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Book of Abstracts

UF WATER INSTITUTE SYMPOSIUM

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Acharya, Subodh

Authors: **Subodh Acharya**, University of Florida
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Category: Hydrology
Session Title: Posters - Hydrology

Estimation of Evapotranspiration from Diurnal Water Table Fluctuation Using a new Expression for Drainable Porosity

In shallow water table (WT) environments, plant evapotranspiration (ET) can be estimated by using the observed diel fluctuations in WT that normally correspond to the 24-hour ET cycle. It is now clearly known that estimation of ET from diurnal WT fluctuations is highly influenced by drainable porosity (λ) of aquifer, which depends on the WT depth and soil hydraulic properties. This parameter is usually estimated by integrating the equilibrium soil moisture profile above the WT. However, equilibrium (Eq.) conditions above WT are rarely met the field due to the occurrence of dynamic evaporation and root water uptake. In this study, we used a new expression for λ (non Eq- λ) to estimate ET from diurnal WT fluctuations. The new expression takes into account the quasi-steady vertical soil moisture flux (ET) from the WT to estimate λ . Evapotranspiration from shallow WT was estimated during 2010 and 2011 spring seasons for two potato fields in northeast Florida, managed under a conventional WT control system and the results were compared with the ET values from Penman-Monteith method. It was found that the non Eq- λ produced much better estimation of hourly as well as daily ET as compared to the Eq- λ . Using Eq- λ resulted in significant overestimation of ET especially during periods immediately after rainfall events. The non Eq- λ , on the other hand, seemed to improve the estimation significantly, even during periods immediately after rainfall events suggesting its advantage over the Eq- λ . While ET estimation from WT fluctuation has been mostly used in natural areas that are not directly intervened by human activities (e.g. natural wetlands and riparian zones), our study suggests that this method can also be used in relatively smaller, managed shallow water table fields intersected by drainage ditches.

Alenicheva, Diana

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Category: Efficacy of nutrient source control strategies
Session Title: Social, Behavioral, and Economic Aspects of Nutrient Management 1

Public Perceptions of North-Central Florida Springs

North-Central Florida springs represent environmentally and economically significant water natural resources with high aesthetic and recreational values. As the environmental quality of springs has been seriously impaired in recent decades, Florida Department of Environmental Protection is working with their Springs Working Groups to develop restoration plans to improve water quality and health in the springsheds.

Local residents living within the springsheds can be considered as an essential part of this socio-ecological system because they have both direct and indirect influences on these valuable natural resources. The process of reducing threats to the springs must involve these residents – people who could change behaviors (reduce of fertilizers use, invest in septic tank maintenance, etc.), or support community regulations on development if they wish to support springs restoration.

The development of regulations and recommendations that will have public support can be enhanced with information about what residents care about, what they believe to be the sources of environmental threats, and what activities and initiatives they are willing to support. Successful environmental education programs and communication campaigns should also be compatible with attitudes, knowledge, behaviors, and intentions of the audience.

This study aims to examine perceptions of natural, economic, social aspects and environmental problems of the springs held by the residents living near the spring ecosystem. The study used a mail survey to assess perceptions, understanding, and behaviors of residents of two springsheds in north-central Florida (Ichetucknee and Rainbow). Several predictors of willingness to accept regulations and change behaviors will be explored, such as perceptions of natural, economic, social aspects and environmental problems of the springs, membership in groups, and personal experiences with the springs. The survey is to be implemented in Fall 2011. The results of the study will be presented at the conference.

Amit, Michelle

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Category: Nutrient dynamics and enrichment impacts in aquatic ecosystems
Session Title: Posters - Nutrient dynamics and enrichment impacts in aquatic ecosystems 2

Syntrophic Acetate-Oxidizing Bacteria along a Nutrient Gradient in the Florida Everglades

The Florida Everglades is historically limited in phosphorus; however, runoff from the Everglades Agricultural Area has resulted in a gradient in phosphorus concentrations running into the interior of the northern Everglades. Phosphorus enrichment resulted in a P- limitation along the gradient, such that a detailed understanding of the impacts of P-enrichment on the methanogenesis which has been recognized as an important final step in the carbon cycle. Syntrophic acetate-oxidation is one pathway for the production of methane, providing hydrogen to a hydrogen-utilizing methanogenic bacterial group. The ultimate objective of this study is to investigate the role(s) of syntrophic acetate-oxidizing bacteria (SAO) in soils along the nutrient gradient in Water Conservation Area 2-A, including a site previously exposed to high levels of nutrients (F1), a transition site (F4), and a site unimpacted by nutrient additions (U3). Previous studies tentatively identified the presence of SAO in these soils by PCR amplification of the gene encoding formyl tetrahydrofolate synthetase, common to all known SAO. In the current study, we identify SAO by using a combined approach of the cultivation and DNA-stable isotope probing with ¹³C-labeled and unlabeled acetate. The Everglades sediment soils were incubated anaerobically with either ¹³C-labeled or unlabeled acetate as sole carbon source and energy sources. Molecular cloning revealed that several different genera of Bacteria related to Clostridiales and yet uncultivated co-existed with hydrogen-utilizing methanogens in active methane producing enrichment cultures, suggesting that various SAO play an important role in the production of methane. An attempt is made to assay the SAO activity by measuring the ratio of ¹²C-labeled methane to ¹³C-labeled methane in sediments supplemented ¹³C-labeled acetate. The results obtained from this study will provide greater understanding of how SAO control methane production along nutrient gradients in the Everglades.

Ammerman, David

Authors: **David Ammerman**, AECOM

Category: Innovative biological, physical, and chemical nutrient reduction & recovery technologies
Session Title: Innovative Biological, Physical, and Chemical Nutrient Reduction & Recovery Technologies 1

Appropriate Treatment for Intended Use

Water and wastewater management strategies have followed a predictable path for the last 100 years. As populations increased water resources were successively tapped from the closest, highest quality supplies to increasingly distant and lower quality supplies. At the same time wastewater management has become more complex as population densities require higher levels of treatment to maintain a habitable environment. Having become comfortable in strategies which rely on greater inputs of energy per gallon of water delivered and waste treated there are indications that this approach has reached its limit. The EPA has imposed numeric nutrient criteria on the state of Florida which go into effect in March 2012. Preliminary evaluations strongly suggest that the tried and true wastewater treatment processes we have used so far will not be able to reliably meet these requirements. Similarly portions of the Floridan and Biscayne aquifers have reached their safe yields and additional withdraws will not be allowed. This presentation will summarize these new pressures facing utilities in Florida. The presentation will include energy inputs as a function of nutrient level achieved and the diminishing environmental returns realized. Alternate approaches to water and wastewater management practices such as tailoring water qualities to intended uses will be considered as a potential means of addressing these challenges.

Anderson, Damann

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Category: Innovative biological, physical, and chemical nutrient reduction & recovery technologies
Session Title: Innovative Biological, Physical, and Chemical Nutrient Reduction & Recovery Technologies 2

Passive, Two-stage Nitrogen Reduction Systems for Onsite Wastewater Treatment

Excess nitrogen in watersheds is an important water quality concern, and nitrogen loading from onsite sewage treatment and disposal systems (OSTDS) is receiving increased attention in many watersheds. The Florida Department of Health has initiated the Florida Onsite Sewage Nitrogen Reduction Strategies (FOSNRS) Project to help develop sound practices for reduction of nitrogen from OSTDS. This presentation summarizes results from a recently completed pilot-scale study of passive nitrogen reduction systems for onsite wastewater treatment. These treatment systems were designed to require no mechanical components other than 1 pump and utilize a reactive media for denitrification.

Pilot scale systems evaluated in this study were two-stage biofiltration systems treating septic tank effluent (STE) using a variety of candidate media at a unique test facility constructed at a University of Florida research center. The two stage systems consisted of a first stage unsaturated media biofilter for ammonification and nitrification, followed in series by a second stage saturated anoxic denitrification biofilter. The test facility allows testing of nine parallel treatment trains. Three promising stage 1 unsaturated biofilter media were examined; expanded clay, clinoptilolite, and filter sand, at two media depths. In addition, the stage 1 unsaturated nitrification biofilters were tested as single pass and recirculating biofilters. Stage 2 biofilters for denitrification were evaluated using elemental sulfur as an electron donor for autotrophic denitrification processes and lignocellulosic media as an electron donor for heterotrophic denitrification processes.

The pilot systems were operated for over 1 year receiving STE with an average total nitrogen (TN) concentration of 53 mg/L. Several of the passive two-stage biofilters have consistently produced final effluent TN values below 5 mg N/L with over 90% reduction in effluent total nitrogen. Results from the pilot study are being used to develop design criteria for full scale systems which will be installed at Florida homes for further testing.

Andreu, Michael

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Category: Understanding natural, anthropogenic and legacy sources of nutrients
Session Title: Posters - Understanding Natural, Anthropogenic and Legacy Sources of Nutrients

The Ecosystem Services from Forests of the Tampa Bay Watershed Building a Collaborative Research and Extension Program

The forests the Tampa Bay Watershed (TBW), a coastal subtropical region in Florida, are changing in part due to an expansion of urban areas. These changes are raising concerns about the loss of services derived from the forest. In 2007, we established 500 permanent plots, in a systematic random sample, to begin quantifying the urban and urbanizing forests of the TBW. Using the data from these plots, we are able to describe forest species composition, size class distributions, canopy cover and other commonly calculated forest metrics. In addition to these values, we used the i-Tree Eco model to calculate values for some of the environmental services provided by the forests including: carbon sequestration, energy conservation, and pollution reduction. Since 2010, we established or are in the process of establishing an additional ~300 new permanent plots in the watershed. We are developing tools to link ground based data with satellite imagery to model forest structure and composition at the landscape scale. In 2011, we initiated the process of re-measuring 200 of the original plots that were located within the city of Tampa. This will provide information about 5-year rates of change (biological growth and land use change) so that we can begin to simulate and model the dynamic nature of ecosystem services on a temporal scale. The existence of this robust data set has generated partnerships with research and government institutions interested in a wide range of social and ecological investigations including water quality and quantity concerns. This long-term study is providing empirical data for the development of models that incorporate land use change with the biological functions of the forests in a range of structural conditions. Such models will provide managers and decision makers with tools for the development of sustainable forest management strategies and policies in a rapidly urbanizing region.

Aponte, Veronica

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Category: Innovative biological, physical, and chemical nutrient reduction & recovery technologies
Session Title: Posters - Innovative Biological, Physical, and Chemical Nutrient Reduction & Recovery Technologies

A Novel Physical-Chemical-Biological Treatment Process for Swine Wastes

Increasing meat demand is a worldwide environmental problem because agriculturally applied animal manure no longer sufficiently treats animal wastes. Swine production represents ~40% of the world's meat production, and its wastes contain high concentrations of organic matter, nutrients (particularly N and P), pathogens, trace metals, and salts. Worldwide, anaerobic lagoons are the most common method for treatment of swine wastes; problems associated with this technology include greenhouse gas emissions, odors, pathogens, and high effluent nitrogen and phosphorous concentrations. The overall goal of this research is to develop an integrated novel, effective, robust, and economical process for treatment of swine waste, aimed at reducing both nutrient (N, P) and organic matter concentrations. The proposed process (consisting of four modules) addresses the weakest part of existing treatment methods for swine wastes, ammonia removal. In the process, anaerobic digestion will first be used to reduce organic carbon, solids, pathogen concentrations, and to generate methane as a fuel source. Phosphorus removal will be accomplished via precipitation of struvite ($MgNH_4PO_4 \cdot 6H_2O$), yielding a valuable fertilizer. Ammonia is subsequently removed by nitrification/denitrification in a sequencing batch reactor (SBR) converting ammonia to benign $N_2(g)$. Ion-exchange (IX) will be implemented to separate ammonia from the wastewater, allowing less COD introduction to the nitrification stage.

In our current research, the following bench scale experiments are being carrying out to optimize each module: (1) semi-continuous anaerobic digestion studies at varying solids retention times (SRT) and organic loading rates (OLR), (2) struvite precipitation experiments with varying magnesium and calcium concentrations and using aeration and chemical buffers for pH control, (3) IX adsorption isotherms experiments with different resins, and (4) adaption of a single sludge nitrification/denitrification culture to high salt and ammonia concentrations in a hybrid attached-suspended growth SBR. The results of these experiments will be presented at the conference.

Asci, Serhat

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Category: Social, behavioral, and economic aspects of nutrient management
Session Title: Posters - Social, Behavioral, and Economic Aspects of Nutrient Management

Costs, Returns, and Nitrogen Application Decisions in Florida Potato Production

This study examines fertilizer application decisions by Florida potato producers, and the potential effects of alternative fertilizer application rates on production costs and returns. The study area is northern Florida, where two main rivers – Suwannee River and the Lower St. Johns River – are classified as impaired with respect to nutrients. A Basin Management Action Plan (BMAP) for the Suwannee River Basin is expected to be completed in 2011. For the Lower St. Johns River Basin, BMAP was adopted in 2008, making best management practices (BMPs, including fertilizer management) mandatory for the potato producers (Section 403.067 (7) (d), Florida Statutes). By definition, agricultural BMPs should be “practical and cost-effective” (FDACS, 2010), and hence, economic analysis should be conducted as a part of the BMP development process. To examine the potential effect of alternative fertilizer application rates on potato production costs and returns, we employ the following methods: a survey of potato producers about the determinants of their fertilizer application decisions, a partial budget analysis to explore the sensitivity of production costs and returns to key economic parameters, and the production risk analysis to examine the changes in production returns associated with the variations in fertilization practices. Preliminary analysis shows that production costs and returns are highly sensitive to the changes in yields, and hence, even weak perceived association between fertilizer application rates and yields can create incentives for the growers to increase the fertilizer use.

Bae, Hee-Sung

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Category: Nutrient dynamics and enrichment impacts in aquatic ecosystems

Session Title: Posters - Nutrient Dynamics and Enrichment Impacts in Aquatic Ecosystems 1

Nitrogen Fixation along a Nutrient Gradient in the Florida Everglades: Distribution and Concentrations of *nifH* Genotypes and Nitrogenase Activities

The Florida Everglades is historically limited in phosphorus; however, runoff from the Everglades Agricultural Area has resulted in a gradient in phosphorus concentrations running into the interior of the northern Everglades. Phosphorus enrichment resulted in a shift from P- to N-limitation along the gradient, such that a detailed understanding of the impacts of P-enrichment on the nitrogen cycle is needed for a complete understanding of nutrient impacts and restoration ecology in the Everglades.

This study aimed to investigate nitrogen fixation rates and the distribution of genes encoding dinitrogenase reductase (*nifH*) in soils along the nutrient gradient in Water Conservation Area 2-A, including a site previously exposed to high levels of nutrients (F1), a transition site (F4), and a site unimpacted by nutrient additions (U3). At the 0-2 cm depths, the highest acetylene reduction rates were observed in F4 (33 $\mu\text{mol C}_2\text{H}_4/(\text{g soil}\cdot\text{h})$), followed by F1 (15 $\mu\text{mol C}_2\text{H}_4/(\text{g soils}\cdot\text{h})$) and U3 (1.4 $\mu\text{mol C}_2\text{H}_4/(\text{g soils}\cdot\text{h})$). These general trends were corroborated by ^{15}N uptake studies. These rates are in good agreement with the abundance of *nifH* measured by a real-time PCR: F4, 7 $\times 10^4$; F1, 5 $\times 10^3$; U3, 109 (in gram soil). The

nitrogen-fixing microbes using *nifH* clone libraries indicated that a broad range of phylogenetic groups, including representatives of the Alpha-, Beta-, Gamma-, and Epsilonproteobacteria, Firmicutes (primarily *Clostridium* sp.), and other anaerobes. Significantly, sequences related to methanogenic Archaea were detected in all sites, with the greatest proportion observed in F4 (~32%) compared with other sites (F4, 9%; U3, 12%). Hydrogen, a common substrate for methanogenesis, was demonstrated to be a favorable substrate for anaerobic nitrogen fixation. These observations indicate that hydrogen is an important factor regulating both nitrogen-fixation rates and methanogenesis in Everglades.

Bays, James

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Category: Innovative biological, physical, and chemical nutrient reduction & recovery technologies

Session Title: Innovative Biological, Physical, and Chemical Nutrient Reduction & Recovery Technologies 2

Natural Treatment Recharge Strategies for Water Conservation, Nutrient Load Reduction, and Aquatic Ecosystem Protection

Nutrient and mass loading criteria are being proposed to support the protection and restoration of Florida's sensitive surface waters from excessive nutrient loading. Similarly, minimum flows and levels for aquifers, wetlands, lakes and streams are defined to achieve resource protection goals. Natural treatment systems offer a management strategy with a benign capacity to reduce nutrient loading and replenish aquifer levels. This approach centers on the use of constructed wetlands as vegetated infiltration basins or as natural pretreatment systems for nutrient and contaminant load reduction. Treatment wetlands have a successful track record of innovative application in Florida since the 1970s. A number of treatment wetland projects constructed over the past 15 years have, by opportunity and design, combined the need for water quality improvement with the potential for passive infiltration of treated waters. Treatment through wetland soils improves water quality over that due just to infiltration; the anaerobic soil and root environment provides opportunities for coupled nitrification/denitrification, organic carbon degradation, and phosphorus assimilation.

Illustrative examples include Palm Beach County Water Utilities' Wakodahatchee Wetlands and Green Cay Wetlands; also the Village of Wellington's Peaceful Waters Sanctuary. Each of these systems provides aquifer recharge through passive percolation basins. Valued as wetland parks by the community, these systems conserve open area and provide diverse, functional wetland wildlife habitat in some of the state's most developed urban centers. Other recent projects combine treatment and recharge in different ways. The CF Industries Aquifer Recharge and Recovery Project in Hardee County includes initial stages of wetland pretreatment and sand filtration, followed by direct aquifer recharge by injection. The Gainesville Regional Utilities Kanapaha Water Reclamation Facility Groundwater Recharge Wetlands is testing vegetated wetland basins to determine maximum hydraulic loading and nitrogen assimilation rates. This presentation will show how these projects describe feasible strategies for sustainable mass load reduction and water recovery through wetland and aquifer recharge.

Bhadha, Jehangir

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Category: Innovative biological, physical, and chemical nutrient reduction & recovery technologies
Session Title: Posters - Innovative Biological, Physical, and Chemical Nutrient Reduction & Recovery Technologies

Evaluating the role of Aquatic Vegetation on Phosphorus Loads in the Everglades Agricultural Area

Farm canals in the Everglades Agricultural Area contain an abundance of floating aquatic vegetation (FAV) and submerged aquatic vegetation (SAV). These species flourish in waters with high phosphorus (P) concentrations and can prevent the co-precipitation of P with the limestone bedrock (CaCO_3). To test the effects of FAV and SAV and the presence of sediments on water quality in the canals, a lysimeter experiment was set up and sTOC_Toped with FAV (water lettuce) and SAV (filamentous algae). Our goal was to test the existing strategy of phytoremediation to reduce P concentrations through plant uptake. The experiment consisted of four treatments with four replicates, and four water exchanges. The four treatments consisted of: (i) limerock, sediment, and FAV, (ii) limerock, sediment, and SAV, (iii) limerock and FAV, (iv) limerock and SAV. The P concentration in all treatments was reduced significantly after each water exchange. Treatments without sediments showed a higher efficiency for P removal in the water samples. The sediments showed a significant difference in P content after the four exchanges. Results from this study were compared to field based observation of eight local farms and used to estimate overall P loads and uptake coefficients. We hypothesize that the presence of vegetation will initially result in a reduction in P-concentration; however will only serve as a short-term sink because of their high turn-over rate and production of labile high-P sediment (floc).

Bhomia, Rupesh

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Category: Innovative biological, physical, and chemical nutrient reduction & recovery technologies
Session Title: Posters - Innovative Biological, Physical, and Chemical Nutrient Reduction & Recovery Technologies

Accretion and Storage of Phosphorus in Recently Accreted Soils (RAS) in the Stormwater Treatment Areas (STAs) of the Everglades Basin

Stormwater Treatment Areas (STAs) are constructed to reduce phosphorus (P) loads to the Everglades Protection Area (EPA). Six STAs (18,000 ha) were strategically located to reduce P loads to the EPA. These STAs have been in operation for varying time periods and are differentiated into cells having emergent and submerged aquatic vegetation. Soil cores were collected from three STAs and sectioned at 2 cm depth interval. Physico-chemical properties – bulk density, total P, total nitrogen (N), total carbon (C) and isotopic ratios of carbon ($\delta^{13}\text{C}$) and nitrogen ($\delta^{15}\text{N}$) were determined. Depth profiles were plotted using these variables to identify the change point as an indicator for boundary between recently accreted soils (RAS) and pre-STA soil. Average change point depths from different variables were used to calculate the mean depth of recently RAS. The depth of RAS was found to be 15 ± 5 cm in STA-1W (16 years), 11 ± 3 cm in STA-2 (10 years) and 10 ± 5 cm in STA-3/4 (6 years). The soil accretion rates (cm/yr) were 1 ± 0.3 , 1.2 ± 0.3 and 1.7 ± 0.8 for STA-1W, STA-2 and STA-3/4 respectively where as phosphorus accretion rates (g/m^2 /year) were 1.3 ± 0.6 , 1.9 ± 0.9 and 3.3 ± 2.0 for STA-1W, STA-2 and STA-3/4 respectively. The comparison of soil accretion rates among the STAs with varying years of operation is aimed towards understanding the effects of age on operational efficiency of these constructed wetlands.

Blair, Susanna

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Category: Governance approaches to nutrient management
Session Title: Posters - Governance Approaches to Nutrient Management

Outstanding Florida Waters: Water Quality Analyses

Through the Outstanding Florida Water (OFW) designation, the State of Florida provides a high level of protection for the water quality of a water body. The OFW Rule establishes an anti-degradation standard for the “existing ambient water quality” at time of designation from which no new permitted degradation may occur. However, this anti-degradation standard may be unenforceable due to the paucity of water quality measurements, from the date of designation to present. In this study, publicly available Florida STORET and Florida Legacy STORET water quality data were analyzed for a subset of OFWs. This subset of OFWs includes 77 fresh water streams and rivers, both Managed (those wholly within designated public land) and Special (those designated by local resident petition) OFWs. The data associated with eight water quality metrics - salinity, nitrogen, phosphorus, dissolved oxygen, chlorophyll, biological oxygen demand, and turbidity - that indicate changes in water quality driven by anthropogenic activities were analyzed. The first phase of this study determines whether sufficient data exist to assess a change in water quality since time of designation for each OFW. Preliminary work shows that adequate data may not exist for some OFWs. While some OFWs have at least one sampling location with greater than 10 years of regularly sampled water quality data, other OFWs have many sampling locations and a variety of data that only represent short sampling periods, and may not be sufficient to establish trends. This research suggests that for many OFWs it may not be possible to determine whether degradation has occurred with data-driven certainty. For those water bodies with sufficient water quality data on the date of designation, trends in water quality are examined in order to explore whether the water bodies have degraded since time of designation.

Bolques, Alejandro

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Category: Efficacy of nutrient source control strategies
Session Title: Posters - Efficacy of Nutrient Source Control Strategies 1

Application of a bioretention/rain garden system to mitigate irrigation runoff from a container plant nursery production bed

Bioretention and rain garden systems are stormwater management strategies designed to capture, retain or detain surface runoff to slow the flow, promote plant root uptake of contaminants and encourage soil infiltration. Benefits to the environment associated with bioretention/rain gardens include: improved water quality, enhanced groundwater recharge, suspended particle reduction, reduced surface flows and associated erosion, habitat creation for birds, butterflies and beneficial insects. In 2008, a bioretention/rain garden was installed at a container plant nursery in north Florida to evaluate the effectiveness of the system to mitigate nutrients in runoff from an ornamental plant production bed. Three native plant species were installed in one of two gardens with the other left unplanted. Nutrient analysis for nitrogen, phosphorus and zinc contaminants, pre and post exposure to the rain garden, has shown nutrient reductions for ammonia, nitrite, nitrate-nitrogen and phosphates. It is anticipated that results from this study will supplement container plant nursery production bed irrigation runoff management practices.

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Category: Efficacy of nutrient source control strategies
Session Title: Social, Behavioral, and Economic Aspects of Nutrient Management 1

Public Attitudes and Perceptions about Water Issues in Southern US

Public Attitudes and Perceptions about Water Issues in Southern US

Tatiana Borisova¹, Damian Adams¹, Diane E. Boellstorff², Jon Calabria³, Jason Evans³, Bob Mahler⁴, and Michael Smolen⁵
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A public survey of water-related attitudes was implemented as a mail-out survey in 2008 – 2010 in nine southern US states: Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, Oklahoma, Tennessee, and Texas. The survey instrument for each state included approximately 60 questions to gauge perceptions about a wide range of water resource issues, as well as to provide background socio-economic and demographic information. Overall survey response rate was 50% (with 3,162 completed surveys). Thirty five percent of respondents indicated that they did not know what the watershed is, and 43 to 55% of respondents answered “I do not know” to the question about pollutants affecting surface and ground water quality, which indicates the need for public education programs. Among 12 potential surface and ground water pollutants, nitrate and phosphate fertilizers and pesticides were selected most frequently (i.e., by approximately 40% of respondents). The responses differed among the states, with 52% of Florida respondents concerned about the fertilizer water pollution, compared to only 30% of Alabama respondents. Surprisingly water quality problems were frequently attributed to industries (42% of respondents), while such pollution sources as agriculture – crops, stormwater runoff, new development, and erosion from roads were selected by 27% – 28% of respondents. Almost half of respondents (49%) believed that local governments are fulfilling their responsibility for protecting water resources in their communities moderately to very well (compared with only 31% for federal and state governments, and 28% for individual citizens). Overall, the survey results indicate that general public in southern US is concerned about nutrient water pollution, but the level of concern and knowledge varies among the states and respondents’ socio-demographics, implying possible differences in the level of support for water quality policies.

Bottcher, Del

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Category: Innovative biological, physical, and chemical nutrient reduction & recovery technologies
Session Title: Understanding Natural, Anthropogenic and Legacy Sources of Nutrients 2

Modeling Anthropogenic Impacts in Florida Watersheds

Hydrography and land use changes and the associated accumulation of nutrients caused by anthropogenic development have resulted in significant hydrologic and ecological impacts to many Florida waterbodies such as; streams, springs, rivers, lakes, and estuaries. To evaluate these anthropogenic impacts, it is necessary to effectively predict the watershed responses under both current and predevelopment (native) conditions. The Watershed Assessment Model (WAM) has long been used to simulate existing and future land conditions, but more recently techniques have been developed to use the model to simulate the historic or native land use and hydrography conditions. Correlations between soil characteristics and native vegetation are used to generate predevelopment land cover maps and then soil and topographic data with historical aerial photographs are used to generate the original native hydrography. These datasets are generated within a Geographic Information System (GIS) data management system so they can be integrated into WAM for simulation. Existing versus predevelopment WAM simulations have assisted in setting nutrient targets for several restoration programs, including Total Maximum Daily Loads (TMDL) and Water Management District regulatory and restoration programs. Three case studies in central and south Florida will be presented to demonstrate the usefulness and potential limitations of such assessments.

Boyer, Treavor

Authors: **Treavor Boyer**, University of Florida

Category: Innovative biological, physical, and chemical nutrient reduction & recovery technologies

Session Title: Innovative Biological, Physical, and Chemical Nutrient Reduction & Recovery Technologies 1

Potential for Phosphorus Recovery and Beneficial Reuse

Phosphorus has traditionally been viewed as a pollutant because of its adverse ecological impacts on water resources. As such, treatment of phosphorus-rich water sources and waste streams has focused almost exclusively on removal technologies that prevent phosphorus release to the aquatic environment. By viewing phosphorus as a pollutant that must be removed at all costs; it fails to recognize that phosphorus is a valuable material resource with beneficial uses. Moreover, recent analysis of phosphate rock reserves has estimated that we are nearing the peak in available phosphate rock, i.e., peak phosphorus analogous to peak oil. The availability of phosphate rock is of critical concern on a global scale because phosphorus is a key nutrient for healthy plant growth, agricultural production, and food security. Hence, there is rapidly growing interest in technologies that recover phosphorus from water sources and waste streams, and allow the phosphorus to be reused for a beneficial purpose such as fertilizer. This presentation will highlight experimental and theoretical considerations related to phosphorus recovery from two different systems: (i) a floating island treatment system designed to remove phosphorus from streams draining into a lake and (ii) source separation and treatment of human urine as a new paradigm in wastewater management. In both systems adsorption is used to selectively recover phosphate from solution. Phosphate can then be precipitated and reused in various mineral forms including struvite and calcium phosphates, or reused as phosphate-loaded adsorbents.

Boyer, Mackenzie

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Category: Water Conservation and Use
Session Title: Posters - Water Conservation and Use 1

Do Florida Friendly Landscaping Homes Reduce Irrigation?

The Florida-Friendly Landscaping (FFL) program has been promoted as a method to conserve water through reduced irrigation (FS 720.3075 (4)(a)), but the actual savings has not been quantified. Success stories with measurable savings for FFL recommendations tend to have been implemented on a subdivision-scale, with most savings occurring in common areas and due to improvements in irrigation practices. The irrigation savings of individual FFL recognized homes has not been documented. This project seeks to estimate actual irrigation water use of FFL homes in Pinellas County, FL and quantify irrigation reduction relative to similar non-FFL homes.

Irrigation water use volumes will be calculated using total monthly potable water data for a subset of FFL homes and their neighbors. Homes have a single water meter that includes indoor and outdoor use. The outdoor (irrigation) water use will be calculated from the total use using three methods of separating indoor and outdoor flows: minimum month, winter average, and per capita indoor.

Irrigable area will be determined using high resolution images. Two irrigable areas will be calculated for each home: the actual irrigable area of the Florida Friendly Landscaping, which will assume that ornamentals do not require irrigation, and the maximum irrigable area. The theoretical irrigation demand for each home and each irrigable area assumption will be calculated using crop coefficients and the ASCE-EWRI standardized evapotranspiration equation.

The theoretical irrigation demand of the maximum irrigable landscape is the maximum irrigation required, whereas the theoretical irrigation demand of the Florida Friendly Landscape is the minimum irrigation required. The estimates of actual irrigation use will be compared to these values to determine how much water, if any, FFL homes are conserving and if the homes have maximized their savings. The FFL homes will also be compared to non-FFL neighbors to determine if similar conservation habits exist.

Brown, Amy

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Category: Nutrient dynamics and enrichment impacts in aquatic ecosystems
Session Title: Posters - Nutrient Dynamics and Enrichment Impacts in Aquatic Ecosystems 1

The Impact of River Water Intrusion on Nutrient and Trace Metal Concentrations in the Floridan Aquifer System at Madison Blue Spring, Florida

Springs located adjacent to rivers can serve as recharge points for aquifers when river stage increases above the spring stage, forcing river water into the spring. Differences in water composition of the surface water and groundwater may be important to nutrient (nitrate and phosphate) and micronutrient (trace metal) concentrations. To assess how intrusion may affect these concentrations during spring reversals, we monitored Madison Blue Spring, which discharges to the Withlacoochee River in north-central Florida, during a period of elevated river stage in April 2011. Intrusion of the river water was observed to last about 20 days with electrical conductivity, temperature and depth sensors installed within the cave system and adjacent wells. The main spring vent and Martz sink, a karst window approximately 150 meters from the spring vent, were sampled seven times over a period of 34 days during and after the decrease in specific conductivity. The samples were measured for nitrate and phosphate, as well as trace metals that serve as micronutrients, such as iron.

Nitrate concentration in the river was an order of magnitude lower than the concentration of the spring water, so river water intrusion decreased nitrate concentration in the groundwater consistent with mixing of two water sources. In contrast, river water had elevated phosphate and trace metal concentrations compared with the spring and thus represented a source of these elements to the aquifer. Spring water iron concentrations are elevated following river intrusion, but mixing calculations suggest that some iron transported into the springs precipitates within the aquifer. Elevated phosphate concentrations can be explained by mixing during river water intrusion, but increased phosphate concentrations observed approximately 30 days after river water intrusion must come from another source. This increase could be due to desorption of phosphate from iron oxides which precipitated during river water intrusion.

Byrd, Seth

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Category: Water Conservation and Use
Session Title: Posters - Water Conservation and Use 2

Optimizing Irrigation of Florida Potato

Additional Author: Ashok Alva, USDA ARS, Prosser, Washington
Irrigation is pivotal in commercial potato production for generating a high yield, but infrastructure and pumping costs can be prohibitive. Proper irrigation scheduling is key to sustainability; this is especially true during the crop developmental period when tubers are filling (tuber bulking) and crop water use is maximal. In an attempt to reduce irrigation input with a minimal reduction in yield, we will evaluate a deficit irrigation treatment utilizing mild water stress during tuber bulking stage in a commercial potato field in Florida. Plant physiological processes, water movement within the plant, and nutrient levels in the plant and soil will be measured to evaluate the effect of altered water application on soil and plant processes. Soil moisture sensors will provide seasonal soil moisture percentage levels. Sap flow collars, which measure the velocity of xylem flow, will be installed in close proximity to the soil moisture sensors to provide a correlation between soil moisture and plant transpiration measurements. Additional physiological measurements will be taken three times during the tuber initiation and bulking period including: leaf area index, stomatal conductance, fluorescence, SPAD chlorophyll content, and stem water potential. Soil and plant nutrient analyses will include soil sampling for fertility analysis and nitrogen extraction; installation of plant root simulation probes (PRS™) for plant available nutrients; and petiole samples for nutrient levels within the plant. This project will test whether applying a mild water stress during tuber bulking can maintain or cause minimal losses in potato yield. Physiological trigger points representing plant stress level may be identified which indicate when water stress could be imposed or halted without a major yield decrease. Overall, this project may lead to a more profitable and sustainable system for commercial potato irrigation.

Chakraborty, Debolina

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Category: Nutrient dynamics and enrichment impacts in aquatic ecosystems
Session Title: Posters - Nutrient Dynamics and Enrichment Impacts in Aquatic Ecosystems 1

Phosphorus Dynamics in the Kissimmee River Sediment and Floodplain Soils

Channelization of the Kissimmee River in south-central Florida in the 1960's led to the degradation of the ecosystem in the river basin. Since the 1990's attempts were made to restore portions of the Kissimmee River and floodplain to its original state. Environmental risk of P loss from sediment/soils can be evaluated using phosphorus saturation ratio (PSR; molar ratio of P to [Al+Fe]) and soil phosphorus storage capacity (SPSC) concepts. The change point (zero SPSC) amounts to a threshold PSR value above which P release from the soil increases. Positive SPSC indicates a soil is a P sink, while a negative value indicates that the soil is a P source. The objective of this study was to evaluate the P retention and release using the SPSC concept for the areas that have been already restored (Phase I) and the areas to be restored (Phase II-III). Surface soil samples (0-10 cm and 10-20 cm) from 115 predetermined sites from both Phase I and Phase II-III were collected resulting a total of 460 samples (2 depth * 2 phases * 115 sites). Soils were analyzed for P, Fe, Al, Ca and Mg in a Mehlich 1 solution at a 1:4 soil:solution ratio. Water soluble P (WSP) was analyzed in a 1:10 soil:water extract. Total P (TP) and total metals, TFe, TAl, TCa and TMg, were determined for all samples. While the TP for some samples were high (up to ~4000 mg kg⁻¹), WSP was minimal indicating low P release risk. The relationship of SPSC and WSP for the floodplain soils and sediments was different compared to that from fertilizer-impacted soils suggesting that non-anthropogenic sources were involved in regulating P release at this river basin.

Chevasco, Daniela

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Category: Social, behavioral, and economic aspects of nutrient management
Session Title: Posters - Social, Behavioral, and Economic Aspects of Nutrient Management

Can Fertilization in Pine Straw Production Threaten Water Quality?

Florida Forest Service county foresters were requested to update a list of pine straw producers and provide general information about pine straw production in their county. The response rate was 77% and most pine straw producers identified were in North Florida. Using the updated list, a second survey was mailed to pine straw producers to obtain information about the extent, location and magnitude of fertilization for pine straw production in North Florida. This survey explored trends in production, pine species raked, leasing costs, pine straw yields, price per bale, raking and fertilization practices, use of herbicides and the presence of the invasive Japanese climbing fern. The second survey response rate was 28%, representing 32,214 raked acres. Slash pine (*Pinus elliottii* L.) was the preferred species for straw raking, representing 89% of surveyed acres. Fifty percent of the surveyed producers were fertilizing, and of these 94% fertilized pine stands on sandy soils. However, only 17% have consulted an extension agent or consultant for fertilization recommendations. Moreover, soil testing was not done by 39% of producers that fertilized. Surveyed producers showed little knowledge about the type and amount of fertilizer that was applied. However, 69% of the surveyed producers were interested in learning about fertilization. Fertilizers were mostly applied during the spring (53%) but there were also applications during the fall and winter, when nitrogen fertilizer use is less efficient. Information from this survey can facilitate extension education efforts to promote sustainable pine straw production following BMPs to protect water quality.

Cohen, Matthew

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Category: Nutrient dynamics and enrichment impacts in aquatic ecosystems

Session Title: Nutrient Dynamics and Enrichment Impacts in Aquatic Ecosystems 2

Decoupling Riverine Nitrogen Uptake and Denitrification from the Geometry of Diel Nitrate Variation

Diel variation in nutrient concentrations, particularly nitrate and phosphate, have been observed in rivers, estuaries and lakes. This diel concentration signal aggregates interactions between biota and their abiotic environment - specifically autotrophic assimilation, abiotic binding (in the case of P), and dissimilatory removal (in the case of N) - into a coherent response at the ecosystem scale. To date, inference for nitrogen has focused exclusively on the magnitude of diel nitrate variation, from which rates of biological uptake have been computed, and against which diel production of oxygen from photosynthesis can be compared. Implicit in this is the assumption that assimilation is solely responsible for diel variation, and thus that denitrification is constant. However, isotopic evidence from the Ichetucknee River suggests that this assumption is poorly supported, and that denitrification may vary significantly in response to oxygen variation, which inhibits denitrification during the day. Repeated UV nitrate sensor deployments in Florida and elsewhere, during which nitrate measurements are made every 15 minutes, have revealed consistent and important asymmetry in the shape of the diel concentration curve with steeper declines at the leading edge. This work focuses on nitrate variation, and investigates the hypothesis that asymmetrical diel curve geometry derives from asynchronous removal pathways, with assimilation variation leading variation in denitrification. The mechanism for this asymmetry follows from the time required for oxygen produced from photosynthesis to diffuse into the sediments and inhibit denitrification; in short, we predict that the curve geometry arises from the addition of two signals that are slightly out of phase. We develop a simple 6 parameter model of nutrient removal that couples two diurnally varying processes (uptake and denitrification); model parameters describe the mean, diurnal amplitude and phase of each process, and we use inverse modeling to estimate them. The method may permit deconvolution of these two important removal processes simultaneously from a single diel concentration signal, providing more accurate estimates of both, and allowing improved understanding of the controls on their magnitude and variation.

Colli-Dula, Reyna

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Category: Nutrient dynamics and enrichment impacts in aquatic ecosystems
Session Title: Posters - Nutrient dynamics and enrichment impacts in aquatic ecosystems 2

Understanding of Benzene and Trichloroethylene Effects in Largemouth Bass Using Microarrays

Benzene and trichloroethylene (TCE), known environmental pollutants, have been detected in aquatic systems causing adverse effects in fish. This is due to high usage and release of both industrial discharges and releases during oil extraction and transport as well as to high mobility of these compounds in the atmosphere. One way to explore mechanisms of toxicity of these compounds is through quantification of gene expression in fish. We used microarrays to investigate changes in gene expression caused by exposure to benzene and TCE in largemouth bass. Twelve fish were injected in each group for vehicle control as well as for each treatment (using a single dose of benzene or TCE 10 mg/kg b/w). After injection, the fish were sacrificed at 48h. Livers and gonads were obtained and analyzed for gene expression changes using microarrays. The hypothesis was that concentrations used for benzene and TCE would produce changes in sensitive genes. Resulting ANOVA analysis in the liver revealed 1272 and 1116 genes were significantly affected (p

Dari, Biswanath

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Category: Understanding natural, anthropogenic and legacy sources of nutrients
Session Title: Posters - Understanding Natural, Anthropogenic and Legacy Sources of Nutrients

Soil Phosphorus Dynamics in a Dairy Farm during a Seven-year Period

Continuous application of dairy manure leads to increased phosphorus (P) accumulation in the soil resulting in P loss via surface and subsurface drainage. This study evaluated changes in P storage and release from soil profiles at three locations in a dairy farm – holding, pasture and sprayfield – located on an Ultisol in the Suwannee River Basin, Florida. Soil sampling (to 5m) was conducted in 2000 and 2007 at 0.5m depth intervals with four replicates at each location. Mehlich 1-P and metals were analyzed for all soils; soluble reactive P (SRP) was determined for the 2007 soils. The soil P storage capacity (SPSC) was calculated: $SPSC = (0.1 - \text{Soil PSR}) * [(Fe/56) + (Al/27)] * 31 * 1.3 \text{ (mg kg}^{-1}\text{)}$ where PSR, the P saturation ratio, is the molar ratio of P to (Fe+Al) in the Mehlich 1 extract. In 2000, SPSC (kg ha⁻¹) was negative to 0.5 m depth for the holding (-2290) and pasture (-40), but positive for the sprayfield (80). The trend in SPSC was similar, though lower, in 2007 for the holding (-5900), pasture (-1840) and sprayfield (-120) locations. SPSC values to 5m-depth decreased from 2000 to 2007 for all locations. Negative SPSC indicate that soils are a P source; SRP values ranged from almost zero at the sprayfield to 4.7 mg kg⁻¹ at the holding area for the 0.5m-depth in 2007. Depth to the clay layer was variable, from 1.0m at the sprayfield to ~2.0m at the dairy pasture. Since SPSC was lower at the lower depths in 2007 compared to 2000, it appears that P has moved below the clay layer. Thus, there has been substantial reduction in SPSC, particularly in the upper 0 to 0.5m depth, and increase in P release during the seven-year period suggesting increased degradation in water quality leaving the farm.

Davis, Stacia

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Category: Water Conservation and Use
Session Title: Posters - Water Conservation and Use 2

Finding the Right Customer: Will Smart Irrigation Controllers Increase Irrigation?

It is essential to determine better methods to manage residential irrigation so that landscapes are irrigated based on plant water needs. The objective of this study was to determine if ET controllers can reduce over-irrigation using scheduling techniques based on evapotranspiration and rainfall estimations in a soil water balance instead of relying on a user-selected time-based schedule. Twenty-one signal-based evapotranspiration (ET) controllers were installed on cooperating homes across three locations within Hillsborough County in southwest Florida. The remaining 15 cooperators were asked to maintain their current irrigation practices as a comparison group. The treatments were compared to a predicted irrigation requirement, calculated using a daily soil water balance, as well as historical average irrigation application. Results from spring 2009 showed that all treatments applied less water compared to the predicted irrigation requirement in all locations with reductions ranging from 6% to 84% and water savings of 9% to 78% compared to their historical averages. Additionally, results from fall 2009 were similar with reductions of 38% to 75% from the predicted irrigation requirement and water savings of 23% to 56% from the historical average. In general, turfgrass quality declined with increasing water savings except in one location where turfgrass quality wasn't affected despite significantly less average irrigation application than the other treatments. The ET controllers increased irrigation application at homes where historical irrigation was less than 450 mm/yr. Targeting homes with historically high water use would maximize the benefit of using an ET controller while homes that traditionally practice deficit irrigation practices would see increases in irrigation application such as in this study. Despite larger reductions in water use by the comparison group, the ET controller group generally had higher turfgrass quality suggesting cooperators in the comparison group were willing to sacrifice landscape quality during drought conditions.

Delesantro, Joseph

Authors: **Joseph Delesantro**, University of Florida, SFRC
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Category: Ecology
Session Title: Posters - Hydroecology

The Effects of Hydrologic Mean Condition and Variation on Wetland Structure and Function

An important debate in ecology considers the relative importance of mean condition vs. variation around that mean for controlling ecosystem structure and function. Wetlands provide a useful setting for examining this question because hydrology acts as the primary exogenous ecosystem driver and may exhibit large variation or fluctuate only slightly around the mean. Most previous studies have compared wetland study sites which vary greatly in mean condition but also in water chemistry, morphology, timing of flooding and dispersal characteristics, limiting independent evaluation of variation. Floodplain wetlands along the Silver River in north Florida provide an ideal hydrologic setting for a controlled natural experiment; stage variation near the spring boil is small so hydrologic conditions deviate only slightly from the mean condition, whereas downstream conditions, which are controlled by the flood regime in the Ocklawaha are highly variable, deviating from the mean with great amplitude and frequency. Where water level variation changes longitudinally, hydroperiod varies laterally across the floodplain creating two orthogonal gradients, which offer the opportunity to isolate their effects independently.

Our objective is to evaluate the hypothesis that variation around the mean is as important as the mean condition in controlling ecosystem structure and function. This is accomplished by contrasting the effect of hydrologic mean condition and variation on attributes of long-term ecosystem self-organization, including net primary productivity, surface morphology/microtopography, organic matter accumulation, and forest community structure. We selected 10 study sites, pairing a short hydroperiod (10-30% inundation) and long hydroperiod (40-60% inundation) located at each of 5 transects along the Silver River gradient in water level variation. We are in the preliminary stages of analyzing our results, and seek to separate responses of ecosystem attributes to hydroperiod and water level variation.

Demorest, Nichelle

Authors: **Nichelle Demorest**, UF/IFAS Columbia County Extension

Category: Innovative biological, physical, and chemical nutrient reduction & recovery technologies

Session Title: Posters - Innovative Biological, Physical, and Chemical Nutrient Reduction & Recovery Technologies

Providing for natural bio-filtering processes in an existing stormwater detention basin

Stormwater runoff is directed into detention basins from the impermeable roofing and paving surfaces that have replaced natural landscapes. Oil and grease from vehicles and other particulate matter that are deposited on the surfaces are washed into basins. Top soil, organic material and significant numbers of microorganisms have been removed during the construction of the basin. In areas of deep, predominantly sand basins, stormwater infiltrates quickly into the groundwater. Without plants, organic matter, or sufficient microbes, pollutants are not retained or adsorbed long enough to be degraded. To reestablish more natural bio-filtering processes, native plants were planted in groups throughout the basin floor and banks. Native plants tolerant of occasional flooding were planted in the low areas. The banks were planted with species tolerant of extended dry periods and have good roots systems to stabilize the banks. Composted hardwood fines were incorporated into the planting site of each grouping as introduction of organic material and microorganisms. The entire area was then covered with two to three inches of shredded hardwood mulch to keep down weeds, retain moisture, and add to the organic material. This biodiversity of native plants on site also sustains wildlife. The project was designed with the intent of sharing this information with builders and developers, and with homeowners interested in constructing rain gardens on their property. The project was funded through a grant from The Wildlife Foundation of Florida.

Dobbs, Nicole

Authors: **Nicole Dobbs**, University of Florida
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Michael Dukes, University of Florida
Kelly Morgan, University of Florida
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Category: Understanding natural, anthropogenic and legacy sources of nutrients
Session Title: Posters - Understanding Natural, Anthropogenic and Legacy Sources of Nutrients

Interactive Tool for Simulating Water and Nutrient Management in a Virtual Turfgrass System

With increasing demands on freshwater with increasing population in Florida, there is a need to promote water conservation practices by homeowners, including outdoor water use. Nutrient pollution from nonpoint sources such as residential land threatens water quality and is especially a concern in an urban setting because of the proximity to drinking water sources. The purpose of this virtual tool is to provide homeowners and landscape professionals with the knowledge to experiment and improve irrigation scheduling and fertilizer application practices to conserve water and reduce nutrient losses. The objectives are (1) develop simple model to simulate the soil water balance and nutrient losses based on site-specific soil characteristics, irrigation schedule, real-time weather data, use of water-saving irrigation device (e.g., rain sensor, soil water sensor, evapotranspiration controller), and type of fertilizer applied (i.e., soluble or slow-release nitrogen) and (2) provide homeowners and landscape professionals with an interactive tool to evaluate and improve irrigation scheduling and fertilizer application practices. The tool will be freely available on the Florida Automated Weather Network (FAWN) website. Based on site-specific user inputs (e.g., root zone depth, soil type, irrigation type, location), the tool will provide the user with feedback via email on the water volume applied, percent of nitrogen and water leached, number of water stressed days and nutrient stressed days, a visual graphic of the quality of the turf, and tips on improving irrigation and fertilization.

Douglass, Rachel

Authors: **Rachel Douglass**, University of Florida
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Category: Nutrient dynamics and enrichment impacts in aquatic ecosystems
Session Title: Nutrient Dynamics and Enrichment Impacts in Aquatic Ecosystems 2

Impacts of Stoichiometric Homeostasis by Algal and Vascular Plant Species Across an N:P Gradient

Homeostasis is an important negative feedback mechanism wherein organisms maintain internal constancy of elemental ratios despite variation in environmental resource concentrations. We investigated the degree of internal homeostatic regulation by algal and vascular plant species across an unprecedented N:P gradient to test the widely held hypothesis that both algal and vascular species will exhibit bounded stoichiometric plasticity, with algal taxa exhibiting less homeostatic regulation than vascular plant species due to differing nutrient storage strategies. Additionally, we tested the light:nutrient hypothesis that plants will display higher C:X ratios under higher light conditions. Florida's karst springs provide an ideal study site for this question because resource stoichiometry, flow and temperature are effectively constant, but the N:P molar ratio of spring vent water varies over three orders of magnitude across springs from 0.06 to 89:1. These spring ecosystems historically supported dense beds of submerged macrophytes including springtape (*Sagittaria kurziana*) and tape grass (*Vallisneria americana*); recently cyanophytes (e.g. *Lyngbya wollei*) and xanthophytes (e.g. *Vaucheria* spp.) have increased in abundance and often form thick algal mats near spring boils. We measured water chemistry (dissolved inorganic carbon; nitrate, the dominant form of N; and soluble reactive phosphorus for P) as well as plant tissue stoichiometry of these four dominant autotrophic species across 42 spring vent ecosystems spanning the gradient in N:P ratios. Our results demonstrate statistically significant differences in mean C:N, C:P, and N:P ratios of species; however we found no evidence in support of the light:nutrient hypothesis. Both algal and vascular species displayed significant ability to maintain homeostasis in the face of environmental variability. Furthermore, comparison of autotrophic stoichiometry with resource stoichiometry indicates differential food quality effects with respect to nitrogen and phosphorus concentrations among springs which carry important implications for higher trophic function and structure in these ecosystems.

Duan, Runbin

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Don Graetz, Soil and Water Science Department, University of Florida

Category: Efficacy of nutrient source control strategies
Session Title: Posters - Efficacy of Nutrient Source Control Strategies 2

Long-Term Nitrate-Nitrogen Trends in Groundwater and Soil at a Dairy Farm in the Suwannee River Basin

Potential nitrate pollution to groundwater has been an important concern at dairy farms in the Suwannee River Basin, Florida for many years. Various best management practices (BMPs) have been developed to reduce nitrate leaching from dairy farms. However, little information is reported on trends of nitrate-N at a dairy farm scale before and after implementing BMPs. The objective of this study was to determine long-term trends of nitrate in groundwater and soil from 2000 to 2007 including pre-BMP and post-BMP periods. One of four planned BMPs, rotation grazing, was implemented since 2004. Twenty one wells were installed at different representative points to monitor the groundwater quality at the dairy farm. Soil samples were taken to the depth of the continuous clay layer on a 5-week basis at locations providing a representative coverage of the various farm components. Mann-Kendall trend analysis was employed to determine the trends in nitrate-N and the change degree after detecting seasonality. Notched box plots indicated that there were significant differences between median soil nitrate-N at sprayfield, pasture, and cattle holding areas, and between median groundwater nitrate-N under different land uses. An increasing trend of nitrate-N was observed in pasture and sprayfield soils while an insignificant trend was observed in animal holding area soils. Nitrate-N in all three soils varied with change of season. An increasing trend of nitrate-N in groundwater was observed under intensive area and sprayfield, a decreasing trend of nitrate was observed under drainage area, and an insignificant trend was observed under pasture. Nitrate in groundwater under different land uses showed seasonal variance with concentrations greater than 10 mg/L. Spearman analysis did not show strong relationships between groundwater nitrate and rainwater, and between soil nitrate and rainwater. Comprehensive BMPs are strongly recommended to control nitrate leaching at dairy farms with similar field conditions.

Fan, Jinghua

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Jason Kruse, University of Florida, Environmental Horticulture Department

Category: Efficacy of nutrient source control strategies
Session Title: Posters - Efficacy of Nutrient Source Control Strategies 2

Effects of Different Soil and Water Treatments with Reclaimed Water Irrigation on Growth of Turfgrass

Reclaimed water (RW) is increasingly viewed as a resource for supplying irrigation water and nutrients for landscape plants growth in urban environments. The purpose of this study was (1) to determine if the nutrients (specifically N) in RW are available for turf plant nutrition and (2) to compare the effects of reclaimed and potable water on turfgrass growth and quality. Container experiments were conducted in a greenhouse on the UF campus using St. Augustine ('Floritam') and Zoysia ('Empire') turfgrass irrigated with reclaimed water. Treatments included irrigation with tap water (control), full irrigation with reclaimed water, irrigation with reclaimed water with additional 2, 6, or 10 mg/L N supply from ammonium nitrate, and a fertilizer treatment based on IFAS standardized N recommendation. Major and minor nutrients other than N were standardized across all treatments.

The average nutrient concentration of RW during summer season from the University of Florida wastewater treatment facility on campus is 1-3 mg/L for total N and 0.5 -1.5 mg/L for total P. The growth rate of turfgrass irrigated with reclaimed water was greater than that of lawn grass irrigated with fresh water. The N content from RW can offset the same nutrients supplied from fertilizer. The effect on the growth and quality of turfgrass from the irrigation treatment will be evaluated by plant dry matter yields and nutrient content.

Fitzgerald, Kiera

Authors: **Kiera Fitzgerald**, TSG Technologies, Inc.
Jesus Antelo, Ameresco
Duane Knecht, City of Miami Beach

Category: Governance approaches to nutrient management
Session Title: Governance Approaches to Nutrient Management 1

City of Miami Beach's Implementation of a MBR Scalping Plant

The best way to address nutrients in a watershed is to prevent them from ever getting there. Wastewater reuse presents an ideal means to divert nutrients from watersheds while mitigating over-pumping of aquifers. However, many utilities have deemed reuse unfeasible due to the cost to transport reclaimed water from remote treatment facilities to high volume, urban users.

With the advancements in Membrane Bioreactor (MBR) technology, the use of satellite plants that can “scalp” water from sewage at the source can make reuse a cost effective means of effluent disposal in some locations. MBRs have very small footprints and can produce high quality effluent under fluctuating flow conditions.

As part of an overall efficiency audit, Ameresco and TSG Technologies worked with the City of Miami Beach to initiate one of Florida's first true scalping plants to irrigate the Miami Beach Golf Course.

This project presented some unique opportunities for reuse, as well as some unique challenges. Due to excess salinity in the sewage in this area, the effluent was previously deemed unsuitable for irrigation. However, since the City's existing golf course utilizes a brackish water supply on salt tolerant Paspalum turf, the elevated salinity was not a major concern.

The major challenge for this project was not its technical feasibility, but it was obtaining the permits necessary to discharge effluent into the existing golf course pond system.

This paper documents the team's experience with recognizing the project's payback potential followed by their navigation of the permit process with the Department of Environmental Resources Management (DERM), Miami-Dade Water and Sewer Department (MDWASD) and the Florida Department of Environmental Protection (FDEP).

Flannery, Michael

Authors: **Michael Flannery**, Southwest Florida Water Management District
Xinjian Chen, Southwest Florida Water Management District

Category: Nutrient dynamics and enrichment impacts in aquatic ecosystems
Session Title: Nutrient Dynamics and Enrichment Impacts in Aquatic Ecosystems 1

Relationships of Water Age with Chlorophyll a Concentrations in the Eutrophic Lower Alafia River Estuary

The Lower Alafia River estuary, which flows to Tampa Bay, is highly nutrient enriched due phosphate mining, point source discharges, and nonpoint source runoff in its watershed. The Lower Alafia frequently has some of the highest chlorophyll a concentrations and phytoplankton counts observed in tidal rivers in west central Florida. Significant inorganic nutrient concentrations often remain in the water column during large phytoplankton blooms, indicating that physical factors strongly affect phytoplankton dynamics. The location of the peak chlorophyll a concentration in the river is related to the rate of freshwater inflow, with phytoplankton blooms moving upstream with decreasing flow. A regression was developed to predict the location of the chlorophyll peak as a function of freshwater inflow. The Southwest Florida Water Management District also developed a laterally averaged, two-dimensional hydrodynamic model of the lower river. The trajectory module of the model was used to simulate particle movements to estimate water age, or the time it takes for water to move from the head of the estuary to various locations in the river, at one kilometer intervals for eighteen rates of freshwater inflow. Curves then were generated to predict water age at these locations for flows in 1 cfs increments. Using these curves and gaged freshwater inflows, chlorophyll a values were matched with the estimated water age near each chlorophyll sampling location on that sampling day. Water ages in the lower river ranged from 50 $\mu\text{g/l}$ chlorophyll a concentrations occurred when water ages were in the range of 1.5 to 4 or 5 days at different locations in the river. These results were used with other findings to establish water quality and ecologically based limits to water supply withdrawals from the Alafia.

Friedman, Kenneth

Authors: **Kenneth Friedman**, University of Florida
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Category: Water Conservation and Use
Session Title: Posters - Water Conservation and Use 1

Data Validation Methodologies for Water Audits in Florida

This presentation focuses on data validation methodologies for water audits in Florida as part of a water conservation plan. Current procedures for estimating water losses in Florida are not uniform and the accuracy of the reported estimates of water loss is questionable. The quality of the water audit is directly dependent upon the quality of the input data. Friedman and Heaney (2009) evaluated the new third edition of the AWWA M36 manual titled Water Audits and Loss Control Programs (AWWA 2009a) and associated free software for evaluating water losses (AWWA 2009b). They recommend that Florida water utilities adopt the water audit and loss control procedures that are described in M36 including the water audit procedures outlined in Chapter 2. They also recommend using Version 4.0 of the AWWA Free Water Audit Software, which offers a top down method to compile water audit data and analyze loss levels and cost impacts.

The AWWA software requires that the user input estimates of up to 18 parameters. The reliability of these estimates ranges from excellent for measured water uses with accurate meters to poor for unsupported estimates of unmetered quantities. The AWWA software addresses the question of the validity of the data using a weighted scoring system that provides a normalized score ranging from 0 to 100 based on the user's estimates of the quality of the data.

Based on a detailed review of the 2009 AWWA M36 Manual on water audits and water loss, and the associated Version 4.0 software, we recommend estimating the validity of the water audit based on the percentage of metered water supplied and used for a relative importance metric, and the gallons per capita per day of unmetered water for an absolute metric of importance.

Gautam, Rajendra

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Category: Efficacy of nutrient source control strategies
Session Title: Posters - Efficacy of Nutrient Source Control Strategies 1

Is St. Augustine grass Environment Friendly From Nitrate Leaching Perspective?

Nitrogen (N) application is very important to maintain the aesthetic quality of turf. However, the frequent arguments about the possible chances of water pollution through nitrate-nitrogen ($\text{NO}_3\text{-N}$) have focused attention on N application in turf. Thus, this research was conducted at Citra, Florida to determine an environment friendly approach to N management in St. Augustinegrass. Ten fertilizer treatments comprised of different sources (soluble and controlled release), timing (with and without summer application) and doses (0, 146, 195 and 244 kg/ha) were laid out in randomized block design with four replications. Drainage lysimeters (57 cm diameter) were installed to collect leachate and the leachates were analyzed for $\text{NO}_3\text{-N}$. Both $\text{NO}_3\text{-N}$ concentration and $\text{NO}_3\text{-N}$ load of the leachate water were very low in relation to the fertilizer applied. The nitrate-N concentration of the leachate was always less than 0.3 mg/L irrespective of the season and amount of fertilizer applied. The leaching load of $\text{NO}_3\text{-N}$ was significantly higher (0.0035kg/ha) in mid-April as compared to other times of the year. Higher leaching load was observed during the slow growth period of the grass (March, April and May). With the increased growth rate after June, the nitrate leaching was reduced even if the rainfall events were more frequent during that period. Controlled release fertilizer (CRF) applied at the rate of 244 kg/ha N had similar effect on average $\text{NO}_3\text{-N}$ leaching load as 195 kg/ha N as ammonium nitrate or no fertilizer (0.007 kg/ha). The cumulative $\text{NO}_3\text{-N}$ leaching load was not significantly different among treatments. The results of the research point out that the $\text{NO}_3\text{-N}$ leaching from the turf is minimal even at a higher rate of fertilizer (244 kg/ha N). Very low concentration (

Gazula, Aparna

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Category: Efficacy of nutrient source control strategies
Session Title: Posters - Efficacy of Nutrient Source Control Strategies 2

The Blue Dye Doesn't Lie: On Farm Demonstration of Water Movement in Plastic Mulched Beds.

Given the low water holding capacity of Florida's coarse textured soils the vegetable growers using drip irrigation oftentimes over-irrigate to maintain adequate moisture levels within the crop root zone. N-P-K fertilizers are highly water soluble, and as growers mismanage the irrigation water application, they generally tend to over-fertigate to compensate for the loss of nutrients from the plant root zone. These practices of over irrigating/fertigating may not only increase leaching of nutrients into the ground water, but also increase crop production costs. Therefore, to demonstrate visually the wetting pattern of drip irrigation water in Florida's sandy soils, soluble blue dye (Terramark SPI High Concentrate, ProSource One, Memphis, TN) was injected into the drip tube of plastic mulched beds at 1:49 (v:v) dye-water dilution rate for approximately 10-minutes. The dye injection was done with a portable battery operated pump prior to an irrigation cycle. At the end of the irrigation cycle, transverse and longitudinal sections of the mulched bed were carefully dug with a shovel. Each hole was dug deep enough to see the bottom of the dye. The blue dye patterns in the soil definitively demonstrate water movement in plastic mulched beds. The depth and width of the wetted front varies with soil type, length of irrigation and flow rate. Several on-farm demonstrations presented throughout the Suwannee Valley area have shown that vegetable growers are more likely to try and adopt Best Management Practices when they actively participate in the educational process than when production changes are mandated through legislation.

Gilbert, Douglas

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Douglas Gilbert, Florida Department of Environmental Protection

Category: Nutrient dynamics and enrichment impacts in aquatic ecosystems
Session Title: Nutrient Dynamics and Enrichment Impacts in Aquatic Ecosystems 1

Lake Munson: Spatial and Temporal Changes in Nutrient Characteristics of Sediments During a Drawdown Event

Lake Munson, located within Leon County, is a 255-acre lake with a 53 square-mile (mi²) drainage area. The lake is impaired due to an elevated Trophic State Index, caused by excessive loadings of nutrients. A lake drawdown occurred from November 2010 through May 31, 2011. The Watershed Evaluation and TMDL Section, within the Florida Department of Environmental Protection, conducted a sediment biogeochemical study to quantify temporal and spatial changes in nutrient composition of lake sediments during February through May of the drawdown. During the study, weekly flows and metered parameters were measured in the "creek" that flowed across the bottom of the dry lake bed. Monthly water quality samples were collected in the creek at the inlet, in a pooled area mid-lake, and the outlet. Samples were collected at these locations for chloride, sulfate, alkalinity, ammonia, Kjeldahl nitrogen, nitrite-nitrate, ortho-phosphate, and total phosphorus. During February, a onetime sampling for pore water was conducted in the shallow pool located mid-lake. Pore water was withdrawn from ten core sections and analyzed for chloride, sulfate, ortho-phosphate, ammonia, and nitrite-nitrate. In addition, monthly sediment sampling was conducted at 19 stations established along gradients on the exposed lake bed. The top 2 cm of sediments were collected and analyzed for organic carbon, total carbon, ammonia, nitrite-nitrate, Kjeldahl nitrogen, ortho-phosphate, total phosphorous, and percent solids. The biogeochemical oxidation/reduction in sediment was of particular interest, to gain an understanding of the importance of in-situ nutrient regeneration during the drawdown. Preliminary results obtained from pore water and surface water quality data indicate that the organic-rich sediments resulted in elevated levels of NH₄ and PO₄ in the pore water. Preliminary results (February) for sediment analysis indicate ammonia-N ranged from 0.28 mg N/Kg sediment to 490 mg N/Kg, with highest values near the inlet and lowest values near the outlet.

Gioeli, Kenneth

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Category: Nutrient dynamics and enrichment impacts in aquatic ecosystems
Session Title: Posters - Nutrient dynamics and enrichment impacts in aquatic ecosystems 2

Hydrilla IPM RAMP- Starting a Statewide Project

Hydrilla verticillata (a.k.a. hydrilla) is an invasive freshwater plant common in Florida. If left unmanaged, hydrilla is capable of creating damaging infestations. In addition, hydrilla is showing resistance to fluridone, a systemic herbicide used to manage it for the past 20 years. A team of research faculty is studying methods as part of an overall hydrilla integrated pest management (IPM) plan. Extension faculty will be transferring these new IPM tactics to clientele groups throughout Florida. Thanks to a new 4-year grant from the USDA NIFA UF / IFAS research and extension faculty, FAMU faculty and an ARMY Corps Engineer are tackling the hydrilla problem head-on. The central hypothesis of this project involves integrating herbivory by a naturalized meristem mining midge *Cricotopus lebetis* Sublette (Diptera: Chironomidae) with the native fungal pathogen *Mycoleptodiscus terrestris* and low doses of a new acetolactate synthase (ALS) inhibiting herbicide (imazamox) as a viable strategy for long-term sustainable management of hydrilla. This project is in the initial stages of research and will be available for technology transfer in 2012 – 2014. An extension advisory committee has been organized and development of extension deliverables has begun. This IPM strategy expected to be used in Florida watersheds and in other locations in the US where the resistant biotypes are expected to become established. By building a strong extension foundation we hope to deliver research results in a rapidly deployable manner that is accessible to our clientele group.

Goswami, Debashish

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Category: Efficacy of nutrient source control strategies
Session Title: Efficacy of Nutrient Source Control Strategies 1

Effect of Wetland Water Retention on Phosphorus Dynamics in Two Wetlands in the Lake Okeechobee Basin

Wetland water retention (WWR) Best Management Practice (BMP) was implemented at two wetland sites (wetlands 1 and 2) within a beef-cattle ranch in the Lake Okeechobee basin. At wetland 1, June-May of 2005-2006 (pre-BMP1) and 2006-2007 (pre-BMP2) were the two pre-BMP periods while June-May of 2007-2008 (post-BMP1), 2008-2009 (post-BMP2), 2009-2010 (post-BMP3), and 2010-2011 (post-BMP4) were the four post-BMP periods. For wetland 2, June-May of 2005-2006 was the only pre-BMP period and June-May of 2006-2007, 2007-2008, 2008-2009, 2009-2010, and 2010-2011 were the five post-BMP periods (post-BMP1, post-BMP2, post-BMP3, post-BMP4, and post-BMP5, respectively). Loads and concentrations of Total Phosphorus (TP) for the pre- and post-BMP periods were compared to evaluate the effectiveness of the BMP for water quality improvement.

At wetland 1, TP loads for post-BMP1 and post-BMP4 periods were lower than the pre-BMP1 TP load due to record drought conditions during these two post-BMP periods. For post-BMP2 (183.4 kg) and post-BMP3 (94.3 kg) periods, TP loads were higher than pre-BMP1 (88.8 kg) TP load even though rainfall amounts were similar for these periods. The mean TP load (74.4 kg), and concentration (1.2 mg/L) for all the post-BMP periods were higher than those for the two pre-BMP periods (47.0 kg, 0.8 mg/L). High Phosphorus (P) release from areas with no P retention capacity (P hotspots) within the wetland due to increased inundation resulting from the BMP might have masked the BMP effect.

At wetland 2, TP loads for all the five post-BMP periods were lower than the pre-BMP TP load but the mean post-BMP TP concentration (2.1 mg/L) was higher than the pre-BMP mean TP concentration (1.5 mg/L). It seems that the BMP was effective in reducing P loads at wetland 2. Long-term data comprising multiple years of pre- and post-BMP periods is necessary to evaluate the effectiveness of WWR BMP conclusively.

Greco, Stacie

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Category: Efficacy of nutrient source control strategies

Session Title: Social, Behavioral, and Economic Aspects of Nutrient Management 2

Using Research to Create a Social Marketing Campaign: Alachua County Landscaping Debris Case Study

In order to reduce nutrient levels in local watersheds and meet Total Maximum Daily Loads (TMDLs), the Alachua County Environmental Protection Department is targeting citizens and businesses with behavior change campaigns that utilize social marketing techniques. Landscaping debris (grass clippings and leaves) that is directed to the stormwater collection system can be a source of nutrients (nitrogen and phosphorus) and a substrate for bacteria. Even though the Alachua County Water Quality Code (Ordinance 02-27) and the Fertilizer Standards and Management Practices Code (Ordinance 09-06) prohibit the discharge of landscaping debris to the stormwater collection system and roadways, these policies are not always followed. To encourage people to properly manage landscaping debris, funding was obtained by the Gainesville Clean Water Partnership to design and implement a social marketing campaign.

One of the cornerstones of social marketing is going beyond the idea of the “general public” and determining who your target audience is and what their barriers and benefits are regarding the desired behavior. In depth interviews and focus groups were conducted with various audiences. The data was used to create campaign ideas designed to resonate with the target audiences. The campaign ideas were market tested with the audiences and then revised based on their reactions and comments.

The campaign was first implemented in the summer of 2011 and was evaluated using a pre and post survey along with additional methods. Consulting the target audience throughout the process kept the campaign focused on them, not on what stormwater educators thought would be effective or eye catching. Lessons learned, research based decisions, and program costs will be highlighted throughout this presentation.

Hall, Hollie

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Category: Governance approaches to nutrient management
Session Title: Posters - Governance Approaches to Nutrient Management

Outstanding Florida Waters: Water Quality Analyses

Through the Outstanding Florida Water (OFW) designation, the State of Florida provides a high level of protection for the water quality of a water body. The OFW Rule establishes an anti-degradation standard for the “existing ambient water quality” at time of designation from which no new permitted degradation may occur. However, this anti-degradation standard may be unenforceable due to the paucity of water quality measurements, from the date of designation to present. In this study, publicly available Florida STORET and Florida Legacy STORET water quality data were analyzed for a subset of OFWs. This subset of OFWs includes 77 fresh water streams and rivers, both Managed (those wholly within designated public land) and Special (those designated by local resident petition) OFWs. The data associated with eight water quality metrics - salinity, nitrogen, phosphorus, dissolved oxygen, chlorophyll, biological oxygen demand, and turbidity - that indicate changes in water quality driven by anthropogenic activities were analyzed. The first phase of this study determines whether sufficient data exist to assess a change in water quality since time of designation for each OFW. Preliminary work shows that adequate data may not exist for some OFWs. While some OFWs have at least one sampling location with greater than 10 years of regularly sampled water quality data, other OFWs have many sampling locations and a variety of data that only represent short sampling periods, and may not be sufficient to establish trends. This research suggests that for many OFWs it may not be possible to determine whether degradation has occurred with data-driven certainty. For those water bodies with sufficient water quality data on the date of designation, trends in water quality are examined in order to explore whether the water bodies have degraded since time of designation.

Hankin, Karl

Authors: **Karl Hankin, JEA**

Category: Efficacy of nutrient source control strategies

Session Title: Efficacy of Nutrient Source Control Strategies 2

Reducing Nutrient Loading to the St Johns River - A Utility's Perspective

In 1997, Northeast Florida's largest electric utility, acquired the City of Jacksonville's Public Utilities Department. Shortly thereafter, JEA set a corporate goal to reduce Total Nitrogen (TN) discharged to the St Johns River by 50%. This non-regulatory driven goal led to a multi-million dollar capital improvement plan to improve wastewater treatment plants to reduce TN. Years later JEA became a partner in the River Accord and also participated in the Total Maximum Daily Load (TMDL) process with stakeholders. As a result, JEA has met the requirements set forth in the TMDL two years early. This presentation will provide a summary of JEA's role in improving the health of the St Johns River, in particular: 1 - The vision and early adoption of JEA as an environmental stakeholder, 2 - Implementation of the Capital Improvement Plan required to meet the vision, and 3 - Participation in the TMDL process.

Hazan, Flavio

Authors: **Flavio Hazan**, University of Florida Program for Resource Efficient Communities
Pierce Jones, UF/IFAS Program for Resource Efficient Communities
Del Bottcher, Soil and Water Engineering Technology
Barbra Larson, UF/IFAS Program for Resource Efficient Communities

Category: Innovative biological, physical, and chemical nutrient reduction & recovery technologies
Session Title: Understanding Natural, Anthropogenic and Legacy Sources of Nutrients 2

Evaluating Master Planned Communities Design Impacts on Water Quality with the Watershed Assessment Model: The Restoration Project Case Study

Anticipating the impacts precipitated by urbanization has clear environmental and economic advantages. Dynamic watershed simulation models have a potential role in urban planning and design, as an important accessory to regional strategies, particularly TMDL programs, providing a more reliable alternative to the current “rebuttable presumption of compliance”. This study sheds light into the environmental impacts to aquatic ecosystem services precipitated by land use change as well as stormwater and landscaping best design and management practices associated with land development. It does so by evaluating the nutrient loading to the Spruce Creek and Indian River Lagoon sub-basins projected to originate from proposed development plans of the Restoration Development of Regional Impact in Edgewater, Florida. Two very distinct –compact and extensive– master plan alternatives of the 5,187 acre, 8,500 dwelling-unit master planned community are compared and contrasted to the pre-development conditions by means of the Watershed Assessment Model (WAM).

Heffernan, Jim

Authors: **James Heffernan**, Florida International University
Andrea Albertin, University of Florida
Megan Fork, Florida International University
Brian Katz, US Geological Survey
Matthew Cohen, University of Florida

Category: Innovative biological, physical, and chemical nutrient reduction & recovery technologies
Session Title: Understanding Natural, Anthropogenic and Legacy Sources of Nutrients 1

Denitrification and N Source Inference in the Karstic Upper Floridan Aquifer

Aquifer denitrification is among the most poorly constrained fluxes in global and regional nitrogen budgets. The few direct measurements of denitrification in groundwaters provide limited information about its spatial and temporal variability, particularly at the scale of whole aquifers. Uncertainty in estimates of denitrification may also lead to underestimates of its effect on isotopic signatures of inorganic N, and thereby confound the inference of N source from these data. In this study, our objectives are to quantify the magnitude and variability of denitrification in the Upper Floridan Aquifer (UFA) and evaluate its effect on N isotopic signatures at the regional scale. Using dual noble gas tracers (Ne, Ar) to generate physical predictions of N₂ gas concentrations for 112 observations from 61 UFA springs, we show that excess (i.e. denitrification-derived) N₂ is highly variable in space and inversely correlated with dissolved oxygen (O₂). Negative relationship between O₂ and $\delta^{15}\text{NNO}_3$ across a larger dataset of 113 springs, well-constrained isotopic fractionation coefficients, and strong $^{15}\text{N}:^{18}\text{O}$ covariation further support inferences of denitrification in this uniquely organic-matter-poor system. Despite relatively low average rates, denitrification accounted for 32% of estimated aquifer N inputs across all sampled UFA springs. Back-calculations of source $\delta^{15}\text{NNO}_3$ based on denitrification progression suggest that isotopically-enriched nitrate (NO₃⁻) in many springs of the UFA reflects groundwater denitrification rather than urban- or animal-derived inputs.

Hellmuth, Rebecca

Authors: **Rebecca Hellmuth**, University of Florida
George Hochmuth, Soil and Water Science

Category: Understanding natural, anthropogenic and legacy sources of nutrients
Session Title: Posters - Understanding Natural, Anthropogenic and Legacy Sources of Nutrients

Use of Drainage Lysimeters to Quantify Leaching for a Nitrogen Mass Budget

The Florida Department of Environmental Protection requires most dairy farms in Florida to have a comprehensive Nutrient Management Plan to help manage nutrients on the farm. These plans manage not only the manure collection and storage, but also the application of manure to fields and its potential impact on ground water and surface water that could be nearby. These plans often include assumptions about certain nitrogen sources and fates on the farm. The objective of this research is to quantify certain N sources in the Nutrient Management Plan for a silage corn field at the Dairy Research Unit at the University of Florida in Gainesville, FL. The inputs of the nitrogen budget are residual nitrogen in the soil, nitrogen in the irrigation water, manure effluent applied through a center pivot irrigation system, inorganic nitrogen fertilizer, and atmospheric deposition. The outputs of the nitrogen budget are the final residual nitrogen in the soil, crop uptake, leaching, runoff, and gaseous losses. Residual nitrogen, crop uptake, and leaching will be directly measured by the nitrogen content of the soil cores, plant samples, and leachate collected in drainage lysimeters under the crop, respectively. Runoff is assumed to be negligible because the field is very level. Amounts of manure effluent and inorganic fertilizer will be obtained from farm records. Atmospheric deposition will be estimated from the National Atmospheric Deposition Program. Gaseous N losses (volatilization plus denitrification) will be estimated from the difference in inputs and outputs. The nitrogen mass budget will be measured over the spring 2011, silage corn growing season. It is hoped the results of this study will draw attention to the important sources of N and their management in silage production in Florida and provide information to improve silage corn yield.

Helms, Katherine

Authors: **Katherine Helms**, Sculpture, SAAH, University of Florida

Category: Understanding natural, anthropogenic and legacy sources of nutrients

Session Title: Posters - Understanding Natural, Anthropogenic and Legacy Sources of Nutrients

Urban Watershed Project

Beginning in 2004, I began formulating an integrated system of working methods to harness the strengths of both the scientific and artistic disciplines to create sculptures, drawings, paintings, and installations. As an ecological artist with a scientific background, I strive to translate empirically documented research into prototypical visual models, conveying authentic data in accessible formats.

I view investigatory research and the process of data collection and representation as an opportunity to contribute to the burgeoning branch of science-based art. Begun in 2009, Urban Watershed Project focuses on highly impacted urban watersheds in Gainesville, Florida, a city with an outdated stormwater management infrastructure with limited storage and retention potential. As a result, much of the city's stormwater races off the impervious surfaces of the urban environment and into local creeks, contributing to numerous environmental impacts including channel incision.

I became interested in measuring the degree of incision in the watershed. I conducted cross-sectional topographic surveys of Tumblin and Sweetwater Branch Creeks to identify and document highly eroded segments. Through the collection of my own measurements, I would have direct physical contact with each data point on the graphs and subsequent artworks, codifying a direct relationship with existing topographies.

The output of Urban Watershed Project has been diverse, from extensive field journals to maps, charts, CAD drawings, sculptures, and installations. For example, the welded steel rebar sculpture "Incised Channel" is a 20-ft scaled model of a segment of Sweetwater Branch Creek that invites the participant to walk through it as they view cross section maps on an adjacent wall. In providing an interactive experience illustrating urban creek erosion, the work serves to educate a community largely unaware of the issue. In conveying my process of data collection through unconventional formats, I hope to connect with a wider audience.

Hensley, Robert

Authors: **Robert Hensley**, University of Florida
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James B. Heffernan, Florida International University, Department of Biological Sciences and Southeast Environmental Research Center

Category: Nutrient dynamics and enrichment impacts in aquatic ecosystems
Session Title: Posters - Nutrient dynamics and enrichment impacts in aquatic ecosystems 2

New Methods for Estimating Riverine N Removal Rates

Previous studies seeking to quantify riverine nitrogen uptake rates have primarily relied on ^{15}N isotope addition. While that approach yields process-specific inference of N fluxes, it is entirely impractical for larger river systems, and yields a single synoptic estimate of uptake, failing to account for diel, seasonal and spatial variation. Here we present a new approach using a deployable Submersible Ultra-violet Nitrate Analyzer (SUNA, Satlantic Corporation, Halifax Nova Scotia) that is scalable and inexpensive enough to permit repeated or prolonged deployment. These optical nitrate sensors are accurate and precise, and permit data acquisition at very high temporal resolution (up to 0.5 Hz). We utilized these sensors to collect both Eulerian and Lagrangian time series of nitrate concentrations in ten spring-fed rivers in north central Florida. First, we deployed sensors at a stationary point for several days to collect Eulerian diel concentration dynamics. Second, we used a Lagrangian approach along the length of each river to collect longitudinal concentration profiles. We used both these data sets, coupled with measured channel geometry and flow data, as two alternative methods of inferring both the assimilatory and dissimilatory nitrogen removal rates. The results of these two methods for calculating N removal rates compare favorably, and indicate that these river systems act as significant permanent sink for nitrogen because the dominant removal pathway is denitrification. Total removal rates ranged from 0.13-1.25 g N/m²/day, and denitrification was typically between 75 and 90% of this total. In the course of this investigation we also identified that an accurate understanding of the hydrology of these systems is a prerequisite to differentiating between actual N removal and dilution. These two methods provide a promising new approach to estimating riverine N removal and allow us to observe temporal and spatial heterogeneity which previously could not be detected.

Henson, Wesley

Authors: **Wesley Henson**, Water Institute/USGS
Richard Niswonger, US Geological Survey

Category: Hydrology
Session Title: Posters - Hydrology

Evaluating the Effects of Horizontal Spatial Discretization on Interflow in the Soil Zone Using the Richards and Groundwater Flow Equations

Infiltration can accumulate to form perched groundwater within the upper few meters of the soil horizon that drains to streams (interflow). Richards Equation has become a commonly used governing equation for simulating interflow in regional-scale models. Recent research has shown that optimal vertical discretization for Richards Equation near land surface and the water table is much smaller than the discretization typically used in basin-scale hydrologic models, yet little is known about optimal horizontal discretization or potential effects of horizontal discretization on interflow solutions. Most of the work related to the effects of discretization on the solution of Richards Equation has focused on the vertical infiltration problem. This study evaluates horizontal spatial discretization effects on interflow predictions using 1) a modified version of GSFLOW and 2) VS2DT. The modified GSFLOW couples Smith-Parlange 1-D infiltration equations with 3-D unconfined groundwater flow equation, whereas VS2DT uses Richards Equation to represent infiltration and variably saturated flow. Interflow solutions and breakthrough at the stream were compared using various horizontal and vertical grid resolutions. Variable horizontal spatial resolutions affected VS2DT interflow solutions (RMSE up to 0.12) and interflow breakthrough at the stream, whereas GSFLOW solutions were well correlated (RMSE

Honour, Danielle

Authors: **Danielle Honour**, CDM Smith
Kimberly Lawrence, Osceola County

Category: Governance approaches to nutrient management
Session Title: Governance Approaches to Nutrient Management 1

Putting Together the Pieces of Lake Tohopekaliga Puzzle

Lake Tohopekaliga (Toho) is a 19,000 acre lake located within Osceola County in Central Florida. Lake Toho has a long, complex history of management activities that have altered the lake's natural hydrology and water quality over time. The lake was placed on FDEP's Verified List of Impaired Waters in November, 2010 for nutrients (increasing trend in trophic state index (TSI)). Osceola County and the City of Kissimmee initially disagreed with the TSI assessment through their own independent analysis. FDEP recognized that since Lake Toho is a macrophyte dominated lake (i.e., Hydrilla), the agency was willing to re-consider the listing based on a macrophyte impairment and not develop a Total Maximum Daily Load (TMDL) for the lake (Hydrilla is a nuisance submergent plant but has been managed in the lake for both fish habitat as well as for the endangered snail kite). As part of the agreement with FDEP, the City and the County would need to provide some assurance that proactive nutrient reductions (source control) are taking place within the watershed until the lake dynamics are better understood and appropriate water quality targets can be developed. This presentation will describe the proactive process the City, the County as well as other local stakeholders voluntarily elected to participate in to develop a Nutrient Reduction Plan in order to satisfy FDEP's request, avoid a reactive regulatory process and to work towards solving the puzzle of how water quality fits into the management of this lake.

Hu, Jing

Authors: **Jing Hu**, University of Florida
Kanika Inglett, University of Florida
Clark Mark, University of Florida
Ramesh Reddy, University of Florida

Category: Nutrient dynamics and enrichment impacts in aquatic ecosystems
Session Title: Posters - Nutrient Dynamics and Enrichment Impacts in Aquatic Ecosystems 1

Hydrological and Biogeochemical Controls on the Nitrous Oxide (N₂O) Production and Consumption in Subtropical Isolated Wetlands

Wetlands are potential sources of greenhouse gases including nitrous oxide (N₂O). N₂O emissions are highly regulated by the wetland hydroperiod and water-table fluctuations. To reduce N₂O emissions and to develop mitigation strategies, it is important to understand the effect of hydrology and biogeochemical factors on production and consumption of N₂O in soils. The objective of this study was to quantify the potential soil N₂O production and consumption rates within soil profile. Laboratory incubation experiments were carried out using soils from an isolated wetland located in agricultural watershed in the Okeechobee Drainage Basin. Soil samples were collected at four depths (0-10cm, 10-30cm, 30-50cm, and 50-70cm) from three areas with different hydroperiods. Soil physical and chemical properties and microbial biomass were performed on soil subsamples. Potential rates of N₂O production from nitrification (PN₂O-nit), and denitrification (PN₂O-den) and consumption (PN₂O-con) were determined for all soil samples. The results indicated higher N₂O potential production rate in soils from location with higher water table. Most of the N₂O production (~70%) and consumption (~80%) in soils occurred in the upper layer (0-10cm) and N₂O was mainly produced by denitrification. Furthermore, microbial biomass and nitrate content were two critical factors that controlled N₂O production and consumption along the soil profile.

Hwang, Syewoon

Authors: **Syewoon Hwang**, Water institute, University of Florida
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Alison Adams, Tampa Bay Water

Category: Climate and Water
Session Title: Posters - Water and Climate

Hydrologic Importance of Spatial Variability in Statistically Downscaled Precipitation Predictions from Global Circulation Models for West-Central Florida

There are a number of statistical techniques that downscale coarse climate information from global circulation models (GCM). However, many of them pay little attention to the small-scale spatial variability of precipitation exhibited by the observed meteorological data which can be an important factor for predicting hydrologic response to climatic forcing. In this study a sTOC_Topographic downscaling technique was developed to produce bias-corrected daily GCM precipitation fields that honor the spatial autocorrelation structure of observed daily precipitation sequences. This approach is designed to produce bias-corrected daily GCM results which reproduce observed spatial and temporal variability as well as mean climatology. We used the proposed method to downscale 4 GCM precipitation predictions from 1961 to 2000 over west-central Florida and compared the skill of the method to results obtained using the commonly used bias-correction spatial disaggregation (BCSD) approach. Spatial and temporal statistics, transition probabilities, wet/dry spell lengths, spatial correlation index, and variograms for wet (June through September) and dry (October through May) season were calculated for each method. Preliminary results showed that the new sTOC_Topographic technique reproduced observed temporal and spatial variability and features very well for both wet and dry seasons while the interpolation based BCSD approach significantly underestimated spatial variability (i.e., overestimated spatial correlation). The two sets of downscaled precipitation scenarios were used with an integrated surface-subsurface hydrologic model to examine hydrologic responses of streamflow and groundwater levels for each climate input scenario for an application in west-central Florida. The results support the hypothesis that accurately representing the spatial variability of precipitation in downscaled GCM predictions is important to reproduce observed hydrologic behavior.

Indarawis, Katrina

Authors: **Katrina Indarawis**, University of Florida
Treavor Boyer, University of Florida

Category: Water Chemistry
Session Title: Posters - Water Treatment and Aquatic Chemistry

Combined Ion Exchange Pretreatment to Reduce Membrane Fouling: Understanding Fundamental Chemistry During Ion Exchange Reactions

Membrane technology is expected to play a critical role in future water treatment design due to the depletion and degradation of existing water sources. Limitations to these technologies are (1) fouling and scaling due to natural organic matter (NOM) and alkaline earth metals, and (2) membrane concentrate management. This research focuses on the removal of NOM and alkaline earth metals as a pretreatment to reduce fouling, and the treatment of membrane concentrate for recycle. The goal is to understand the behavior and relationships between NOM and alkaline earth metals using cation exchange reactions, and then evaluate those relationships during combined ion exchange reactions. A novel approach used in this research is the use of cation exchange as a tool to understand the behavior of the ions in solution with NOM by varying the mobile counter ion on a cationic magnetic exchange resin (MIEX). Stoichiometry of all cation exchange reactions will be compared to stoichiometry of combined ion exchange.

A major result was that NOM, a negatively charged molecule, was removed with a cation exchange resin. This was due to NOM-metal complexation (including complexation with iron oxide exposed from the MIEX). Other results showed sulfate was reactive during these experiments due to precipitation of barium sulfate. The dissolved organic carbon (DOC) removal was relatively the same for each water with hardness (regardless of the calcium to magnesium ratio); however, there was significantly less DOC removed in the absence of these cations. This phenomenon was observed with two NOM isolates.

This work provides new knowledge about NOM-metal complexation with alkaline earth metals during cation exchange reactions and increases understanding of water chemistry during combined ion exchange reactions. This new knowledge will be applied in future experiments to decrease membrane fouling and be used in an innovative approach for treatment of membrane concentrate.

Irick, Daniel

Authors: **Daniel Irick**, University of Florida
Yuncong Li, UF, Soil and Water Science
Patrick Inglett, UF, Soil and Water Science
Binhe Gu, South Florida Water Management District
Michael Ross, FIU, Department of Earth and Environment

Category: Understanding natural, anthropogenic and legacy sources of nutrients
Session Title: Posters - Understanding Natural, Anthropogenic and Legacy Sources of Nutrients

Distribution of Soil Phosphorus Forms in Everglades Tree Islands

The Florida Everglades is considered a phosphorus (P) limited ecosystem, however large amounts of P are accumulated in tree island soil throughout the ecosystem. Recent literature has suggested tree islands may play an important role in soil nutrient distribution dynamics in the landscape as focal points of potential P sequestration and redistribution. Little data is available regarding the specific forms of P present in tree island soil and how P forms may be distributed at the intra-island scale. Tree island ecosystems in the Florida Everglades offer a unique opportunity to study distribution of soil P forms to determine if P accumulation occurs in discrete regions of islands, or diffusely throughout an islands areal extent. Characterization of the forms of soil P can provide insight of P source, and potential mobility. Surface soil (0-5 cm) from tree islands (n=5) in the Central Everglades was sequentially extracted to quantify the proportions of different forms of soil P. Total P and inorganic P are highest in the head center region and inorganic P accounts for ~60% of the total P. Organic P is the dominant form of P in soil outside of the head center region. The high proportion of inorganic P observed in the head center region of tree island soil and decrease in both total P and inorganic P in other regions of tree islands suggests current tree island nutrient dynamic hypothesis may be accurate. It appears likely that P accumulation in head center region of tree island soil is derived from an external source of inorganic P.

Ishii, Stephanie

Authors: **Stephanie Ishii**, University of Florida
Treavor Boyer, University of Florida

Category: Water Chemistry
Session Title: Posters - Water Treatment and Aquatic Chemistry

Behavior of Reoccurring PARAFAC Components in Fluorescent Dissolved Organic Matter in Natural and Engineered Systems: A Critical Review

The need for methodologies that allow for frequent and informative monitoring of dissolved organic matter (DOM) has become increasingly obvious due to the integral role of DOM in both natural and engineered systems. In response to this need, fluorescence spectroscopy, in combination with parallel factor analysis (PARAFAC), has shown great promise for monitoring DOM concentration and composition in a wide variety of settings. These methods involve exciting a water sample with a range of wavelengths of light and measuring the wavelengths and intensities at which the sample fluoresces. The DOM in the sample is then characterized based on the intensity, shape, and location of independent fluorescent components identified by PARAFAC. These components represent groups of fluorophores with similar fluorescent qualities.

The application of fluorescence spectroscopy with PARAFAC covers a wide range of systems and has allowed researchers to make inferences regarding the origins, mixing, production, and degradation of DOM. However, considerable uncertainty still remains regarding the relevance of an identified component due to a lack of discussion regarding the characteristics of similar components across studies. An investigation of the ubiquity of certain PARAFAC components and the consistently with which these components behave in different systems is needed.

The overall goal of this work is to evaluate PARAFAC results for a wide range of studies in order to better understand the chemistry of reoccurring fluorescent components. More specifically, comparisons of similar components across studies will be made regarding wavelength locations, characteristic ecosystems, physiochemical processes in the natural environment, and treatability in engineered systems. This synthesis is intended to describe the tendencies of reoccurring fluorescent components in a variety of settings such that PARAFAC users can be more confidently predict DOM composition and behavior based on identified components.

Jacobson, Dianne

Authors: **Dianne Dilger Jacobson**, University of Florida Extension Service

Category: Social, behavioral, and economic aspects of nutrient management

Session Title: Posters - Social, Behavioral, and Economic Aspects of Nutrient Management

Volunteer Mobile Irrigation Lab ...Model lab for SWFWD

Florida faces water scarcity problems due in part to population increases, tourist, and current drought conditions. Because the nation and world faces many of the same challenges regarding water, scarcity will also have national and global relevance. Irrigation of lawns and landscaping in Florida represents the single largest use of water from our municipal water supplies. This water use has seriously impacted the aquifer, which is a source of our drinking water and water that supports our ecosystems. In addition, fertilizers and pesticides used on lawns are major sources of pollution in our lakes, rivers. According to UF Irrigation Specialist, regular irrigation checks with installation of rain sensors constitute up to a 50% savings of your water use in your landscape.

To help the residents within the Peace River Basin area of Highlands County reduce their potable drinking water usage and pollution to our water systems a volunteer mobile irrigation lab in Highlands County was formed and the urban homeowners within the Peace River Basin area were targeted. 428 site visits were performed by checking the condition of the landscape by observing and documenting the existing irrigation system. The goal is to achieve the highest distribution uniformity and efficiency as possible. This is achieved by providing recommendations for improving the design, installation, operation and maintenance of the system. Success requires a commitment on the owner's part to maintain the system to proper specifications and to provide qualified personnel to operate it. The MIL to date has provided a water savings of 102,720 gpd (gallons per day) of potable water was achieved. 35 low volume lateral line breaks were found/repared saving an additional 1,512,000 gpm (gallons per minute) of potable water. When poled, 93% of the 428 sites had unmatched precipitation rates/mixed heads, 72% of the 428 sites had their clocks set on the wrong duration, time of day, or adjusted to seasonal needs and 28% of the 428 sites knew how to set their irrigation clock

Jarvis, BobbiJo

Authors: **B.J. Jarvis**, UF/IFAS Pasco County Extension
Chris Dewey, UF/IFAS Pasco County Extension

Category: Social, behavioral, and economic aspects of nutrient management
Session Title: Posters - Social, Behavioral, and Economic Aspects of Nutrient Management

Educating certified property managers of landscape management practices that influence water quality

Millions of acres of residential landscapes may impact the quality of Florida's watersheds. Agriculture operators have long been a focus for education about the effects that various land management practices have can allow nutrients to enter watersheds. Residents, and the companies that direct the management of residential properties, frequently apply more fertilizers and pesticides per acre than agricultural operations, and can employ landscape management practices that can cause unacceptable social and economic impacts to area waterways. Education of this nutrient-loading population segment has been overlooked. Recently this group has been the focus of education to raise awareness of the potential impacts and to change maintenance behaviors to balance the perceived goals of landscape aesthetics and water quality. To address this educational gap, Pasco Extension began educating certified property managers (CPM) about the many landscape best management practices which affect landscape quality. Training was created for certified property management professional organizations who primarily manage large acreages in homeowner associations. This training included the perception of property aesthetics and the resulting competitiveness of an individual contract's sales/rental potential while implementing Florida-Friendly Landscape practices. The perception prior to attending the training was that employing Florida-Friendly Landscapes could decrease the value or salability of units, or that the CPM firm was not doing a "quality job". Following the training, participants exhibited a significant increase in the belief that FFL practice implementation would save water (and therefore money), and would protect watersheds, while having no negative influence on rental/sales potential of managed properties. Initial program outcomes also indicate that CPM-managed communities recommend development of FFL-based guidelines for their architectural review committees, that resident should be encouraged to employ FFL landscape practices to reduce stormwater run-off, and that stormwater pond management practices were modified resulting in improved water quality.

Jazil, Mohammad

Authors: **Mohammad Jazil**, Hopping, Green & Sams, P.A.
Christopher Pettit, University of Florida Water Institute

Category: Governance approaches to nutrient management
Session Title: Governance Approaches to Nutrient Management 2

EPA's Numeric Nutrient Criteria for Florida Waters: Background, Fault-Lines and Implications

Under the Clean Water Act (CWA), states have primary responsibility for establishing water quality standards. The U.S. Environmental Protection Agency (EPA) may promulgate its own standards where EPA determines that a new or revised standard is necessary. Such determinations are rare.

After being sued by environmental organizations for failing to set numeric nutrient criteria in Florida, EPA determined in January 2009 that numeric nutrient criteria are necessary for Florida to comply with the CWA. In late 2009, EPA and the environmental litigants entered into a consent decree that requires EPA to promulgate nutrient criteria for all of Florida's surface waters in a two-phase rulemaking process. Consistent with this consent decree, EPA finalized numeric nutrient criteria for Florida's rivers, lakes, and springs in November 2010. These now-final criteria have an effective date of March 6, 2012. The consent decree requires EPA to finalize criteria for Florida's estuaries, marine waters, and southern canals by August 15, 2012. The November 2010 rule is the subject of over 30 legal challenges. The State of Florida, local governments, utilities, and private industry litigants claim that the rule and its predicate – the January 2009 determination – are legally, and scientifically indefensible. Environmental litigants allege that the rule is too lax.

This presentation will discuss the November 2010 rule in general, and why the rule has been the source of such consternation for both public and private entities. A summary of the arguments being advanced by various parties both for and against the rule will be included. State and federal actions outside the legal forum will also be discussed. The presenters note that they have been involved with the issue since 2009 as counsel to various public and private entities.

Jin, Jin

Authors: **Jin Jin**, Department of Geological Sciences, University of Florida
Andrew Zimmerman, Department of Geological Sciences, University of Florida

Category: Nutrient dynamics and enrichment impacts in aquatic ecosystems
Session Title: Posters - Nutrient Dynamics and Enrichment Impacts in Aquatic Ecosystems 1

The Influence of DOM and Microbial Processes on Arsenic Release from Karst during ASR Operations in the Floridan Aquifer

The mobilization of subsurface As poses a serious threat to human health, particularly in a region such as Florida where population is heavily dependent on highly porous karstic aquifers for drinking water. Injection water used in aquifer storage and recovery (ASR) or aquifer recharge (AR) operations is commonly high in dissolved organic matter (DOM) and OM can also be present in the subsurface carbonate rock. Using batch incubation experiments, this study examined the role of core preservation methods, as well as the influence of labile and more refractory DOM on the mobilization of As from carbonate rock. Incubation experiments used sealed reaction vessels with preserved and homogenized core materials collected via coring the Suwannee Formation in southwest Florida and treatment additions consisting of 1) source water (SW) enriched in sterilized soil DOM, 2) SW enriched in soil DOM and microbes, and 3) SW enriched in sodium acetate. During an initial equilibration phase in native groundwater (NGW) with low dissolved oxygen (DO; Phase 1), we found the greatest As release of the whole incubation. In the beginning of Phase 2 (N₂ headspace) in which NGW was replaced with treatment solutions, there was little As release except in the vessel with Na-acetate added, which also had the lowest ORP. At the start of Phase 3, when incubations were exposed to air, most vessels saw more ion (including As) release into solution. Vessel with Na-acetate had less As release in Phase 3 than in Phase 2. During all experimental phases, treatments of DOM or microbe additions had no apparent effect on the amount of As release. The core materials was found contain significant amount of indigenous DOM (about 8 g OC/kg core) which was released during the incubation so DOC concentrations displayed no clear pattern among different treatments. At least three abiotic As mobilization mechanisms may play a role in As released during different stages of the experiment. Desorption of As from iron oxyhydroxides may have occurred, particularly at the beginning of each experimental phase. Reductive dissolution and oxidative dissolution likely lead to As release during phase 2 and 3, respectively. While not directly implicated, the presence of labile OM clearly fueled microbial alteration of redox conditions, leading to further As release. Addition of microbes had no effect as indigenous microbes were just as active in untreated cores.

Jones, Gregg

Authors: **Gregg Jones**, Cardno ENTRIX
Brandon Ashby, Cardno ENTRIX

Category: Innovative biological, physical, and chemical nutrient reduction & recovery technologies
Session Title: Understanding Natural, Anthropogenic and Legacy Sources of Nutrients 1

Florida's Nitrate + Nitrite Criterion for Springs – A Methodology for Predicting What it Would Take to Achieve it at an Impaired Spring

The Environmental Protection Agency's recently finalized nitrate + nitrite criterion for springs in Florida stipulates that the spring is not meeting its designated use if its concentration exceeds 0.35 mg/L as an annual geometric mean more than once in three years. Numerous springs currently exceed this criterion, including 19 of the state's 33 first magnitude springs. The average nitrate + nitrite concentration of these 19 springs is nearly 1.3 mg/l, which exceeds the criterion by a factor of 3.7. Achieving the criterion will be a difficult undertaking because the nitrate emanating from the springs results from decades of nitrogen loading from agricultural and residential non-point sources spread over hundreds of square miles of the springshed. Large-scale reductions in nitrogen loading across the springshed would be required and once the reductions were achieved, the slow travel time of groundwater suggests that flushing the aquifer to the required level could take decades. This paper presents a GIS-based methodology to predict the magnitude of nitrogen loading reductions that would be required in the springshed of an impaired spring and the time it would take once the reductions were achieved for the nitrate + nitrite criterion to be met. The methodology was applied to Rainbow Springs in southwestern Marion County because the hydrogeology, water quality, groundwater travel times, and nitrate sources and loadings were extensively researched by the author in the mid 1990s. The spring discharges nearly 450 mgd and nitrate concentrations exceed 1.3 mg/l. The springshed is dominated by agricultural land uses and exceeds 700 square miles in extent. As part of the analysis, capture zone groundwater travel times and nitrate loading estimates were developed for the springshed.

Kadiyala, Dakshina Murthy

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Devender Reddy, Water Technology Center, ANGR Agricultural University, India

Category: Water Conservation and Use
Session Title: Posters - Water Conservation and Use 2

Study of Spatial Water Requirement of Rice under Various Crop Establishment Methods Using GIS and Crop Models

Traditional rice transplanting method of cultivation faces severe yield limitations due to frequent monsoon rain failures, which result in water stress during critical periods of rice growth. To meet the water demands of traditional flooded rice crops, farmers need to pump more water from underground aquifers. This continuous pumping causes depletion of the underground water and creates serious ecological and environmental consequences. Crop models have been utilized for yield predictions, irrigation planning, irrigation optimization, comparing various scenarios and strategies, analyzing yield trends over time, etc. However, these models need to be applied at scales that are economically useful for analysis of various alternate rice management strategies on water savings across the watershed or the region. Linking crop models with Geographical Information System (GIS) has demonstrated a strong feasibility of crop modeling applications at a spatial scale. In the present study, spatial analysis of long-term simulations were carried out with DSSAT spatial analysis tool linked with GIS to estimate irrigation requirements and nitrate leaching under alternate rice establishment methods in the Wargal watershed, Andhra Pradesh, India. Rice yields were compared among three management scenarios: rainfed, aerobic and flooded. Grain yield, seasonal water balance components, nitrate leaching, water use efficiency and irrigation use efficiency were calculated, visualized and mapped with GIS. The rice productivity increased by 22% and 27% under aerobic and flooded management compared to rainfed rice. The adoption of new water efficient aerobic rice cultivation in the watershed resulted in 36% water saving with a relatively small yield reduction of 4%, thus increasing the water productivity to 0.77 g kg⁻¹ in aerobic compared to 0.56 g kg⁻¹ in flooded rice. The aerobic rice method reduced the overall water pumping to 88 h ha⁻¹ during rice crop season compared to 299 h ha⁻¹ with flooded rice cultivation, resulting in 71% energy savings.

Keller, Chris

Authors: **Chris Keller**, Wetland Solutions, Inc.
Richard Hutton, Gainesville Regional Utilities
Russell Ingram, Gainesville Regional Utilities

Category: Innovative biological, physical, and chemical nutrient reduction & recovery technologies
Session Title: Innovative Biological, Physical, and Chemical Nutrient Reduction & Recovery Technologies 2

Groundwater Recharge Wetlands for Enhanced Nitrate Removal and Aquifer Recharge

This paper presents results from a demonstration study utilizing groundwater recharge wetlands to cost effectively use reclaimed water for aquifer recharge, while achieving very low nutrient levels. Use of municipal reclaimed water for aquifer recharge can be highly beneficial in maintaining aquifer levels and addressing concerns about water supply availability. However, conventional reclaimed water infiltration systems often result in groundwater nitrate levels that are below the drinking water standard (10 mg/L) but still above pre-development concentrations. In some cases even low groundwater nitrogen concentrations can contribute to eutrophication in springs, lakes and rivers. Currently, EPA and the FDEP are developing rules that will require nitrate concentrations less than 0.35 mg/L in springs. As these efforts continue, it is necessary to develop technologies that can cost effectively reduce nutrients. Treatment wetlands are a proven technology for nitrate removal because they optimize natural microbial processes that eliminate nitrate. Internal production of reduced carbon in wetland plant communities, combined with anaerobic conditions near the water/sediment interface, result in high denitrification rates. Constructing and operating wetlands on “leaky” soils combines the benefits of effective nitrate load reduction with groundwater recharge and habitat creation. Gainesville Regional Utilities has implemented two demonstration projects to evaluate groundwater recharge wetlands for application in their service area. The first project retrofitted two existing ponds at the Kanapaha Middle School to facilitate a comparison of nitrate removal rates in ponds and wetlands. The second project implemented groundwater recharge wetland cells at the Kanapaha Water Reclamation Facility. Results from both projects demonstrate nitrate removals to below 0.35 mg/l are achievable using groundwater recharge wetlands. Nitrate removal was greater in wetlands than in ponds or traditional rapid infiltration basins. Sustainable infiltration rates make groundwater recharge wetlands a cost-effective approach to minimize nitrate loads to the aquifer and adjacent springs.

Khare, Yogesh

Authors: **Yogesh Khare**, University of Florida
Christopher Martinez, Assistant Professor

Category: Climate and Water
Session Title: Posters - Water and Climate

Global Sensitivity Analysis of a Drought Index Model – ‘Agricultural Reference Index for Drought (ARID)’

Water stress (deficit) experienced by plants is one of the crucial factors that determine the loss in crop yield. Agricultural Reference Index for Drought – ARID is a generic plant water stress index which estimates the level of water stress as the ratio of reduction in potential evapotranspiration to the potential evapotranspiration, on daily time step, considering perennial turfgrass as the reference crop (Woli et al., 2010). Objective of this study was to perform global sensitivity analysis (GSA) of ARID to determine the most important parameters which shall be obtained carefully while applying this model. Root zone depth (Z), maximum uptake factor (MUF), wilting point (WP), field capacity (FC), drainage coefficient (DC) and run-off curve number (CN) are the model parameters; while inputs consist of rainfall and potential evapotranspiration to completing Plant-Soil-Atmosphere continuum. GSA was performed for five locations in south east USA and four soil types namely sandy loam, silty loam, sand clay loam and silty clay. Latin Hypercube Sampling technique was used to generate samples from the marginal probability distributions of the respective parameters. Correlation and regression based sensitivity indices were calculated amongst which the partial correlation coefficient (PCC) was considered for ranking the parameters. Scatterplots of average aridity index as well as PCCs indicate that root zone depth (Z) is the most important parameters for ARID for all soil types. FC and WP were ranked second and third in case of three soils while in silty clay the ranking was interchanged between the two. R2 values of regression model on raw values and ranked values were very high (> 0.92) indicating model is linear while scatterplots indicate the model is monotonic.

King, Sean

Authors: **Sean King**, University of Florida - EES

Category: Nutrient dynamics and enrichment impacts in aquatic ecosystems

Session Title: Nutrient Dynamics and Enrichment Impacts in Aquatic Ecosystems 2

Effects of Flow and Nitrate Concentrations on Filamentous Algae in Florida Springs and Rivers: Implications for Numeric Nutrient Criteria

Many artesian springs and rivers in Florida are experiencing proliferation of filamentous algae and other changes which have led to degraded ecosystem structure and function. Elevated nitrate concentrations have been observed in many springs and therefore alleviation of N-limitation has been suggested as the main driver of algal proliferation. However, past studies concluded that nutrient limitation was not apparent in springs historically when nitrate concentrations were lower than at present, and more recent studies have not found strong evidence that nitrate enrichment is the primary cause. In flowing aquatic systems, nutrient limitation may only occur at relatively low nutrient concentrations due to the continuous replenishment of nutrients from upstream sources. Currently numeric nutrient criteria are based mostly on concentrations of N and P that would theoretically limit algal growth; however in flowing systems nutrient concentrations alone are often not reliable predictors of algal nutrient limitation. This study tests the hypothesis that the nutrient flux (the product of concentration and flow rate) is a better indicator of nutrient availability than concentration, and examines whether it could be a suitable metric for numeric nutrient criteria. Overall the role of flow as a control on filamentous algal biomass in Florida springs and rivers has yet to be thoroughly studied, although it is likely a major driver of algal dynamics. This research focuses on how flow rate affects the growth of filamentous algae, both directly and due to its contribution to nutrient flux. Laboratory experiments were conducted to determine the degree to which flow rate, nitrate concentration, and nitrate flux influence the growth of the filamentous alga *Lyngbya*. Results to date indicate that flow significantly affects filamentous algal growth in comparison to nitrate levels.

Kiser, Kristine

Authors: **Kristine Kiser**, UF Art History Student

Category: Water Conservation and Use

Session Title: Posters - Water Conservation and Use 2

“Effect” - An artist’s message to save local springs

Many springs in Florida today are no longer a crystal clear blue; the water has reached a point of no return. Some of those springs are no longer safe for humans or animals to occupy due to the water pollutants. There is a great concern rising among water specialist on the water issue in the world and for the Florida Aquifer. The Floridan aquifer is located in the southeastern United States and is one of the world's most productive aquifers. The aquifer is Florida's main source of clean, salt-free drinking water. It is also at risk. I created an artwork that would not only encourage me to become more familiar with the problems that the springs are in, but also make other people aware. My artwork was my inspiration to help save the local springs. Right now the algae and nitrate levels are rising causing the animal and marine life to decrease. There are nine billion people in this world and a very small percent have experienced the enjoyment that comes with a day at the springs. Most people do not understand what needs to be saved. I want my artwork to bring the knowledge to those who cannot experience the icy cold water. People need to understand what they should be saving.

Knight, Robert

Authors: **Robert Knight**, Howard T. Odum Florida Springs Institute

Category: Nutrient dynamics and enrichment impacts in aquatic ecosystems

Session Title: Nutrient Dynamics and Enrichment Impacts in Aquatic Ecosystems 2

Nitrate Effects in Spring Ecosystems - A Working Hypothesis

Nitrate nitrogen concentrations are elevated above natural background in the Floridan aquifer system due to human activities. Due to the relatively high threshold for human-health effects of nitrate in drinking water, regulatory agencies have purposely encouraged municipal and agricultural interests to direct their wastewater nitrogen loads to the groundwater as a beneficial alternative to surface water discharges. The resulting wide-spread contamination of the drinking water supply by nitrate has resulted in the almost universal contamination of Florida's springs – surface-water resources that derive their flow from groundwater aquifers. Nitrate concentrations in over 80 percent of Florida's springs are above the level considered to be harmful to spring ecosystems and many of these springs have been found to be impaired. This paper presents an hypothesis for the effects of elevated nitrate levels on springs' ecology that is supported by studies in 18 separate Florida springs. These data suggest that elevated nitrate concentrations above normal spring background levels stimulate a form of springs' eutrophication, initially characterized by increased growth and reduced diversity of submerged aquatic macrophytic plants typical of un-impacted springs. At higher nitrate concentrations, macrophytes in springs may be outcompeted by a variety of filamentous benthic and attached algae. Increasing nitrate availability also appears to stimulate ecosystem gross primary productivity at lower nitrate levels and then reduces springs' productivity at higher nitrate concentrations. This presentation provides suggestions for field studies that will help build a more complete understanding of the benefits that might accrue to springs by reducing nitrate levels in the Floridan aquifer system.

Kreye, Melissa

Authors: **Melissa Kreye**, SFRC/UF
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Francisco Escobedo, SFRC, University of Florida

Category: Efficacy of nutrient source control strategies
Session Title: Social, Behavioral, and Economic Aspects of Nutrient Management 1

Willingness to Pay to Protect Well-Conserved Aquatic Systems: A Meta-Analysis

Nutrient pollution from anthropogenic sources is a leading cause of water impairment in the United States. Forested ecosystems are highly effective in protecting water quality by reducing nutrient loading and soil erosion; however information about the economic benefits and ecosystem services associated with preserving forested areas is frequently lacking. This study is unique because it focuses on values associated with water resource and forest conservation programs that protect “well conserved” aquatic systems. Quantifying these values is important for making informed policy decisions and designing effective incentive programs to protect water quality. Using a meta-analysis and econometric modeling of 47 observations, we estimate the public’s willingness to pay (WTP) for water resource protection and related forest conservation programs. Our econometric model performed well ($R^2 = 0.85$; F-Statistic= 17.78) and parameter estimates reveal several important drivers of WTP for water protection programs, including: Geographic context, type of water protection program, type of aquatic resources, scope of the conservation project (e.g. watershed, statewide), and county-level median income. Our results can be used to inform public choices about water quality incentive programs and payments, and to evaluate their cost-effectiveness according to their characteristics. For example, when this model was applied to a representative site in Florida we find that annual household WTP is \$2.29 for programs that use land acquisition or easement type strategies, and \$42.27 for programs that do not. This suggests an important relationship between the attributes of water quality protection programs and individual welfare that policy makers should carefully consider.

Kurz, Marie

Authors: **Marie J. Kurz**, University of Florida
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Matthew J. Cohen, UF School of Forest Resources and Conservation
Rachel L. Douglass, UF School of Natural Resources and Environment
Chad Foster, UF School of Forest Resources and Conservation

Category: Nutrient dynamics and enrichment impacts in aquatic ecosystems
Session Title: Posters - Nutrient dynamics and enrichment impacts in aquatic ecosystems 2

Influence of Autotrophic Assimilation on Diel Elemental Cycling in a Spring-Fed River

Ecosystem respiration and photosynthesis by submerged aquatic plants result in diel (24-hr) cycles in dissolved oxygen (DO) concentrations, pH, redox conditions and mineral saturation states in streams, which in turn drive diel variations in elemental concentrations. Direct assimilatory uptake of micronutrients by aquatic plants may also contribute to diel elemental cycles. The objective of this study is to quantify the importance of biotic assimilation relative to abiotic controls on diel elemental cycling in streams by analyzing primary producer tissue stoichiometry, environmental element availability, and the magnitude and phase of diel variations. We deployed in-situ sensors and used ICP-MS to analyze elemental concentrations in the water and dominant algal and vascular plant species of the Ichetucknee River and its five main source springs. The entirely spring-fed Ichetucknee River, in north-central Florida, is a model system for distinguishing between the multiple drivers of diel chemical cycles due to its stable discharge, known input spring chemistry, and high primary productivity. Five kilometers downstream of the source springs, diel cycles were observed in DO, pH, NO₃, and PO₄, reflecting aquatic primary production. Thirteen major and trace elements exhibited diel cycling. Concentrations of Mg, K, Fe, Cu, As, U, Cr, V, and Co peaked in the afternoon, in phase with DO and pH, while Ca, Mn, Ba, and Sr concentrations peaked in the morning. Elemental concentrations in both plant species were similar to concentrations in terrestrial leaves but varied considerably between collection sites. Concentrations of V, Cr, Mn, Co, Ni, Sr, Ba, and U in plants from the springs correlated well ($r^2 > 0.6$) with spring water concentrations. Differences between assimilation estimates and observed diel elemental cycles should reflect the magnitude and timing of abiotic drivers of diel elemental cycles and provide insight into the interactions between micronutrient availability and acquisition within aquatic ecosystems.

Leeds, Jennifer

Authors: **Melissa Meeker**, South Florida Water Management District

Category: Efficacy of nutrient source control strategies

Session Title: Efficacy of Nutrient Source Control Strategies 1

“Stormwater Treatment Areas – The Water-Cleaning Workhorses of Everglades Restoration”

As a major component of Everglades restoration, the construction and operation of six large-scale freshwater treatment wetlands, known as Stormwater Treatment Areas (STAs), are successfully removing excess total phosphorus from surface waters prior to entering the Everglades ecosystem. Varying in size, configuration and period of operation, the STAs are shallow freshwater marshes divided into treatment cells by interior levees, with water flows managed via pump stations, gates or culverts. The dominant plant communities in the treatment cells are emergent aquatic vegetation, submerged aquatic vegetation and floating aquatic vegetation – interspersed with periphyton communities. The STAs retain nutrients through several mechanisms including plant nutrient uptake and litter decay, settling and sorption, sedimentation and microbial activities. The State of Florida has committed more than \$1.8 billion in water-quality improvements aimed at lowering phosphorus levels in runoff water, including stormwater treatment areas. Considered the water-cleaning workhorses of Everglades restoration, the South Florida Water Management District operates the network of STAs south of Lake Okeechobee with a combined treatment area of 45,000 acres. Since 1994, the constructed wetlands have treated more than 11 million acre-feet of water and retained about 1,470 metric tons of total phosphorus. The construction of an additional 11,500 acres of stormwater treatment area is nearly complete. A decade ago, phosphorus concentrations in Everglades-bound waters averaged 170 parts per billion (ppb). Today, the concentrations in discharges to the Everglades are as low as 12 ppb, repeatedly surpassing the predictions for what could be achieved. The STAs built to improve the quality of water entering the Everglades system are the largest of their kind in the world. To augment progress, the design and utilization of flow equalization basins are also being evaluated to help manage flows into the STAs, thereby improving treatment capability and further reducing total phosphorus concentrations entering the Everglades.

Lenhardt, Matthew

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Category: Governance approaches to nutrient management
Session Title: Posters - Governance Approaches to Nutrient Management

Balancing Florida's agricultural future with the proposed numeric nutrient criteria water quality standards

The state of Florida has one of the nation's most comprehensive water quality monitoring programs. In fact, Florida already leads the nation in the amount of water quality data collected to preserve the quality of Florida waters. The agricultural community has been a key player in the state's evaluation process and implementation of 'Best Management Practices' or BMPs, which have made a positive impact on Florida's water quality. In spring of 2010, the United States Environmental Protection Agency (EPA) proposed additional water quality standards, (known as Numeric Nutrient Criteria) which will only apply to the State of Florida. While it is important to maintain stringent water quality standards, the proposed EPA criteria may have negative impacts on Florida's agriculture, putting it at a competitive disadvantage behind states which do not have to comply with these standards. IFAS research has concluded that approximately 10% of agricultural lands will be taken out of production to meet these standards, with a total annual revenue loss of \$631 million dollars to Florida agriculture. It has also been estimated that the state of Florida will incur an estimated total cost of 2.8 to 8.1 billion dollars if these new standards are implemented. Four of the five water management districts, FDACS, and FDEP have also expressed concerns with the current EPA's proposal. Florida agriculture commodity groups continue to work cooperatively with state and industry partners to ensure sound environmental stewardship practices. Agricultural producers need clean water and support science-based efforts to further protect Florida's waters. Creating a balance between the proposed Numeric Nutrient Criteria and the state's economic sustainability is an important challenge facing Florida agriculture.

Liao, Xiaolin

Authors: **Xiaolin Liao**, Soil and Water Science
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Ben Hogue, soil and water science department, UF
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Category: Nutrient dynamics and enrichment impacts in aquatic ecosystems
Session Title: Posters - Nutrient Dynamics and Enrichment Impacts in Aquatic Ecosystems 1

Seasonal patterns of periphyton nitrogen fixation in seasonally-flooded calcareous wetlands of the Florida Everglades

Fire is an important driver in various ecosystems and can affect nutrient cycling by changing the form, distribution and amount of nutrients. However, nitrogen (N) cycling in response to fire is not well understood, especially for ecosystems like the oligotrophic wetlands. In this study, a restored wetland (restored in 2000, high phosphorus) and a native calcareous wetland (reference site, low phosphorus) were burned on 4th May, 2010 in the Hole-in-the-Donut (HID) of Florida Everglades, where farmed marl prairie wetlands have been restored through complete soil removal to reduce nutrient levels. In each site, we had two pairs of 30m by 30m burn and control plots set. Soil properties were measured to evaluate the immediate (2 days), short (1 month) and long time (around 1 year) changes of soil nitrogen cycles after the fire. Results showed that immediately after the fire, extractable nitrate/nitrite (NO₃-N) and ammonia (NH₄-N) elevated in the burn plots compared to the control plots in both restored and reference site. After one year of the fire, the extractable NO₃-N and NH₄-N gradually returned to the control level. These results suggest that the inorganic nitrogen would release to the soil very rapidly after the fire, but with the time, the nutrient uptake by plants would deplete soil available nitrogen. The N-related enzyme (Leucine-aminopeptidase, LAP and N-acetyl-β-D-glucosaminidase, NAG) were highly correlated with nitrogen mineralization, and their response to fire varied with different time and sites. An increase of LAP: NAG ratio was also observed in the burn plots immediately after the fire, indicating the possible changes of microbial community after the fire. We also saw a 20% higher denitrification rate immediately after the fire in the burn plots but after 1 month it decrease to the control level. The correlation between the denitrification and the NO₃-N suggested the denitrification was not only caused by the increased NO₃-N, the charcoal mechanism would be a possible reason. The low-P reference site responded to the fire much greater than the high-P restored site, indicating the P released by the fire in the reference site would fuel the nitrogen cycle.

Liebowitz, Dina

Authors: **Dina Liebowitz**, University of Florida
Matthew Cohen, University of Florida
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Category: Ecology
Session Title: Posters - Hydroecology

Experimental Evidence of Environmentally Mediated Top-Down Control of Algal Proliferation in Florida's Springs

Many of Florida's 700+ springs have undergone dramatic shifts in autotroph dominance (from submerged aquatic vegetation to benthic filamentous algae), yet the drivers of these changes remain ambiguous. While nitrogen enrichment has been implicated, new data suggest other drivers are at play in these unique spring-fed karst ecosystems. Recent surveys revealed a negative relationship between gastropod biomass and algal abundance across and within springs. In this study we expand on these observational findings, by conducting in situ grazing experiments to examine three linked hypotheses developed to help explain patterns of algal density in Florida's springs. These are (1) that the dominant gastropod grazers can control algal accumulation; (2) that there is potential for hysteretic behavior, i.e. once an algal bloom forms, even abundant grazers cannot exert enough grazing pressure to induce a low-algae state; and (3) dissolved oxygen (DO) influences the distribution and grazing efficiency of gastropods. We conducted grazer enclosure experiments (in situ cages containing high grazer densities, zero grazers, or partially caged controls) in four connected springs with similar water chemistry, but varying DO regimes (steady high DO, steady low DO, and two fluctuating DO regimes). We ran the enclosure experiments in two directions: one with initial conditions of low algal biomass, and the second with initial conditions of high algal biomass, to explore potential hysteresis and density dependent removal efficiency. This allowed us to explore the mediating effects of DO regimes (levels and fluctuations) on grazing efficiency, and the ability for grazers to control algal accumulation under algal bloom and non-algal bloom conditions. We observed significant grazer impacts at all sites, with grazing rates and algal accumulation varying due to environmental factors and initial conditions. Additionally, we report preliminary results from laboratory mesocosm experiments conducted to closely examine the mechanism of DO stress as it affects grazing efficiency.

Lusk, Mary

Authors: **Mary G. Lusk**, University of Florida
Gurpal S. Toor, Soil and Water Quality Laboratory, Gulf Coast Research and Education Center, University of Florida

Category: Innovative biological, physical, and chemical nutrient reduction & recovery technologies

Session Title: Understanding Natural, Anthropogenic and Legacy Sources of Nutrients 2

Nitrogen Transport Across an Urbanization Gradient in a Coastal Watershed

Urbanization creates altered soil and modifies vegetation and hydrology in ways that increase nitrogen (N) transport from land to water, making N pollution a key means of water quality impairment in N-limited ecosystems such as Tampa Bay estuary. Research to understand the controls on N transport in urbanizing watersheds is urgently needed to improve water quality. We evaluated the spatial and temporal evolution patterns of N forms (inorganic and organic) in streams draining sub-basins of an urban watershed of the Tampa Bay Estuary using long-term monthly (1991-2009) and weekly (2009) stream N concentration. The sub-basins were classified as developed (18–24% residential, 1–14% built up) and undeveloped (3–11% residential, 1–3% built up). Results showed that monthly total N concentrations in streams were 0.84-2.43 mg/L and were greater in developed than undeveloped sub-basins. Among N forms, NO₃-N was greater in developed (53–68% of total N) than undeveloped (25–30% of total N) sub-basins, while organic N (both dissolved and particulate forms) was greater in undeveloped (66–71% of total N) than developed (30–44% total N) sub-basins. Compared with long-term monthly total N concentrations, weekly total N concentrations were higher (1.90-2.90 mg/L) during the 2009 high-flow period (June to September), with greater concentrations in developed (2.40-2.95 mg/L) than undeveloped (1.90-2.06 mg/L) sub-basins. Organic N was much greater (65-85% of total N) across all sites as compared to 1991-2009 monthly data (30-71% of total N) and approached 77-85% of total N in undeveloped and 71-75% of total N in developed sub-basins. This presentation will conclude with a discussion on implications of presence of greater amounts of N in the organic forms as opposed to conventional wisdom of greater NO₃-N in urban watersheds. Data will also be compared with total N numeric criteria values.

MacNair, Doug

Authors: **Doug MacNair**, Cardno ENTRIX
Barbara Wyse, Cardno ENTRIX
Rush Childs, Cardno ENTRIX

Category: Governance approaches to nutrient management
Session Title: Governance Approaches to Nutrient Management 2

Numeric Nutrient Criteria in Florida: Costs of Compliance and Uncertainty

In January 2010, the Environmental Protection Agency published “Proposed Water Quality Standards for the State of Florida’s Lakes and Flowing Waters” (proposed Numeric Nutrient Criteria, or NNC). These proposed standards would replace Florida’s narrative nutrient criteria with numeric limits for total nitrogen and total phosphorus. EPA’s preliminary economic analysis of costs did not quantify the cost of urban stormwater management (EPA later quantified costs of urban stormwater compliance in the economic analysis of the final rule). Numerous Florida municipalities, industries, non-profits, and state agencies provided comments on the proposed rule and the preliminary EPA Economic Analysis. Many of these disputed the methods and the findings of the EPA Economic Analysis.

Due to the proliferation of cost estimates regarding the proposed NNC, members of the regulated community contracted with Cardno ENTRIX to independently estimate total compliance costs. Our analysis reflects the best available information about the uncertainty of the costs and the impact of the proposed federal NNC. We augment previous estimates by: 1) evaluating uncertainty, 2) clearly identifying how costs differ based on implementation requirements, and 3) estimating the distribution of costs by county and by economic sector. Such analyses enhance the policy-making process by highlighting the true range of costs and help shape cost-effective policies by illustrating how implementation strategy affects overall compliance costs. This presentation will detail the approach used by Cardno ENTRIX to estimate statewide costs for complying with the NNC. It will demonstrate the importance of accounting for sources of uncertainty and the economic effects of different compliance strategies and enforcement. We will present findings related to the distribution of total costs and economic impacts to Florida.

Maleski, Jerome

Authors: **Jerome Maleski**, University of Florida
Christopher Martinez, University of Florida

Category: Climate and Water
Session Title: Posters - Water and Climate

Climate Trends in ACF-ACT River Basins

Climate stationary is often an assumption in water planning, however this assumption has recently been called into question in light of long-term climate variability and climate change. The purpose of this analysis is to evaluate climate trends in the Alabama-Coosa-Tallapoosa (ACT) and Apalachicola-Chattahoochee-Flint (ACF) river basins in Georgia, Alabama, and Florida. Water supply in these river basins is of a particular interest given the disputes regarding equitable management of water between the three states. This work evaluated trends in the United States Historical Climate Network (USHCN) stations using both linear regression and Mann Kendal trend tests for annual, seasonal and monthly time frames for average rainfall, mean temperature, maximum temperature, and minimum temperature. Trend analyses were conducted over the 1895-2009 period for which data was available and also analyzed on the period 1950-2009 to evaluate recent trends. Since station records are not independent, the collective or field significance of trends were evaluated using a Monte Carlo permutation procedure. All trends were evaluated at the ($P \leq 0.05$) significance level. For rainfall, field-significant positive trends were only found in the September-November season for the 1895-2009 period of record. Field significant trends for temperature variables were found for both time periods. For temperature means a large number of stations were found to be decreasing in the summer and increasing in the winter. The maximum temperatures were found to be decreasing in the summer and fall and increasing in the spring and summer. The minimum temperatures were found to be mostly decreasing. During the 1950-2009 there were fewer field significant trends and less stations showing significant trends, the exception was for minimum temperatures with a large number of stations showing a significant trend in increasing minimum temperatures.

Martin, Kirk

Authors: **Kirk Martin**, CDM Smith

Category: Governance approaches to nutrient management
Session Title: Governance Approaches to Nutrient Management 1

Public Private Partnerships: A Better Way to Manage Water in Florida?

Like many areas of the world, Florida is facing water resource challenges in supply, quality, and management. Over the past couple of decades, what were once considered almost inexhaustible sources of water have become progressively more limited. Yet Florida is a water rich state abundant in rainfall, world class aquifers, and numerous and varied surface water features. The problems lie in the unequal distribution of supply and demand, highly successful drainage programs, and a concentration of demands for all types of uses. But Florida is also a big state with lots of open land in both private and public ownership that may hold the key to better management of the resources available to us. Strategic use of large land areas for seasonal water storage, groundwater recharge at critical locations, nutrient reduction, and overall water quality improvement is how nature handled it originally and providing incentives to private land holders to manage water for public benefit may ultimately be the more cost effective solution to Florida's water woes. It is a concept currently supported by state congressional initiatives and the Department of Agriculture. It is also being recognized by some private land holders as a means to diversify their holdings. A number of governance and economic issues remain to be resolved for implementation of such programs but successful initiatives are already being realized and more ideas will be generated as we begin to think more comprehensively about how best to manage our water resources around the state.

Mattson, Robert

Authors: **Erich Marzolf**, St. Johns River Water Management District
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Category: Innovative biological, physical, and chemical nutrient reduction & recovery technologies
Session Title: Understanding Natural, Anthropogenic and Legacy Sources of Nutrients 1

Relationships between Discharge and Nutrient Concentrations in Florida Springs

A major water quality management issue in Florida springs is nutrient enrichment, primarily nitrate. Elevated nitrate levels have been implicated in ecological changes in springs, primarily proliferation of filamentous and epiphytic algae. While the existence of long-term temporal trends in nitrate concentrations in springs is established, less is known about shorter-term temporal dynamics in both nitrogen and phosphorus concentrations in springs. Here we present evidence that there are significant positive relationships between flow and nutrient concentrations in Wekiwa, Rock and other springs. In Wekiwa Springs, there are significant positive correlations between flow and nitrate concentration (as NO_x-N). We also show that there is a significant positive correlation between flow and orthophosphate concentration at Wekiwa Spring, and strong positive (but not significant) relationships between flow and dissolved forms of P in Wekiwa and Rock Springs. These relationships have implications for sources of dissolved N and P. The relationship between flow and nitrate suggests that much of the anthropogenic N is coming from relatively “young” water; the relationship between flow and various forms of P suggest that some of the phosphorus in Wekiwa and Rock Springs may be due to anthropogenic loading, and not weathering from P-bearing geologic formations. This interpretation is supported by a significant negative relationship between discharge and calcium.

Millstein, Max

Authors: **Kevin Wittmann**, US Army Corps of Engineers
Max Millstein, US Army Corps of Engineers

Category: Efficacy of nutrient source control strategies
Session Title: Efficacy of Nutrient Source Control Strategies 1

Reduction of Cattail Expansion in the Everglades: A Performance Measure Application

Due to the intricacies of natural systems, predicting the ecological response of proposed structural or non-structural measures is often dependent upon simplifying assumptions, which are necessary to create an effective and efficient environmental benefit evaluation process. Broward County Water Preserve Areas (BCWPA), a large-scale ecosystem restoration project, is part of the Comprehensive Everglades Restoration Plan (CERP). The BCWPA project used three spatially discrete performance measures (PMs) to gauge its success and calculate the potential for ecosystem restoration. One PM calculated the reduction in the rate of cattail expansion, and the total acreage of expected cattail growth, partially based on the existing soil phosphorous concentrations and expected decreases in phosphorus loading.

Cattail (*Typha* spp.) is considered an invasive species in the Everglades, and has a negative impact on natural ecosystems. Elevated soil phosphorous concentrations promote rapid cattail growth. A primary goal of the BCWPA project is to improve marsh / ridge and slough habitat, which is partially accomplished through a reduction in the cattail expansion rate and total future acreage. BCWPA project construction features work together to retain clean water in the Everglades and reduce pumping of phosphorous-rich runoff from urbanized areas into the adjacent Water Conservation Area 3 (WCA 3). The connection between reduced pumping to WCA 3 and reduction in cattail expansion was determined by equations based on observed patterns of cattail expansion and related water quality and soil nutrient properties.

The BCWPA project demonstrates how even in a large-scale application, a straightforward ecosystem analysis based solely on changes in hydrology or water flows and associated nutrient loads is possible. Using this project as an example will hopefully allow others working on ecosystem restoration planning at any scale to see the “bigger picture”.

Milon, J. Walter

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Patrick Walsh, National Center for Environmental Economics, U.S. Environmental Protection Agency, Washington, D.C.

Category: Governance approaches to nutrient management
Session Title: Governance Approaches to Nutrient Management 2

Assessing the Economic Benefits of Water Quality Regulations: Are All Criteria Measures the Same?

Measures of the economic benefits attributable to enhanced water quality are important for regulatory analysis of standards to protect fresh water bodies from nutrient pollutants. Recent federal approaches to water quality regulation, particularly in Florida, have focused on numeric standards for specific target pollutants such as TN and TP. Most previous economic research on the valuation of water quality changes, however, has focused on subjective measures of water quality such as a poor – excellent rating scale, a boatable – swimmable recreation index, or a quasi-objective measure such as secchi depth (SD). The lack of equivalent metrics in these studies makes it difficult to accurately estimate the benefits of alternative numeric standards.

This study evaluates and compares the use of alternative objective and subjective measures in an economic assessment of water quality impacts on property values in urban housing markets. The analysis focuses on alternative numeric nutrient measures (TN, TP, and Chl-a), the composite indicator trophic state index (TSI), and SD. Data for the analysis include over 140 lakes over a 9 year period in the metropolitan Orlando housing market that spans both waterfront properties and others within 1,000 meter proximity to a lake.

Econometric analysis indicates that the alternative measures provide comparable qualitative information about the impacts of enhanced water quality on both waterfront and nearby properties. As expected, the largest benefits are enjoyed by waterfront properties but the benefits to non-waterfront properties vary considerably across the different measures. In general, the composite TSI is more consistent with the SD results than the individual nutrient measures. Implications of the study for cost-benefit analyses of alternative nutrient management policy options are discussed.

Minogue, Patrick

Authors: **Patrick Minogue**, University of Florida
Masato Miwa, University of Florida
Donald Rockwood, University of Florida
Cheryl Mackowiak, University of Florida

Category: Innovative biological, physical, and chemical nutrient reduction & recovery technologies
Session Title: Innovative Biological, Physical, and Chemical Nutrient Reduction & Recovery Technologies 2

Use of Bioenergy Tree Crops for Nitrogen and Phosphorus Removal at the Tallahassee Municipal Wastewater Sprayfield

Various progenies of *Eucalyptus grandis* and *E. amplifolia* and clones of *Populus deltoides* were evaluated for plant removal of nitrogen (N) and phosphorus (P) for 27 months at a municipal wastewater spray field in north Florida having a deep sandy soil, limestone parent materials, and an unconfined aquifer. Tertiary treated wastewater containing 2.73 mg L⁻¹ nitrate N and 0.30 mg L⁻¹ total P was applied using sprinkler irrigation (93.8 m³ ha⁻¹ d⁻¹) to newly planted fast growing bioenergy trees. *Eucalyptus amplifolia* and *E. grandis* survived and grew very poorly because of severe winter injury in two successive and exceptionally cold winters, and were not evaluated for nutrient removal. Survival and growth of *P. deltoides* demonstrated suitability for phytoremediation, and selected clones were evaluated for biomass and nutrient content. Removals of total N (TN) and total P (TP) were greatest for main stem (36% and 44%, respectively) and foliage (44% and 36%, respectively). Consequently, harvest of all above ground biomass during the growing season, when trees are foliated, will optimize nutrient removal. Low biomass producing clones generally had higher nutrient concentrations, but high biomass producing clones removed more TN and TP. Approximately 789 kg ha⁻¹ TN and 103 kg ha⁻¹ TP were removed by the highest biomass (112 Mg ha⁻¹ 27 mo⁻¹) producing *P. deltoides* clone, representing 215% of N and 615% of P inputs. Research is needed to address how successive harvests, background soil nutrient concentrations, and other nutrient amendments may affect the efficacy and sustainability of this practice.

Mirsaeid Ghazi, Niloufar

Authors: **Niloufar Mirsaeid Ghazi**, FSU

Category: Water Chemistry

Session Title: Posters - Water Treatment and Aquatic Chemistry

Study on the Degradation of Nitrobenzene Utilizing Ultraviolet (UV) Radiation Process and the UV/ Hydrogen Peroxide Advanced Oxidation Process (AOP)

The degradation of Nitrobenzene was investigated via ultraviolet (UV) radiation process and the UV/ hydrogen peroxide advanced oxidation process (AOP). Nitrobenzene (C₆H₅NO₂) is hazardous both in acute and chronic exposure and has been found in leachate in landfills of the United States. Leachate is treated via conventional water treatment systems before entering the public drinking water supply. On the grounds that Nitrobenzene is only partially removed with conventional water treatment systems, there is a need to use alternative treatment processes. At this study, for Nitrobenzene tested, direct UV photolysis quantum yields were derived for use with monochromatic low pressure (LP) UV lamps and second-order hydrogen peroxide radical rate constant was developed. Utilizing these parameters, UV treatment of the Nitrobenzene in laboratory and natural waters were modeled. Nitrobenzene was more effectively degraded utilizing UV/H₂O₂ advanced oxidation as compared to direct UV photolysis treatment using LP lamps which omit UV 254 nm radiation.

Mitchell, Jennifer

Authors: **Jennifer Mitchell**, Alachua County EPD
Mark Clark, UF Soil and water science
Jim Myles, Alachua County DEP

Category: Understanding natural, anthropogenic and legacy sources of nutrients
Session Title: Posters - Understanding Natural, Anthropogenic and Legacy Sources of Nutrients

The Influence of Stormwater Pond Substrate on Surface Water Phosphorus Dynamics across Alachua County

Sizing and design of stormwater basins in the past has primarily focused on quantity of water storage; however, water quality leaving these ponds is of increasing importance as numeric nutrient criteria (NNC) are implemented. Phosphorus is often the limiting nutrient for plant growth in freshwater systems and is often a target for management. Phosphorous management in the landscape is often focused on fertilizer and animal waste management, but in areas with naturally high phosphatic geology, increasing the exposure of this material to weathering during development could result in increased surface water phosphorus levels. To evaluate the potential influence phosphatic soils may have on stormwater basin water quality as well a preliminary survey of 15 stormwater ponds across Alachua County was conducted in Fall of 2011. Ponds were selected based on their location in the county and accessibility. Phosphorus (P) rich Hawthorne series clays underlie the eastern section of the county, while the western side has rapid infiltration rates resulting from the lack of a confining layer. In this study we calculated soil P storage capacity (SPSC) of the newly accreted surface layer and the underlying native soil to use as a possible index of P flux potential. These two layers were easily identified and separated. Melich-1 extractions were conducted for P, aluminum (Al), iron (Fe), calcium (Ca), and magnesium (Mg). Water extratable P was also determined on these samples. Intact soil cores collected from three locations within each basin were incubated with rain water for up to 14 days. Based on the SPSC values using Fe, Al, Ca, and Mg and small change in surface water soluble reactive P (SRP) concentration over the incubation these stormwater wetlands should serve as a sink for P. Interestingly the cores with the greatest P flux were from the basins which were not flooded during sampling, indicating the importance of reducing conditions for P storage. Despite some soils having up to 1000 mg/kg of Melich-1 extractable P, concentrations of Fe, Al, Mg, and Ca were in similar abundance and prevent release of P when soils remained under flooded conditions.

Miwa, Masato

Authors: **Patrick Minogue**, University of Florida
Masato Miwa, University of Florida
Anna Osiecka, University of Florida
Jeffrey Vowell, Florida Forest Service
Roy Lima, Florida Forest Service

Category: Efficacy of nutrient source control strategies
Session Title: Efficacy of Nutrient Source Control Strategies 2

Effectiveness of Silvicultural BMPs in Pine Straw Production to Protect Groundwater – Third Year Results

A silvicultural fertilization BMP effectiveness monitoring project was conducted for three years, at two Florida study locations having contrasting leaching potential, to observe the environmental fate of nitrogen (N) and phosphorus (P) applied at various amounts relative to BMP guidelines. Two sequential annual diammonium phosphate (DAP) fertilizations, providing 22/24, 67/72, or 112/120 lb/ac N/P per application, were monitored in mid-rotation slash pine plantations with and without pine straw raking and compared to unfertilized controls. Periodic monitoring for two years following the first fertilization included N and P concentrations in surficial groundwater, soil at various depths, pine foliage, pine straw litter, and harvested straw. Other periodic monitoring included pine straw litter mass and harvested straw yield, tree growth and health, soil physical and chemical properties, soil moisture and temperature, and weather parameters. Groundwater NH₃-N, total Kjeldahl nitrogen, and total P concentrations in monthly samples did not increase when compared to pre-fertilization baseline levels or distant control wells during the monitoring period at either location. At a Blountstown location, having somewhat poorly drained clay soil, surficial groundwater (3.0-13.5 ft depth) nitrate-nitrite N (NO_x-N) concentration was consistently high relative to baseline measures and the distant control well following the second fertilization. However, the highest observed concentrations were ≤ 1.4 mg L⁻¹ greater than distant control wells, not excessive in terms of water quality, and did not exceed state water quality standards. At a Suwannee Valley location, having excessively drained deep sandy soil, periodic measures of soil NO_x-N concentration showed rapid leaching, but treatment effects were not observed in groundwater (32.9-42.4 ft depth) during the monitoring period. Early results suggest a need for annual N limits rather than three-year maximums, and continued monitoring is underway to support recommended N amounts for soils representing different leaching potential.

Monaghan, Paul

Authors: **Paul Monaghan**, University of Florida
Gail Hansen, University of Florida
Amanda Concha Holmes, University of Florida
Michelle Atkinson, Manatee County Extension
Shangchun Hu, University of Florida

Category: Efficacy of nutrient source control strategies
Session Title: Social, Behavioral, and Economic Aspects of Nutrient Management 2

Targeting Specific Audiences with Community Based Social Marketing to Improve Neighborhood Stormwater Ponds

A key tenet of community based social marketing is identifying specific target audiences and designing programs for them instead of for a “general public”. The benefits of audience segmentation include a better use of scarce resources, clearer understanding of what motivates behavior while hindering behavior change and a more effective evaluation of outcomes. A smaller, more homogenous audience is more efficient for social change interventions and they can still have a significant impact on larger social behaviors. Segmenting audiences and targeting them is what successful marketers do and water conservation efforts can learn from this approach. This presentation will highlight social marketing research to improve water quality in stormwater ponds in the Braden River watershed. With assistance from a community advisory board, the Southwest Florida Water Management District and Manatee County Extension, researchers at the University of Florida were able to help residents understand the issues of nutrient loading of stormwater ponds, nuisance algae growth and the complexities of possible solutions. The target audience selected for this research consisted of upper income households, composed primarily of retirees, most of whom did not do any of their own landscaping. Nevertheless, they were a key audience to understanding the landscaping practices that contributed to water quality problems. We used focus groups to collect data on attitudes regarding residential landscaping practices and to seek out acceptable alternatives that would reduce nutrient loading in the watershed. This presentation will provide an overview of the research, the role of target audiences and the outcomes that resulted from a community based social marketing approach.

Morales, Miguel

Authors: **Miguel Morales**, University of Florida
James Heaney, University of Florida

Category: Water Conservation and Use
Session Title: Posters - Water Conservation and Use 1

Analysis of Non-Residential Urban Water Use Through Water Billing and Property Appraiser Databases

The non-residential (NR) sectors are significant contributors to public water demand. For estimating NR water use, utilities have historically relied on water use coefficients developed through studies in the literature. Typically, these water use coefficients use number of employees or a variety of other measures of size. However, it is difficult to get this information in a fine enough resolution with consistent databases to differentiate between individual water users and adequately evaluate water conservation options. To overcome these challenges, this poster presents a bottom-up methodology by which to estimate NR water use through publicly available (from the Florida Department of Revenue (FDOR)) spatial, physical, and economic property attribute information for every one of the 326,000 NR parcels in Florida. By estimating water use at the parcel level, this methodology provides baseline water use estimates to prioritize NR water conservation options and allows utilities to compare their utility profile with other utilities. FDOR data are available in a standard format, and include land use classification of 55 NR subsectors. Water use data for 3,172 NR parcels from two utilities were linked with FDOR data to develop average and peak water use coefficients normalized by heated building area. The parcel-level information from FDOR allows for the development of pertinent relationships to estimate the number, efficiency, and frequency of use of water using devices in the 55 NR subsectors. This bottom-up approach allows for benefit-cost analysis and subsequent optimization of water conservation options.

Nair, Vimala

Authors: **Vimala Nair**, Soil and Water Science Department, University of Florida

Category: Innovative biological, physical, and chemical nutrient reduction & recovery technologies

Session Title: Understanding Natural, Anthropogenic and Legacy Sources of Nutrients 2

A Quantitative Approach to Soil Phosphorus Loss Risk Assessment

Reliable techniques must be developed to predict phosphorus (P) storage and release from soils of uplands, ditches, streams and wetlands in order to better understand the natural, anthropogenic and legacy sources of P and their impact on water quality at a watershed scale. Environmental indicators of P loss such as soil test P (STP) do not allow an assessment of the capacity of a soil to retain further addition of P. To address this shortcoming, a new concept called the “Safe” Soil Phosphorus Storage Capacity (SPSC; <http://edis.ifas.ufl.edu/pdffiles/SS/SS54100.pdf>), which entails a “threshold” phosphorus saturation ratio (PSR) has been developed for Florida soils. The PSR (<http://edis.ifas.ufl.edu/pdffiles/SS/SS53900.pdf>) is the molar ratio of P to Fe and Al, and SPSC is a PSR-based calculation of the remaining soil P storage capacity that would consider risks arising from previous loading as well as inherently low P sorption capacity of a soil. The relationship between water soluble P (WSP) or the equilibrium P concentration (EPC0) and SPSC shows that as long as SPSC is positive, WSP and EPC0 are at a minimum, but when SPSC is negative, the release of P from the soil increases. Therefore, zero SPSC amounts to a threshold value below which P runoff or leaching risk increases precipitously. Typical uses of this simple, cost-effective, and quantitative approach at a field/plot as well as at larger scales for P risk assessment and management will be discussed.

Northrop, Robert

Authors: **Robert Northrop**, University of Florida IFAS

Category: Efficacy of nutrient source control strategies

Session Title: Efficacy of Nutrient Source Control Strategies 2

A Rapid GIS-based Assessment of the Potential for Riparian Buffers to Influence Water Quality within Hillsborough County, Florida.

Objectives: Assist the Hillsborough Board of County Commissioners in developing science-based criteria for the establishment of riparian buffers for the protection of water quality in open water bodies, through the attenuation of dissolved nitrogen.

Methods: De-nitrification has been shown to occur within the biologically active rooting zones of grasses and forest, approximately 0 to 2 ft. below soil surface. Using a series of free and available GIS data sets and shapefiles, I developed a rapid assessment methodology that combined land use/land cover, zoning, soils, wetlands and open water features to identify potential hot spots for de-nitrification within current and projected (zoning) land use/land cover types. Results: Output maps of the geographic distribution of de-nitrification hotspots illustrated the range of zoning, land use/land cover combinations associated with the hotspots. Tabular data sets provided a more detailed statistical analysis and summary data concerning land ownership patterns within the hot spots. Conclusions: Maps and tabular data developed through the use of this assessment tool were used to inform a series of alternative strategies that identified the most effective and efficient locations for riparian buffer establishment, suggested the strengths of various buffers widths within the watershed and identified the total cost for establishment including the cost of the land. These alternative strategies are being used by the Hillsborough County Technical Advisory Group on Ecological Buffers to assist in the evaluation of the ecological, economic and social implications of establishing riparian buffers for surface water quality protection through changes to the comprehensive plan.

Oppenheimer, Joan

Authors: **Joan Oppenheimer**, MWH
Joseph Jacangelo, MWH/Johns Hopkins University

Category: Innovative biological, physical, and chemical nutrient reduction & recovery technologies
Session Title: Understanding Natural, Anthropogenic and Legacy Sources of Nutrients 1

Efficacy of Selected Organic Microconstituents as Markers for Nitrogen and Phosphorus Loading from Reclaimed Water Plants in Florida

Nitrogen and phosphorous loading into Florida waterways from point and non-point sources is of increasing concern. Effective control measures to minimize nutrient loading from beneficial reuse of treated wastewater requires the development and validation of markers that can serve as tools in identifying nutrient loading sources. This information can then be used to establish appropriate reuse water treatment needs, loading rates and best management practices.

The overall objective of this study was to provide a more perspicuous understanding of the contribution of nutrient loading due to reclaimed water through the development of a conservative maker for nitrogen and phosphorus. The markers evaluated included several microconstituents: sucralose, gadolinium, coprostanol, galaxolide, dalapon, carbamezapine, tonalide, atenolol and iohexal. In addition to reuse water, samples were also collected from septic drainfields and stormwater ponds to determine if the markers could distinguish between various potential sources of nutrient loading. Additionally, their behavior or fate relative to phosphorus and nitrogen, was examined by performing bench-scale experiments focusing on adsorption to soils, biodegradation, and photodegradation.

Of the microconstituents studied, sucralose, an artificial food sweetener, was found in the highest concentrations. This compound was present in all eight of the reclaimed water effluents analyzed, irrespective of type of treatment and effluent nitrogen and phosphorus levels; concentrations ranged from 18,000 to 30,000 ng/L. Gadolinium, which is associated with magnetic nuclear resonance imaging, was also identified in each of the effluents with concentrations ranging from 24 to 140 ng/L. Several other microconstituents were also detected. Of significance is the finding that sucralose, gadolinium and the other selected markers were not detected or were found at levels close to the analytical detection limits in stormwater and septic samples. Thus, these compounds, along with others assayed, have the potential to distinguish between the various sources of nutrient loadings into surface waters.

Ott, Emily

Authors: **Emily Ott**, University of Florida, Agricultural Education and Communication
Paul Monaghan, University of Florida Center for Landscape Conservation and Ecology
Jessica Kochert, University of Florida Agricultural Education and Communication, Extension Education
Wendy Wilbur, Alachua County Cooperative Extension
Stacie Greco, Alachua County Department of Environmental Protection

Category: Social, behavioral, and economic aspects of nutrient management
Session Title: Posters - Social, Behavioral, and Economic Aspects of Nutrient Management

Social Research for Water Conservation: Solutions for a Water-Wise Future

A convenience sample of Alachua County residents exposed to Cooperative Extension landscaping programs were surveyed about their landscaping practices. Many respondents want yards that require less maintenance and use less water and chemicals than the standard yard. Additionally, 34% owned at least one rain barrel. Those respondents who owned a rain barrel were unique as they fertilized, watered, and used a landscaping service less frequently than non-owners. These results indicate rain barrel owners may be adopters of other conservation-based landscaping practices.

Based on these survey results, rain barrel owners will be interviewed about their perceptions of the springs and their understanding of their personal landscaping practices on their watershed. This information will be compared with perceptions of springs and connectedness of yards to springs of high water users. I hypothesize that rain barrel owners constitute a unique target audience with specific needs that Extension can meet through its programming. The data from this study will be used by Extension to develop a water conservation social marketing campaign.

Social science research is a vital piece of the water conservation puzzle. By identifying sympathetic audiences, assessing stakeholder perceptions, and creating programming that meets constituent needs, Extension can be an agent of change developing ecologically literate citizens.

Palacio, Darina

Authors: **Darina Palacio**, University of Florida

Category: Understanding natural, anthropogenic and legacy sources of nutrients

Session Title: Posters - Understanding Natural, Anthropogenic and Legacy Sources of Nutrients

Water Resource Management Challenges in Florida: Geospatial Assessment of Stream Impairment

We are at a critical time for environmental science within the state of Florida, particularly in water resource management and stream restoration sciences. Many of our streams are currently impaired based on previous metrics and many may potentially be impaired when compared to the recent Numeric Nutrient Criteria legislation. The 2010 Integrated Water Quality Assessment for Florida (2010) reported that well over 50% of stream miles assessed for water quality were impaired in at least one criterion and required the development of Total Maximum Daily Loads (TMDL). In the area of biological status, assessments made using the BioRecon and SCI tools found that approximately 37% and 21% of measurements failed to meet the required metrics of stream health. There will be a need for increasing restoration efforts in the near future to improve the health of our streams and rivers. This poster aims to spatially assess areas where stream impairment are most concentrated. Various data that identifies stream impairment were used in this analysis. Using geospatial statistics, areas with a high density stream impairment were identified. Areas were assessed using various administrative, political and natural boundaries. The results of the spatial analysis demonstrates trends for stream impairment which can be utilized to develop restoration strategies across the state.

Pawlitz, Rachel

Authors: **Rachel Pawlitz**, University of Florida

Category: Governance approaches to nutrient management

Session Title: Posters - Governance Approaches to Nutrient Management

Beyond Uncertainty: Designing Tools for Adaptive Water Governance

It is widely believed that the "water crisis" requires new, adaptive governance tools to help balance competing human and environmental water uses. Adaptive approaches are thought to be a means to embrace uncertainty and learn by doing through an iterative policy process. This ethnographic study looked at the relationship between political uncertainty and hydrologic uncertainty in the twenty year conflict over water in the Apalachicola-Chattahoochee-Flint (ACF) basin. Political "uncertainty" stemmed from legalistic interpretations, meta-discourses about the "interests" of the basin. Models perpetuated those meta-discourses and fed into polarized narratives about the goals of water management. Both policy analysis tools and governance institutions fueled this tendency by simplifying trade-offs and black-boxing assumptions about how technical information would be used to make decisions. The findings suggest that water governance requires more transparent decision metrics and models that can be designed with stakeholders' full array of interests in mind. This begins with a careful definition of stakeholders, and requires reducing the policy problem into parameters that are recognizable to stakeholders as explicitly related to their concerns. Finally, stakeholders must have access to governance institutions that provide an equitable, participatory forum for agreeing on a shared ethic for balancing multiple tradeoffs and concerns.

Penniman, Daniel

Authors: **Daniel Penniman**, SNRE program
Mark Hostetler, Wildlife Ecology and Conservation
Glenn Acomb, Landscape Architecture
Tatiana Borisova, Food and Resource Economics

Category: Social, behavioral, and economic aspects of nutrient management
Session Title: Posters - Social, Behavioral, and Economic Aspects of Nutrient Management

Cost Analysis of Low Impact Development Stormwater Treatment Methods in Florida

Low Impact Development (LID) is a fairly new practice used to treat stormwater, and it has been shown to effectively reduce pollutant loading. A 2007 USEPA study indicated that LID projects may be cost effective, however, there has been a lack of research on the economic costs of implementing LID in Florida. The objectives of this study are (1) to compare LID costs to conventional stormwater treatment costs for construction in Florida; (2) to create a cost profile of different LID methods for stormwater treatment; and (3) to identify the primary barriers for firms attempting to implement LID in Florida. Using a snowball sampling method, we identified 30 design firms throughout Florida that have used LID within the planning and/or other stages of residential development projects. A combination of online surveys, a specialized cost data collection tool and phone interviews with key employees of the firms is being used to obtain opinions and cost data. Preliminary results will be presented from these surveys and interviews. The findings from this research will help better inform the Florida design/development industry on economic aspects of LID, help regulatory bodies craft policies to encourage LID implementation, and provide a source of information/data for proper consideration of LID costs and benefits.

Post, Annemarie

Authors: **Annemarie Post**, UF/IFAS Sarasota County Extension

Category: Social, behavioral, and economic aspects of nutrient management

Session Title: Posters - Social, Behavioral, and Economic Aspects of Nutrient Management

Community efforts to improve water flow and filtration through natural area restoration

The Sarasota County Florida-Friendly Landscaping™ Program for Community Associations provides outreach programs to educate communities on strategies to preserve and restore natural areas as part of its outreach efforts. Assistance and information on identification of non-native invasive plants, strategies to remove non-native invasive plants, selection of appropriate native replacement plants, and management strategies, is provided during on-site outreach programs. In addition, grant funding opportunities to help these efforts are researched and discussed. Of the 402 community associations that received on-site educational programs during the length of the program (2000-2009), 11% (44) reported that they have removed invasive plants and restored natural areas or stormwater retention areas. One such effort took place in the Calusa Lakes community, where about 16 acres of wetland preserve areas were infested with Brazilian Pepper. During 2006-2009, volunteers worked to remove Brazilian Pepper in about 12.5 acres (80%) of the infested areas, and replanted appropriate native wetland species such as Wax Myrtle, Dahoon Holly, Red Maple and Sweetbay Magnolia. Plans are underway for a collaborative effort to remove non-native invasive plants between Calusa Lakes and their neighbor, Mission Valley Golf Course. Invasive plants alter the functions and value of natural and stormwater retention areas by displacing native species and disrupting natural processes such as water flow and filtration. Preserving and restoring natural areas will improve natural processes, and improve water quality and quantity. As an added benefit, this project brought the community together, and proved to be a positive community building effort.

Poudel, Bishow

Authors: **Bishow Poudel**, University of Florida
Diane Rowland, University of Florida
Kevin Kenworthy, University of Florida

Category: Water Conservation and Use
Session Title: Posters - Water Conservation and Use 2

A Study on Root Morphological and Physiological Characteristics of Warm Season Turf Grass Species for Their Field Drought Performance

Root morphology is considered important in selecting for field drought performance of warm season turfgrass species. There is considerable variability among turfgrass genotypes in their rooting behavior. A mini-Rhizotron camera system was used to study rooting behavior of two commercial warm season turf grass species from April to June, 2011 at the University of Florida turfgrass research center. The mini-rhizotron technology has been widely used to study root morphological parameters in situ and in a non-destructive manner for crops and natural plant populations but has rarely been used in turfgrass. The technology allows the measurement of rooting depth, diameter, volume and surface area that can be further correlated with a plant's relative ability to extract nutrients and water from the soil. Using this technology, we evaluated the effect of mowing height on the two turfgrass species, St. Augustine and Bermudagrass. We found that higher mowing heights promoted better root growth, development and proliferation; while higher mowing height reduced average root diameter. Similarly, lower mowing heights were associated with poor root growth and development, but the average root diameter was comparatively higher in lower mowing heights. This suggests that lower mowing heights were associated with decreased new root growth and may have a significant impact on decreasing the drought tolerance of a turfgrass species.

Prasad, Rishi

Authors: **Rishi Prasad**, Soil and Water Science Department
George Hochmuth, Professor
Christopher Martinez, Assistant Professor

Category: Understanding natural, anthropogenic and legacy sources of nutrients
Session Title: Posters - Understanding Natural, Anthropogenic and Legacy Sources of Nutrients

Nitrogen Budgeting and Cycling for an Integrated Farm: A Step towards Improved Nitrogen Management in the Suwannee River Watershed

Increasing levels of nitrate in ground water in the Suwannee River Basin has raised concerns over past 30 years (SRWMD, 2007). Among non point sources, agricultural operations have been associated with continuous increase in-stream nitrogen load, and surface and groundwater nitrogen contamination. Best management practices are being encouraged for agricultural fertilization in this watershed. The development and optimization of N budget for farms located in this watershed can be an effective tool to refine BMPs for reducing the N load in the watershed. Suwannee Farms is a large integrated farm located 1.25 km SW of Suwannee River. The diversity of cropping systems and the incorporation of the livesTOC_Topk feeding operation with the anaerobic digester employed on this farm makes it an ideal operation for determining N budget for a large farm operation. The objective of this study was to quantify the N balance associated with cropping system (potato, sweet corn), livesTOC_Topk feeding operation and anaerobic digestion of waste generated from livesTOC_Topk unit. For the growing season 2010, a partial nitrogen balance for potato crop indicated a total nitrogen recovery of seventy percent within the plant with an estimated unaccounted N loss of 85 kg ha⁻¹ where as for sweet corn the total nitrogen recovery was 68 % with an estimated unaccounted N loss of 92 kg ha⁻¹. The two major pathways associated with unaccounted N were hypothesized to be the leaching and volatilization losses which would be measured in subsequent seasons for sandy soil and center-pivot irrigation on this farm.

Qiao, Yu

Authors: **Qiao Yu**, Florida State University

Category: Innovative biological, physical, and chemical nutrient reduction & recovery technologies
Session Title: Posters - Innovative Biological, Physical, and Chemical Nutrient Reduction & Recovery Technologies

Ozone Pre-Treatment to Enhance Anaerobic Degradation of Refractory Landfill Leachate Organics.

When conventional biological treatment alone is not adequate for treatment of low-flow, high-strength wastewaters (e.g, landfill leachate), Advanced Oxidation Processes (AOPs) have been investigated as a precursor to biological treatment. These processes involve generating the hydroxyl radical ($\cdot\text{OH}$), a nonselective, highly reactive oxidizing species. Ozonation alone, and $\text{O}_3+\text{H}_2\text{O}_2$ can both favor the production of $\cdot\text{OH}$, and can increase the biodegradability of landfill leachate. This research studied the effectiveness of O_3 and $\text{O}_3\text{-H}_2\text{O}_2$ as a precursor to anaerobic biological treatment of landfill leachate. The main reasons anaerobic biological treatment instead of aerobic biological system was conducted in this research are due to its higher organic loading, good process stability, lower nutrient requirements, and lower operating costs compared with aerobic system. An incubation of leachate with anaerobic sludge in an oxygen-free reactor was used as the anaerobic biological treatment method in this research.

Three chemicals: Tris(2-chloroethyl) phosphate (TCEP), Tris(2-butoxyethyl) phosphate (TBEP), and 17- β -Estradiol (E2) were chosen as representative refractory organic contaminants found in municipal landfill leachate. Molecular structures of the three compounds are shown below:

TCEP

TBEP

E2

Different dosages of O_3 and $\text{O}_3+\text{H}_2\text{O}_2$ were added to the leachate that contained mg/L concentrations of the three chemicals mentioned above. Leachate samples mixed with sludge were taken from the reactors after days of incubation to quantify the degradation of the three contaminants. The aim of this research was to quantify the impact of advanced oxidation pretreatment on further anaerobic biological treatment, and to assess the impact on co-metabolism of 3 contaminants. The varying degree of anaerobic degradation with and without pre-ozonation treatment will be presented.

Qin, Zhixuan

Authors: **Zhixuan Qin**, University of Florida
Amy Shober, University of Florida
Vimala Nair, University of Florida

Category: Efficacy of nutrient source control strategies
Session Title: Posters - Efficacy of Nutrient Source Control Strategies 1

Evaluation of Nutrient Leaching from Simulated Residential Mixed Landscapes

Nutrient leaching from residential landscapes has been suggested as a cause of water quality degradation in Florida due to the heavy use of fertilizers and irrigation in these systems. The objective of this study was to determine nutrient leaching losses from mixed landscapes that were planted with varying proportions of turf grass and woody ornamental plants (i.e., sweet viburnum and magnolia). Mixed landscapes consisting of 60, 75, or 90% St. Augustine turfgrass (40, 25, or 10% ornamentals, respectively) were installed in nine drainage lysimeters in a randomized complete block design at the University of Florida/IFAS (UF/IFAS) Mid Florida Research Center in Apopka, FL. Landscapes were fertilized and irrigated based on UF/IFAS recommendations. Plants were allowed to establish in the lysimeters for a period of one year, after which time daily leachate samples were collected for a period of 18 months. Daily leachate samples were combined to produce weekly flow-weighted samples. Leachate samples were stored at 0°C until analysis for N (e.g., NO₃+NO₂, NH₄, total Kjeldahl N) and P (e.g., dissolved reactive P). Flow-weighted concentrations and loads of N and P were calculated to determine the effects of vegetative cover on nutrient leaching. Preliminary results showed that there was no significant plant cover effect on flow-weighted concentration or load of dissolved reactive P or NO₃+NO₂ leached from lysimeters. However, lysimeters planted with 90% turfgrass (10% ornamentals) lost significantly more TKN and NH₄ (flow-weighted concentration and load) than lysimeters planted 60% turfgrass (40% ornamentals). Our results suggest that urban landscapes containing significant areas of ornamental plants do not necessarily leach more nutrients than turfgrass monoculture.

Rainey, Donald

Authors: **Donald Rainey**, UF/IFAS Extension Florida-Friendly Landscaping (TM)

Category: Efficacy of nutrient source control strategies

Session Title: Posters - Efficacy of Nutrient Source Control Strategies 1

Florida-Friendly Landscaping™ Green Industries Best Management Practices (FFL/GI-BMP)

The FFL/GI-BMP program is focused on reducing non-point source pollution resulting from fertilization or pesticide application. Situation: as of June 2009, F.S. 403.9338 (603.9338) states that all commercial fertilizer applicators must have a license from the Florida Department of Agriculture and Consumer Services (FDACS) by January 1, 2014. To obtain this license, each Green Industry professional must be trained in the FLL/GI-BMPs and to receive a certificate of completion from UF/IFAS and FDEP. Objective: Build awareness and participation that will lead to certifying 100,000 Green Industry Professionals. Method: provide six hour in-person training, consisting of five PowerPoint modules designed to GI-BMP train/certify professionals. A pre/post-test is given to determine knowledge gained. The passing post-test score must be >75% to obtain the FFL/GI-BMP Certificate of Completion. Results: over 13,000 certified FFL/GI-BMP professionals; >15% measured knowledge gain.

Reijo, Courtney

Authors: **Wes Henson**, University of Florida
Grant Weinkam, Environmental Engineering Sciences, University of Florida
Chris Pettit, College of Sociology, Criminology, and Law, University of Florida
Joelle Laing, School of Natural Resources and Environment, University of Florida
Courtney Reijo, UF School of Forest Resources and Conservation

Category: Nutrient dynamics and enrichment impacts in aquatic ecosystems
Session Title: Posters - Nutrient dynamics and enrichment impacts in aquatic ecosystems 2

Characterization of Nutrient Kinetics in a Spring-Fed North Florida Stream

Additional Author: Valerie A. Burkett, UF Environmental Engineering Sciences
Management decisions often regulate nutrient loads in streams based on information from regional to basin-scale models which can be limited by sparse datasets. Research is needed to assess stream nutrient kinetics to better inform water managers of the assimilative capacity of streams and further assist in development of downstream protection values and total maximum daily loads (TMDLs). This study employs the Tracer Additions for Spiraling Curve Characterization (TASCC) method (Covino et al. 2010) to examine nutrient kinetics in a small spring-fed north Florida stream. Applied methodology investigates spatial and temporal variability in nutrient kinetics under various initial conditions associated with energy input fluctuations related to diurnal changes and the presence/absence of tree canopy coverage. The TASCC method provides an efficient way to fully characterize the stream reach nutrient uptake velocity and rate models through analysis of conservative (C) and reactive tracers (N, P). Overall, this study investigates the characterization of nutrient kinetics and provides a basis for further studies in a variety of stream systems.

Reyes-Cabrera, Joel

Authors: **Joel Reyes-Cabrera**, University of Florida
Lincoln Zotarelli, Horticultural Sciences
Michael Dukes, Agricultural and Biological Engineering
Diane Rowland, Agronomy Department
Steven Sargent, Horticultural Sciences

Category: Efficacy of nutrient source control strategies
Session Title: Posters - Efficacy of Nutrient Source Control Strategies 1

Drip Irrigation as an Alternative Strategy to Increase Water Saving for Potato Production in Northeast Florida.

Potato is the most important spring crop in northeast Florida. Seepage irrigation is the predominant grower irrigation practice where the water table is raised to moisten the root zone. Irrigation techniques with higher delivery efficiency such as drip have potential to save water by applying it direct to the root zone as the crop needs. The objective of this study was to assess the feasibility of drip irrigation as alternative irrigation method for potato production. Irrigation treatments and potato varieties were tested in a split plot design in a randomized complete-blocks design with four replicates. Main plots received the irrigation treatments: surface drip tape (SUR); subsurface drip tape (SUB); and seepage (SEP). The subplots received three potato varieties: Atlantic, Fabula and Red LaSoda. Volume of applied water, plant biomass, marketable yield and tuber quality were determined. Use of drip treatments (both surface and subsurface drip) reduced irrigation water by 57% compared to the seepage treatment; 393 812 gal water/ac saved when drip tape was used. Marketable yields achieved in SUR treatment were 234, 143, and 113 cwt/ac for Atlantic, Fabula and Red LaSoda respectively. SUB yields were 177, 107, and 146 cwt/ac while for SEP irrigation marketable yields were 209, 141, and 233 cwt/ac for Atlantic, Fabula and Red LaSoda respectively. Low yields obtained for Red LaSoda under SUR and SUB treatments indicated that alternative irrigation scheduling needs to be investigated for this variety. Appropriate use of SUR can sustain profitable yields while saving irrigation water in soils with low water-holding capacity.

Roberts, John

Authors: **John Roberts**, SFRC
Michael Andreu, SFRC
Wayne Zipperer, USDA Forest Service

Category: Nutrient dynamics and enrichment impacts in aquatic ecosystems
Session Title: Posters - Nutrient dynamics and enrichment impacts in aquatic ecosystems 2

Denitrification Potential within Riparian Zones of Urban Impacted Forests in the Tampa Bay Watershed

Population growth and land use change has presented coastal areas with considerable challenges for the conservation of water resources while sustaining the communities. Urbanization and associated increase in impervious surfaces have been established to be detrimental to water quality. The major nutrient implicated for water quality deterioration in many water bodies in coastal regions, including our study site, is nitrogen (N). Riparian zones have been shown to have disproportionately greater denitrification rates relative to most other surrounding landscapes. Our research objective of this study is to determine the denitrification potential of common riparian forest types in a coastal-urban landscape. Due to anthropogenic alteration to vegetation and hydrology, riparian zones within relatively close proximity to urbanized areas will likely exhibit some degree of diminished denitrification potential relative to riparian zones in less disturbed rural areas. Prior research into forest communities within the Tampa Bay watershed will provide us with the information needed to select urban and analogous rural control sites. The sites will be monitored for their belowground water tables depth with perforated PVC wells with attached data loggers. Soil samples will be collected from varying distances perpendicular to the riparian zone, and the microbial denitrification potential of these soils will be measured using the acetylene block method. This method allows for the obtainment of denitrification enzyme activity (DEA) assays which will be analyzed by gas chromatography. The long-term goal is to understand the fate and transport of N in urbanized watersheds within a coastal plain environment and the role vegetation plays in improving water quality in urban areas. We believe the future results will provide some inference into the degree denitrification potential has been impacted by urbanization in the Tampa Bay watershed.

Rodriguez-Jorquera, Ignacio

Authors: **Ignacio Rodriguez**, University of Florida
Kevin Kroll, Department of Physiological Sciences & Center for Environmental and Human Toxicology, University of Florida, Gainesville, USA
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Nancy Denslow, Department of Physiological Sciences & Center for Environmental and Human Toxicology, University of Florida, Gainesville, USA

Category: Nutrient dynamics and enrichment impacts in aquatic ecosystems
Session Title: Posters - Nutrient dynamics and enrichment impacts in aquatic ecosystems 2

LINKAGES BETWEEN POLLUTANTS AND PHYSIOLOGICAL PROCESSES IN FISH EXPOSED TO URBAN EFFLUENTS.

Urban effluents may contain mixtures of pollutants that can be toxic to fish. As fish can be used as indicators to determine the effect of water pollution on other vertebrates, information about pollutants toxic effects on fish can be helpful to protect water resources. The fact that toxicity is preceded by gene expression alteration allows the use of approaches like microarrays to early detection of toxic effects. Here, we show the gene expression profiles of male fathead minnow liver, exposed to three typical urban effluents from Gainesville, Florida: surface water collected from downstream of a wastewater treatment plant (streamwater), a wastewater treatment plant effluent used for landscape irrigation (wastewater), and a lake (stormwater). These waters were collected and used as whole effluents in a 48-hour exposure study. Microarray analysis was used to assess changes in gene expression for exposed fish, historic and present analytical chemistry data were used to make links with observed effects. The statistical significant differences in gene expression from fish exposed to effluents were compared to controls by using LOESS normalization and ANOVA $p \leq 0.05$. Results showed that out of 16,000 genes analyzed, 588 genes were altered in fish exposed to streamwater compared with 800 genes in stormwater and 384 genes in wastewater exposed fish. A total of 9-11 biological processes were affected in fish exposed to these effluent. The major processes affected were biosynthetic and liver development in streamwater, electron transport and protein phosphorylation in stormwater, and carbohydrate metabolic process and regulation of apoptosis in wastewater exposed fish. Fish exposed to both streamwater and stormwater also showed lipid metabolism process altered. The microarray results suggest that a mixture of pollutants present in these effluents influenced normal physiological responses in fish after only 48-hours of exposure.

Rokicki, Christopher

Authors: **Christopher Rokicki**, University of Florida
Treavor Boyer, University of Florida

Category: Water Chemistry
Session Title: Posters - Water Treatment and Aquatic Chemistry

Does Inorganic Fouling Limit the Uses of Ecologically Friendly Anion Exchange?

Increasing demands and decreasing supplies of high quality water sources have led to the use of alternative water sources for potable supplies; with new water sources bringing new treatment complications. Ion exchange (IEX), frequently used for water softening, has potential for dissolved organic matter (DOM) removal. Currently chloride-form resins are used for most IEX processes that target DOM, which generates a concentrated brine solution that is difficult to dispose. Work done by the authors has demonstrated that bicarbonate-form resins are as effective at removing DOM, without producing brine that is difficult to dispose of. Despite the potential of bicarbonate-form IEX, little published work exists exploring it.

It is well known that many divalent cations form precipitates in the presence of carbonates. The goal of this work is to quantify the fouling potential of bicarbonate-form resins in the presence of divalent cations. To explore the fouling potential, resins will treat solutions containing Ca^{2+} , Mg^{2+} , or Co^{2+} , which have carbonate species with varying solubility products. DOM removal was expected to decrease with increasing solubility product due to precipitation causing fouling of fixed charged sites on the resin surface, however preliminary results with Ca^{2+} and Mg^{2+} do not show this. It is believed ion size and subsequently the ion's ability to enter the pore volume impacts the fouling potential. Resins will be used and regenerated multiple times to explore how the progressive fouling of resins impacts the capacity of the resin and the kinetics of the IEX process.

This study is expected to show the impact of divalent cations on bicarbonate-form IEX, which will provide new information about the water chemistry conditions that are favorable for bicarbonate-form IEX. In addition, this study will also provide information on the impact of ion size and pore size on the fouling potential of IEX resins.

Rooney, Robert

Authors: **Robert Rooney**, University Of Florida
Christopher J. Martinez, University of Florida

Category: Climate and Water
Session Title: Posters - Water and Climate

Implementation of Analog Forecast Technique In Tampa Bay Waters Operational Hydraulic Models

Reforecasts are retrospective weather forecasts generated with a fixed numerical model. Large reforecast datasets allow for the correction of systematic model error, thus improving upon the raw forecast. In this study, 1-14 day lead-time precipitation forecasts were evaluated in the Tampa Bay region using a two-step analog technique and the 30-year reforecast dataset developed by the Climate Diagnostic Center (CDC) of the National Oceanic and Atmospheric Administration (NOAA) using the Global Forecasting System (GFS) Model. The two-step analog technique consisted of finding historical forecast analogs within a +/-45 day search window followed by retrieving an ensemble of observed precipitation on the analog dates. Different lead days, number of analogs, precipitation thresholds and predictors were evaluated with respect to different months in the year using multiple verification methods. The results of this forecast technique were then incorporated into Tampa Bay Waters Stream Flow and Demand Model in order to enhance reliability in the operational (1day to 2 week) water allocation decision making process.

Sansalone, John

Authors: **John Sansalone, UF**
Saurabh Raje, UF

Category: Efficacy of nutrient source control strategies
Session Title: Efficacy of Nutrient Source Control Strategies 2

Can BMPs Compete With Florida-based Economic and Nutrient Load Reduction Benefits Provided by Current MS4 Sustainability Operations?

Current sustainability operations of urban infrastructure systems such as storm sewer and pavements significantly reduce nutrient loads that along with wastewater discharges contribute to the impairment of receiving waters. Quantifying the nutrient and particulate matter (PM) load recovery and economics thereof is beneficial for all stakeholders. The hypothesis that sustainability matters is quantifiable and is critical in all economic conditions. These sustainability operations recover gross solids (detritus), coarse PM and associated nutrients from the urban inventory; inventory that is transported through, stored in, and on urban infrastructure systems. This PM is a source and sink of nutrients that result from the interaction and imposition of anthropogenic/biogenic activities and urban infrastructure design practices/materials on the hydrologic cycle. Quantifiable knowledge of sustainability operations across Florida is demonstrated to provide a defensible foundation to build the allocation of nutrient load reduction credits. The economics and nutrient load reduction of primary sustainability operations (pavement and urban infrastructure appurtenance cleaning) are compared to BMPs.

Knowledge from this effort is categorized in terms of hydrologic functional units (HFU) and land use for nitrogen (N, as TN), phosphorus (P, as TP) and PM. Florida-based results indicate that the metrics of TN and TP are log-normally distributed, an observation that is important for allocation of load credits because the results are not represented by a singular concentration [mg/kg] but by log-normal distributions thereof. A Florida-based metric for a kg of urban PM recovered is converted to mg of TN or TP recovered by a sustainability operation or BMP. Results indicate that both sustainability operations are significantly more economical than current BMPs. In lieu of such current BMPs, engineered unit operation and process systems at centralized locations designed for soluble and fine PM-based nutrients are needed. Such systems incorporate modern tools such as continuous simulation (as with the Storm Water Management Model, SWMM) and computational fluid dynamics (CFD).

Sansalone, John

Authors: **Gaoxiang Ying**, UF
John Sansalone, UF
Giuseppina Garofalo, UF

Category: Innovative biological, physical, and chemical nutrient reduction & recovery technologies
Session Title: Innovative Biological, Physical, and Chemical Nutrient Reduction & Recovery Technologies 1

The Role of Computational Fluid Dynamics and Continuous Simulation to Optimize BMPs

Urban stormwater and wastewater are primary sources of nutrients in soluble and particulate matter (PM) phases. PM is a mobile substrate and the primary vehicle to and from which pollutants partition from source areas to inland and coastal waters of Florida. Control of rainfall-runoff PM is challenging; in part due to the wide gradation of PM, solubility of nutrients, complex geometries of many urban drainage systems and unit operations and variable flow rates. Such challenges and the expense associated with resolving such challenges have led to the relatively common examination of a spectrum of unit operations as black-box systems. Myths and measurements examined include the concept of a transport first-flush, discretized analysis of PM and nutrient partitioning and distribution, the critical role of water chemistry such as salinity and temperature on PM transport and fate through unit operations. The failure of unit operations through scour and washout is illustrated. These are critical considerations for the management of urban water in Florida which is subject to limited economic resources. This study illustrates the importance of continuous simulation modeling for the urban hydrology cycle and the role of computational fluid dynamics (CFD) to predict the particle and nutrient clarification behavior of these urban systems subject to dilute multiphase flows, typical of rainfall-runoff. CFD results are shown to closely follow physical model results across the entire range of influent flow rates for the transport and fate of PM. CFD results also demonstrate the role of scour in the rapid degradation of unit operations that are not maintained. Results are based on one of the largest nutrient databases for stormwater, collected on the University of Florida campus. For Florida environs CFD is arguably the most powerful tool available for tracking nutrients whether through the fate of PM or surface complexation of nutrients with engineered media and soils. Combining CFD analysis and pollutant source control with continuous simulation modeling for hydrologic restoration allows for more effective management of PM than current practices and at a significantly lower cost.

Schmidt, Michael

Authors: **Michael Schmidt**, CDM Smith
Larry Schwartz, CDM

Category: Efficacy of nutrient source control strategies
Session Title: Efficacy of Nutrient Source Control Strategies 1

The Lake Okeechobee Fast Track (LOFT) Project –

The SFWMD is implementing the LOFT Project to reduce phosphorus loads to the Lake as part of Everglades restoration. The LOFT Project consists of constructed facilities and operational coordination with the existing water management system. CDM developed the Basis of Design Report (BODR) for the Taylor Creek Reservoir, Lakeside Ranch Stormwater Treatment Area (STA), and the potential re-routing of several subbasins to the STA for treatment. This included the evaluation of the 360 sq. mi. study area for coordination with three other STAs, the operations of two flood control pump stations, three navigable locks and a major flood control gated structure to capture high TP concentration stormwater flows for treatment. The project components range in size from 3 to 7 square miles in area.

This paper presents the evaluations and recommendations from the LOFT BODR, including sizes, locations, configurations, and design criteria for the facilities along with potential benefits, risks, and probable conceptual construction costs based on a 50-year design life.

In the formulation and refinement of alternatives, the Project Team identified ranges of project cost opinions that were beyond the identified budget; therefore, analyses focused on facilities which provided greater unit benefit for the cost to achieve the greatest system-wide TP-removal benefits for the available budget. An analysis was performed for each of the LOFT Project area subbasins to quantify the amount of available water for treatment and the average annual TP loadings, as well as to determine the contributions from each subbasin to the overall TP loading. The project team identified an operational change for the existing water management system to provide reservoir benefits and regulate flow to the Lakeside Ranch STA, which is a constructed wetland on a 2,700 acre site. The first phase of the LRSTA is nearing completion.

Schumann, Arnold

Authors: **Arnold Schumann**, University of Florida
Kevin Hostler, University of Florida
Kirandeep Mann, University of Florida
Laura Waldo, University of Florida

Category: Innovative biological, physical, and chemical nutrient reduction & recovery technologies
Session Title: Innovative Biological, Physical, and Chemical Nutrient Reduction & Recovery Technologies 1

Open Hydroponics - Implications for Water and Nutrient Efficiencies and Groundwater Protection under Citrus Production

During the past 2.5 years the “open hydroponics” (OH) method of advanced crop production has been intensively studied for proof of concept and adaptation to a new method of growing citrus in Florida. A major incentive for the improved, more efficient citrus production system is the need to remain economically viable despite an increasing incidence of introduced diseases such as citrus greening or Huanglongbing (HLB). The foundation of a successful OH system is based on early, high yields, made possible through 1) high density planting, and 2) accelerated growth from optimal balanced nutrition and water relations achieved with precise computerized fertigation. This paper will discuss the outcomes from 2.5 years of ‘Hamlin’ orange growth in a replicated Central Florida field experiment. Recent results of fruit yield and quality, fertilizer and water use, and nitrate-nitrogen leaching will be discussed.

Sims, Roger

Authors: **Roger Sims**, Holland & Knight LLP

Category: Governance approaches to nutrient management
Session Title: Governance Approaches to Nutrient Management 1

Reclaimed Water - A Key Strategy for Nutrient Management and Water Conservation

Reclaimed water is the result of required wastewater treatment, which involves significant expenditures by local governments and private utilities. Technology has evolved to the point of producing high-quality effluent but some nutrients remain. By reusing reclaimed water, pressure for use of "fresh" water from natural systems is reduced and nutrients are diverted from discharge to rivers, streams, estuaries and ocean outfalls. This paper will trace the water cycle from use through treatment and into reclaimed systems, and address costs and savings involved. Case studies will be included to illustrate how the nutrient removal and water conservation purposes are achieved. Laws and regulations addressing reclaimed water will be discussed.

Sindelar, Hugo

Authors: **Hugo Sindelar**, University of Florida
Treavor Boyer, University of Florida
Mark Brown, University of Florida

Category: Innovative biological, physical, and chemical nutrient reduction & recovery technologies
Session Title: Posters - Innovative Biological, Physical, and Chemical Nutrient Reduction & Recovery Technologies

Evaluating Advanced Oxidation Processes for the Transformation of Organic Phosphorus into Biologically Labile Compounds

Phosphorus (P) remains a primary pollutant in natural waterways. Phosphorus in agricultural and residential fertilizers, cattle feed, and reclaimed water, eventually finds its way into surface waters. Excessive P loads can cause eutrophic or hyper-eutrophic conditions in surface waters or significantly alter the ecosystem's nutrient balance. This latter phenomenon has been documented in the Florida Everglades, where high P loads promoted the growth of *Typha latifolia* (cattail) at the expense of previously abundant *Cladium jamaicense* (sawgrass). Accordingly, the main objective of this research is to develop an innovative combination of chemical and biological treatments for P removal from surface waters. The research will focus on understanding the P processes within algae scrubbers and developing treatment technologies that will enhance their P uptake. Three specific objectives are being explored: (1) using advanced oxidation processes to transform organic and particulate P to more biologically labile compounds; (2) understanding Ca-P co-precipitation and natural organic matter interactions within algae scrubbers; (3) testing different operating conditions and potential chemical amendments to maximize algae scrubber P uptake. Data for Objective 1, using hydrogen peroxide + UV, sodium percarbonate + UV, and sodium perborate + UV, showed conversion (20-100%) of both dissolved organic P and particulate P to more biologically available, soluble reactive P. This presentation will highlight results for Objective 1 in the context of the larger research project aimed at increasing P uptake from algae scrubbers.

Singleton, Lloyd

Authors: **Lloyd Singleton**, UF/IFAS Sumter County Extension

Category: Social, behavioral, and economic aspects of nutrient management

Session Title: Posters - Social, Behavioral, and Economic Aspects of Nutrient Management

Florida-Friendly stormwater ponds

Stormwater ponds are under-utilized and under-appreciated as potentially aesthetic wildlife attractors, key principles of Florida-Friendly Landscaping™. The common unattractive, rectangular engineered ponds featuring turf grass to the water's edge could foster an attractive environment for wildlife if enhanced with natural aquatic and wetland plantings. The role of a well designed detention pond can balance goals of water quality, landscape aesthetics and attracting wildlife. A natural shape design will greatly increase the aesthetic value of a water body as part of the landscape. Planting desirable aquatic and wetland plants on the pond banks and shallow areas will help to stabilize banks, prevent erosion, and filter pollutants out of stormwater runoff. These plants also enhance the aesthetics of the area with a natural look, and provide valuable wildlife habitat for many animal species. A video of surprising wildlife activity at a suburban stormwater pond adjacent to a very busy intersection is featured on this poster. That particular basin, in a heavily populated suburban area The Villages, Florida receives runoff from CR 466, Morse Blvd., and the surrounding commercial areas. It is also interconnected with a basin on the east side of Morse. At very high levels, the storage system overflows into Lake Sumter. The basin's design water level is 52.46 ft. (NGVD). All of the runoff storage is in the area above the design water level. The top of bank for the basin is 62.46 ft. (NGVD). The surface area at its design level is about 1.1 acres, and the total volume of storage from design level to basin bottom is about 1.6 million gallons. This well engineered stormwater pond is beautiful, functioning, and a thriving wildlife habitat. The video shows the natural interaction between a baby alligator, the mama gator and a heron against a backdrop of car traffic.

Smith, Adrienne

Authors: **Christine Wiese**, University of Florida
Dr. Carrie Reinhardt Adams, University of Florida
Leah Cobb, University of Florida
Adrienne Smith, University of Florida

Category: Nutrient dynamics and enrichment impacts in aquatic ecosystems
Session Title: Posters - Nutrient Dynamics and Enrichment Impacts in Aquatic Ecosystems 1

Influence of Initial Soil Nutrients and Seedbank on *Ruellia Simplex* Control and Resulting Native Species Establishment

We evaluated the outcome of invasive *Ruellia simplex* control treatments and the influence of initial soil nutrient levels and seedbank contents on resulting native vegetation re-establishment. A field experiment (1.5 m x 1.5m plots) was established in a *R. simplex*-dominated floodplain forest in Paynes Prairie State Preserve. Glyphosate was applied in either fall or spring at four application levels (0, 1, 2 or 3 applications at 3-month intervals). Vegetation percent cover of each species was recorded pre-treatment and every three months post-treatment. Seedbank and soil nutrient samples were collected from each plot selected for *R. simplex* control and an additional twelve plots with no *R. simplex* present.

Glyphosate treatments reduced *R. simplex* cover; season of spray treatments and number of glyphosate applications had no effect on *R. simplex* cover. Initial soil pH, phosphorus and mg content were higher at sites with initial *R. simplex* cover compared to sampling areas without *R. simplex*, but had no effect on *R. simplex* cover after the first glyphosate treatment. Early (3-6 months post-treatment) re-colonization of native vegetation was affected by initial soil nutrient levels. Total and native species richness increased as initial pH increased. In contrast, total and native species richness decreased as soil ca and mg levels increased. Quality of vegetative cover assessed with FAQWet (Ervin et al., 2006) decreased when initial levels of soil phosphorus, ca, and mg increased. After 9 months of treatments, initial soil nutrient levels had little effect on native vegetation re-establishment.

A seedbank assay conducted in fall and spring showed high native and total species richness with little germination of *R. simplex* seed. We suggest the seedbank has potential for use in native re-vegetation provided that any barriers to native vegetation growth presented by high soil nutrient levels can be overcome.

Steinbrecher, Paul

Authors: **Paul Steinbrecher**, FWEA Utility Council

Category: Governance approaches to nutrient management
Session Title: Governance Approaches to Nutrient Management 2

Effects of EPA's NNC Rule on Utility Customers

The Florida Water Environment Association Utility Council's (FWEA UC) members collect and treat the sewage waste produced by millions of Floridians, and then safely return the treated reclaimed water to the environment or provide it to the State's citizens to beneficially reuse for irrigation or other purposes. Because the raw sewage taken into these systems is rich in nutrients, utilities have significant experience implementing nutrient water quality control programs. This presentation will provide a summary of the Utility Council's concerns regarding EPA's Numeric Nutrient Control approach in Florida, in particular: 1 – critical commentary regarding EPA's lack of sound scientific basis 2 – the NNC rules' displacement of existing effective nutrient control programs 3 – the expected cost impacts of EPA's rule on utility ratepayers.

Szafraniec, Mary

Authors: **Mary Szafraniec**, University of Florida

Category: Ecology

Session Title: Posters - Hydroecology

Light Availability in Florida Spring Ecosystems

Light availability is a major forcing factor for spring ecosystem productivity and sustainability. Over the years, water clarity has decreased in many spring-fed rivers in Florida. Factors controlling the loss of water clarity and light availability are poorly defined in Florida spring ecosystems. The objective of this study is to understand the causes of increased light attenuation in the water column by measuring the quantity and quality of light available to primary producers (submerged aquatic vegetation, epiphytes, and benthic algae) in spring fed-rivers. Optical water quality determines the underwater light field that provides the basis for habitat suitability, in terms of vegetation abundance, distribution, and survival in spring ecosystems. This study will focus on assessing the quality of light, i.e. the spectral distribution and potential limitation of wavelength-specific photosynthetically active radiation [PAR (λ)] by estimating the percent blue, green and red light available to primary producer communities in Rainbow Springs and River. Optical properties of the underwater light field are currently being assessed to determine the relative magnitude and contribution of key water clarity driving components. The resulting underwater spectral light field characteristics will be used to establish relationships with the primary producer community structure in the Rainbow Springs ecosystem.

Thompson, Joshua

Authors: **Joshua Thompson**, UF Agronomy

Category: Water Conservation and Use

Session Title: Posters - Water Conservation and Use 1

The Use of Primed Acclimation and Reduced Tillage to Increase Water Use Efficiency in Peanut and Cotton Production Systems

Peanut (*Arachis hypogaea* L.) and upland cotton (*Gossypium hirsutum* L.) are crops well adapted to the southeastern United States, with over 1.2 million acres of peanut and 3 million acres of cotton harvested in 2007 (USDA Ag. census, 2007). A major factor that is currently affecting the profitability and sustainability of these two crops is water. Reduced tillage has been shown to increase soil water infiltration, increase soil water content, reduce bulk density and reduce soil compaction. Additionally, reduced tillage has been shown to increase yields in peanut and cotton. Adjusting irrigation scheduling may be another way to decrease water inputs and increase water use efficiency. Unpublished data on peanut and cotton from Texas and Georgia suggest that it is possible to place a mild water stress on a crop (less than full evapo-transpiration replacement) during the early part of the growing season without having negative effects on yield. This strategy has been termed primed acclimation (PA) and seems to change the physiology of the crop to have a deeper rooting depth and more prolific roots by decreasing the carbon allocation ratio of shoots to roots, while saving water. To further validate the efficacy of these management strategies for water conservation, a large research project is being conducted at the University of Florida, Plant Science Research and Education Unit. The treatments being tested consist of conventional and strip tillage (reduced tillage), as well as irrigation treatments that apply 100%, 60%, 60PA (60% during vegetative growth and 100% during reproductive growth), and 0% of evapotranspiration. To characterize the environmental and physiological responses to these treatments, we will be measuring soil moisture and temperature, canopy temperature, root architecture, canopy development, and fruiting rate in peanut. We hypothesize that the combination of reduced tillage and PA will allow for the greatest water savings and highest yields.

Tian, Di

Authors: **Di Tian**, University of Florida
Christopher Martinez, University of Florida

Category: Climate and Water
Session Title: Posters - Water and Climate

Evaluation of reference evapotranspiration forecast analogs in Southeastern United States

Accurate estimation of reference evapotranspiration (RET) is needed for determining agricultural water demand, reservoir losses, and driving hydrologic simulation models. This study was conducted to explore the application of downscaled NCEP's Global Forecast System (GFS) reforecast dataset combined with NCEP-DOE Reanalysis 2 dataset to forecast RET over the states of Alabama, Georgia, Florida, North Carolina, and South Carolina in the southeast United States. Since only 12-hour temperature, wind speed, and relative humidity are available in the GFS reforecast dataset, six approaches of estimating RET using the Penman-Monteith (PM) and Thornthwaite equations were evaluated by substituting or adding the climatological mean values of variables including temperature, solar radiation, and wind speed from the Reanalysis 2 dataset. Both GFS and Reanalysis 2 datasets have coarse resolution with roughly 200-km grid spacing. Forecasts were downscaled using forecast analogs and the North American Regional Reanalysis (NARR) dataset (approximately 32-km per grid cell). Two evaluation criterion: Linear Error in Probability Space (LEPS) score and Brier Skill Score (BSS), were used to evaluate the overall forecast skill and the categorical forecast skill, respectively. The skill of both terciles and extremes (10th and 90th percentiles) were evaluated. The RET methods that combined Reanalysis 2 solar radiation data with GFS temperature and wind speed data to estimate parameters in the PM equation showed better skill compared to those that estimated these parameters from GFS outputs only. Most of the forecasts are skillful in the first 8 lead days. The upper extreme forecasts in coastal areas are more skillful than in inland; on the contrary, the lower extreme forecasts in inland areas demonstrated better skill than in coastal areas. Although the five categorical forecasts are skillful, the skills of upper and lower terciles forecasts are better than those of lower and upper extreme forecasts and middle terciles forecasts.

Tomasko, David

Authors: **David Tomasko**, Atkins
Emily Keenan, Atkins North America
Mike Britt, City of Winter Haven

Category: Nutrient dynamics and enrichment impacts in aquatic ecosystems
Session Title: Nutrient Dynamics and Enrichment Impacts in Aquatic Ecosystems 1

A Water Quality Management Plan for the City of Winter Haven Interior Lakes

The lakes of the Winter Haven Interior Lakes (WHIL) system have experienced increased development of their watersheds, similar to the lakes of the Chain of Lakes (WHCOL) system. This development has been accompanied by increased loads of nutrients and sediments through stormwater runoff and (in some lakes) point source discharges. However, the lakes of the WHIL appear to differ from the lakes of the WHCOL system in that the majority of lakes within the WHIL do not show evidence of impairment, using current NNC guidance (EPA 2010). The TMDLs developed by FDEP to address the “impairment” status of Lakes Daisy, Pansy, Maude, Silver, Martha, Elbert, and Buckeye by FDEP may be problematic, as there is no evidence of impairment of the WHIL using EPA’s NNC criteria. The lakes of the WHIL, in contrast to the WHCOL, do not show evidence of decreased lake levels, compared to those found historically (1850s). When considered together, the results found in this report suggest that the maintenance of historic lake levels has helped the WHIL to accommodate impacts of increased development without exhibiting the evidence of eutrophication found in the WHCOL system. These findings support a recommendation that maintaining natural hydrology could be a preferred technique in water quality management, more so than controlling stormwater loads alone.

Tripathi, Rahul

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Category: Innovative biological, physical, and chemical nutrient reduction & recovery technologies
Session Title: Posters - Innovative Biological, Physical, and Chemical Nutrient Reduction & Recovery Technologies

Polyacrylamide Grafted Hydrogel Balls of Sodium Alginate-Psyllium for Water Restoration

The present study deals with the development of polyacrylamide (PA) grafted hydrogel balls of sodium alginate (NaAlg) and psyllium (PSY) which could hold water up to a great extent and be reused after a multiple squeezing without demise of its water holding capability. Grafting carried out by the reaction of different concentrations of monomer [acrylamide; 2.9×10^{-1} and 4.35×10^{-1} mole/L], crosslinker [N-N' methylene bis acrylamide; 19.45×10^{-3} and 29.16×10^{-3} mole/L] and initiator [ammonium persulfate; 1.09×10^{-2} and 2.19×10^{-2} mole/L] in an aqueous solution of NaAlg and PSY at a controlled temperature of 350C for 4 hours. Ionotropic gelation method was used to obtain spherical polyacrylamide grafted hydrogel balls (PA-g-HB). The characterizations were done by FT-IR spectroscopy, XRD, CHN analysis and DSC. Percent grafting, grafting efficiency, swelling study were carried out. Water holding capacity and mechanical strength of PA-g-CB were studied by In-house developed modified syringe method.

FT-IR and DSC results showed that PA and cellulose networks of NaAlg and PSY were held together by hydrogen bond and secondary valence forces. CHN analysis and XRD data supports the successful grafting. The water holding capacity ranged between 3.03-4.35 ml/gm in all the grafted batches. Chain relaxation or uncoiling of hydrogels of grafted polymer promotes expansion of PA-g-HB. Water imbibes through diffusion dependent kinetics within these balls. Sizes of these macroballs were found between 3-4.5 mm. Grafting could give sufficient mechanical strength to PA-g-HB that could hold large amount of water. The potential application of these hydrogel macroballs could be in the diversified areas of water conservation. PA-g-HB could be commercialized as economical soaking carrier system for waste water management.

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Tucker, William

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Category: Nutrient dynamics and enrichment impacts in aquatic ecosystems
Session Title: Nutrient Dynamics and Enrichment Impacts in Aquatic Ecosystems 1

Effects of Fertilizer Use on Groundwater Quality in a Residential Area

Although the effect of agricultural fertilizer use on groundwater quality has been monitored and reported for many different agricultural practices, the effect of residential fertilizer use on groundwater quality has not been documented by field scale monitoring programs. In many areas of the country, agricultural land has been rapidly converted to residential use, and the effect on springs, streams, and lakes – by the groundwater pathway – is not well understood. The subject study defines the effect of residential fertilizer use on groundwater quality in a central Florida springshed. The results are expected to be relevant at other locations with similar climate and geology.

Concentrations of constituents associated with fertilizer use were monitored in shallow ground water in residential areas in Orange and Seminole Counties of central Florida, within the springshed of Wekiwa Springs. Sampling locations were selected to represent land in residential use for more than five years, and to avoid septic systems and areas recently used for citrus production. Twenty-six (26) wells were installed in the surficial aquifer, screened within approximately 10 feet (ft) of the water table, which was encountered between 1 and 38 ft below land surface. Of these wells, 24 were in residential areas, scattered over an area of about 10 square miles; while 2 were in nearby undeveloped areas. Samples were collected four times between October 2008 and July 2009. Concentrations of nitrate/nitrite nitrogen (NOX-N) averaged 2.0 ± 0.2 milligrams per liter (mg/l) in the residential areas and 0.3 ± 0.1 mg/l in undeveloped areas. NOX N concentrations in residential areas were significantly elevated above those observed in the undeveloped areas. Groundwater was also analyzed for stable isotopes of nitrogen and oxygen, and bacteria (by others) which confirmed that these wells were not affected by human or animal waste. Levels of NOX-N in the residential areas are attributed to residential fertilizer use. The results support evaluation of the relative importance of agricultural and residential sources of nitrate in spring fed river systems.

Van Dam, Bryce

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Category: Understanding natural, anthropogenic and legacy sources of nutrients
Session Title: Posters - Understanding Natural, Anthropogenic and Legacy Sources of Nutrients

Soil subsidence in a impacted Florida wetland

Current water management practices in the Upper St. Johns River Basin have resulted in significant losses of wetland soils in the St. Johns Marsh Conservation Area to subsidence (SJMCA). Because organic soils accrete at a very slow rate and oxidize rapidly under drained conditions, this soil subsidence is of major concern to water managers. With this permanent loss of soil material to oxidation comes the mineralization of other nutrients that contribute to downstream water quality degradation. Managers have relied on historic soil subsidence rates established as early as 1956 in the Everglades Agriculture Area which have been used to model soil loss in the SJMCA. While these well documented subsidence rates are certainly valid for the environments in which they were determined, their applicability to other systems is questionable. Therefore, we seek to model the effect of hydrologic status on soil subsidence for soils in the SJMCA. Field and laboratory studies were conducted in which CO₂ and CH₄ fluxes were monitored over changing hydrologic conditions. A separate lab study determined a subsidence rate that can be modeled along with gaseous carbon losses.

VanZomerer, Christine

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Category: Nutrient dynamics and enrichment impacts in aquatic ecosystems
Session Title: Posters - Nutrient Dynamics and Enrichment Impacts in Aquatic Ecosystems 1

Comparison of Extracellular Enzyme Activities in an Everglades Stormwater Treatment Area

Soil enzyme activities are used as proxies for microbial mineralization of organically bound macro-elements including carbon (C), nitrogen (N), and phosphorus (P). Enzymes play key roles in hydrolyzing complex polymers into simple labile compounds. This study compares the activities of select extracellular enzymes including: alkaline phosphatase (monesterase), phosphodiesterase, β -glucosidase, and leucine aminopeptidase, in floc, recently accreted and underlying native soil of Stormwater Treatment Area-2 (STA-2). The STA-2 has been in use for 10 years supporting a combination of emergent and submerged aquatic vegetation cells. We hypothesized that enzyme activity will decrease with soil depth and enzyme activities will vary in emergent and submerged aquatic vegetation cells. Triplicate soil cores were obtained from the center of each cell and sectioned into floc, newly accreted, and native sections. Newly accreted soil is material accreted after the creation of the STA and native soil is peat deposited before the construction of the STA. Enzyme activities with depth were quantified using the microplate fluorimetric enzyme assay using 4-methylumbelliferone (MUF) and its conjugates for alkaline phosphatase, phosphate diesterase, and β -glucosidase. Leucine aminopeptidase was quantified using 7-amino-4-methyl coumarin and its conjugate. Preliminary results show that in general, floc has the highest enzyme activity while enzyme activity decreases with soil depth until native soil is reached. Native soil does not follow the pattern of enzyme activity of newly accreted soil. Ongoing research includes soil characterization using potentially mineralizable N, microbial biomass C, N, and P, total C, N, and P soil moisture content, bulk density, and $\delta^{15}\text{N}$ and $\delta^{13}\text{C}$ for potential relationships.

Vibhava

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Category: Hydrology
Session Title: Posters - Hydrology

Effect of Geologic Heterogeneity on River-Aquifer Interactions: Lesson Learned From the Application of an Integrated Surface-Subsurface Model in a Complex Karst Watershed

This study aims at identifying and modeling river flow producing processes in the Santa Fe River Basin (SFRB), through the use of a fully integrated surface-subsurface hydrologic model PARFLOW.CLM. The characterization of important flow producing processes across the entire basin is challenging as the basin is divided roughly into two regions with contrasting hydro-geological characteristics, resulting into disparate flow producing mechanisms. In the eastern half of the SFRB (commonly termed as the upper confined region) the underlying Floridan aquifer is confined by the Miocene Hawthorn Group which limits mixing of surface and deep ground water, and consequently, hydrologic processes are dominated by surface runoff and surficial stores (wetlands and lakes). The western half of the SFRB (commonly termed as the lower unconfined region), erosion has removed the confining layer allowing direct mixing between surface water and the Floridan aquifer. In this region minimal surface runoff occurs, and there are virtually no stream networks feeding the river. Cody Escarpment, is the semi-confined transitional region which separates the eastern confined and the western unconfined regions of the basin. In the transition zone the Santa Fe River sinks in its entirety into the Floridan aquifer, emerging as a first order magnitude spring 6 km to the south.

The ability to fully identify these interwind flow producing processes and more importantly to incorporate them in an integrated predictive modeling framework is a key to successfully identify the mechanism and thereafter the source producing the streamflow at various locations within the SFRB. This predictive model can be used in future to study the transport of natural or synthetic contaminants through the system.

Watts, Danielle

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Category: Understanding natural, anthropogenic and legacy sources of nutrients
Session Title: Posters - Understanding Natural, Anthropogenic and Legacy Sources of Nutrients

Carbon Accounting and Alternative Peat Accretion Equilibria in the Ridge Slough Everglades

The historic ridge slough Everglades has been characterized as a peat basin with distinct elevation modes where vegetative communities differentiate based on local hydrology. It has been hypothesized that these ridges and sloughs represent alternative ecosystem configurations to achieve carbon equilibrium with the regional landscape, a hypothesis which invokes a homeostatic feedback between hydroperiods, primary production, and ecosystem restoration. The presence of a hydrologic gradient in response to modern hydrologic modification that spans conditions that are too dry and too wet to sustain this differentiation allows us to investigate deviation from this bi-stable equilibrium.

Here we will present preliminary results of a study to measure the carbon dynamics of the two dominant patch types in the ridge slough patterned landscape along a gradient of hydrologic modification in Water Conservation Area 3. A two-pronged method is used, combining in situ measurements of net ecosystem carbon dioxide exchange with a simulation model designed to explore the role long-term water levels and ecosystem carbon budgets play in the development of observed soil elevation bimodality. In combination, the goals are to test whether the bi-stable states in the best conserved portion of the Everglades are in equilibrium, to investigate the degree to which net autotrophy has been lost with hydrologic modification, and to test the degree to which homeostatic carbon budgets can reproduce the persistence and loss of soil elevation bimodality. Demonstrating multiple peat accretion equilibria would provide mechanistic evidence for the existence of alternative stable states in the ridge-slough region, and aid in understanding the hydrologic requirements for landscape maintenance and restoration.

Watts, Adam

Authors: **Adam Watts**, University of Florida

Category: Hydrology

Session Title: Posters - Hydrology

Does a Hydrologic “Switch” Affect Microclimate in Wetland Forest Patches?

Effects of edge distance or patch size on microclimate in forest patches are well established in uplands, but less understood in wetland forests with fluctuating water levels. I tested the influence of edge distance on microclimate in cypress swamps relative to the effects of water levels and the presence of canopy leaves. I hypothesized that attenuation of temperature and humidity with increasing distance from edge is greater during periods of inundation than when water levels are below ground. This poster will present results of a study to test for the presence of such a hydrologic “switch” that may affect the occurrence or strength of edge effects on microclimate depending on water levels. The study involved measurements of temperature and humidity in 12 forest patches of varied sizes at 30-minute intervals for a year. Because half of the forest patches experienced a drought-condition wildfire, interactive effects of edge and wildfire occurrence also will form the basis for a conceptual model relating this hypothesized hydrologic effect on microclimate to wildfire threats. These findings may be relevant to the management of wetland forests under scenarios of future climate change, when drought conditions are predicted to occur with greater frequency and severity and may increase risks to desiccated wetland forests from wildfires.

Wells, Ondine

Authors: **Peter Colverson**, Normandeau Associates, Inc.
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Category: Efficacy of nutrient source control strategies
Session Title: Social, Behavioral, and Economic Aspects of Nutrient Management 2

What Does “2 mg/L of Nitrate” Mean to You?

What does “2 mg/L of nitrate” mean to the average citizen? How is our drinking water connected to springs protection? Changing behavior is key to reducing nutrient concentrations in our springs. And, yet, the numbers and messages used to communicate the problem and to promote behavior change often have little meaning or context to the layperson. This presentation will discuss the challenges and strategies for changing people’s behavior in the context of conventional education and outreach programs and springs working groups.

Traditionally, education and outreach programs that work on springs protection (or water quality) have defined success by numbers: number of attendees, number of workshops, or number of brochures handed out. Achieving behavior change requires a paradigm shift. This shift, however, brings with it many challenges both in goal setting and evaluation. We will discuss how a Community Based Social Marketing approach can provide a framework for these programs to begin modifying their focus from education to behavior change.

For the past 15 years, springs working groups have brought groups of diverse stakeholders together to learn about and take actions for the protection of springs. These forums are typically designed to be accessible to scientists, agency representatives, non-governmental associations, and members of the public alike. The presentation will discuss some of the techniques used by working groups and their stakeholders to communicate to the public and examine what is working and what isn’t. The presentation will be followed by an interactive exercise on the future of springs protection.

NOTE: We will need a minimum of two 15 minute sessions for this presentation.

If interest in this topic is high, we could develop this presentation into a full-fledged interactive panel discussion for 1 hour or 1 ½ hours with up to 3 additional panel members and a longer interactive exercise with the audience members.

Wu, Lei

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Category: Water Chemistry
Session Title: Posters - Water Treatment and Aquatic Chemistry

Experimental Analysis of Colloid Capture by a Cylindrical Collector in Laminar Overland Flow

Transport of colloidal particles by a cylindrical collector is not only governed by the rate at which the colloid strike the collector but also the fraction of the contacts between colloids and the collector that successfully results in attachment. In this study, the attachment efficiency (α) of colloid capture by a cylindrical collector in laminar overland flow was examined through laboratory flow chamber experiments and theoretical analysis. Florescent microspheres of various sizes were used as experimental colloids. The colloid suspensions were applied to a glass cylinder (simulated plants stem) installed in a small size flow chamber at different flow rates. Different solution ionic strengths (IS) coupled with pH were applied to simulate unfavorable attachment conditions. Our results showed that at a given ionic strength and colloidal particle, decreases in flow velocity increased the value of α and critical value of velocity might exist at which α did not change with decrease of velocity. In addition, the critical value of flow velocity varied with different IS and colloidal particles. Several analytical and numerical methods were used to predict the attachment efficiency (α). Comparison of experimental results and corresponding predictions showed that Maxwell model coupled with torque approach (DLVO force and hydrodynamic drag force) can acutely predict the attachment efficiency by a cylindrical collector in laminar overland flow under most conditions.

Yao, Ying

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Category: Innovative biological, physical, and chemical nutrient reduction & recovery technologies
Session Title: Posters - Innovative Biological, Physical, and Chemical Nutrient Reduction & Recovery Technologies

Adsorption of Sulfamethoxazole on Biochar and its Impact on Reclaimed Water Irrigation

Reclaimed water irrigation can satisfy the increasing water demand, but it may also introduce pharmaceutical contaminants into the soil and groundwater environment. In this work, a range of laboratory experiments were conducted to test whether biochar can be used as soil amendment to remove sulfamethoxazole (SMX) from reclaimed water. The adsorption ability of eight biochars was tested. Two biochars with relatively higher solid-water distribution coefficients (K_d) were used in leaching column experiments to study their effect on the transport of SMX in reclaimed water through soils. We found that biochar amelioration reduced the transport of SMX dramatically. Only about 14% and 2% of SMX were transport through biochar-amended soils, while 60% was found in the leachate of the untreated soils. TCLP extraction experiments confirmed that the mobility and bioavailability of SMX in amended soils were lower than that in untreated soils. Bacterial growth inhibition experiments were conducted to test the toxicity of SMX-laden biochars. Results from this study indicate that biochar soil amelioration can not only sequester carbon and improve soil quality, but also be used to enhance the safety of reclaimed water irrigation to prevent the leaching of pharmaceutical contaminants in soil and groundwater systems.

Yuan, Jing

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Category: Ecology
Session Title: Posters - Hydroecology

Detecting Pattern and Pattern Loss in the Everglades Ridge and Slough Landscape

Detecting vegetation change in the Everglades is vital for effective ecosystem management and monitoring restoration performance. The ridge and slough patterned landscape in the central Everglades has been changing in response to altered hydrology and water quality. The characteristic patches (ridges and sloughs) are on average 75 meters wide, and markedly elongated parallel to historical flow. The spatial configuration patches is widely thought to be a response historical flow regime, and massive system-wide hydrologic over the last 60 years are changing that configuration. Specifically, pattern loss is most evident in significant topographic flattening; this loss of corrugated peat surface morphology, which is strongly bi-modal under the best conserved conditions, ultimately results in loss of the habitat mosaic as vegetation becomes more uniform. Recent evidence suggests that the loss of peat elevation bi-modality precedes changes in simple vegetation pattern metrics as an indicator of landscape degradation. Because the costs of collecting field measurements of soil elevation are high, refined metrics of pattern that yield leading or at least contemporary indicators of landscape degradation are needed. In this work, we present a suite of new and existing pattern metrics developed from theory regarding the source of pattern prevalence, geometry and connectivity; implement those metrics in numerous settings spanning the hydrological gradient from too dry to well conserved to too wet based on high quality vegetation maps delineated from aerial imagery; and evaluate these metrics based on co-variation with contemporary measurements of soil elevation bi-modality. Preliminary results indicate that some of the metrics in the best conserved areas are distinctly different from hydrologically modified areas, suggesting potential early warning signals of pattern degradation and ultimately vegetation change. By linking pattern metrics explicitly with bimodality, we hope to identify new sensitive and specific diagnostic indicators of landscape change.

Zamora Re, Maria

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Category: Water Conservation and Use
Session Title: Posters - Water Conservation and Use 1

Optimizing Water Use for Frost Protection

Abstract

Irrigation is the primary active method for frost protection. In recent years, as water supplies have been stressed due to unusual freeze events in the Dover/Plant City region, the necessity to become more efficient in the management of the water resources emerged. Overwatering plants can cause several problems such as resource depletion, nutrient leaching, and increased plant diseases. In order to protect the plants, sprinkler irrigation of 0.25 inches per hour (in h-1), is recommended but alternative rates have not been tested to determine if they are effective at freeze protection.

In order to determine the impact of varying sprinkler supply pressure on application rate and sprinkler distribution uniformity, two sprinkler irrigation systems were tested at three system pressures under varying wind conditions. One of the irrigation systems was evaluated using Wade Rain impact sprinklers (WR-32) and another, using Nelson (R33). Overall, the Low Quarter Distribution Uniformity and the Coefficient of Uniformity averaged 68.8% and 76.9%, respectively for the WR-32 sprinklers system; and 69.1% and 80.6% for the R33 sprinklers system at the different system pressures tested. The application rate averaged 0.10 in h-1 for the WR-32 sprinklers; and 0.19 in h-1 for the R33 sprinklers, indicating a difference of 52.63% greater application rate for the R33 sprinklers. Work is being continued to document sprinkler performance on frost protection of strawberry.

Keywords Sprinkler irrigation – Uniformity- Low Quarter Distribution Uniformity - Strawberries - Variable pressure – Application rate.

Zhang, Bo

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Category: Efficacy of nutrient source control strategies

Session Title: Social, Behavioral, and Economic Aspects of Nutrient Management 1

How Does Land Meet Water in Sustainable Ways? An Evaluation of Contemporary Urban Waterfront Park Designs

Sustainable development is a balance of environmental, economic, and social values (Kaiser et al, 1995). Given that, this study explores the sustainable attributes of recently designed urban waterfront parks. Attracting extensive public attentions, waterfront improvement projects associate with sustainable development in aspects such as flooding control, brown field cleaning, stormwater treatment, public health, economic development, social equality, etc. To avoid addressing sustainability as a vague idealism, this study seeks to examine the compatibility of different sustainable principles upon urban waterfront park sites, or, to investigate whether these valuable lands are used to accomplish more than one sustainable objective. The study comprises four phases. Firstly, we define five comprehensive sustainable principles for waterfront design from existing research. Then, we select 20 waterfront improvement plans from those recognized in the landscape architecture discipline (winning a national or state level award, being introduced in professional magazines, or being mentioned in academic papers). The study examines each project by answering the following questions. (1) What design programs concerning sustainable development are developed for the park? And what percentage of land does each program take in the whole area? (2) Do these sustainable principles compactable in a parcel of land? If some principles are missing, do they have the potential conflicts with those exist? The results indicate that most waterfront parks celebrate a merger of environmental, economic and equal (social) principles, while high percentage of park land accommodates more than one sustainable principle. The patterns of incompatible pairs of sustainable principles in waterfront parks are summarized. A set design models that strategically merge multiple sustainable principles are also worked out to guide the future waterfront park designs.

Zhuang, Yilin

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Category: Governance approaches to nutrient management
Session Title: Posters - Governance Approaches to Nutrient Management

A System Dynamics Approach to Municipal Water and Energy Resources Management in Hillsborough County

The rapidly growing population is placing increasing stress on water and energy resources management. Population drives the municipal water and energy demand, at the mean while, different water supply sources, such as reclaimed water, sea water desalination, also have different energy requirement. There are few studies that consider both water and energy resources in a unified system despite of their intricate interactions. System Dynamics (SD) is capable of capturing the dynamic relationships within a system and simulating the behaviors produced by the system. This study develops an Integrated Municipal Water and Energy resources Management (IMWEM) SD model for Hillsborough County by capturing the water-energy-population interactions. Water and energy are linked by the energy rate. IMWEM is a demand driven simulation model because municipal water supply usually is the priority of water supply system. Efforts will be taken to first meet the municipal water demand. IMWEM investigates the impacts of different policy options on the water and energy demand. Scenarios include the influence of unemployment rate, population growth, different water supply sources, water conservation, and energy conservation. The simulated results will be consulted with local authorities and stakeholders. Ultimately, IMWEM provides supportive information for decision makers on an effective and comprehensive resources management strategy.

