soil. The only item left for debate was pepperoni.

Each student group had spent a day at the Sternberg Geology Museum. Most talks centered on the importance of soil and its relationship to geology. The students were shown how quickly soil erodes, and then the scientists discussed how long it takes to produce an inch of topsoil. The group was then

Figure 1.—Crisped rice cereal is used to demonstrate how soil structure affects water infiltration. One cup represents a soil with good structure that allows water to infiltrate the soil, while the other cup represents a soil with compacted structure and ponding of water.

Figure 2.—John Warner explains the sizes of sand, silt, and clay that make up the textures of a soil. A student is catching a grapefruit, which represents sand. The other students hold a lemon, which represents silt, and grapes, which represent clay.

allowed to texture the core of Harney silt loam, which is the State Soil of Kansas. The students enjoyed picking the horizons of the soil core and seeing the changes in the soil profile.

John explained to the students that having all-sand or all-clay soils can make farming difficult. It was demonstrated how a good mixture may make the best soil for some uses. The teachers commented that each class continued to talk about soils and geology on the bus ride back to Salina. The students and teachers agreed that they all learned more about soil and geology by being out in the field. ■

Lessons from a Detail on the Data Model

By Ann Tan, soil scientist, NRCS, Arcata, California.

During the week of July 22, Senior Regional Soil Scientist Dan Wing and I were at the National Soil Survey Center (Lincoln, Nebraska) to glean as much information as possible about the NASIS data model from Soil Scientist George Teachman. Along with the new Database Manager Kyle Stephens, we were given an overview of the NASIS data model. George went over the model's history, talked about the various people who worked on it, and walked us through the existing documentation.

We also worked on accessing Microsoft SQL Server Management Studio and were exposed to its capabilities. Information Technology Specialist Tammy Cheever joined us and gave an overview of CoLab, which is a tracker for the SET team (team of programmers designed to work on NASIS). Requests to change the database are usually received through submissions of "639.10: Proposed Amendment to the NASIS Data Dictionary." These requests are then sorted into tasks we can do in the data model, or into programming changes put into CoLab. Next, as the number of programmers working on NASIS is limited, the issues are prioritized based on whether or not they are bugs that crash the database.

The next few weeks are focused on practicing on the 7.3.1 NASIS tutorial database, implementing the changes that will be in 7.4. One important lesson we learned while

implementing these changes is that there is a suite of databases, and if we make a change to one of them, we typically will have to manually make changes to the rest of them. For example, if a new table is added to the Component table in NASIS, it also will need to be added to the Staging Server, Soil Data Warehouse, Soil Data Mart, and SSURGO. This is a monotonous but important task since lack of precision could corrupt the data during database transfers. To assist us, George made a tutorial version of each of these databases. Once George decides that we have shown proficiency in navigating the database, we will work on the non-tutorial databases.

Another important lesson we learned is to be thoughtful about the columns we are adding, to think about how they could potentially be used. Adding useful text notes in the Help section is important, as well as thinking through the maximum and minimum values, because they cannot be easily changed once implemented without affecting existing data.

Lastly, we learned about the importance of knowledge transfer. With so many moving parts, the complexity of our database, the amount of information stored in it, and the age of the system, fewer and fewer people have the knowledge to work with the data model. As a result, converting that tacit knowledge into accessible written form and providing training is invaluable. ■

Detailee for Soil Metrics

In early July, Laura Emberson filled the detail at the National Soil Survey Center (NSSC) for developing a set of standard metrics for tracking soil applications (Web Soil Survey, Soil Data Access, Soil Web, etc.) and website (soils.usda.gov) use. She has been working as a management analyst in the agency for 2 years, holds degrees in ecological sciences and soil science, and has a passion for furthering science literacy. She has combined her skillset to update metrics into easily consumable information for multiple audiences. She is working to move soil metrics reporting away from a litany of numbers and toward meaningful value-based reports. She has been working to leverage Tableau, a current data analytics and visualization software that NRCS has begun to support. She has also been making headway on turning the counting of data elements, such as the number of clicks in a web app, into the ability to estimate the dollar value of products and customer services. Leadership of NRCS Soil and Plant Science Division is encouraged by the headway and looks forward to the future, when capitalizing on the work the division does in data collection, dissemination, and analysis for its customers is strategically planned and at the forefront of its metrics reporting. ■

Observations on the State of Soil Survey

By Tom D'Avello, soil scientist, NRCS, Morgantown, West Virginia, and Jay Skovlin, MLRA soil survey leader, Missoula, Montana.

A few thoughts and observations come to mind as our discipline deals with changing roles and opportunities, expanding data and computing resources, and new ways to map and represent our soils knowledge. We will highlight a few significant advances and some prescient words from our predecessors.

During the early years of soil survey, the transition of the base for mapping from plane table to aerial photography took about 10 years. However, nearly 10 years after the first county soil survey was published using aerial photography as a base, the 1937 edition of the Soil Survey Manual had several references citing the topographic map as the superior base for mapping and devoted more space describing the proper use of the older, plane table technique than to air photo interpretation (Gardner, 1998).

The State Soil Survey Database (SSSD) was released in the late 1980s and was the first database available to soil scientists below the national level, specifically database managers at the State office level. The National Soil Information System (NASIS) evolved from SSSD with a similar data model and became the repository and management tool for soils data in the mid-1990s. By the late 1990s, working in NASIS became a major workload for soil scientists in much of the country.

The first standard for SSURGO was completed in 1995. The transition from hand drawing lines on mylar and scanning them to onscreen, heads-up digitizing in a geographic information system (GIS) was made in the early 2000s. Web Soil Survey was released in 2005 and provided a readily accessible means to deliver soil survey data to the world without the requirements of expensive GIS software or expertise.

Readers can decide if we in soil survey exhibit change-averse tendencies, are just careful, or possess "the maneuverability of an oar boat." A combination of all three are likely at play for what many describe as slow adoption rates.

Not counting Soil Taxonomy, these three things—the air photo base, the relational database, and geospatial capabilities—have been significant advances in soil survey. Our objectives and the challenges to meeting them have been a constant since 1899, but has our ability to meet them improved?

Several decades ago, Berman Hudson noted, "We do a poor job of explaining how and why the soil classification and mapping process works, we have failed to describe a comprehensive conceptual model to explain how soils are mapped and interpreted. This has resulted in a crisis of confidence within soil survey itself"… and "The obsession with map unit variability and all of the concern about inclusions and taxonomic purity are the result of conceptual, not technical deficiencies" (Hudson, 1990). In one of the most widely cited papers on soil survey, a typically overlooked portion notes, "If research findings are not expressed linguistically, they will not affect the general body of scientific knowledge... and maps occupy an intermediate position between pictures and human language… after the maps are made, the understanding of the soil-landscape relationships required to make the maps are seldom communicated. As a result, a researcher may 'discover' relationships that have already been recognized and used by field soil scientists for many years" (Hudson ,1992).

The technologies we have adopted have broadened our user base immensely, but we write less today than we did when the cited Hudson papers were published. It is reasonable to assume that given this broad user base, even more researchers are "discovering" relationships that we have already established. We are managing, even embracing, an inverse relationship between the volume of data we develop and disseminate and any corresponding text explaining the relationships and behaviors of soils. Now that we have better data to help define the setting and relationships of soilscapes, we have an opportunity to do a better job of explaining those relationships to ourselves and our users.

The expanding volume of data in our database and the time required of soil scientists to work within the database has been noted (Indorante, 2007). The wording is dramatic, but the NASIS workload sucked the life out of many soil survey offices in the late 1990s and led to a prevalent and persistent shift in emphasis, from a map-centric to a database-centric perspective among soil scientists (D'Avello, personal witness). A cautionary observation noted, "However, over time the cost and expense of maintaining a massive digital database could limit innovation and reduce the incentive to respond to the changing needs of users. If care is not taken, the soil survey of the twenty-first century could merely become a broker for its own existing data. As a result, users would seek new kinds of data elsewhere. This must not happen. The U.S. Soil Survey must continue to be perceived as the preferred organization to collect, analyze, and supply the data to meet the nation's soil information needs" (Smith and Hudson, 2002).

Have we “merely become brokers for our existing data”? Those in the West, where initial surveys are still ongoing, may take offense, but the rest of the country has been a servant to the data quite a bit over the past 20 years. In general, we have become less involved with the science of soil, particularly the field science/pedology/soil geography aspects, and more focused on our custodial duties of maintaining our soil data.

We have been struggling to find a way forward for many years. The increase in data sources and improved software and hardware capabilities offer the tools to chart a new path. Much time has been spent talking about digital soil mapping (DSM) over the past several years. DSM would qualify as new, even though the most cited paper on the topic was published 16 years ago (McBratney et al., 2003). In general terms, DSM processes and output are similar to analog soil mapping approaches with the advantages of the latest data, software, and hardware. The acquired knowledge of soil scientists can be used with DSM techniques to produce the best representation of pedological knowledge; it does not have to be an either/or proposition. We should be careful to not discount our knowledge of the soil system and landform relationships in favor of using data from other disciplines. Our expert knowledge of those relationships can inform the models, enabling them to go beyond a bottom-up, no-knowledge approach. The challenge for future projects will be finding ways to integrate and balance the wealth of tacit knowledge with new techniques. Doing anything new is difficult and requires a skill set that takes time to learn; however, learning by doing is a definite way to progress.

It is important that we come to DSM approaches with a healthy dose of skepticism and critical evaluation. Methods are constantly evolving, and as experts on soil mapping, we should be a part of the evolution and improvement of methods and implementation. DSM methods have the potential to show us new relationships and document existing knowledge, but it is vital that a soil scientist has a proper understanding of the soil-landscape relationships to differentiate the signal from the noise. New methods do not always equate to better methods or increased understanding.

We have heard the old saying, “If you do what you’ve done, you’ll get what you’ve got.” A soil survey is not typically described in grand terms like “sailing across unchartered waters searching for new lands,” but the figurative nature is the same. DSM techniques are uncharted waters for many of us. Understanding the work that we have done so far, adopting a confident outlook, and vowing to persist with a critical eye on improving the methods will allow us to advance from the known world and products of “what we’ve got” to something new. The new products should re-engage the soil geographer side of our discipline and provide a new opportunity to address the challenges outlined in Hudson’s 1992 paper, redoubling our efforts to explain the relationship of soils to the landscape and the resulting effects on use and management to the general public and fellow scientific community.

References

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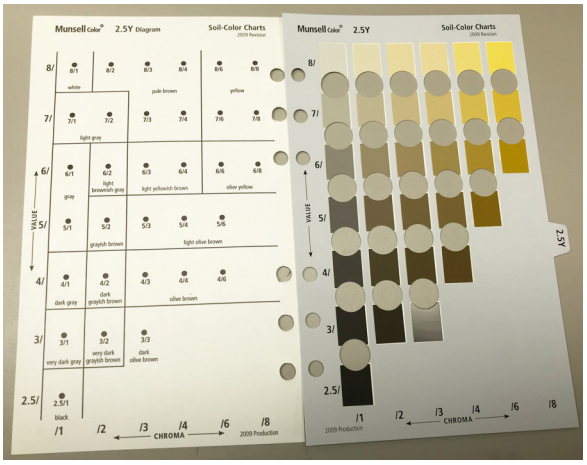
Mistake on Munsell 2.5Y Page

Some sharp-eyed soil scientists in Texas were importing revisions to an OSD (Official Soil Series Description) and noticed a pattern in the OSD Check warnings. The warning indicated that the apparent color name "pale brown" for Munsell color code "2.5Y 8/2" did not match true name "pale yellow." When the scientists checked the current edition (2009) of the 2.5Y page, they found that 2.5Y 8/2 was in fact pale brown. However, a copy of the page from the 1994 printing indicated the color as pale yellow, which agreed with several online color calculators (for example, https://logiteasy.com/free-tools/munsell-calculator.php).

Xrite (the successor company to Munsell) was contacted about the discrepancy between the 1994 and 2009 editions. After some checking, the company admitted that a mistake had been made and that the color names for chips 2.5Y 7/3, 7/4, 8/2, 8/3, and 8/4 should in fact be pale yellow, not pale brown. It is not known when an official update of the 2.5Y page will be issued. For now, please make a pen and ink change on the 2.5Y page to change "pale brown" to "pale yellow."



The National Cooperative Soil Survey uses soil color to describe and document soil profiles and to estimate soil properties. The NRCS soil database has over 27,000 entries using the 2.5Y 7/3, 7/4, 8/2, 8/3, and 8/4 color chips and corresponding names. ■

2019 National NCSS Meeting—Committee Reports

Technology Committee

The topics covered by the committee varied from dealing with "big data" to supporting applications and processes for data collection.

More and more, the NCSS is dealing with large datasets, which include not just soils data but the large geospatial datasets used by Soil Survey. The NCSS Digital Soil Mapping Team have almost completed creating national geospatial datasets, known as the Covariate Stack, that will cover everything from surface morphometry, to vegetation cover, to spectral imagery, etc. These covariates are at various resolutions, from 10 to 90 meters or more, and range from a few dozen to hundreds of gigabytes. This coupled with the sheer volume of raster products from NRCS is creating difficulties in handling and sharing these large datasets over the Internet or through the cloud. To

help transfer these large datasets, NRCS is utilizing Box accounts and CloudVault to facilitate the sharing of this data with NCSS partners and the public.

The committee is supporting the development of a soil interpretation generator (SIG). Currently, the SIG is internal to the National Soil Information System (NASIS) and available to relatively few NRCS staff and NCSS cooperators. The creation of a SIG outside of the NASIS database would enable customers to run soil interpretations based on local data or local conditions.

The committee is also lending its support to the development of a database to collect and store data on dynamic soil properties and other soil properties from NCSS cooperators. Cooperators would then have better access to this data for research. The committee's support extends to developing a means to capture pedon data utilizing two of the latest ESRI applications, Survey 123 and Collector. These electronic pedon forms would be available to the NCSS and the public.

The last topic the committee discussed was the development of a model to adequately describe soil horizons that have undergone extensive alteration due to cryoturbation. Efforts to digitally capture these complex horizons are underway through collaboration between researchers from Alaska and Wisconsin and soil survey staff from Alaska and the National Soil Survey Center.

Soil and Ecosystem Dynamics Committee

The committee meeting was exceptionally well attended during both sessions (60 to 70 people) and the discussion was spirited and productive. After reviewing the recommendations from last year's regional meetings, most of which were related to how to complete Ecological Site Inventory and Interpretations in the Ecosystem Dynamics Interpretive Tool, the attendees were vocal about next steps in the implementation of the Provisional Ecological Site Initiative and what will follow post-2020. Recommendations included:

- Get EDIT linked to NASIS.
- Expand EDIT to contain catalogs for the LRR, MLRA, and LRU levels of the hierarchy, including keys, descriptions, and maps (National Soil Survey Center would provide the maps; States and soil survey regions would provide the keys and descriptions).
- Make AgLearn ecological site courses available to partners.
- Develop a query mechanism within EDIT.
- Add a U.S. Forest Service land hierarchy catalog to EDIT.
- Provide more opportunities for EDIT training (train the trainer).
- Integrate soil health into the state-and-transition model.
- Create an initiative to concentrate efforts on hydric landscape ecological sites, in support of Food Security Act compliance.
- Encourage the addition of responsibilities related to ecological sites to the performance plans of other NRCS employees and partners.

Soil Taxonomy Committee Report

Two time periods were allotted for discussion of national-level Soil Taxonomy issues: Monday, June 10, 2019, at 10:15—11:45 a.m. and 2:15—3:00 p.m. Given this time allotment, only two issues were discussed—definitions of densic and organic soil materials. These were selected based on their need for a national discussion.

Densic

As originally conceived, the *d* suffix signified geogenic dense glacial till. With time, progressively more workers used the *d* suffix to signify non-pedogenic (e.g., non-fragipan, non-duripan, etc.) root-restrictive materials. Some of the root-restrictive material was dense, some was not. In light of these complications, a working group

was formed in 2018 to clarify the *d* suffix and the related definitions of densic and paralithic materials. Below are their recommendations as of March 2019.

Recommendations of the Working Group

1. Currently "densic material" must have a noncemented rupture-resistance class (Table 3-7 of the *Soil Survey Manual*). The working group proposes changing the term "cemented" because some root-restrictive material is not cemented *per se*; that is, it does not have a cementing agent. The working group therefore recommends replacing the term "cemented" with "coherent." Coherent is more descriptive of densic materials and is also applicable to materials that are cemented.

2. Many root-restrictive materials have different origins, yet are all symbolized with a *d* suffix. The committee, therefore, recommends an expansion of *d* and *r* horizon suffixes as follows:

— *Crd* for root-restrictive and non-coherent materials derived from rock weathering, such as weathered shale and soft saprolite;
— *Cda* for densic materials that have been anthropogenically compacted, such as reclaimed mine spoil; and
— *Cd* for densic materials that were compacted during deposition, such as dense till.

3. Include the term "lithic materials" in all revised definitions of root-restrictive densic and paralithic materials/contact horizons or layers. For example, "Densic materials differ from paralithic and *lithic* materials, both of which are extremely weakly or more coherent."

4. Systematically and comprehensively evaluate coherent class and other characteristics of densic, paralithic, and lithic materials with different origins and from different regions of the United States.

5. Evaluate and, if necessary, develop methods that: (a) effectively separate cohesive (cemented) materials from those that are non-cohesive (uncemented), and (b) can be performed in the field, office, or small lab. Current slake tests, for example, are insufficient.

During the mid-week field trip, densic material as originally conceived for the Cd horizon was shown to the participants. In November 2019, as part of the Soil Science Society of America (SSSA) conference, a field trip will be given to show participants root-restrictive and non-coherent materials derived from rock weathering. A recommendation on which proposed changes to adopt will be decided soon after the SSSA conference.

Definition of organic soil materials

Two questions were discussed.

1. The current definition uses a sliding scale between organic carbon and clay. The purpose of the sliding scale was to show the unique importance of organic carbon (OC) on available water capacity in coarse-textured soils (originally sand and loamy-sand textures). Is this sliding-scale relationship important to keep?

2. If the answer to Question #1 no, what single value should be used? Is the proposed 12 percent OC for both saturated and non-saturated soils too low? That is, will some mollic, umbric, and melanic epipedons become organic soil material and, if so, what will be the taxonomic impact? In addition, how will forest soils with folistic horizons be impacted?

For Question #1, most attendees at the committee meeting agreed, by a show of

hands, that the sliding scale was unnecessarily complicated and were in favor of a single value. The resolution to Question #2 was more uncertain. Concerns remain as discussed in the 2018 report of the West Regional Standards Committee West Taxonomy Report. An analysis of the impact of changing the definition of organic soil material will be completed this fall and discussed at the SSSA meeting in November at the Fundamental Changes to Soil Taxonomy session. ■

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