Myakka

Grants and Contracts

A Message from the Chair - K. Ramesh Reddy

The Soil and Water Sciences Department (SWSD) faculty conduct research on critical and emerging issues in soil, water, and environmental sciences in a wide range of ecosystems such as agricultural, forest, range, urban, wetland and aquatic systems. Addressing critical issues in these ecosystems requires both basic and applied research conducted from molecular to landscape levels, with expertise in ecology, hydrology, physics, chemistry, microbiology, biogeochemistry, and modeling.

Our research has broad implications in addressing various ecosystem services, including plant productivity, water quality and quantity, sustainable use of land and water resources, carbon sequestration, and climate change. The statewide network of SWSD faculty is currently involved in several aspects of soil, water, and environmental sciences. The faculty are working closely with other disciplines and universities,

with state and federal agencies, and with industry to address emerging issues and to meet the needs of the clientele.

To address these complex interrelated challenges, the SWSD research programs are designed and conducted in an interdisciplinary manner while maintaining disciplinary strength. The SWSD faculty actively collaborate with researchers in other UF departments and other universities and with state and federal agencies by offering complementary programs.

This issue of our newsletter contains some examples of our research priorities for land and water resources as related to Florida's ecosystems that simultaneously have relevance to national and global issues. These research programs also demonstrate the interdisciplinary and collaborative nature of SWSD research.

Myakka (pronounced 'my-yak-ah' — Seminole word for "big waters") gives a special identity to our department, as it is also the name of Florida's State Soil, Myakka fine sand. The State of Florida has the largest total acreage of Myakka fine sand (sandy, siliceous, hyperthermic Aeric Alaquod) on flatwood landscapes.

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Soil & Water SCIENCES

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Mining of Soil Legacy Phosphorus without Jeopardizing Crop Quality

Loss of legacy phosphorus (P) from agricultural soils is waste of a vital resource with severe ecological consequences. At the same time, global phosphate reserves are being depleted at an alarming rate. We evaluated the potential for using soil P storage capacity (SPSC) as an indicator to determine when P becomes limiting to plant growth during P mining. We obtained a threshold P saturation ratio (PSR) for soils across
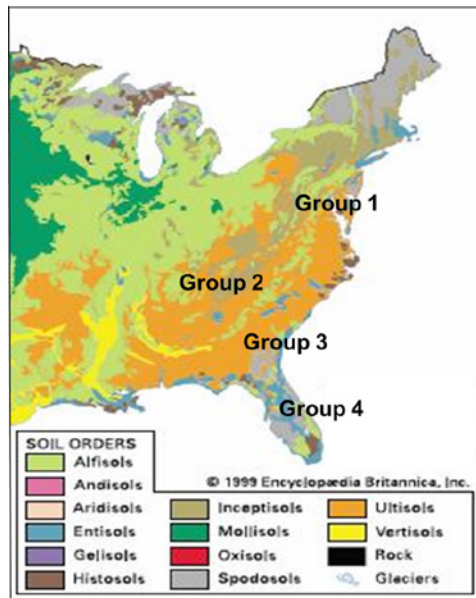
geographical diversity (Eastern USA) to enable SPSC calculations. Field experiments *with and without P applications* for a rye – silage corn – sorghum cropping cycle were conducted at three sites on different soil types, and plant response related to SPSC.

There appears to be minimal negative impact of P mining after the first three cropping cycles (Year 1) with the mined and fertilized sites maintaining similar crop yields, tissue nitrogen and P concentrations. Continued P mining could eventually lead to crop failure when SPSC becomes positive (soil PSR < threshold PSR). This project, funded by USDA-NIFA, includes a multidisciplinary team with Vimala Nair as PI, Co-PIs Lynn Sollenberger (Agronomy Dept.), Willie Harris (SWSD) and Andrew Sharpley (University of Arkansas), and Collaborators Peter Kleinman (USDA-ARS, PA) and Dorcas Franklin (University of Georgia). For additional information, see **https://youtu.be/ScyoWhqHlg**, or contact Vimala Nair at: **vdn@ufl.edu**.

Greenhouse Gas Emissions from Grazing Lands

Grazing land soils play an important role in global climate through uptake and release of carbon dioxide and nitrous oxide. These greenhouse gases are produced by microbes (bacteria and fungi) living in soils. The study funded by USDA-AFRI investigates how grazing land management and environmental factors (temperature and precipitation) affect microbial communities in soils, and how greenhouse gas production is shaped by these factors. Field measurements and laboratory experiments

on greenhouse gas production in grazing land soils are tied to molecular analyses that assess microbial community structure (who is there?) and function (what are they doing?).

The goal of the work is to have

a modeling tool that can predict the release of carbon dioxide and nitrous oxide from soils under a climate that is expected to be warmer and experience more extreme dry/wet periods across the southeastern US. This project, funded by USDA-NIFA, includes Stefan Gerber as PI and Co-PIs Patrick Inglett, Kanika Inglett, Maria Silveira, (SWSD) and Ryan Penton (Arizona State University). For additional information, contact Stefan Gerber at: **sgerber@ufl.edu**.

Citrus Under Protective Screen (CUPS) for HLB Management

Citrus greening or Huanglongbing (HLB) disease makes it virtually impossible to profitably grow citrus with conventional methods. UF/IFAS proof of concept studies showed that high yielding trees can be grown under protective screen structures for fresh fruit production by completely excluding the Asian citrus psyllid (ACP, *Diaphorina citri*) and therefore HLB disease. In partnership with UF/IFAS, many Florida fresh citrus growers are rapidly adopting "Citrus Under Protective Screen" (CUPS) to ensure viable, sustainable supplies of high quality fresh citrus for Florida packing houses and consumers while keeping the U.S. industry competitive in the world marketplace. CUPS are also being implemented in California where HLB is increasing at an alarming rate.

Research/extension activities proposed in this project focus on improving CUPS by developing efficient, automated detection methods for ACP incursions, integrated pest management with biocontrol, horticultural methods such as selective canopy management, hydroponics and sensor-based irrigation, suitable varieties and rootstocks to boost yields, and a comprehensive economic analysis. Extension/outreach

activities are integrated into every research activity, most notably by conducting research with growers in their own facilities. CUPS is a readily available technology that can be immediately adopted by growers to revitalize the Florida citrus industry and prevent the California citrus industry from reaching a similar stage of decline and consolidation. CUPS may reduce insecticide use and further improve premium HLB-free fruit marketability by providing consumers with lower pesticide residues than equivalent outdoor fruit, and with less impact on the environment. This project, funded by USDA-NIFA, includes Arnold W. Schumann as PI and Co-PIs Ariel Singerman (Food and Resource Economics Dept.), Rhuanito Ferrarezi (Horticultural Sciences Dept.), Jawwad Qureshi (Entomology and Nematology Dept.), Philippe Rolshausen (University of California, Riverside), and Andrew Krajewski (International Citrus Technologies Pty Ltd, Australia). For additional information, contact Arnold Schumann at: schumaw@ufl.edu.

Improving Sustainability in Agroecosystems Using Biological Soil Crusts

Sustainable agricultural practices are increasingly important due to rising input costs and greater concern about environmental impacts. Biological soil crusts (BSCs), naturally-occurring phototrophic consortia of microorganisms on the soil surface, were recently identified in agroecosystems in Florida and Oregon. BSCs are well-documented in arid ecosystems where they are a source of fixed nitrogen (N) and help improve soil moisture. However, they have not been examined in agroecosystems. BSCs from contrasting agroecosystems of tree crops in Florida and wheat fields and vineyards in Oregon will be characterized for changes in the microbial community structure, composition, and abundance. The project will also examine the impact of BSCs on soil N cycling and plant growth in these agroecosystems.

This project will advance our understanding of the ecology of agricultural BSCs and determine whether these microbial consortia can improve sustainability of agroecosystems through reduction of nutrient and water inputs. This project, funded by USDA-NIFA, includes Sarah Strauss as PI, co-PIs Patrick Inglett (SWSD) and Catherine L. Reardon (USDA-ARS, OR) and Collaborator John Williams (USDA-ARS, OR). For additional information, contact Sarah Strauss at: strauss@ufl.edu.

USDA – Long-Term Agroecosystem Research (LTAR) Network

U.S. agriculture faces tremendous challenges in providing food for a growing population while meeting multiple societal and conservation goals. To address these challenges, the USDA Long-term Agroecosystem Research (LTAR) network was created to enable long-term, multidisciplinary research across diverse agricultural systems. In 2014, through a collaborative effort with Archbold Biological Station, the UF/IFAS Range Cattle

Research and Education Center (REC) was selected to join the LTAR network.

Our joint site (Archbold-UF-LTAR) resides in the heart of Florida's cow/calf production area and is strategically located in an ecologically-sensitive region in the state.
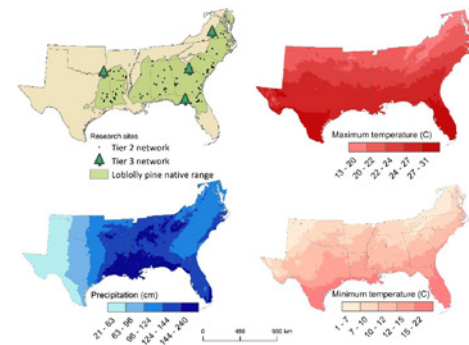
Encompassing three working ranches with 4,800 cattle, the Archbold-UF-LTAR serves as living laboratories to understand the impacts of grazing land management on water and soil resources and biodiversity.

Our primary goal is to address globally relevant questions related to the interaction and dynamics of grazing land productivity and adaptability, climate change variability and conservation. This project, funded by USDA, includes PIs Maria Silveira (SWSD) and Hilary Swain (Archbold Biological Station), and Co-PIs John Arthington, Elizabeth Boughton, Raoul Boughton, Philipe Moriel, Chris Prevatt, Brent Sellers, and Joao Vendramini (Range Cattle REC). For additional information, contact Maria Silveira at: mlas@ufl.edu.

PINEMAP: Pine Integrated Network: Education, Mitigation, and Adaptation Project – Role of Soil and Water Sciences Faculty

Sabine Grunwald and her student Wade Ross conducted region-wide analysis of terrestrial carbon cycling across "The Land of Pines", southeastern US. It was found that the largest fraction of terrestrial carbon was attributed to soil (53%), followed by stemwood (28%), coarse root (8%), branch (5%), stembark (4%), and foliage (2%). Regional soil organic carbon and terrestrial carbon models were developed using machine learning showing high accuracy. DayCent simulation forecasts to the end of the 21st century demonstrate that forest productivity is clearly sensitive to projected climate perturbations.

Our findings suggest that the terrestrial carbon sink capacity of pine forests will increase under a broad range of potential climate scenarios.

This research project was part of the PINEMAP project, one

of the largest interdisciplinary research projects in IFAS (2011 to 2017) funded by the Coordinated Agricultural Project (CAP) USDA NIFA, with Tim A. Martin (UF/IFAS School of Forest Resources & Conservation) as PI and 50 Co-PIs (http://www.pinemap.org/). Grunwald served as one of the Co-PIs and was responsible for the overall PINEMAP project data infrastructure and integration of Terra C (http://TerraC.ifas.ufl.edu).

The overall goals of PINEMAP were to (1) address impacts of global climate change on planted southern pine from different perspectives, among them forestry, ecophysiology, genetics, education, extension, economy, climatology and soil science, and (2) develop strategies to adapt to change. The Pinemap project team won the national NIFA USDA Partnership Award for Mission Integration (2016). For additional information, contact Sabine Grunwald at: sabgru@ufl.edu.

Data source climate data: Abatzoglou, J.T. (2013). Development of Gridded Surface Meteorological Data for Ecological Applications and Modelling. *International Journal of Climatology* 33, no. 1: 121–31. doi:10.1002/joc.3413. Geodata processing by Ross and Grunwald.

Restoration of Submerged Aquatic Vegetation (SAV) in Lake Apopka

Historically, Lake Apopka was characterized by clear water, dense SAV, and a thriving largemouth bass fishery. However, strong wind events that uprooted SAV, land use change, nutrient enrichment, and darker water have altered the system. The lake is now characterized by a less desirable condition, with sediments that are easily re-suspended to cloud the water, resulting in little light reaching the bottom, little SAV, and a fish population dominated by the less desirable gizzard shad. Large scale

SAV restoration could dramatically improve the lake by stabilizing sediment, increasing water clarity, increasing fish habitat, and sequestering nutrients; however, present conditions in Lake Apopka are not ideal for SAV growth and survival. This means that re-establishing SAV will require innovative methods matched with a careful understanding of environmental stressors.

Over three years, the team will use experiments (conducted in part in ponds at Duke Energy) to identify planting techniques and plant stock that will be more likely to survive poor conditions in Lake Apopka and will measure success by the functions and services that will improve the lake. Experimental results will be incorporated into two one-acre plantings conducted each year. Over time, increased information should result in increased restoration success. This project, funded by the SJRWMD, includes Laura Reynolds as PI, Co-PIs Carrie Reinhardt Adams (Environmental Horticulture Dept.) and Charles Martin (UF/IFAS Nature Coast Biological Station) and Collaborators Florida Fish and Wildlife Conservation Commission scientists. For additional information, contact Laura Reynolds at: lkreynolds@ufl.edu.

Photolytic Mineralization Processes of Organic Carbon, Nitrogen and Phosphorus in a Wetland Ecosystem Managed for Water Quality Improvement

Landscape scale treatment wetlands, known as stormwater treatment areas, or STAs, are currently utilized to preemptively improve water quality before surface waters enter the once oligotrophic Everglades ecosystem. Of primary interest is the reduction of phosphorus (P), which has a cascading detrimental effect on the overall ecology of the ecosystem. By increasing P availability in an otherwise P-limited ecosystem, P enrichment induces dramatic shifts in plant and algal community structure.

These changes in the source and magnitude of primary productivity alter biogeochemical processes that govern soil formation and thus carbon sequestration. Further, the vegetation communities associated with elevated P provide lowered habitat value to native species. In this investigation, we are evaluating the role natural sunlight has in mineralizing dissolved organic matter (DOM), a well-known process for carbon cycling but much less understood for other components of DOM such as N and P.

Preliminary results indicate that organic P mineralization is possible via the photolysis pathway, and thus consideration of open water areas to stimulate photolytic breakdown of organic P compounds may be a beneficial approach to increasing P retention in the STAs.

This project, funded by the SFWMD, includes Todd Osborne as the PI and co-PIs Lorae Simpson (SWSD), Paul Julian (Florida Department of Environmental Protection and SWSD), Rupesh Bhomia (SFWMD and SWSD), and Odi Villapondo (SFWMD). For additional information or research updates, contact Todd Z. Osborne at: osbornet@ufl.edu.

Everglades Stormwater Treatment Areas: Water Quality and Biogeochemistry

As mandated by the Everglades Forever Act (EFA), several constructed wetlands, known as Everglades Stormwater Treatment Areas (STAs), with a cumulative footprint of 57,000 acres, were built on former agricultural lands in strategic locations between the Everglades Agricultural Area (EAA) and the Water Conservation Areas (WCAs). These STAs are designed to reduce excess total phosphorus from surface waters prior to discharging that water into the Everglades Protection Area (EPA). Overall during the period of record, these STAs have experienced variable loadings, extreme weather conditions and internal management of vegetation. Changes in management strategies and the expansion of STA treatment areas during the past three years have aided in improving the effluent water quality.

The South Florida Water Management District (SFWMD) and other state and federal agencies developed a Science Plan for the Everglades STAs that identified key factors that may potentially influence outflow phosphorus concentration of the STAs. The Collaborative Research Initiative Science Plan for the Everglades STAs (CRESTA) is a joint 4-year research effort of the SFWMD and UF/IFAS to understand internal biogeochemical processes regulating water quality. This project, funded by SFWMD, includes K. Ramesh Reddy as PI and Co-PIs Stefan Gerber, Kanika Inglett, Patrick Inglett, Todd Osborne and Alan Wright, and Research Associates Rupesh Bhomia, Paul Julian, and Lilit Vardanyan (SWSD). For additional information, contact K. Ramesh Reddy at: krr@ufl.edu.

Florida Springs: Collaborative Research Initiative on Springs Protection and Sustainability (CRISPS)

The Floridan aquifer is arguably Florida's most significant water resource. The springs not only reflect the status of the aquifer but also influence the ecological health of many of Florida's most significant surface water ecosystems. Recognizing the ecological and economic significance of the Floridan aquifer and its springs, the St. Johns River Water Management District (SJRWMD) developed a Springs Protection Initiative (SPI). In support of the Initiative's scientific research program, UF and the SJRWMD formed a program in 2014 called the Collaborative Research Initiative on Springs Protection and Sustainability (CRISPS).

The overarching goal of CRISPS was to understand the relative influence and manageability of natural and anthropogenic factors that affect a key indicator of spring ecosystem health — the relative abundance of submerged aquatic vegetation (SAV) and nuisance benthic algae (hereafter, nuisance algae). The CRISPS program's multidisciplinary research effort coordinated through the UF Water Institute aims to understand more fully the complex biogeochemical, hydrologic, social and ecological processes regulating health of these fragile ecosystems.

The CRISPS research effort increased our understanding of the Silver Springs ecosystem specifically, and of Florida's springs in general. A final report of this four-year research effort is available at: https://www.sjrwmd.com/static/waterways/springs-science/CRISPS_Final_Report-All_Sections.pdf. This project, funded by the SJRWMD, includes K. Ramesh Reddy as PI and Co-PIs Matt Cohen, Tom Frazer, Wendy Graham, Jim Jawitz, Jon Martin, Patrick Inglett, and Todd Osborne (Water Institute affiliated UF faculty). For additional information contact K. Ramesh Reddy at: krr@ufl.edu.

Opening the Black Box: Linking Nutrient Storage and Stability with Microbial Activity in Constructed Wetlands

Constructed wetlands for nutrient removal have proven to be effective, but their internal processes and functioning remains poorly understood, particularly at the microbial level. This study sought to look inside this microbial 'black box' to examine microbial and soil characteristics to better understand how nutrients are stored and how management options (e.g., flow rate/velocity) and system types (e.g., different vegetation types) affect the efficiency of nutrient removal through plant growth and soil accretion processes. Microbial activities are highly responsive and give us a clear picture of both existing conditions and the stability of soil nutrients. Both flow and vegetation type were significant factors affecting microbial abundance, stoichiometry, enzyme expression, and respiration and nutrient turnover.

The results will help guide future decisions regarding constructed wetland design and predicting their role in ecosystem protection and restoration. This project funded, by the SFWMD, includes Patrick Inglett as PI and Kanika Inglett as co-PI. For additional information, please contact Patrick Inglett at: pinglett@ufl.edu.
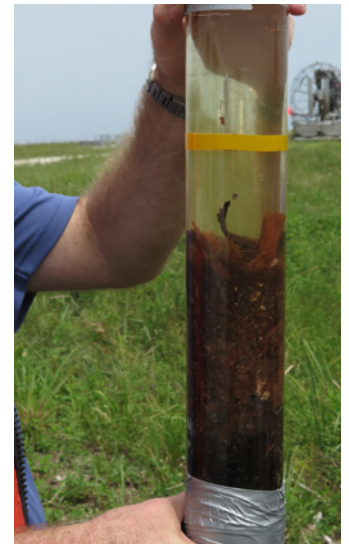
Mary Lusk Joins the SWSD Faculty

Mary Lusk has joined the Soil and Water Sciences Department as an Assistant Professor of Urban Soil and Water Quality at the Gulf Coast Research and Education Center (GCREC). Mary received her PhD from the SWSD at GCREC, where she studied organic nitrogen in urban stormwater ponds and urbanizing streams. Most recently she worked as a UF/IFAS Regional Specialized Agent for Water Resources, as part of a five-person team addressing statewide water resources issues. She worked on projects collaborating with the Florida Dept. of Agriculture and Consumer Services to improve adoption of water quality BMPs on small equine farms, developing a statewide outreach program on the connections between septic systems and water quality in Florida springs, and building programs to encourage homeowners to reduce outdoor water consumption.

In her new position at GCREC, Mary plans to continue studying nitrogen, especially organic nitrogen, in urban landscapes. She is interested in how management practices in residential landscapes affect the composition and cycling of nitrogen in lawns, stormwater runoff, and urban surface waters. Future research projects include investigations into lawn age and nitrogen cycling, and a study of compositional differences in urban stormwater for residential areas with varying levels of tree canopy cover. In Extension, Mary is looking forward to working with residents and the builder/developer community to encourage adoption of urban BMPs for water quality, such as expansion of green infrastructure and low impact development. For more information, contact Mary Lusk at: mary.lusk@ufl.edu.

Welcome New Students

Summer 2018

PhD
Kira Sorochkina (Strauss and P. Inglett)

MS
Christina Carr (Deitch)
Joseph Molenda (Reddy)
Tiffany Turnbull (Daroub)

BS - IS-EMANR (Advisor - Curry)

Deni Briann Barrington
Sarah Birkmire
Bianca Canales
Erika Childers
Nicholas Eder

Nicky Macias
Tiffany Opachich
Colin Opsatnic
Kyle Thayer

Spring 2018

MS
Russell Edwards (P. Inglett)

BS - IS-EMANR (Advisor - Curry)

Monica Fernandez

Congratulations Spring 2018 Graduates!

PhD
Evandro Barbosa da Silva
(Ma & Wilkie)
Andree George (Teplitski & Ogram)
Paul Julian (Wright)
Harmanpreet Sidhu (O'Connor)

MS
Kristi Dobra (Toor)
Brandy Foley (Wright)
Jay Gilbert (Osborne)
Yaslin Gonzalez (Bacon)
Cassie Henegar (Wright)

MS (cont.)
Mark Hinz (Clark)
Jeffrey Ragucci (Ma)
Melissa Savoy (Clark)
Jessica Sharpe (Ogram)
Taylor Smith (Wright)

BS - IS-EMANR (Advisor - Curry)
Ryan Goebel
Leigh Heverly
Thomas Johnson
Ashley Nicolls
Sarah Redmond
Kimberly White

SLS Minors (Advisor - Bonczek)
Austin Dartez
John Glass
Ryan Goebel
Robert Hjort
Christiana Rarie
Eden Schoepflin
Landon Smith

Faculty, Staff and Student Accomplishments

James Jawitz received a 2018 University of Florida Research Foundation Professor Award.

Julio Pachon (Bacon) was awarded a NSF Graduate Research Fellowship.

Amanda Desormeaux, Interdisciplinary Ecology (Jawitz), received the Jack L. Fry Award of Excellence in Teaching.

Kaylee August (Osborne) received the Future Leaders in Science Award from the Soil Science Society of America, which included communication and advocacy training on how to effectively work with members of Congress and their staff.

Elise Morrison (PhD Summer 2017, Ogram and Turner), received the SWSD Excellence in Graduate Studies Award at the PhD level.

Stefan Kalev (MS Fall 2017, Toor) received the SWSD Excellence in Graduate Studies Award at the MS level.

Siti Jariani Mohd Jani (Toor and Koeser)'s poster, *Rainy Season Nitrogen Transport in Urban Residential Stormwater Runoff*, was one of the four top-scoring winners in the Student Poster Competition at the 2018 UF Water Institute Symposium.

The **Student Compost Cooperative** (SCC) was awarded 2017 Composting Program of the Year Award by the U.S. Composting Council (USCC) for outstanding compost education and outreach. The SCC is open to all majors and is housed at the BioEnergy and Sustainable Technology (BEST) Lab under the guidance of **Ann Wilkie**.

The **Student Compost Cooperative** received a 2018 Champions for Change Award from the UF Office of Sustainability for their significant contributions to sustainability at the campus and community level.

UF President Kent Fuchs presents the Champions for Change award to the SCC, pictured L to R: Carlita Fiestas (Master of Sustainable Development Practice student and past SCC coordinator), Brett Higgins (Microbiology and Cell Sciences major and past SCC coordinator), Ann Wilkie, Sierra Richardson (SWS major and current SCC coordinator), and Lars Bjorndal (Electrical Engineering major).

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