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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@usda.gov. ■

2020 NCSS Regional Conferences—Overview

South Region

The 2020 Southern Regional Cooperative Soil Survey Conference was "virtually" headquartered from the Don Tyson Center for Agriculture Sciences on the Milo J. Shult Agricultural Research & Extension Center, in Fayetteville, Arkansas. This year's theme was "Soil Survey for Soil Health and Water Quality: Applications in the Natural State." Co-chairs for the event were Dr. Kristofor Brye, Professor of Applied Soil Physics and Pedology, University of Arkansas, Fayetteville, and Edgar Mersiovsky, Arkansas State Soil Scientist. Dr. Larry West (retiree, NRCS) also played a significant role in developing the conference.

The conference began on Monday, May 19, with welcomes from Dr. J.F. Meullenet, Senior Associate Vice President for Agriculture–Research and Director of the Arkansas Agricultural Experiment Station; Dr. Deacue Fields, Dean, Dale Bumpers College of Agricultural, Food and Life Sciences; Mike Sullivan, Arkansas State Conservationist, Little Rock; and Dr. Luis Tupas, Deputy Chief, USDA-NRCS Soil Science and Resource Assessment, Washington D.C. Jeff Olson gave a welcome from the Arkansas Association of Professional Soil Classifiers. Dr. Dave Lindbo, Director of NRCS Soil and Plant Science Division, gave a talk on the next steps for the division. David Hoover, Director of the National Soil Survey Center, gave an update of the activities at the center. Regional Directors Debbie Anderson, Jo Parsley, and Dave Kingsbury gave updates for their respective region.

Tuesday afternoon, there were presentations on the update to Agriculture

Handbook 296, the proposal for the Aquasol soil order, and creating historic orthoimagery from 1980s NHAP photography. There was a 2.5-hour-long "virtual" tour of northwest Arkansas. Participants learned about the Discovery Farm network in Arkansas from the University Arkansas Extension Service and its emphasis in water quality and soil health. There was a lot of talk generated by the Chesney Prairie Natural Area, focused on the long-time question of what created the mima mounds. The Illinois River Watershed Partnership spoke about their water-quality conservation efforts, especially in an urban environment. The session ended with a lightning round of posters and videos, which will be posted on the conference website.

Wednesday was for the committees, which had met "virtually" since January. The committees were given time to finish work on issues and hear any new perspectives from new members in attendance. A big thanks go to all that attended; each of the committees had great discussions, which resulted in items to present to National Leaders for consideration. A special thanks to the co-committee chairs for their hard work and dedication.

Thursday morning focused on the SPSD Focus Teams. Each team had an opportunity to talk about their progress and accomplishments. Cooperators got to know a bit more about the activities of the teams and see where they may be relevant to their work, and a lot of discussion was generated.

The conference concluded Thursday afternoon, May 21, with the business meeting. Each of the committees gave a report, and amendments to the bylaws were approved. Full committee reports and minutes of the meeting will be posted online. A special thanks to the small army of people that helped to pull off the virtual format. The virtual meeting accomplished several aims of this conference. The main drawback was it did not allow the important networking and development of professional relationships that typically occur at these conferences. The next Southern Regional conference, in 2022, will be hosted by South Carolina.

Northeast Region

The 2020 Northeast Regional Cooperative Soil Survey Conference was hosted by Dr. John Galbraith, Virginia Polytechnic Institute and State University (Virginia Tech), and Dave Harper, Virginia NRCS, as well as the Virginia Agricultural Experiment Station and Virginia Cooperative Extension. This year's theme was "Soil—Our Common Wealth." Due to travel restrictions and personal health concerns related to the COVID-19 pandemic, the conference was virtual, held from 8 a.m. EST Monday, June 22, to 4:30 p.m. Wednesday, June 24. Despite the challenges of holding a virtual conference, there were as many as 150 attendees. All 3 days had more than 120 attendees per day, which is outstanding. The success of the virtual meeting is spawning discussions of future NCSS hybrid meetings, i.e., meetings that are held face-to-face but also offer a virtual option. Everyone agrees that a face-to-face meeting is significantly more fruitful, but the virtual option allows inclusion of those who cannot attend in person. Increasing participation and communication is always a plus for meetings like these.

In the coming weeks, look for the Northeast Regional NCSS committee reports on the NCSS website, at https://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/survey/partnership/ncss/?cid=nrcseprd1491815.

West Region

New Mexico State University and New Mexico NRCS, in cooperation with the U.S. Forest Service (USFS), and New Mexico Bureau of Land Management (BLM) hosted the 2020 Western Regional Cooperative Soil Survey Conference. Originally intended to be held in-person in Albuquerque, New Mexico, the conference was instead held virtually on July 20, 21, and 22. This year's theme was "Uses of Soil Survey."

The conference began on Monday with addresses from the major agencies involved in the West Region Cooperative Soil Survey including NRCS, BLM, USFS, United States Geological Survey (USGS), and National Park Service (NPS). These addresses revealed developing, ongoing, and reinvigorated soil survey programs in all agencies. In particular, NPS is restructuring their operations to provide high-intensity detailed soil survey, whenever and wherever needed, in many of the parks. Also revealed was the potential of multiple job openings for soil scientists in the near future, particularly with BLM and USFS. This was particularly welcome news to the students who were among the 110 participants. Monday afternoon concluded with committee meetings, including Research (24 participants), Ecosystem Dynamics (26 participants), Technology (27 participants), and Taxonomy (19 participants).

A major highlight of the conference began on Tuesday with a virtual field tour. The tour featured 10 soil scientists and ecologists from 9 States (New Mexico, Montana, Arizona, Wyoming, California, Utah, Oregon, Arkansas, and Hawaii) highlighting unique soils and landscapes from their areas. Presentations included the soils of north-central Montana, ecosystems of the Huachuca Mountains of southern Arizona, Wyoming soils that were both calcareous and hydric, soils from the tops of the Sierra Nevada and the Los Angeles Basin in California, soils in Utah influenced by Ancient Lake Bonneville, soils affected by Mount Mazama eruptions in Oregon, Gelisols of the Cooper River Basin in Arkansas, and a catena of soils along an intact native forest on Mauna Kea in Hawaii. Post-conference feedback indicated that the 128 attendees were grateful to have been able to “visit” soils in remote locations that they would otherwise never visit. Although holding a virtual field trip that had so many presenters was an experiment, the organizers feel that it was successful and recommend that this format be incorporated in future meetings. Pre-meeting practice sessions helped ensure that technical

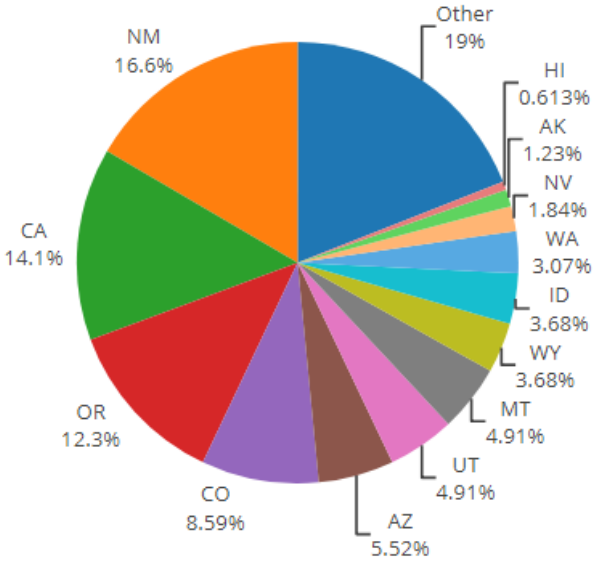

Figure 1.—Conference participation by State. The “Other” category includes participants outside of the West Region, including one international (Spain) participant.

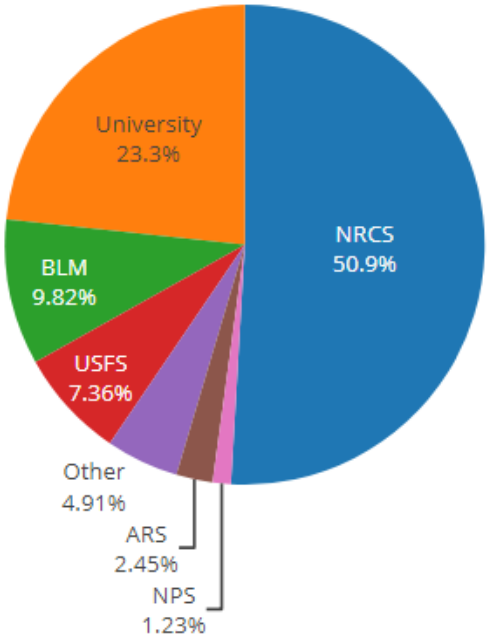

Figure 2.—Conference participation by agency. The “Other” category includes participants from private contractors, risk management, USGS, and retirees.

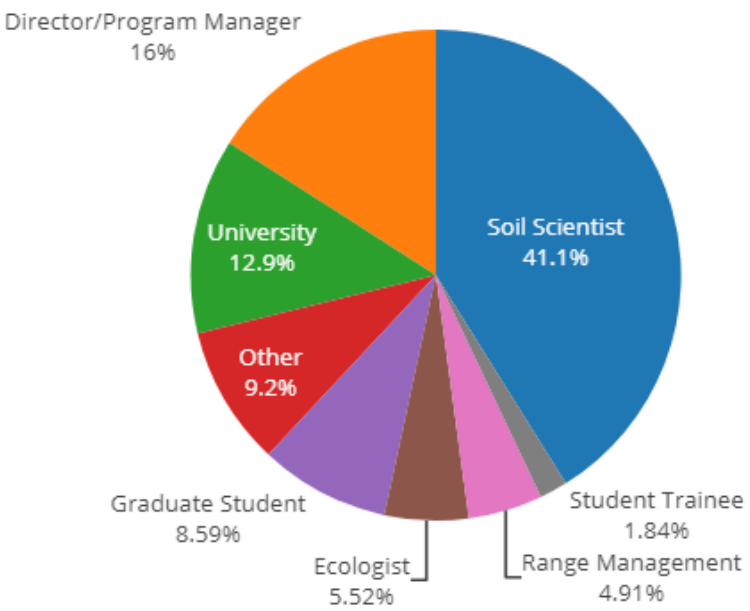

Figure 3.—Conference participation by job title. The "Other" category includes scientists and administrators that did not fit into another category.

difficulties were held to a minimum. Recordings of the virtual field trip (and all other sessions) are available at https://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/survey/partnership/ncss/?cid=nrcseprd1578844.

On Wednesday, three PhD candidates, two master's students, and one undergraduate student (representing 6 different universities) competed for a chance to win the award for "best" presentation. The presentation topics included soil systems, iron sulfide, water repellency, visible-near infrared spectroscopy, sampling design, and soil genesis. After students finished, the 89 participants in this session voted. Chelsea Duball (PhD candidate, University of Wyoming) and Jalene Weatherholt (MS student, University of Washington) tied for the best presentation. Chelsea, whose topic was iron sulfide, and Jalene, whose topic was water repellency, will split the $650 award. The organizing committee is grateful for the contributions by conference participants for this award.

Technical reports, committee reports, and awards followed the student presentations on Wednesday. One hundred and one participants joined to watch the technical reports, which included updates to the MLRA concepts and boundaries, updates to the Soil Data Access application, a proposed wet soil order for Soil Taxonomy, and a new Digital Soil Atlas of Idaho. Rob Vaughn received the "Cooperator of the Year" award at the end of the conference.

Overall, there were 165 registrants and participants for the conference. Eighty-one percent of these attendees were from the West Region while 19 percent were from outside the region (fig. 1). Conference participants were from all States in the West Region, with New Mexico, California, and Oregon each fielding more than 10 percent of the overall participants.

Slightly more than 50 percent of the attendees were from NRCS, approximately 25 percent were university participants (including faculty, staff, and students), and the rest (approximately 25 percent) were from other Federal agencies (fig. 2).

Only slightly more than 40 percent of the attendees were soil scientists. The rest consisted of directors or program managers, university faculty and staff, graduate students, ecologists, range managers, and student trainees (fig. 3).

The Regional Steering Committee includes Dr. Colby Brungard, New Mexico State University; Rick Straight, NRCS; Mark Casillas, Forest Service; Alex Dado, Montana NRCS; Nathan Coombs, New Mexico BLM; and Dave Hoover, NRCS.

North Central Region

By Conference Planning Team: Patricia Quackenbush (University of Missouri); NRCS Employees Sam Indorante, Jorge Lugo-Camacho, Mark Abney, Curtis Monger, and Doug Wallace; and John Kabrick (Forest Service).

The 2020 North Central Cooperative Soil Survey Workshop was a virtual meeting hosted by the University of Missouri (MU) and Missouri NRCS and held on August 11, 12, and 13. This year's theme was "Measuring Soil Ecosystem Responses in a Changing Climate." Jorge Lugo-Camacho and Pattie Quackenbush hosted the Tuesday morning session with welcomes from Scott Edwards (Missouri State Conservationist), Luis Tupas (NRCS Deputy Chief of Soil Science and Resource Assessment), and David Lindbo (Soil and Plant Science Division Director).

Regional updates were provided by Chad Remley (Director of Soil Survey Region 5), Dave Kingsbury (Director of Soil Survey Region 6), and Kevin Norwood (Director of Soil Survey Regions 10 and 11). Dan Wing (NRCS) provided a report on the update to Agriculture Handbook 296, and Mark Stolt (University of Rhode Island) reported work being done on the wet soil order.

Featured speakers set the tone for the meeting and included Martha Shulski (Nebraska State Climatologist); Tom Bonnot (University of Missouri); and Mike Wilson, Skye Wills, Dylan Beaudette, Zamir Libohova, David Lindbo, and Dave Hoover (NRCS). Twelve speakers presented during the concurrent sessions. Topics covered soil health and soil quality measurements, update soil mapping on the Mark Twain National Forest, applying dendrochronology to understand climate change, open source soil education, Coastal Zone Soil Survey, and the presentation of Nic Jelinski's TED Talk "How Soils Unite Us." Speaker details and presentations will be available on the NCSS website page for regional meetings (North Central Region's meeting).

Virtual breakout sessions were set up for the standing committees: Soil Ecosystems, New Technology, Taxonomy, Research Needs, Interpretations, Bylaws, Hydric Soils and Wetlands, and Standards. The reports will be made available on the NCSS website. Virtual tours were organized by Mark Abney, John Kabrick, and Doug Wallace. Mark presented an overview of the virtual tours and video that would be presented the next day.

The Thursday virtual tour began with stops at the University of Missouri's Basket Research Center. This 2,200-acre outdoor laboratory is used for research and education in ecology, forestry, soil science, and wildlife management. Soil pits were examined to compare soils that formed in loess, soils that formed in hillslope positions, and soils that formed in clayey residuum from limestone. Forested and reforested soils also were compared.

Two other virtual tour stops were the historic Sanborn Field and the historic Duley-Miller plots on the University of Missouri campus. Sanborn Field was established in 1888 and remains one of the oldest active agricultural research and demonstration plots in the world. Long-term research on the physical, chemical, and biological properties of soils under different tillage and cropping management practices for more than a century was presented. The Duley-Miller soil erosion plots represent some of the oldest long-term plots set up to study the long-term effects of erosion.

Mark Abney presented a video on how to prepare a pit face with the use of power washing to expose critical soil features, such as fragipans. A virtual tour of the Soil Health Assessment Center (SHAC) was led by Director Donna Brandt. Plans are underway to make all of the talks, virtual tours, and videos available on the NCSS website.

Special thanks to Jenn Hartwick, Sarah Devoto, Joshua Rhodes, and Sharon Rodes from the University of Missouri Conference Center for their organization, attention to detail, thoughtful planning, and expertise with Zoom. Thanks to Robert Mize and Megan Silvey from the University of Missouri Team for recording, editing, and producing our virtual field trip for the conference. The virtual field trip was a big success! Also, a big thank you to all of the speakers and participants! ■

Coastal Blue Carbon in New Jersey's Tidal Salt Marshes

By David, Steinmann, NRCS soil scientist.

The National Coastal Blue Carbon Assessment (NCBCA) project is an initiative started by the Soil and Plant Science Division's Coastal Zone Soil Survey (CZSS) Focus Team to measure the amount of coastal blue carbon sequestered in the coastal soils in the United States. The soil surveys in these coastal areas are typically mapped at a very broad scale, with little or no laboratory data associated with the mapping units. This project provides many benefits to all partners involved.

The Hammonton Soil Survey Office (3-HAM) partnered with the Barnegat Bay Partnership (BBP), 1 of the 28 National Estuary Programs, to provide soils data for an EPA Regional Applied Research Effort (RARE) grant project. The goal of the project is to study coastal wetland marsh degradation within the Barnegat Bay and Little Egg Harbor estuaries within eastern New Jersey. The project involves 25 sampling sites. The BBP is providing habitat and biological studies. NRCS is providing full Kellogg Soil Survey Lab (KSSL) sample analysis for each of the 25 sites. Along with the typical lab sampling, blue carbon samples will also be sent to the lab for analysis. This project will correct a huge data gap for coastal marshes along the New Jersey coast.

Figure 1.—Pathways Intern Jeanette Myers and David Steinmann retrieve a vibracore from the soil using an aluminum ladder and a chain hoist.

Figure 2.—David Steinmann holds two bulk density "brownies." Once the length, width, and depth are recorded and the field volume is calculated, the samples are sent to the KSSL for dry weight analysis. This "brownie" method is typically performed in the top two horizons as it is easy to cut exact measurements with a sharp knife and other bulk density methods are not viable due to the extensive rhizomes.

Due to the COVID-19 pandemic, the start of field sampling was delayed with stay-at-home orders in New Jersey. Once stay-at-home orders were lifted, field sampling began at the beginning of June, with staff practicing proper social

Figure 3.—Soil profiles of different soils found in the marshes in New Jersey. The profile in the left photo is dominantly mineral (coarse-loamy) with auger refusal on sands. The other two profiles have good Oise and Oese horizons with fine-silty mineral material at the bottom. McCauley samples are taken in the field to measure incubated pH and allow a quick description of the upper 100 cm.

distancing and using proper PPE equipment. Field sampling consists of locating and navigating to the site by boat. For most sites, the boat will only take staff to the edge of the marsh. At that point, the staff have to carry the equipment for sampling. At each site location, three vibracores are retrieved (fig. 1). Two vibracores will be sampled and sent to the Kellogg Soil Survey Lab for full characterization. The third core will be sent to a separate team at the National Soil Survey Center for “whole core” blue carbon analysis. After all three vibracores are retrieved, a 100-cm McCauley auger is pulled to capture incubated pH samples which will be tested for hyper and hypo sulfidic materials. On most sites, a bulk bag and bulk density “brownies” are taken out of the top two horizons as they are extremely fibric and hard to sample in the vibracores (fig. 2). At the end of sampling, the vibracores are transported to the NRCS Cape May Plant Materials Center where they are stored in a walk-in freezer for sampling at a later date.

This project consists of three phases: field sampling (vibracoring), lab sampling, and laboratory analysis. In the first phase, vibracores are retrieved in the field and site notes and attributes of the site are recorded. In the second phase, the vibracores are split open, photographed, described, sampled, and shipped to the lab for analysis (fig. 3). The third phase involves analysis at the KSSL.The members of the Hammonton Soil Survey Office already have visited and vibracored 10 sites and are in the process of describing and sampling those 10 sites.

Benefits of the project include, first and foremost, soils knowledge provided to the BBP to be incorporated into their project of studying the degradation of coastal wetland marshes. Second, NRCS can incorporate their sampling into the NCBCA project, which will better inform coastal scientists on the carbon stock and pool within these ecosystems. Third, data developed from this project will be used in developing new and updated SSURGO mapunits and data mapunits and mapping in the marshes. The new updated data will be used by local partners in marsh restoration projects in protection of this deteriorating but critical soil resource. ■

Stewards by the Shovel: Understanding Dynamic Soil Properties in New York

By Zachary Warning, NRCS soil scientist, Belmont, New York.

The duration of a single human life is but a moment in the context of soil development. With pedogenesis working on the scale of centuries or even millennia, a soil observed over a mere 80 years will undergo no noticeable change in any of its inherent properties, such as texture, no matter what management practices are implemented. There are, however, select properties identified as "dynamic" for the simple reason that they *can* be altered within a single lifetime and, in some cases, show results in less than a decade. Dynamic soil properties (DSPs) are often inadvertently changed through improper management, and manifest in decreasing crop yields, impenetrable plow pans, and devastating erosion, painfully contextualized in just one or a handful of generations. With ever-increasing knowledge of best management practices to improve soil health, we are witnessing on lands across the country that just as improper management can lead to degradation on a small timescale, so can proper management breathe new life into soils once exhausted. Despite their malleability over such short duration, the impacts on dynamic soil properties can be lasting. For example, *terra preta*, the most fertile soil ever discovered, is anthropogenic in origin and has been regenerating itself in the Amazonian rainforest for over 2,000 years—a testament to the power of proper management on dynamic soil properties.

Figure 1.—Typical profile of a Honeoye soil. The white pins mark the boundaries between the Ap, Bt/E, Bt, and C horizons.

To understand DSPs, we must study them closely. In late July, NRCS employees from across the State of New York met to collect large quantities of data in both pasture and wheat field settings, focusing on the Honeoye series, which is spread over more than 300,000 acres of the State. The Official Soil Series Description states: "*The more gently sloping Honeoye soils are among the most productive upland soils in New York State. The Honeoye series has been unofficially recognized as the State soil of New York*." This soil is known and loved by hundreds of farmers across the State, and placed, by virtue of its inherent properties, under multiple modes of management, making it a prime soil to study for this project.

As the caravan of government plates arrived in the rural countryside of New York's Finger Lakes region, we began by scanning the field with our augers and cross-referencing the published survey, ensuring that our pits would be dug on true Honeoye. As the wheat was being harvested, we planted our shovels in the pastured Honeoye of Yates County, New York.

Each of our vehicles was packed with supplies, not only for standard pedon descriptions, but also for bulk density sampling and clod preservation, completing an NRCS soil health assessment, and collecting samples to be sent for Cornell Soil Health Assessments. A typical Honeoye will have an A horizon, near-ubiquitously marked with the clear, smooth boundary reminiscent of the plow, reaching 30 or more centimeters down to the B horizon. There, we find a sudden and noticeable increase in clay content—the telltale illuviated clays of an argillic—and what's more, interfingering albic materials, created by the degradation of the argillic, which give

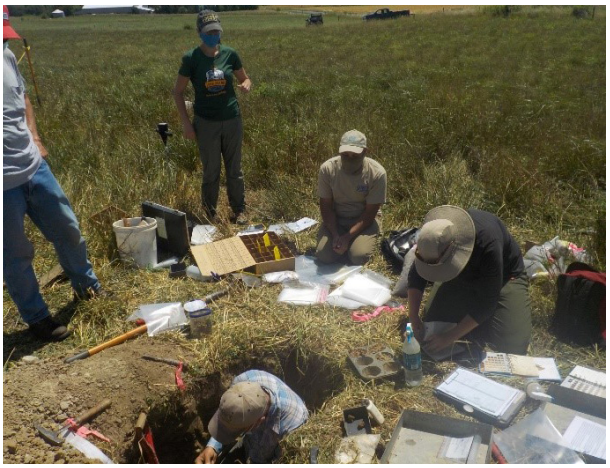

Figure 2.—A full-fledged pedon description is underway—masks included.

Honeoye its taxonomic distinction as a Glossic Hapludalf. A few feet down, the C layer is discovered, marked most prominently by its violent reaction to hydrochloric acid, thanks to the glacial till parent material with its high content of lime.

Once we had confirmed the soil under our feet was Honeoye, we got to work digging out the pits—one central and two satellites—down to 150 cm and 50 cm, respectively. The goal was to sample sites which had been in pasture for around a decade. By happenstance, on our last day surveying pastures, we found ourselves on a farm with two to choose from—one about a decade old, the other just a few years. We were astounded to find that we could tell the difference with a hole just 15 centimeters deep—for the Ap horizon in the young pasture was *half* the depth we had come to expect from typical, pastured Honeoye.

The traditionally cropped corn-soybean-wheat rotation fields were a completely different story. Our first day out, we were met with soil so compacted and dry that even the surface horizons proved difficult to excavate. The A horizon was also noticeably altered here: it had subangular blocky structure rather than the granular structure we had come to expect in pastured fields.

We tested the infiltration capacity of dry and wet soil by pouring a defined volume equivalent to 1 inch of rainfall over a set area within a steel ring. In pastured sites, dry infiltration times were around 18 seconds, with wet infiltration taking about a minute and a half. In the cropped fields, dry infiltration took over 10 minutes, and after an hour and a half of waiting for the wet infiltration to finish, we simply had to leave the site because of the time. To put that into context, a field pastured for around a decade had a dry infiltration capacity about 24 times greater than a cropped wheat field and a wet infiltration capacity 29 times greater. The numbers, though in some sense expected, are still almost too shocking to believe.

From a mere glance, we could tell that the pastured and cropped sites were different. We felt it with our own hands from the shuddering of a shovel splitting compacted layers inch by painstaking inch. A mere decade's difference of practice had astounding impacts on everything, including infiltration capacity and ease of digging; presence, abundance, and diversity of biota; and soil structure, stability, consistency, and color.

Soil management can be thought

Figure 3.—A soil scientist ponders the age-old question: Silt loam or loam?

Figure 4.—Socially distanced soil scientists (left to right): Keith Shadle, Amy Langner, Zach Warning, and Matt Havens.

of as a sort of chess game we play with nature itself, with the inherent properties acting as the rules—unchanging, unbreakable, something within which we have no choice but to work. The dynamic properties—the very properties which showed such immense difference between pasture and traditional cropping—may be considered the multitude of moves available to us within the so-called rules. If we play the game strategically, creatively, innovatively, constantly correcting for mistakes and reading nature's responses, we can find immeasurable success. However, if we ignore the consequences of poorly informed choices, or fail to plan our moves with the entire duration of the game in mind, we forsake our participation in the game itself and find ourselves defeated by our own mistakes. In many ways, it is a game that cannot be "won." However, with each small success or failure, we move closer to or further from our goal of sustainability, productivity, and harmony with the natural system.

Heavy rains, blusterous winds, smoldering heat waves, and parching droughts are moves played against us ever more frequently. The very sites we visited in the Finger Lakes were several inches short of their expected rainfall this time of year. Even the pastured sites showed signs of desiccation. But on the final day of sampling, when a wicked thunderstorm with a 30-mph gust and a 15-minute monsoon (another sight increasingly common in a changing climate) forced us into our vehicles, we knew which sites were graciously absorbing the much-needed rain and which were slaked to mud.

Special thanks to Soil Conservationists Julie Miller and Miranda Ciardulli and Pathways Intern Anthony Acevedo, as well as all the gracious landowners who allowed us to sample from their fields. ■

Soil Refresh Complete!

The SSURGO dataset was refreshed August 31. The latest soils information is now available on Web Soil Survey and Soil Data Access. The annual refresh is very important in providing timely, relevant soils information. NRCS provides nearly 4 billion dollars in program funds to American farmers and ranchers, and soils information plays a crucial role in how those funds are allocated and where conservation is implemented. The annual refresh is possible thanks to the efforts of numerous NRCS staff, including field soil scientists and ecological site specialists, regional offices, state soil scientists, the National Soil Survey Center, and contractors. ■

CSU Students Assist with Soil Survey During COVID-19 Restrictions

By Kari Sever, MLRA soil scientist, Lakewood, Colorado.

Since it was first staffed in 2008, the Fort Collins MLRA Office has been located on the Colorado State University (CSU) campus through a cooperative agreement between NRCS and the university. The agreement, supervised by CSU Principal Investigator and Pedology Professor, Dr. Suellen Melzer, allows the MLRA office to employ four to seven undergraduate or graduate student hourlies to assist the staff with research projects, research investigations, data entry, and other miscellaneous tasks associated with soil survey. Students are responsible for data entry of soil pedon descriptions, geo-referencing soil pedon locations, quality control and quality assurance, and incorporating lab data into the descriptions. Students are assigned projects based on their blocks of availability around classes, their interest and experience, and skill set.

Although special projects vary, students assist with the State FFA contest and lab test soil samples to analyze and verify chemical and physical soil properties, including pH, electrical conductivity, texture, color, and structure. As an additional project this year, the students compiled and georeferenced historical climate data for use in regional GIS climate modeling for local MLRAs.

Figure 1.—Left to right: Lucille Rollins (CSU Soil and Crop Science major) prepares a spot plate to test soil pH, Sienna Levine (CSU Ecosystem Science and Sustainability major) records data, and Kari Sever prepares to measure slope and aspect while Jared Catterson (CSU Hydrology major) augers the hole.

Figure 2.—Jared Catterson (CSU Hydrology major) looks over the post-fire terrain of Ingram Gulch that burned in the 2010 Fourmile Canyon Fire. Photo by Kari Sever. NRCS soil scientists and CSU students collected field data to examine soil properties that affect post-fire soil erodibility. This collaborative effort is part of a long-term project with the Colorado Geological Survey and the Fourmile Watershed Coalition to develop a debris-flow early warning system for Ingram Gulch, near Boulder, Colorado.

COVID-19 and the resulting stay-at-home and social distancing orders presented a challenge to the MLRA staff and CSU students. While many university students lost their jobs during this time, the MLRA staff and Dr. Melzer made a decision in March to transfer skills to a fully online working environment to keep the students employed and maintain the workflow. Four students were assigned specific projects and CSU desktop computers, which are normally housed on campus in the MLRA office, while two students were assigned specific tasks to close out projects and accommodate their last days at CSU before graduating. MLRA staff worked with CSU IT to provide students remote access to the CSU-MLRA online server, and weekly Zoom meetings were held to keep all staff and students connected, engaged, and on track.

To complement data entry in the PedonPC database, the MLRA staff normally provides CSU student hourlies the opportunity to gain field experience at least a few times per year. Some student hourlies are on the CSU Soil Judging Team and have exposure to soil pits on practice days. However, busy academic schedules and unpredictable Colorado weather rarely allow for hands-on field experience. The new remote and flexible working environment provided students the freedom to set aside blocks of time in the spring and summer to better understand the field data collection process. As a result, five students regularly assisted with field collection of soil pedon descriptions for the Sedimentary Foothills Update project. Some students also participated in collecting field data for a collaborative effort with the Colorado Geological Survey to describe soils, for use in a project for predicting shallow landslides resulting from fire. These efforts involved all aspects of field data collection, including use of GPS to navigate to sites, hand digging and augering soil

pits, analyzing and describing physical and chemical soil characteristics (such as color, texture, electrical conductivity, and pH), and recording data on pedon field sheets.

The practical application of soil survey field work has proven to be invaluable to both the students and the MLRA staff. The students gain an understanding of the field data collection process and how it correlates with pedon data entry in PedonPC, while NRCS benefits from additional assistance collecting data. In addition, the students receive a paycheck during especially challenging and uncertain times. Some students discover a passion for field science and take a closer look at soil and plant science as a profession for themselves. Due to the positive feedback and results, we are confident that summer field work will be an integral part of the student hourly experience in the furture. ■

MLRA Soil Scientists Assist with Kansas State University Research Project

By Matt Bromley, MLRA soil survey office leader, Grand Rapids and Flint, Michigan.

Three soil scientists from the combined MLRA soil survey offices in Grand Rapids and Flint, Michigan, provided assistance in collecting data the week of July 6 for a Kansas State University research project. The project, officially named “Disaggregating SSURGO soil maps across large areas using existing qualitative knowledge and modern data sources,” was proposed last year by Dr. Arnaud Temme and selected to receive USDA research funding. The project’s goal is to downscale order-2 soil survey polygons into smaller map unit components using a combination of the qualitative knowledge found in soil map unit descriptions and the application of GIS procedures using modern digital elevation model data. Mason County, Michigan, in MLRA 96, was selected as one of three pilot study areas for the project.

Figure 1.—A validation point in a wet swale between nearshore dunes in Ludington State Park. This ecosystem is the largest area of freshwater interdunal ponds in the world.

Soil Scientists Eric Gano, Jonathan Diaz Cruz, and Matt Bromley met with Dr. Temme and Graduate Student Jordan Watson in Ludington, Michigan, to get an overview of the project goals and to discuss the major glacial landforms and parent materials of the county. The crew then headed out to locate and describe randomly chosen sites that will be used as validation points for the disaggregated soil map units (fig. 1). After spending the first day working together, the team split up to be more efficient for the remainder of the week. A total of 41 new soil descriptions were recorded across a variety of parent materials and drainage classes. In addition to these new randomly selected sites, approximately 170 existing soil descriptions recorded during the initial survey of Mason County will be entered into NASIS and used to validate the project results. ■

SATURO Infiltrometers Collect and Analyze Data in the Field

By NRCS South Central Region, Kerrville Soil Survey Office, Texas.

Earlier this year, the South Central Region purchased 21 SATURO infiltrometers. Seven MLRA offices each received three infiltrometers that can be used individually, or as a set, and plan to share them with other MLRA offices. The infiltrometers are designed to collect and analyze data in the field for MLRA update projects, dynamic soil properties projects, and during soils demonstrations.

Figure 1.—Ashley Anderson, soil scientist, sets up the SATURO infiltrometer to take the first field readings at the Roam Ranch.

The SATURO is a dual-head infiltrometer that can do almost everything, including field measurements and conversion of data into hydraulic conductivity and infiltration rates. Each infiltrometer and all its components are packed in a wheeled, ruggedized case that can be used under any field condition, making set up quick and user friendly. The Kerrville office is housing one set of the infiltrometer equipment, which consists of three infiltrometers that can take multiple readings on

Figure 2.—Roam Ranch bison graze (in the background) as the SATURO infiltrometer collects data in the first field.

site at the same time. Regional staff attended a training session conducted by two employees that helped design the infiltrometer. The trainers provided not only hands-on demonstrations but answered real-situation questions as well. If given a short, hands-on training session, local field offices can also use the infiltrometer equipment with supervision from the soil survey staff.

Currently, the Kerrville office is assisting the Roam Ranch in tracking their improvement of soil health. The Roam Ranch is involved in multiple projects related to soil health and holistic management, with guidance from General Mills, the Savory Institute, and the National Center for Appropriate Technology (NCAT). Although several samples have been taken for multiple soil properties and soil health indicators, previous results of infiltration rates were only estimates. With these infiltrometers, the staff has been on site, taking actual readings and downloading the results in real time, in the specific fields that the Roam Ranch is working to improve. With accurate, on-time delivery, the staff and ranch managers can see how the soil health practices are affecting the soil infiltration rates over time.

Other ranches in the area are doing similar soil health practices. As interest in the new technology increases, the Kerrville staff anticipate using the SATURO infiltrometers to establish baseline data for many fields in the area. The Kerrville Soil Survey Office envisions the SATURO infiltrometers as efficient, time-saving, and accurate tools that can show soil health improvements over time and collect soils data to improve information in the NASIS database. ■

Figure 1.—Coarse Clay ecological site showing characteristic dune-like landscape in the Bitter Creek Wilderness Study Area.

NRCS and Partner Staff Converge in Glasgow, Montana, for Ecological Site Development Project

By Scott Brady, NRCS ecological site specialist, Havre Soil Survey Office, Montana.

During the week of July 6, a group of dedicated scientists braved severe thunderstorms, gale-force winds, muddy roads, mosquitoes, and the sheer vastness of the Montana plains for the sake of collecting data for ecological site development in MLRA 52.

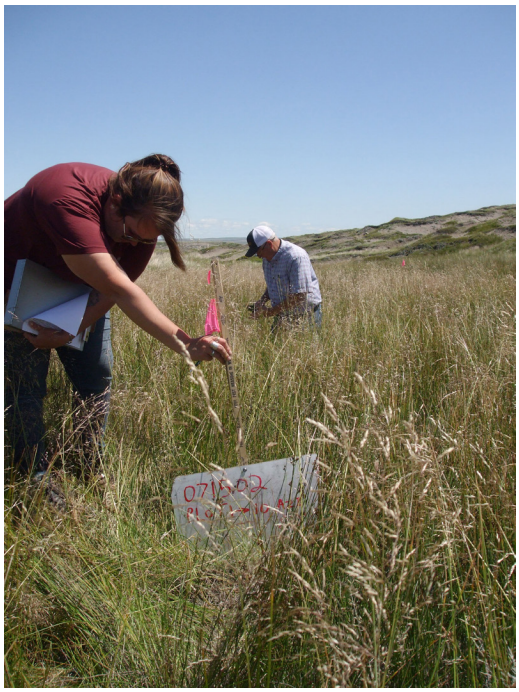

Figure 2.—Heather Nenninger, BLM ecologist, and David Kraft, regional ecologist, sample a saline subirrigated site.

Personnel from soil survey offices (SSOs) in Havre (Montana), Pierre (South Dakota), and North Platte (Nebraska); the Salina Regional Office in Kansas; the Montana NRCS State Office; the Great Falls (Montana) NRCS Area Office; and the Malta and Glasgow, Montana, Bureau of Land (BLM) Management Field Offices arrived in Valley County, Montana, for a week of collecting vegetation data and soil samples for analyses by the Kellogg Soil Survey Lab (KSSL). Sampling was especially challenging due to the remoteness of the field sites, the unsettled weather patterns, and the fact that the acid shale soils underfoot quickly turn into slippery mud with the slightest bit of rain. Despite the challenges, the crew managed to collect data to develop Rangeland Health Reference Worksheets for the Coarse Clay ecological site (fig. 1), conduct initial investigations on saline subirrigated and hillside seep (saline) sites (fig. 2), and obtain KSSL sampling data for characterization of four to five soil series, some of which have not been previously described (fig. 3).

The story began in 2014, when a local technical team, consisting of NRCS and BLM staff, determined that ecological site descriptions (ESDs) in MLRA 52 needed to be revised to include updated soils and vegetation information and better assessments of critical sage grouse habitat and to address evolving scientific principles. After developing a suite of updated ESDs as part of the Provisional Ecological Site Initiative, it was evident that further work was still needed before the new ESDs could be utilized in the field. The Rangeland Health Reference Worksheets needed to be updated to reflect the new information. The reference worksheet is a critical tool used by land managers to assess the ecological condition of rangeland, and it allows the land managers to make science-based management decisions. Staff from the Havre SSO, the St. Paul Regional Office in Minnesota, and BLM partnered to conduct a field project aimed at collecting the necessary data for developing these critical worksheets.

In July of 2018, NRCS crews from Montana, North Dakota, Minnesota, and Wisconsin joined forces with Montana BLM staff from Malta and Glasgow to sample 30 field locations over the course of 2 weeks. This initial effort resulted in completed reference worksheets for 10 high-priority ecological sites and obtained much-needed KSSL data for soils characterization.

In July of 2019, efforts were focused on a suite of sites known locally as the “natric catena,” a group of ecological sites with complex soil and plant community interactions. The Malta BLM office provided equipment and oversight for digging three excavator pits, each of which spanned the entire catena, in order to obtain detailed soil observations on each of the four soil series involved. Soil scientists from the Havre and Bismarck SSOs and the Malta BLM staff described the soils while Montana NRCS, Havre SSO, and Glasgow BLM staff collected vegetation data.

July 2020 marks the third year of the field project, which to date has succeeded in developing 11 of the most critical reference worksheets, permitted further refinement

Figure 3.—KSSL sampling crew (left to right): Mike England, Andrea Williams, Stuart Veith, and Mike Rokus.

of natric ecological site concepts, and obtained lab data for improved soil classification on over a dozen soil series.

Plans are already being laid for next year, which marks the final year of the agreement. This project has been an outstanding example of interagency collaboration, and its success has been nothing less than extraordinary. We would like to extend a big Thank You to all who have contributed to this project in the last several years. ■

Forest Ecological Sites in Eastern Cascades of Washington State: Process and Procedures

By Bonda Habets, Washington State Resource Conservationist.

NRCS Washington (WA) began the process of completing ecological sites for Eastern Washington in 2017. For this work, they contracted through the ACES (Agriculture Conservation Experienced Services) Program to bring on retired NRCS foresters. The retired foresters worked with NRCS soil scientists and the current NRCS WA State Forester.

The information below outlines the task of completing ecological sites for the Eastern Cascades (Major Land Resource Area 6) in Washington. This area extends from the Canadian border (to the north) to the Columbia River (to the south) and southward through Oregon. The task was challenging as there was only limited

Figure 1.—Warm Frigid Xeric Hills and Mountain Slopes (Douglas-fir Warm Dry Shrub MLRA 6 Eastern Cascades).

staff to cover a large area that had over 100 plant associations and 4 climate zones. We relied on current forest plant association publications, recognized ecological guides and maps, published NRCS soil surveys, and experience of ACES foresters and current soil scientists.

The ecological sites were classified as “Provisional Ecological Sites” (PES) as intensive field inventories were not conducted due to limited staff, time, and budget. The PES will serve to give NRCS personnel and clients a good understanding of the landscape and the ecological processes that occur there.

The key procedures for completing PES for the Eastern Cascades were:

- Gather current forest plant association and State and national references
- Gather current ecological and climate maps and references
- Compile current soil survey information
- Use the “modal” concept in classifying PES
- Complete limited field reconnaissance for confirmation of PES concepts

NRCS Common Resource Areas (CRAs) (fig. 2) were used to identify distinct biophysical areas within MLRA 6. These CRAs closely resembled the EPA’s Ecoregion Level 4 Zones. Published NRCS soil survey information was compiled to address the major soils and recorded plant associations. U.S. Forest Service’s Forest Plant Association Guides were used to properly identify and group plant associations into specific PES. Field reconnaissance with the ACES forester and NRCS West Region’s soil scientist was conducted to get photos and verify PES concepts. Vegetation cover varied from cold subalpine sites in the north, to moist grand fir sites in the central area, to hot Oregon white oak sites to the south.

The “modal” concept is important in understanding our process. Soils with the largest acreages corresponding to specific plant associations were used for PES write-ups. For example, the Douglas-fir/pinegrass (*Pseudotsuga menziesii/Calamagrostis rubescens)* is one of the largest plant associations in the northern area of MLRA 6 (fig. 3). Soil acreages of 1,000 acres or more were used for vegetation documentation and information on soil characteristics. The modal concept also applied to plant associations. Plant associations with the largest acreages were given priority—more time was spent on technical write-up and field recon for these associations.

Plant associations were put into biophysical groups or plant association groups (PAGs). Temperature reflected the overstory trees and moisture the understory vegetation (e.g., Douglas-fir/pinegrass was designated Douglas-fir Cool Dry Grass). Sometimes three to four plant associations were designated by one PAG because they had similar vegetation and ecological processes. The PAGs were then included in one PES.

Examples of some of the major PES biophysical (vegetative) names are: Douglas-fir Cool Dry Grass (DF/pinegrass), Grand fir Cool Dry Grass (GF/pinegrass), Ponderosa pine Warm Dry Grass (PP/bluebunch wheatgrass-Idaho fescue), Grand fir/Warm Moist Shrub (GF/vine maple), Douglas-fir Warm Moderately Dry Shrub/Herb (Douglas-fir/snowberry/pinegrass) (fig. 1), Oregon White Oak-Ponderosa pine Hot Moderately Dry Shrub (Oregon White Oak/snowberry-western hazel), and Subalpine fir Cold Dry Shrub (SF/grouse whortleberry). Biophysical (vegetative) names are considered more user friendly for the Field Office Planner. We do, however, have abiotic names for all the PES. For example, the abiotic name for Douglas-fir Cool Dry Grass is Cool Frigid Xeric Ashy Slopes. These names allow planners look up the ecological site by vegetation or location within the landscape.

In summary, 14 provisional ecological sites were completed for the most extensive plant associations and soil acreages in MLRA 6. Major identifying tree species in these PES were ponderosa pine, Douglas-fir, grand fir, western hemlock, western larch, subalpine fir, lodgepole pine, and Oregon white oak.

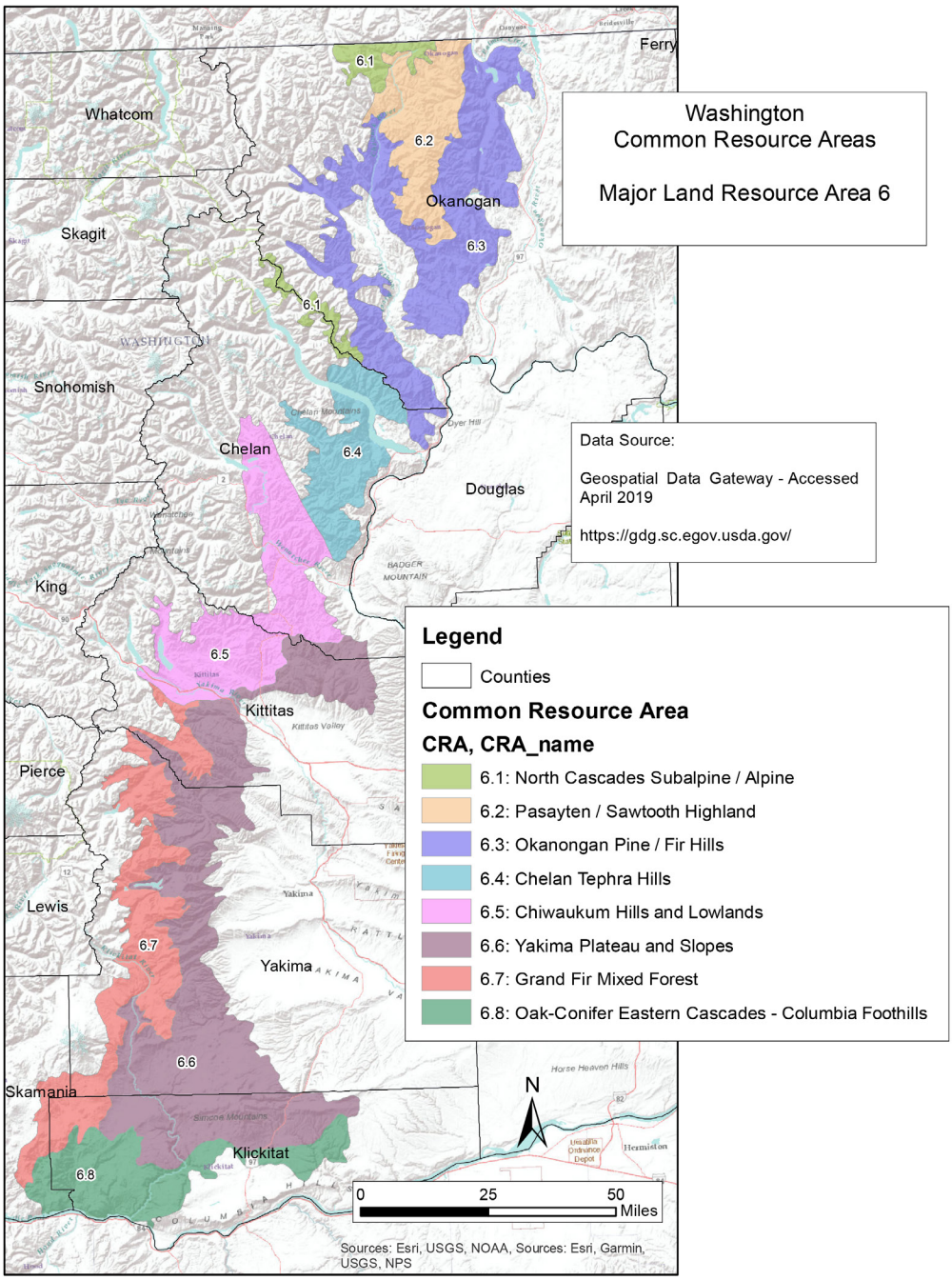

Figure 2.—WA Common Resource Areas for MLRA 6 Eastern Cascades.

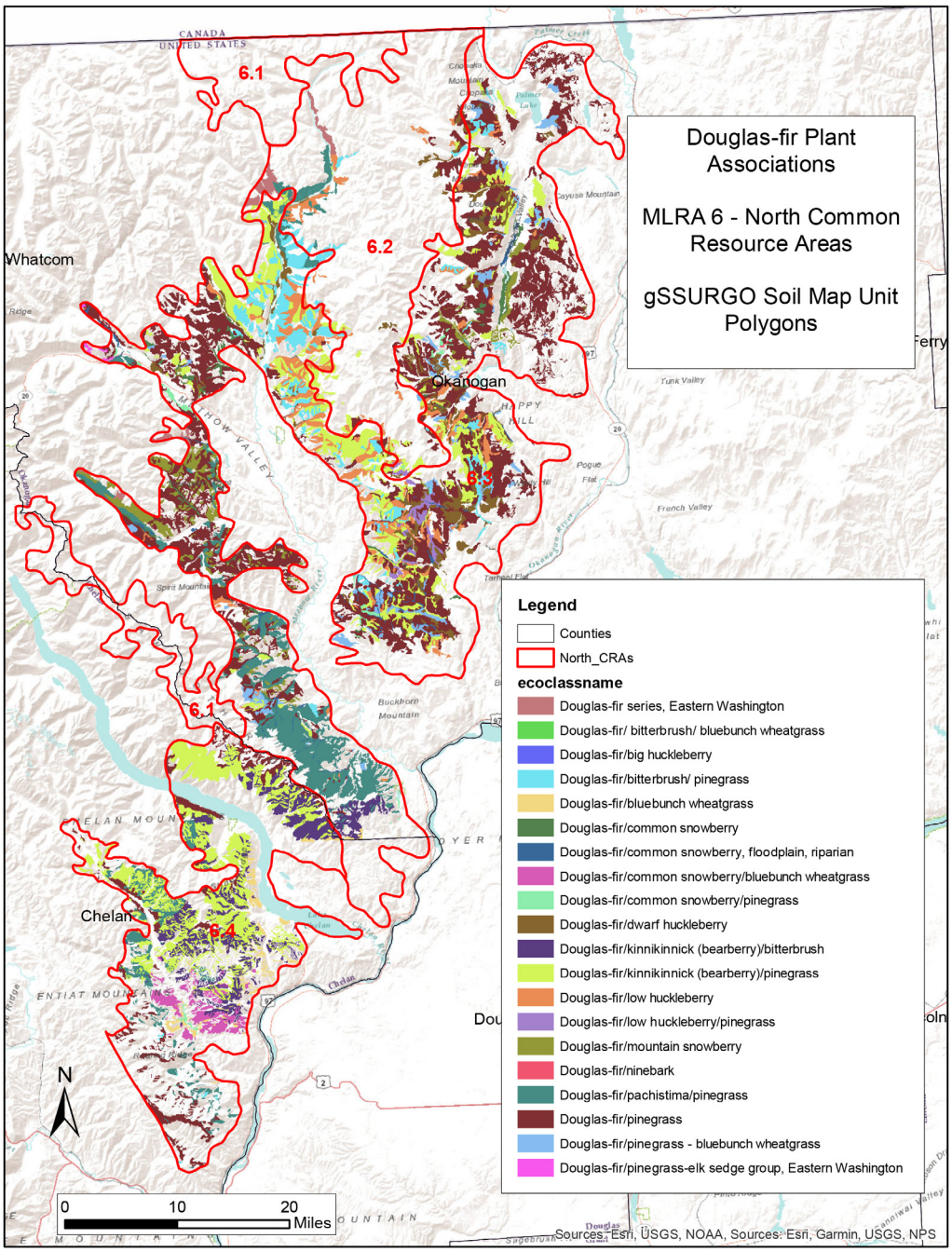

Figure 3.—WA Douglas-fir Plant Associations in MLRA 6 Eastern Cascades.

Blast from the Past: What Every Soil Mapper Should Know—John Hawley's Remembrances of Soil Survey Investigations

By Curtis Monger, National Leader–Soil Survey Standards, NRCS, and Ken Scheffe, former State Soil Scientist of New Mexico and soil classification specialist, NRCS (retired).

How do you make a soil map? Drill a lot of holes and connect the dots? Sometimes. But better soil maps come from soil scientists who understand the landscape—its geology and how water flows through it, the relationship between diagnostic horizons and geomorphic surfaces, and how vegetative patterns provide clues about what is below ground. The Soil Survey Investigations Division of the late 1950s to early 1970s was designed to discover and teach basic principles and thereby increase the quality and accuracy of USDA soil maps.

For almost four decades (1934-1971), the Soil Survey program in USDA was under the direction of Charles E. Kellogg. In 1969 alone, he directed 23 units consisting of field operations, correlations, cartography, interpretations, manuscripts, and soil survey investigations. The Soil Survey Investigations Division (SSI), led by Dr. Guy Smith, consisted of the World Geographic Unit; laboratories at Beltsville (Maryland), Lincoln (Nebraska), and Riverside (California); and seven research scientists in the Field Investigations Unit (see figure 1).

Dr. John W. Hawley, a geologist, was one of the research scientists. This article provides a brief summary of some of the activity in the SSI unit based on interviews with Dr. Hawley in May, June, and July of this year. Dr. Hawley worked on the SSI staff from 1962 to 1977. His first 10 years were spent in southern New Mexico with the Desert Soil Geomorphology Project. This was followed by 3 years as a research geologist in the Southern High Plains at Texas Tech in Lubbock with the SSI Division. The SSI, however, was soon dismantled with the retirement of Guy Smith in 1973, and John Hawley was transferred to the Pacific Northwest, to work at the West National Technical Center in Portland, Oregon. This position, however, did not provide support for linked geology-soil investigations or effective training opportunities, so he accepted an offer to return to New Mexico as the senior environmental geologist with the New Mexico Bureau of Mines and Mineral Resources. In that position he was able to expand his research and focus on hydrogeology, a discipline for which he was particularly well suited because it enabled him to connect earth-surface processes (soil geomorphology) with the geologic subsurface.

During Hawley's time with SSI in the 1960s and early 70s, many of the field soil mappers, although trained to make conservation surveys with the Soil Conservation Service (SCS), lacked scientific training in geology. After 1952, SCS was combined with the Bureau of Plant Industry, Soils, and Agricultural Engineering, which housed the pedologists. There was now a need to provide geological and pedological training to field soil scientists. Much of Hawley's time was spent in the field helping soil scientists see the link between geology and soils. He also hosted a numerous formal and informal field seminars. Hundreds of soil scientists and students from many parts of the United States and the world participated in these field tours.

Many of the most important concepts for understanding landscapes are captured in the syllabus for a short course that John taught in 1969 at New Mexico State University. These are the principles that every soil mapper should know. The syllabus is reproduced on the following page. Figure 1 is after the syllabus.

Lecture Outline for 1969 Graduate and Advanced-Undergraduate Level Seminar on Soil-Geomorphic Relationships (NMSU Agronomy 520)

John W. Hawley, Ph.D., C.P.G.
Emeritus Senior Environmental Geologist
NM Bureau of Geology & Mineral Resources, N.M. Tech
1000 Vassar Dr. NE, Albuquerque, NM 87106-2631
Phones: Office (505) 255-4847, Mobile (505) 263-6921

Lecture l5a, Geomorphic surfaces and soils—Introduction

III. Definitions

A. Geomorphic surface -- "a landform or group of landforms that represents (a major) episode of landscape development" (Balster and Parsons, 1968, p. 3). - - "a portion of the land surface that is specifically defined in space and time" (Ruhe, 1969, p. 5).

B. Soils - - refer to definitions in Lecture 1 and 2 outlines.

C. Paleosol (Ruhe, 1965; Gile and Hawley, 1966; Ruhe and Daniels, 1958); "A soil that formed in a landscape of the past" (Ruhe, 1965, p. 755).

1. Relict soils -- paleosols "that formed on pre-existing landscapes (geomorphic surfaces), but were not buried by younger sediments." The implication is that subsequent pedogenesis has not obliterated properties developed during a former episode of soil formation.
2. Buried soils - - paleosols that "formed on pre-existing landscapes and were subsequently covered by younger sediment or rock."
3. Exhumed soils -- buried soils which "have been re-exposed on the land surface by erosion of the covering mantle."

II. Elements of the soil landscape - (Dalrymple and others, 1968; Ruhe, 1960; Ruhe and Walker, 1968; Ruhe, 1969, p. 132).

A. As has been pointed out in Lectures 7 to 11, an appreciable portion of the earth's surface has landscapes formed by subaerial agents of denudation (mainly running water and mass wastage).

B. The fully developed landscape and products of an erosion cycle are often similar whatever the climate. (See Lecture l1b.)

C. According to Ruhe (1960, p. 165) "Landscapes in a fully developed terrain have common elements." NOTE: Ruhe and Walker (1968) and Ruhe (1969) use the terms underlined and drop the "pediment" and "alluvial" designations.

1. These include:
   a. Upland (including summit and shoulder)
   b. Pediment backslope
   c. Pediment footslope
   d. Alluvial toeslope (including bottomland or floodplain)
2. Soils occur on these landscapes and are part of them. Soils are landscapes as well as profiles.

3. Catena concept of Milne and the soil landscape (Milne, 1936a, b).

   a. Milne (1936b, p. 16 -17)—Catena: ". . . the sequence of soils encountered between the crest of a low hill and the floor of the adjacent swamp, the profile changing from point to point of this traverse in accordance with conditions of drainage and past history of the land surface. Two variants of the catena can be distinguished in the field . . . . In one, the topography was modelled, by denudation or other processes, from a formation originally similar in lithologic character . . . Soil differences were then brought about by drainage conditions, differential transport of eroded material, and leaching, translocation, and redeposition of mobile chemical constituents ... In the other variant, the topography was carved out of two or more superposed formations which differ geologically . . ."

   b. Ruhe (1960, p. 166-168) shows how soils of Milne's Catena concept relate to the four landscape elements, both in Africa and in Iowa (humid tropical and humid temperature regions).

      1) A younger geomorphic surface is cut into and below an older surface by processes of denudation.

      2) Through time, erosional backslope and footslope elements and constructional toeslope elements develop at the expense of an upland (older geomorphic surface remnant).

      3) Transported sediment commonly accumulates on the younger erosion surface as a pedisediment, or as an alluvial fill at the toe of the surface.

         A basal gravel or stone line (Ruhe, 1959) may mark the base of the pedisediment. Alluvial toeslope sediments may include alluvial-fan or apron, or floodplain deposits (also locally lake or swamp deposits).

      4) "Upon stabilization of the younger surface a new cycle of pedogenesis follows, soils form on elements of the landscape, and are members of a catena in the sense originally defined by Milne." (See C,3,a, above.)

D. Dalrymple, Blong and Conacher (1968) have developed a hypothetical nine-unit landsurface model based on studies of soil-landscape relationships in a humid-temperate region of New Zealand – "The model is defined in terms of surface morphology and contemporary (geomorphic and pedogenic) processes . . ." Note that mass movement (colluviation) is a dominant hillslope process in the area described, and that the model would have to be significantly modified before it could be applied in subhumid to arid regions where alluvial processes are dominant.

III. Extension of soil-landscape (descriptive-genetic) into the geologic past.

A. A number of detailed field investigations have shown how the processes outlined in steps (1) - (4) above can be repeated during successive erosion cycles resulting from lowering of the local base level (e.g. Ruhe, 1956a, p. 64-77; 1956b; Balster and Parsons, 1966-1968; Daniels and Jordan, 1966, p. 1-50; Gile, et al., 1966; Ruhe, Daniels and Jordan, 1966, p. 1-50; Gile, et al., 1966; Ruhe, Daniels and Cady, 1967; Nettleton, et al., 1968; and Hawley and Kottlowski, 1969, p. 93-99). The end result is a stepped sequence of geomorphic surfaces with progressively older and higher relicts of geomorphic surfaces having progressively stronger soil profile

development (and profiles of weathering). Climates ranging from humid tropical to humid temperate, and to arid temperate are represented in the above investigations.

B. The importance of episodic sedimentation and soil formation on constructional landscapes has also been recognized by Butler, 1959; Gile and Hawley, 1966, p. 261-268; Gile and others, 1969; Hawley and Kottlowski, 1969, p. 99-100; Hawley and Wilson, 1965, p. 11-20, 45-53; Morrison, 1964, p. 17-91; Ruhe, 1965, 1967; and Ruhe and Daniels, 1958. In these examples, periodic sedimentation and alternating with episodes of landscape stability and soil formation has led to development of depositional surfaces and underlain by vertical successions of sediments (alluvial, glacial, and/or lacustrine) separated by unconformities, which are commonly marked by buried paleosols. Such constructional landscapes often coexist with dominantly erosional landscapes that are located upslope.

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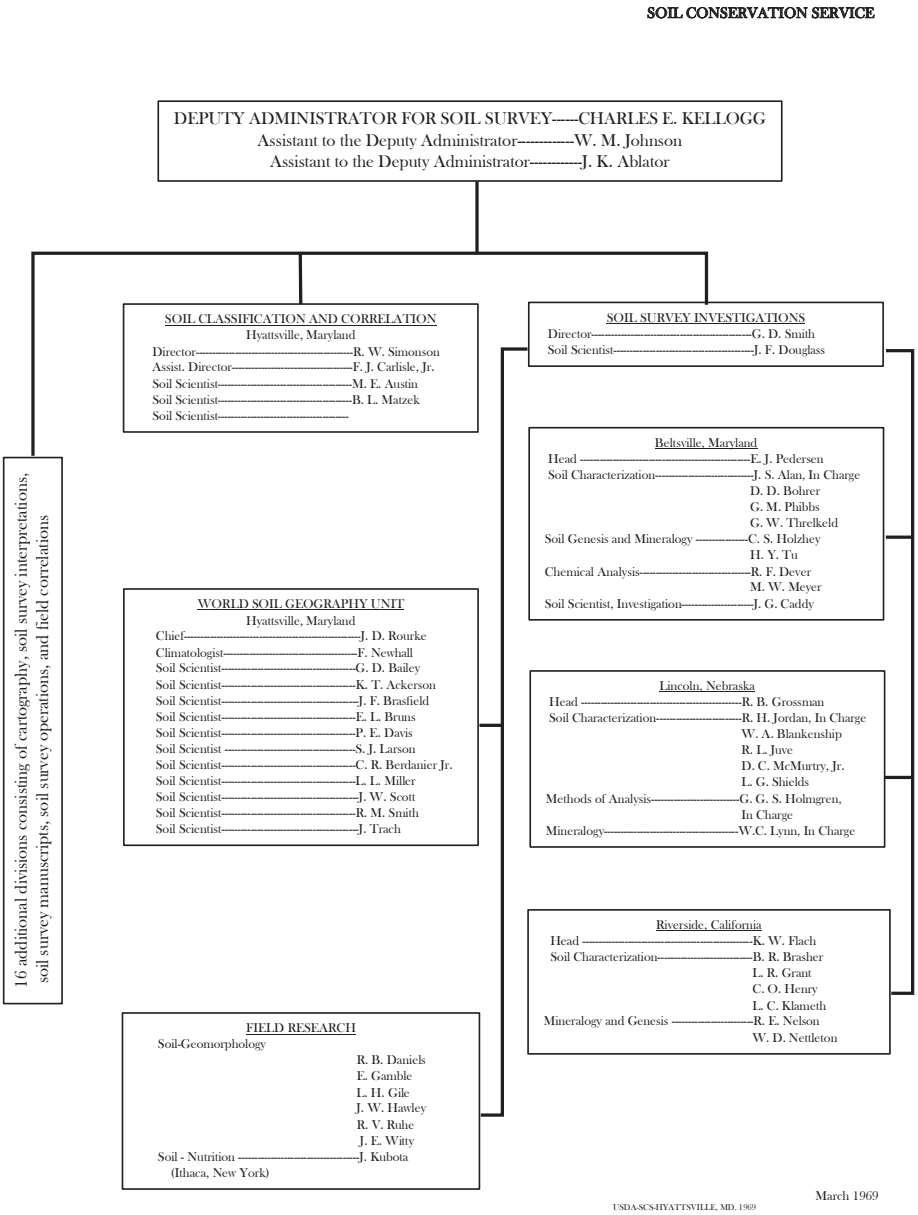

Figure 1.—Part of organizational chart from 1969. It shows the units of the Soil Survey Investigations Division under the direction of Guy D. Smith.

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