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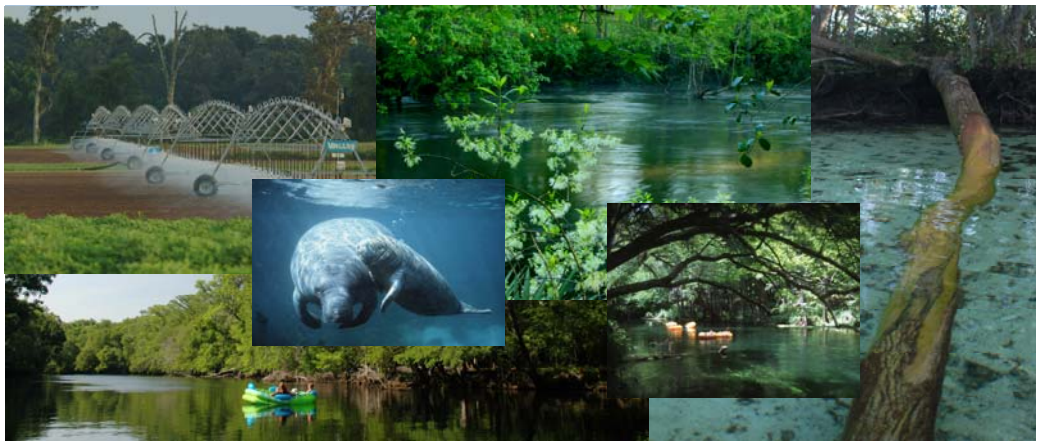
Sustainable Water Resource Management



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http://soils.ifas.ufl.edu

EDITORS:
Susan Curry
scurry@ufl.edu

Dr. Vimala Nair
vdn@ufl.edu

Michael Sisk
mjsisk@ufl.edu

GUEST EDITOR:
Dr. James Jawitz
jawitz@ufl.edu

From the Chair...

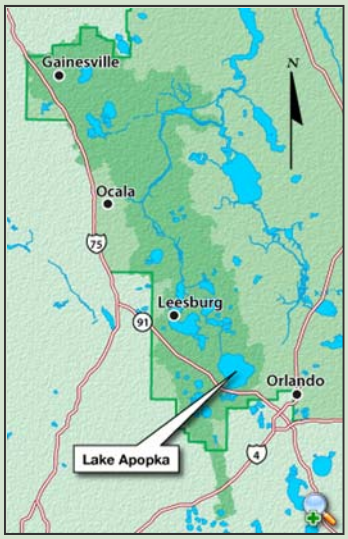
The sustainable water resource management challenge is to provide sufficient water resources for human needs while at the same time maintain the valuable ecosystem services provided by water in natural systems. As Florida's population grows, demands on freshwater resources to provide drinking water for cities and irrigation water for agriculture continue to expand. Simultaneously, there is increasing awareness of the importance of preventing pollution and leaving enough water for natural ecosystem functions. These combined pressures define the need for sustainable water resource management.

Florida is relatively rich in fresh water resources, especially groundwater. Florida has more available groundwater in aquifers than any other state. The Floridan aquifer, which underlies much of the State and is used for drinking water in North and Central Florida, is among the world's most productive aquifers. The principal aquifers of Florida combine to supply drinking water to greater than 90% of the State's population. The abundant groundwater emerges as spring water in parts of Florida. Of the 84 largest springs in the United States, 33 are in Florida—more than in any other state.

While the rivers in Florida do not rank among the nation's mightiest (even Florida's largest rivers—the Apalachicola, the Suwannee and the St. Johns—have only a fraction of the flow of the continent's and the world's largest rivers), Florida has thousands of lakes, large and small. The largest of these is Lake Okeechobee, which is the second largest lake wholly within the United States.

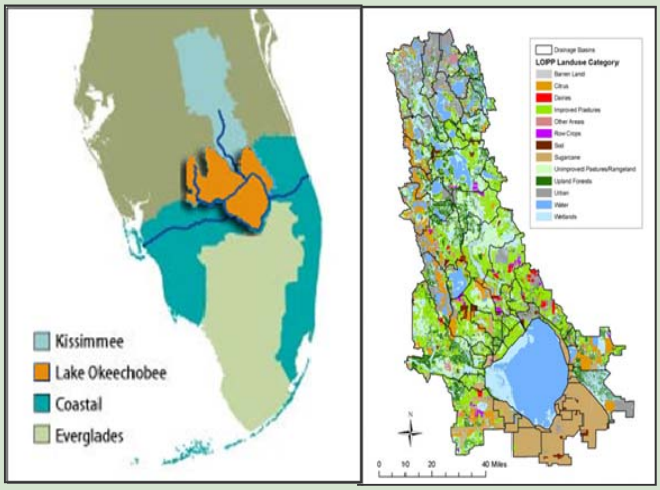
In this newsletter we present a few examples on teaching, research and extension programs the department is engaged in sustainable water resource management. Additional information on departmental programs can be found at: http://soils.ifas.ufl.edu

Legacy Phosphorus: Implications for Restoration of Shallow Lakes



Globally, shallow lakes are orders of magnitude more numerous than deep lakes. Shallow lakes provide a range of ecosystem services: source of drinking water, fisheries, irrigation water for crops in the drainage basin, recreational activities, and others. These lakes are often the final recipients of nutrients (especially nitrogen and phosphorus) and other pollutants from non-point source contributions from agriculture and urban sources. These nutrients are essential to maintain productivity of fisheries and aquatic life. The Federal Clean Water Act mandates the improvement of water quality and requires that the input of these nutrients (and other pollutants) does not impair aquatic habitat including fish and wildlife, drinking water quality, and recreation activities such as swimming or fishing. Since many shallow lakes are phosphorus limited, loading of this nutrient is of particular concern to environmental managers. Nonpoint sources of phosphorus dominate eutrophication processes of these lakes. Thus, in many situations, alternative land use management practices in the watershed are implemented in an effort to reduce the overall load to receiving water bodies and reverse the eutrophication process. The question is why have not all of these lakes have responded to phosphorus reduction measures? **Legacy phosphorus** in uplands, wetlands and lake sediments results from accumulation over decades when there was high export from agricultural lands, and is now slowly leaching back into the surface water. This internal memory of phosphorus within lake sediments and watershed soils can extend the time required to reverse the eutrophic status and reach background levels. The lag time for recovery can be in the order of decades and should be considered in developing management strategies to restore shallow lakes.

For the past three decades, researchers in the Wetland Biogeochemistry Laboratory have worked on a number of shallow lakes in Florida, including Lake Apopka and lakes in Ocklawaha River Basin, Upper Kissimmee Chain of Lakes, and Lake Okeechobee. For example, internal load from sediments of Lake Okeechobee to the water column is very significant, especially from the mud zone sediments. These sediments are fine grained and are readily suspended into the water column. Based on our research, internal load from mud sediments to the water column was estimated to be at 100+ metric tons of phosphorus per year. Managing internal load through chemical amendments will not be effective considering the size of the lake. If external loads are curtailed to TMDL levels (140 mt per year), it is likely the lake would show signs of recovery in the next three decades and reach an alternate stable condition. For additional information contact: K. R. Reddy at krr@ufl.edu



The 14th Annual Soil and Water Science Research Forum

The 14th Annual Soil and Water Science Research Forum was held on September 6, 2013, in Gainesville, Florida. Primary theme of the 2013 SWSD Research Forum was **"Sustainability of Land and Water Resources"**. Dr. Linda S. Lee, Associate Department Head and Professor of Agronomy; Expertise: Environmental Chemistry, Purdue University, was the keynote speaker at the Research Forum. Dr. Lee is a UF alumni and graduate of the SWSD. Dr. Lee's research focuses on developing a mechanistic understanding of the processes that govern environmental fate and remediation of contaminants for use in decision tools and management guidelines for industrial and agricultural settings. Current research projects include the fate of emerging contaminants including pharmaceuticals (trenbolone, estrogens, human and veterinary antibiotics) and perfluorinated telomer compounds in soils, sediments, streams, and biosolids; and plume control of chlorinated solvent contamination. Dr. Lee's keynote presentation at the Forum was entitled: **Technology, Stewardship, & Quality of Life: Chemicals of Emerging Concern in the Balance.** In addition there were 10 oral presentations and 40 poster presentations at the research forum. Please mark your calendars for the **15th Annual Soil and Water Science Research Forum scheduled on September 18, 2014.**

Springs Protection Initiative

A new, multi-year partnership is being formed between UF and the St. Johns River Water Management District (SJRWMD) as part of a $3 million initiative to protect Florida's springs. A group of faculty from the Soil and Water Science department is leading this effort, in partnership with the Water Institute and the faculty from across the UF campus including Geology, School of Forest Resources and Conservation, School of Natural Resources and Environment, and Engineering School of Sustainable Infrastructure & Environment. The Floridan aquifer is a world-class resource, providing drinking and irrigation water to most of Florida. In more than 700 places in Florida, the Floridan aquifer bubbles up to the ground surface as springs. In these locations, the low-permeability layer that confines the Floridan aquifer is breached and the potentiometric surface in the aquifer is above the ground surface (i.e., artesian conditions). At more than 30 of these springs, the flow rates are among the highest in the world. These springs, known as first magnitude, have flow rates of at least 100 cubic feet per second (2.8 kL s^{-1}).

All Floridians are invested in maintaining the purity of the water in the Floridan aquifer, and the water flowing from the springs is a highly visible indicator of the groundwater quality. But the springs reflect not only aquifer status; they also exert direct influence on the ecological health of many of Florida's most significant river ecosystems.

Floridians enjoy recreation in springs bountifully discharging clear waters.

However, in recent years many of Florida's springs have seen substantial declines in both the quantity and quality of the water that is discharged. Groundwater withdrawals for human use have increased steadily for decades. But, rainfall and aquifer recharge have also decreased in part due to multidecadal climatic patterns. Thus, the specific contribution of groundwater pumping to reduced spring flow is an active research question with direct social and policy relevance.

Water quality degradation is receiving increasing public recognition.

Further, it is not just spring water quantity that has declined. At many Florida springs the ecosystem health has recently degraded, with native underwater plants overtaken by a proliferation of algae. Eutrophication is a well-understood phenomenon where increased supply of limiting nutrients promotes algae growth. The concentration of nitrates, largely derived from fertilizer application, have increased substantially in many Florida springs – on time scales that are consistent with the observed ecosystem changes. However, the correlation between nitrate concentration and algae cover does not hold across all of the springs that are monitored. Thus, other hypotheses (such as the loss of snails or other top-down controls on algae growth) have been put forward to explain the increased algal presence.

There is increasing evidence that human activities are decreasing both the quantity of quality of the water in Florida's springs. The specific mechanisms behind these changes are the first half of the new research partnership with the SJRWMD. The second part of the project is focused on practical management and policy directions to reverse the degradation and improve the condition of Florida's springs. For more information, contact James Jawitz at jawitz@ufl.edu.

Welcome Spring 2014 New Students!

PhD

Reginald Toussaint (Wilkie)

MS

Mark Hinz (Clark)
Kimberly Jones (He)
Geoffrey Kahl (Kramer)
Stefan Kalev (Toor)
Aaron Kinty (Wilson)
Randall Martin (Ma)
Daniel Sitaras (Grunwald)
Mohsen Tootoonchi (Daroub)

BS

Agustin Francisco – SLS - WS (Bonczek)
James D. Erich – IS – EMANR (Curry)
Haley Glaab - IS – EMANR (Curry)
Cindy Lamour – IS – EMANR (Curry)
Mohamed Gheit – IS – EMANR (Curry)
Lindsey Sweet – IS – EMANR (Curry)
Jennifer Trevis – IS – EMANR (Curry)
Joshua Tveraas – IS – EMANR (Curry)

Congratulations! Fall 2013 Graduates

PhD

Santanu Bakshi (He & Harris)
Hollie Hall (Clark)
Yingjia Zhu (Ma & Harris)

MS

Neal Beery (Clark & Hochmuth)
Ellen M Bourne (He)
David Goldstein (Wright)
David Niebch (Wilson)
Michelle Ouellette (Wilson)

BS

Leah Crosby – SLS – WS (Bonczek)
Felipe Depaz – SLS – SS (Bonczek)
Dorah K. Foster – SLS – SS (Bonczek)
Daniel Pleasant – SLS – WS (Bonczek)
Shawn Christopherson – IS - EMANR (Curry & White)
Brooke Giuliano – IS – EMANR (Curry)
Kimberly Jones – IS – EMANR (Curry & White)

Lurking under the water surface

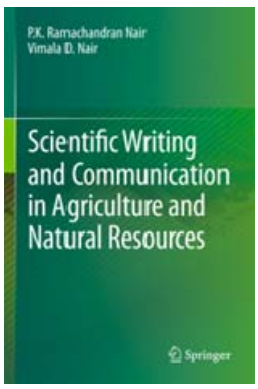
It is, perhaps, not surprising that the quality of water – whether habitat for aquatic life, or used for drinking or irrigation – depends to an important extent on the microorganisms residing within it. Graduate students (Marcos Moraes and Andree George), post-doctoral scientists (Julie Meyer and Clayton Cox) as well as faculty members, Massimiliano Marvasi and Max Teplitski focus on understanding how pathogens survive in water and exploit alternate hosts.

A screen of *Salmonella* promoters that were expressed inside oysters helped Cox learn how this multi-host pathogen contaminates economically important bivalves. Defining steps involved in the formation of sessile bacterial communities (biofilms) by *Salmonella* led Marvasi to the identification of compounds capable of dislodging these biofilms. The research on dislodging bacterial biofilms has important implications in pre- and post-harvest safety of fresh produce, and it is not surprising that Florida Tomato Committee and UC Davis Center for Produce Safety are funding Marvasi's research on industrial applications of the biofilm-disrupting compounds. Even more progress could be made in the future once a surrogate avirulent pathogen, suitable for field studies, is developed. SWS Graduate Fellow, Marcos Moraes is systematically deleting *Salmonella* virulence genes in order to develop such an avirulent surrogate strain.

The second focus of our research on ecology of aquatic pathogens is the study of coral diseases. Corals are crucial to the health of reef ecosystems and sustainability of the surrounding human communities. Coral reefs around the world, and especially in the Caribbean, are under increasing stress. Global climate change, overfishing, and terrestrial run-off are just a few of the examples of such stressors. When stressed, corals become susceptible to infections with pathogens, which may result in dramatic, ecosystem-wide outbreaks of coral diseases. While coral diseases are common in ecosystems around the world, there are uncertainties associated with the question of what *exactly* causes them. Julie Meyer is applying metagenomics and metatranscriptomics to better understand interactions within disease consortia formed on corals.

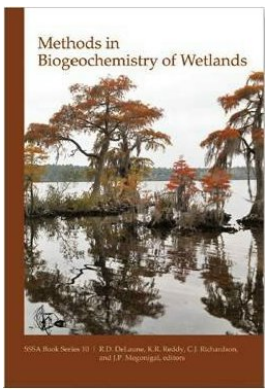
Defining ecology of pathogens in the various aquatic environments holds great promise, both in finding tangible solutions for controlling them and also better understanding interactions that take place in the ecosystem. For more information contact Max Teplitski at maxtep@ufl.edu

Book Announcements



The book, *Scientific Writing and Communication in Agriculture and Natural Resources,* by P.K.R. Nair and V.D. Nair has just been published.

For details visit the Springer website at: http://www.springer.com/life+sciences/agriculture/book/978-3-319-03100-2 or contact Vimala Nair at vdn@ufl.edu

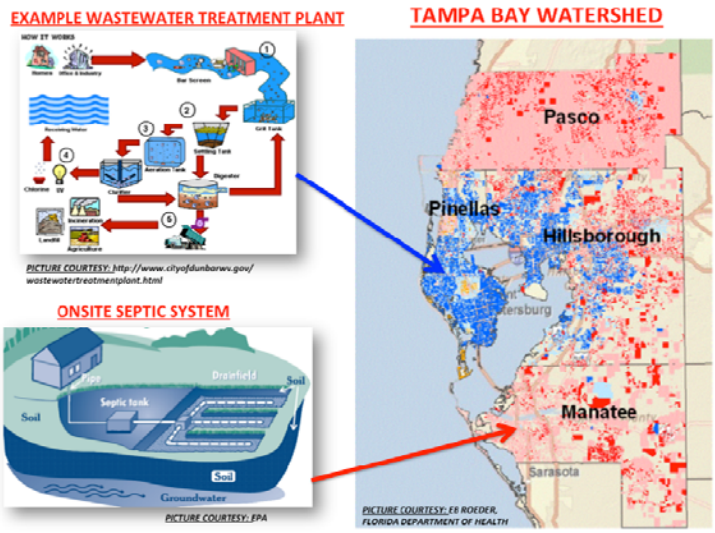


The book, *Methods in Biogeochemistry of Wetlands,* by R.D. DeLaune, K.R. Reddy, C.J. Richardson and J.P. Megonigal, editors has just been published by the Soil Science Society of America. For details visit: www.soils.org.

For additional information, contact K. Ramesh Reddy at krr@ufl.edu

Urban Water Quality

A variety of contaminants from a multitude of sources affect water quality in urban areas. The main pollutants in the state's water bodies are nutrients: nitrogen and phosphorus. Phosphorus is generally a limiting nutrient in inland (freshwater) waters, while nitrogen is a limiting nutrient in coastal waters resulting in eutrophication. In addition, our water bodies contain a range of organic contaminants (such as pharmaceuticals, personal care products, hormones, perflurochemicals) due to anthropogenic (human use and disposal) activities. The main source of these organic contaminants in water bodies is wastewater from households, which is either (1) collected, treated, and discharged to water bodies by wastewater treatment plants in cities or (2) discharged onsite in soil profile by septic systems in rural areas. Our group conducts research in collaboration with researchers from academia, federal and state governments, and industry. Current research efforts related to urban water quality are focused on (1) unraveling the contribution of nitrogen and phosphorus from various sources (urban areas, septic systems) to surface- and ground- water, (2) understanding the behavior of pharmaceuticals and hormones in the vadose zone and groundwater, and (3) investigating toxicity of perflurochemicals to fish and birds in wastewater-dominant urban streams. Our group extends research findings to educate extension clientele and Florida citizens on ways to protect water quality in urban areas. For more information contact Gurpal Toor at gstoor@ufl.edu.



Areas served by wastewater treatment plants (Blue-ish parcels) and septic systems (Red-ish parcels) in the Tampa Bay Watershed. In addition to these two obvious sources of pollutants in waters, many other sources such as atmospheric deposition, land uses contribute a variety of pollutants. The connectivity of surface- and ground- water and existence of multiple sources adds to complexity in urban systems.

Environmental Toxicology and Chemistry

Water quality is one of the most important issues facing the state of Florida and the world. Protection of water quality requires 1) identification of possible constituents causing degradation, 2) identification of effects on natural resources, and 3) development of management strategies for removing the contaminants or preventing their movement into water. The Environmental Toxicology and Chemistry program uses this paradigm for developing research and extension activities. Research through this program has helped characterize the impact of land management activities on water quality, and is contributing to our understanding of organic pesticide contaminant dynamics and risks in canal-drained watersheds in southern Florida. In addition to monitoring- and chemical fate-type studies, this program also develops analytical methods for contaminant analysis in complex matrices such as sediments and plants. Current studies evaluating the effects of contaminants on aquatic biota include: evaluation of the interactions of mixtures of commonly detected herbicides in surface water within the Indian River Lagoon watershed and exploration of the recovery dynamics of aquatic macrophytes following exposure to herbicides. Projects are also being developed to evaluate the bioavailability of pyrethroid insecticides in sediments to aquatic macro-invertebrates, and the effects of single and multiple stressors on seagrasses. The program maintains cultures of *Vallisneria americana* (American tapegrass), *Lemna minor* (duckweed), and *Selenastrum capricornutum* (freshwater green algae) for aquatic plant-focused toxicology work. In addition, efforts are focusing on bringing several seagrass species into culture and developing methods for evaluation of toxicity. The lab will also soon establish a *Daphnia pulex* culture for exploration of bioavailability and toxicity of traditional and emerging contaminants. For more information, contact Chris Wilson at pcwilson@ufl.edu.

Counting *Lemna*

***Vallisneria* toxicity test**

Evaluating Agricultural Irrigation Water Salinity and Implications of Water Conservation Practices on Future Water Management Decisions

Potatoes are the major irrigated crop in the Tri-County Agricultural Area (TCAA) located in the Putnam, Flagler and St. Johns counties in northeast Florida. Increasing salinity concentrations in irrigation water from the Floridan Aquifer within the TCAA has been of growing concern. The source of elevated salts in the groundwater of this region is not explicitly understood, but is generally the result of vertical saltwater intrusion through a semipermeable confinement layer between the saline rich Lower Floridan Aquifer and the Upper Floridan Aquifer. There is a need to improve our understanding of spatial and temporal salinity issues in the TCAA in an effort to inform future water management decisions.

Potato field in the Tri-county Agricultural Area in northeast Florida

Installation of alternative irrigation and drainage system ("irridrain"). Seen are rolls of irridrain pipe (background) and the filled trench where it was installed (foreground).

This new investigation will be conducting a survey of irrigation wells in the TCAA to determine the extent of salinity issues now and contrast them with a survey of wells conducted by the St. Johns River Water Management District in the mid1970s. To evaluate the efficiency of alternative irrigation practices (overhead, subsurface drip and irridrain as compared to traditional seepage irrigation), monitoring of water consumption will be conducted at four different farms. A model will then be used to scaled up implications of various water conservation alternatives to determine if any reduction in total volume or rate of groundwater pumping might reduce salinity impacts. This information will also help guide water managers in regard to any reallocation of water conserved by agricultural operations providing for a more sustainable water management in the TCAA.

For more information contact Eunice Yarney at eeshun@ufl.edu or Mark Clark at clarkmw@ufl.edu.

Undergraduate Education in Water Science

In 2010 the Soil and Water Science Department introduced a Water Science specialization within the Soil and Water Science undergraduate major. This specialization was designed to broaden the scope as well as the appeal of the major and to train students in the foundational components required for a career in water resource management across a broad range of systems including agricultural, forested, urban, and wetland ecosystems. The specialization also prepares students for pursuit of advanced degrees in related disciplines.

The core of the curriculum includes the introductory water science course, The World of Water, as well as more advanced coursework in Water Resource Sustainability, Soil and Water Chemistry, Wetlands, Environmental Policy, and Ecology of Waterborne Pathogens. Additionally, students are guided by their advisors in the selection of a wide array of elective courses tailored to their individual academic or career objectives.

Currently more than two-thirds of the department's undergraduates and an ever greater proportion of our most recently enrolled students have elected the Water Science specialization. Results thus far are encouraging. All of our most recent graduates currently are employed in related fields in the private or public sector, or are pursuing advanced degrees. For more information contact James Bonczek at bonczek@ufl.edu

Managing Expectations:
Creating a Community Based Stormwater Pond Nutrient Management Program

A typical development in central Florida with homes closely associated with stormwater ponds

Stormwater basins and ponds are often used in developed landscapes to attenuate increased rainfall runoff and mitigate for increased contaminate loads. However, in many communities stormwater ponds are perceived as lakes and homes adjacent to ponds are often marketed at a premium as "lake-front" property. Homeowner expectations and aesthetic demands for these "lakes" drive management decisions in the ponds that often include the use of algaecides and herbicides to suppress excess plant growth responding to elevated nutrient inputs from the watershed. Suppressing the biological response often allows homeowner expectations to be met, but can reduce nutrient retention mechanisms within the pond resulting in increased nutrient release downstream. New management strategies and tools are necessary to address homeowner expectations while minimizing downstream impacts. To develop these strategies a better understanding of homeowner expectations and tolerance thresholds of plant growth is required as well as an understanding of the biogeochemical relationship between nutrient stimulus and biological response in stormwater ponds.

A new collaborative research project between the Department of Agricultural Education and Communication, the UF Water Institute and the Soil and Water Science Department was initiated to assess homeowner expectations as well as water chemistry and algal response dynamics of stormwater ponds. Thirty six ponds were sampled monthly this past summer in a large development in west central Florida (Lakewood Ranch) for water column nitrogen , phosphorous, and chlorophyll-a concentrations. Pond biological characteristics including filamentous algae coverage, submerged aquatic vegetation (SAV) coverage, littoral zone characteristics and shoreline characteristics were also assessed. A subset of 12 ponds exhibiting a range of water quality conditions found in the initial 36 ponds are now being sampled for 8 additional months. To compare pond condition to homeowner expectations, a survey will be conducted with residents to identify thresholds of biological responses in the ponds considered acceptable or unacceptable by residents. Biological response thresholds will then be linked to nutrient levels within the ponds, creating nutrient targets that pond managers can monitor that are compatible with homeowner preference of biological condition with little or no herbicide suppression. In addition, pond sediment sampling will be conducted to determination the degree to which the internal flux of nutrients from sediments may be influencing the water quality in the ponds.

An example of undesirable algal growth in response to nutrient conditions in the water column

Research findings will improve managers' ability to identify nutrient conditions that would likely result in undesirable biological conditions in ponds thereby focusing management decisions on appropriate nutrient sources controls while minimizing the need for herbicide treatments and maintaining pond function to minimize downstream release of nutrients.

For additional information, contact Charlie Nealis at cpnealis@ufl.edu (SWSD Doctoral student and 2011 Water Institute Graduate Fellow) or Mark Clark at clarkmw@ufl.edu.

Soil and Water Science – Endowments

The SWSD established several endowments with the generous support from the Carlisle, Graetz, Polston, Robertson, and Skulnick families. Recently, the **Soil and Water Science Department Program Enhancement Fund** was established from funds by private donors in support of various departmental activities. In addition, K. Ramesh Reddy established a **Wetland Biogeochemistry Laboratory (WBL) Program Enhancement Fund** to support wetlands and aquatic systems programs in the department. We sincerely thank all our donors for their kind and generous support of soil and water science programs.

To our alumni and friends please show your support for soil and water science by selecting and making your gift to a specific area of interest. Details can be found at: http://development.ifas.ufl.edu/online_giving.html

Congratulations to our Faculty, Staff and Students ….

2013 Annual Meetings of the Soil Science Society of America Awards
Oral Presentations: **Julius Adewopo** - 3rd (Silveria/Gerber); **Baijing Cao** - 3rd (Grunwald); **Jing Hu -** 5th (Reddy/K. Inglett); **Wade Ross -** 1st (Grunwald); **Debjani Sihi -** 3rd (P. Inglett)
Poster Presentations: **Pasicha Chaikaew -** 2nd (Grunwald); **Biswanath Dari** 2nd - (Nair/Mylavarapu); **Jorge Leiva** - 1st (Nkedi-Kizza/Morgan); **Alexandra Rozin** -3rd (Clark); **Christine VanZomeren** - 3rd (Reddy); and **Xiong Xiong** - 2nd (Grunwald/Harris)

Biswanath Dari received the 2013 Outstanding Environmental Graduate Student Award from the American Society of Agronomy

Alexander Rozin was awarded the 1st Place for graduate student presentations at the Society of Wetland Scientists / Florida Association of Environmental Soil Scientists / Florida Association of Environmental Professionals

Alexandra DeBose-Scarlett, undergraduate student (Advisors: Teplitski /Massimiliano/ O'Connor), was selected as the 2013 recipient of the Young Investigator Scholarship by the Composting Council Research and Education Foundation (CCREF)

Mark Clark is featured in this EPA video: **Campus Rainworks Challenge**

UF/IFAS Awards
2013 – 2014 Grinter Fellowship Recipients: **Amy Hylkema** (Morgan/Hanlon), **Anne Sexton** (Daroub), **Biswanath Dari**, **Jianru Shi (**O'Connor), **Ky Gress** (Ma), **Mary Litrico** (Clark), and **Yan Liao** (Gerber)
Biswanath Dari was selected from IFAS to advance to the university-wide selection committee for the 2014 Howard Hughes Medical Institute (HHMI) International Student Research Fellowship.

College of Agriculture and Life Sciences (CALS) Awards 2013-2014
Outstanding International Graduate Student: **Debjani Sihi**
Alec Courtelis Award: **Julius Adewopo**
A.S. Herlong, Sr. Scholarship Fund: **Julius Adewopo**
Doris Lowe and Earl and Verna Lowe Scholarships: **Biswanath Dari, Kelly Ladd** (Bonczek)**, Elise Morrison** (Ogram)
William C. and Bertha M. Cornett Fellowship: **Debjani Sihi**
Florida Fertilizer and Agrichemical Association Scholarship: **Alexandra Rozin**
John F. Smoak Memorial Scholarship: **Jennifer Brown** (White/Curry); **Ashley Witkowski** (White/Curry)
Florida Rural Rehabilitation Corporation (Off Campus) Scholarship: **Kimberly Jones** (White/Curry)
Southern States Scholarship: **Andrew Land** (Curry);
Suwannee County Conservation District & W.B. Copeland Scholarship: **Andrew Land**

2013- SWS Research Forum Awards
Best Oral Presentation: **Rishi Prasad** (Hochmuth/Martinez)
Best Graduate Poster Presentations: **Odiney Alvarez** (Daroub); **Ky Gress**; **Jorge Leiva; Alexandra Rozin**; **Christine VanZomeren**
Best Undergraduate Poster Presentation:**Tommie Brent Lovato** (Wilkie)

Departmental awards and scholarships
Outstanding Undergraduate Award – **Brooke Giuliano** (Curry)
Frederick B. Smith Scholarship – **Kelly Ladd**
Don Graetz Award – **Simon Sokolof-Kemp** (White/Curry)
Ben Skulnick Scholarship – **Alexandra Rozin**
Sam Polston Scholarship - **Julius Adewopo**
William Roberton Scholarship - **Anna Normand** (Reddy) **and Debjani Sihi**
Victor Carlisle Scholarship **– Biswanath Dari**
Pedometrics Award – **Wade Ross**

Bill Reve Superior Accomplishment Award – **Greg Means**

Pasicha Chaikaew was awarded the 1st Place at the GIS poster competition, Map and Imagery Library, UF