

**Illinois Water Resources Center
Annual Technical Report
FY 2010**

Introduction

The Illinois Water Resources Center seeks to develop solutions to water challenges of importance to Illinois, the Midwest and the nation. The Center's mission is to promote research, education, and information transfer towards that objective.

Research Program Introduction

The Illinois Water Resources Center (IWRC) requests proposals to fund graduate students from a college or university in Illinois who are conducting research that will lead to publication of a thesis related to Illinois water resources issues.

An Agent-Based Model of Nitrogen and Carbon Trading at the Watershed Scale

Basic Information

Title:	An Agent-Based Model of Nitrogen and Carbon Trading at the Watershed Scale
Project Number:	2010IL202B
Start Date:	3/1/2010
End Date:	2/28/2011
Funding Source:	104B
Congressional District:	15th
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Descriptors:	None
Principal Investigators:	J. Wayland Eheart, Ximing Cai

Publications

1. Ng, T. L.; J. W. Eheart; X. Cai; J. B. Braden and G. F. Czapar (2011), Farmer decisions and stream nitrate load in response to price incentives for second-generation bioenergy crop cultivation, and carbon and nitrogen fertilizer reduction, In preparation.
2. Ng, T. L.; J. W. Eheart; X. Cai and J. B. Braden (2011), An agent-based model of farmer decision-making and water quality impacts in a watershed under markets for carbon allowances and second-generation bioenergy crops, Submitted for review.

Project title:

An Agent-Based Model of Farmer Decision-Making and Stream Nitrate Load in Response to a Nitrogen Fertilizer Reduction Subsidy, and Carbon and Second-Generation Bioenergy Crop Prices

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Problem and research objective

Excessive nitrogen loads in surface waters are a major cause of hypoxia in coastal ecosystems, adversely affect suitability of raw water for domestic use, and contribute to eutrophication in surface waters. In many places, agriculture is the single largest source of nitrogen runoff to receiving waters. Agricultural sources are highly dispersed and largely unregulated. Oftentimes, there is no limit on the amount of fertilizer farmers may apply, nor is there any requirement to adopt best management practices (BMPs) to reduce runoffs.

Previous studies have shown the second-generation bioenergy crops miscanthus (*Miscanthus x giganteus*) and switchgrass (*Panicum virgatum*) to have some advantages in reducing nitrate runoff (Ng et al., 2010a; McIsaac et al., 2010). It is likely that there will be an increased demand for these crops due to federal mandates under the Renewable Fuel Standard (RFS) program, which seeks partially to displace the use of gasoline by liquid biofuels in transportation. Currently, the primary feedstock for biofuels in the U.S. is corn. However, with improvements in cellulosic ethanol technology, it can be expected that second-generation bioenergy crops will take on larger and larger roles.

Previous studies have also shown carbon allowance trading to have water quality co-effects, including reductions in stream nitrate load (e.g. Pattanayak et al., 2005). Thus, the objective of the present study is to estimate farmer decisions under the influence of market prices for a second-generation bioenergy crop and carbon reduction, and in turn, the effects of those decisions on stream nitrate load. For comparison, results are also obtained for farmers under the influence of a nitrogen fertilizer reduction subsidy (as well as various combinations of the three), which has long been a subject of study in the water quality policy literature (e.g. Chowdhury and Lacewell, 1996).

It is meaningful to estimate the responses of farmers to these incentives. A second-generation bioenergy crop market may induce them to switch from conventional crops to perennial grasses, carbon allowance trading provides incentives for them to adopt certain BMPs (and/or switch to perennial grasses), and a nitrogen fertilizer reduction subsidy will lead to reductions in fertilizer inputs by farmers (which in turn, may lead to the switching of crops). The Salt Creek watershed in Central Illinois is used as a study site. The watershed is typical of most agricultural watersheds in the Midwest and like many of these systems, faces problems of excessive nitrate loads in its waters. This study is limited to miscanthus as the sole second-generation bioenergy crop of interest.

Methodology

To achieve the objectives of this study, an agent-based model (ABM) of farmers is developed and coupled to the hydrologic-agronomic model of the Salt Creek watershed developed by Ng et al. (2010b) using the Soil and Water Assessment Tool (SWAT). The hydrologic-agronomic model is used to compute crop yields and stream nitrate load at the watershed outlet as functions of the crop and BMP decisions of the farmers. To model miscanthus growth in SWAT, the miscanthus growth parameters evaluated by Ng et al. (2010a) are applied.

The ABM of the farmers consists of fifty hypothetical heterogeneous farmers in the study watershed. At the beginning of each growing season, the farmers choose between three crop types (corn, soybeans and miscanthus) and two BMPs (conservation tillage and cropland conversion to grassland). They may claim carbon allowance credits for cultivating miscanthus, adopting conservation tillage and/or converting cropland to grassland. They may also claim nitrogen subsidy payments for reducing their fertilizer application rates, which depend on their crop choices.

A farmer seeks to maximize his sum of discounted utilities over time by selecting the right of combination of crops and BMPs that best balances potential gains from crop sales, carbon trading and nitrogen subsidies, and potential losses from fertilizer and other production costs. Each farmer is assumed to divide his land into three plots, of which the smallest is of marginal land and the other two, of equal sizes of cropland of standard quality.

The decisions of a farmer depend on his level of risk aversion, as well as his forecasts of future conditions, which update with time as he makes new observations of prices, costs, yields and weather. The farmer also updates his forecasts as he shares information on initially unfamiliar activities (carbon trading, miscanthus cultivation and cultivation tillage) with neighbors. The updating of the farmer's forecasts is assumed to follow a Bayesian algorithm that weights new observations against existing perceptions.

Principal findings and significance

Of all the scenarios examined, none is able to produce the 45% reduction in nitrate load recommended by EPA SAB (2007) to mitigate the hypoxia problem in the Gulf of Mexico. The only scenarios capable of producing a reduction that is 25% or greater are those where there is a market value for miscanthus that is in excess of 50% of the average of corn and soybean prices. For the simulation period used in this study (1985-2008), this translates to an average miscanthus price of \$83/Mg. This price is somewhat lower than \$100/Mg, the historical average of the price

of corn, a first-generation bioenergy feedstock. The nitrogen reduction subsidy is also effective, but carbon trading is unlikely to cause any major change in nitrate load for the case study watershed.

In reality, miscanthus prices may never reach levels that are sufficiently high to induce large land use changes. As farmers switch to miscanthus, it is at the expense of conventional crops, causing their supplies to decline and prices to rise. The final state of the system may be such that miscanthus prices are much less than 50% of the average of corn and soybean prices. At low miscanthus prices, nitrate load reductions can be improved by offering farmers a nitrogen reduction subsidy. For example, for the particular case study examined here, when miscanthus prices are 40% of the average of corn and soybean prices, a subsidy rate of \$2250/Mg-N results in a 20% reduction, which is a significant improvement over the 4.5-5.3% reduction that can be expected without the subsidy.

Note however, the nitrogen reduction subsidy, under the rules currently envisioned, where there is no cap on the total amount of fertilizer farmers may use, is likely lead to a substantial change in cropping behavior. That is, to change from devoting roughly half of the land to corn and the other half to soybeans in the same year (the historical pattern in the Midwest), to devoting all of the land to corn in one year and all to soybeans the next year and then back to all corn the following year. This allows farmers to claim subsidy payments while maintaining the average acreage of corn. Policy makers should be aware of this possibility and include appropriate constraints to prevent this change in behavior if it is deemed undesirable.

Notable achievements

- The development of an ABM coupled to a hydrologic-agronomic model of the system to model farmer decision-making and stream nitrate load in response to a nitrogen fertilizer reduction subsidy, and carbon and second-generation bioenergy crop prices.
- The application of the ABM to assess and compare the price incentives in managing agricultural nitrogen pollution.
- The quantification of the potential of the cultivation of miscanthus, a potential second-generation bioenergy crop, for reducing stream nitrate load.

Student supported with funding

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Degree date: August 2010

Publications and presentations

Ng, T. L.; J. W. Eheart; X. Cai; J. B. Braden and G. F. Czapar (2011), Farmer decisions and stream nitrate load in response to price incentives for second-generation bioenergy crop cultivation, and carbon and nitrogen fertilizer reduction, In preparation.

Ng, T. L.; J. W. Eheart; X. Cai and J. B. Braden (2011), An agent-based model of farmer decision-making and water quality impacts in a watershed under markets for carbon allowances and second-generation bioenergy crops, Submitted for review.

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Pattanayak, S. K.; B. A. McCarl; A. J. Sommer; B. C. Murray; T. Bondelid; D. Gillig and B. DeAngelo (2005), Water quality co-effects of greenhouse gas mitigation in U.S. agriculture, *Climatic Change*, 71, 341-372.

Linking microbial community structure to water quality function: investigating nitrogen cycling during early floodplain development

Basic Information

Title:	Linking microbial community structure to water quality function: investigating nitrogen cycling during early floodplain development
Project Number:	2010IL207B
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Principal Investigators:	Angela Kent, Angela Kent

Publications

1. Peralta, A.L., J.W. Matthews, E. Johnston, and A.D. Kent. In preparation. Abiotic correlates of microbial community structure and function vary within and among wetland ecosystems.
2. Peralta, Ariane. In preparation. Soil microbial community structure and function along environmental gradients: Implications for wetland nitrogen cycling. Ecology, Evolution and Conservation Biology, University of Illinois at Urbana-Champaign, Urbana, IL.

PROJECT TITLE

Linking microbial community structure to water quality function: Investigating nitrogen cycling during early floodplain development

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PROBLEM AND RESEARCH OBJECTIVES

Land use change and increased nutrient inputs in combination with wetland losses have exacerbated degradation of Illinois waterways and downstream waters. Floodplain restoration within agricultural landscapes along the Illinois waterways can potentially mitigate nutrient loading and improve water quality. Microorganisms are responsible for biogeochemical cycling of nutrients, but little is known about the relationship between microbial community composition and ecosystem processes within restored floodplain wetlands. Further, microbial processes and the populations responsible for microbially-mediated ecosystem functions are influenced by environmental factors that are likely to vary dramatically in response to changes during floodplain development. Understanding the response of microorganisms to local environmental soil factors is essential for restoration of wetland water quality functions.

Restoration of floodplain wetlands adjacent to major waterways could potentially reduce nutrient (nitrate) export and improve water quality to downstream coastal areas. Excess nitrates from agricultural runoff can be converted to gaseous forms through the processes of denitrification ($\text{NO}_3^- \rightarrow \text{N}_2$) and nitrification ($\text{NH}_4^+ \rightarrow \text{NO}_3^-$). Denitrification is an anaerobic process that occurs in saturated soils and sediments. In contrast, nitrification is an aerobic microbial process, which is responsible for nitrogen retention in soils. Both of these processes are sensitive to oxygen levels, and are responsive to fluctuations in water levels in the newly restored St. Joseph Wetland (Champaign County, IL) and Emiquon Preserve (Fulton County, IL). Changes in water saturation of soils will influence oxygen availability in the floodplain sediments, and will affect the balance between nitrification and denitrification activities.

We investigated the link between microbial community composition and activity, specifically related to nitrogen cycling, in response to changing water levels in early floodplain development. The objectives of this study were to (1) assess changes in nitrogen-specific microbial populations related to denitrification and nitrification along a moisture gradient and (2) quantify potential denitrification and nitrification rates along a moisture gradient. Comparison between nitrogen cycling functional groups provides the opportunity to test whether particular soil factors are associated with microbial community structure and function differently, depending on the environmental tolerance of the denitrifier or ammonia oxidizer communities. We predicted that changes along an upland to wetland gradient at different wetlands will result in variable shifts in microbial community composition and activity. Understanding how microorganisms vary in functional response can enhance management of water quality functions within restored wetlands.

METHODOLOGY

Field site

Restored floodplain wetlands at St. Joseph Wetland (IL-1; Champaign, IL) and Emiquon Preserve (IL-2; Fulton County, IL) were sampled in this study. The St. Joseph Wetland was converted from cropland to floodplain wetland in 2006. Depressional areas were excavated to enhance water retention of floodwaters originating from the Salt Fork River. The Emiquon Preserve contains approximately 3000 hectares of land bordering the Illinois River. Beginning in 2007, this site began a conversion from agriculture to its original state as a floodplain river ecosystem.

Sample collection

At each wetland site, four transects (20 m apart) were laid out perpendicular to the shoreline of the pond/lake. Along each transect, four plots were positioned along an upland to wetland gradient (A to D), according to distinct changes in plant community composition (Fig. 1). Topography and plant community composition were used as proxies for soil moisture changes within wetlands. Within a 4-m² area at each established plot, cover class of each plant species was assigned and recorded to survey herbaceous vegetation. No vegetation was present in the saturated plots (plot D at each transect) at Emiquon Preserve (Emiquon).

Wetlands were visited monthly from June to August 2009. Within a 1-m² quadrat at each plot, six soil cores (3.048 cm diameter) were collected to a 12 cm depth, combined, and homogenized. Samples were transported on ice, and stored at 4°C prior to processing in the laboratory. A subsample was collected for storage at -20 °C for microbial analysis.

Soil chemical analysis and activity assays

For soil collected at each plot, on each sampling date at each wetland, gravimetric soil moisture was assessed from a 20-30 g subsample. In addition, a subsample of air-dried soil was ground into a fine powder and analyzed to quantify total organic matter content (total organic C and total N) using combustion methods (ECS 4010, COSTECH Analytical Instruments, Valencia, CA). Soil pH, available ammonium (NH₄⁺-N) and nitrate (NO₃⁻-N), and soil texture were also determined for all samples. On fresh soil samples, denitrification potential of the soil microbial community was estimated using the acetylene inhibition method (Royer et al. 2004). Potential nitrification activity of the soil microbial community was assayed using a short-term incubation (Kandeler 1996).

Microbial community analyses

Since the majority of environmental microbes are not easily cultured using standard laboratory culture techniques (Torsvik et al. 2002), molecular microbial ecology methods were used to assess functional community composition in soil. Microbial populations of denitrifying bacteria and ammonia-oxidizing archaea were compared among samples using molecular analysis of terminal restriction length polymorphism (T-RFLP), where the genes involved in denitrification and nitrification were targeted. Community analyses based on functional genes coding for nitrous oxide reductase (*nosZ*) and ammonia monooxygenase (*amoA*) were used to characterize populations of denitrifiers and ammonia oxidizers, respectively (Rosch et al. 2002, Rich et al. 2003, Francis et al. 2005, He et al. 2007). All of the microbial community analyses (total community and analyses based on functional genes) take advantage of DNA sequence variation in the target gene to differentiate microbial populations. We use these “DNA fingerprint”

approaches to create a census of microbial populations present in each sample. Microbial assemblages were compared among samples, and in relation to environmental gradients using multivariate analysis.

Statistical analysis

St. Joseph Wetland and Emiquon Preserve were analyzed separately since the environmental gradient was not identical at each site. Analysis of variance (ANOVA) was used to test for differences in microbial activity along the gradient over three months. Sampling month and plot along the gradient were considered fixed factors, plot within transect was a random factor, and month was used as a repeated measure. ANOVA was run in the MIXED procedure of SAS (PROC MIXED, SAS v9.2, SAS Institute).

Similarity matrices were generated for denitrifier and ammonia oxidizer communities by calculating the Bray-Curtis similarity coefficient for each pair of samples based on terminal restriction fragment (T-RF) relative fluorescence data generated from microbial analysis method T-RFLP. Nonmetric multidimensional scaling (NMDS) was used to visualize the relationship among microbial communities along the moisture gradient using the metaMDS function in the R Statistics Package (R development Core Team 2011). NMDS is based on the rank order relation of dissimilarities based on the Bray-Curtis similarity coefficient, where the largest distance between points on the NMDS plot denotes the most different microbial communities. The envfit function was used to fit microbial activity and soil factors significantly associated with microbial variation (based on PERMANOVA) on each NMDS plot.

Permutational (nonparametric) multivariate analysis of variance (PERMANOVA) was used to assess the effect of location and sampling date along the gradient (plot) within each wetland, and to assess the relationship among different environmental factors and potential microbial activity on microbial community variation within each wetland (Anderson 2001, McArdle and Anderson 2001).

PRINCIPAL FINDINGS AND SIGNIFICANCE

Soil characteristics along the upland to wetland gradient

The St. Joseph Wetland was characterized as a high fertility site, compared to lower soil fertility (lower SOM, inorganic N) at Emiquon Preserve (Tables 1 & 2). The soil pH gradient was relatively large at Emiquon, but narrow at St. Joseph. In addition, the St. Joseph site had more finely textured soils, while Emiquon was characterized as fine to coarsely textured along the gradient (Tables 1 & 2).

Microbial activity along the gradient

Higher soil fertility at the St. Joseph Wetland supported higher potential denitrification and nitrification rates (Tables 3 & 4) compared Emiquon. Potential denitrification rates generally increased from upland to wetland plots, while potential nitrification rates were highest in wet-dry transition plots at Emiquon and decreased over time (Tables 3 & 4).

Denitrifier structure-function relationship along the gradient within each wetland

Location along the gradient significantly associated with distinct denitrifier community composition along the environmental gradient (PERMANOVA: St. Joseph: $R^2 = 0.3627$,

$P = 0.0010$; Emiquon: $R^2 = 0.4043$, $P = 0.0010$) (Fig. 1). At St. Joseph Wetland, sampling date significantly related to denitrifier community variation (PERMANOVA, $R^2 = 0.0928$, $P = 0.0040$) but not at Emiquon. Based on length of the denitrification vector on the NMDS plots, the relationship between composition and function was stronger at St. Joseph Wetland compared to Emiquon (Fig. 1).

The relationship between local soil factors and denitrifier community composition varied between restored wetlands. At the St. Joseph site, distinct denitrifier communities were observed in upland compared to wetland plots, but there was no measured soil factor that significantly associated with community variation (Fig. 1A). At the Emiquon site, soil pH and percent clay significantly related to denitrifier community variation along the gradient (PERMANOVA, pH: $R^2 = 0.2159$, $P = 0.0010$, clay: $R^2 = 0.0439$, $P = 0.016$) (Fig. 1B).

In summary, denitrifier community structure and function was decoupled at Emiquon Preserve, where potential denitrification rates were observed to change but composition stayed constant over time. Soil pH was significantly associated with denitrifier community composition at Emiquon, where pH ranged the most widely.

Ammonia oxidizer structure-function relationship along the gradient within each wetland

Location along the gradient significantly linked to differences in ammonia oxidizer community composition (St. Joseph: $R^2 = 0.2975$, $P = 0.0010$; Emiquon – $R^2 = 0.5314$, $P = 0.0010$) (Fig. 2). Sampling date did not influence ammonia oxidizer variation (data not shown). Based on the nitrification vector associated with the NMDS plots, potential nitrification rate at the St. Joseph site was observed to increase toward wetland plots (Fig. 2A), while potential nitrification rate increased toward plots at the wet-dry transition zones at the Emiquon site (Fig. 2B).

At St. Joseph, soil pH significantly related to differences in ammonia oxidizer community composition along the gradient (PERMANOVA, $R^2 = 0.0722$, $P = 0.0110$) (Fig. 2A). Soil pH, total organic carbon (TOC), ammonium-N and percent clay significantly associated with ammonia oxidizer community variation along the gradient at the Emiquon site (PERMANOVA, pH: $R^2 = 0.955$, $P = 0.0010$, TOC: $R^2 = 0.0209$, $P = 0.0440$; ammonium: $R^2 = 0.0347$, $P = 0.0110$, clay: $R^2 = 0.0365$, $P = 0.0100$) (Fig. 2B).

In summary, ammonia oxidizer community structure and function were decoupled, where function changed over time but composition did not. Soil pH, texture and organic matter concentration, factors that do not temporally change over short timescales, tended to associate with ammonia oxidizer community change among wetland sites.

NOTABLE ACHIEVEMENTS

- Microbes involved in nitrogen cycling variably respond to environmental conditions within restored wetland ecosystems. Understanding how soil factors influence these microorganisms will allow enhanced restoration of specific water quality functions.
- Restoring wetland water quality functions can be complicated by site-specific environmental factors.
- To predict microbial functional response to restoration activities, it is imperative that microbial functional groups related to nutrient cycling processes are specifically investigated.

- Microbial functional groups respond to the environment differently, and the assumption that microorganisms are extremely diverse and therefore functionally redundant can misguide management of nutrient cycling functions within wetlands.

STUDENT SUPPORTED WITH FUNDING

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Degree sought: Ph.D. (expected August 2011)

PRESENTATIONS

Peralta, A.L., J.W. Matthews, E. Johnston, S. Ludmer, and A.D. Kent (2011). Linking microbial community structure to water quality function in restored floodplain wetlands. Midwest-Great Lakes Society for Ecological Restoration Chapter Annual Meeting. Springfield, IL, USA. April 1-3, 2011. Oral presentation.

Peralta, A.L., J.W. Matthews, and A.D. Kent (2010). Linking microbial community structure to water quality function: Investigating nitrogen cycling influenced by hydrology in wetland ecosystems. Illinois Water Conference 2010, Champaign, IL, USA. Oct. 3-5, 2010. Poster presentation.

Peralta, A.L., J.W. Matthews, and A.D. Kent (2010). Linking microbial community structure to water quality function: Investigating nitrogen cycling influenced by hydrology in wetland ecosystems. The 13th International Symposium on Microbial Ecology, Seattle, WA, USA. August 22-27, 2010. Poster presentation.

PUBLICATIONS

Dissertation in preparation

Peralta, Ariane. In preparation. Soil microbial community structure and function along environmental gradients: Implications for wetland nitrogen cycling. Ecology, Evolution and Conservation Biology, University of Illinois at Urbana-Champaign, Urbana, IL.

Publication in preparation

Peralta, A.L., J.W. Matthews, E. Johnston, and A.D. Kent. In preparation. Abiotic correlates of microbial community structure and function vary within and among wetland ecosystems.

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FIGURES AND TABLES

Figure 1. Experimental design established at wetland sites. Four plots along an upland to wetland gradient were established within each of four replicate transects (TR 20 m apart).

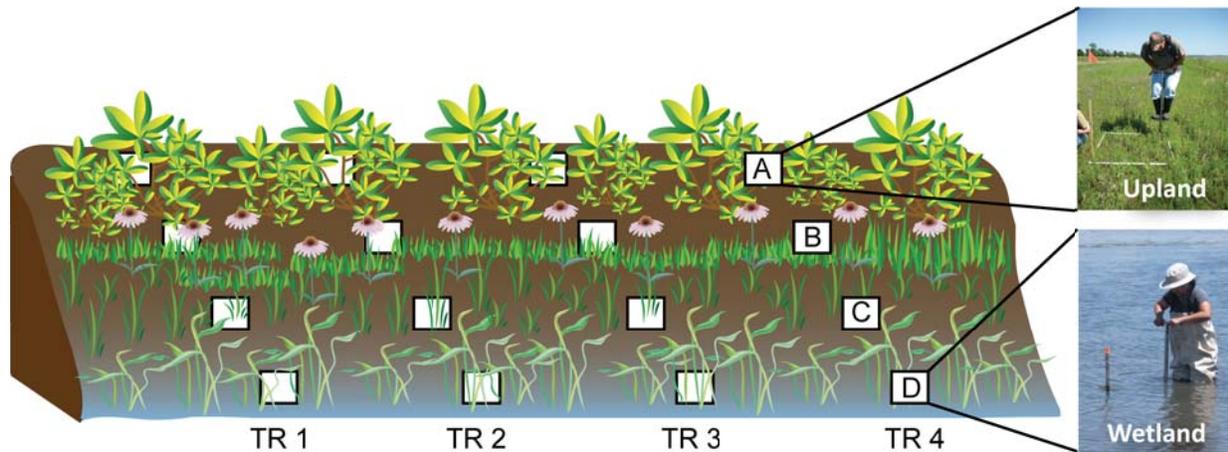


Figure 2. Non-metric multidimensional scaling plot of denitrifier community composition. Symbols are colored white to black and differ in shape to represent samples along an upland to wetland gradient at St. Joseph Wetland (IL-1) and Emiquon Preserve (IL-2). Each point represents the community composition of the denitrifiers based on T-RFLP relative fluorescence at different wetland sites. Arrows on plots relate denitrifier communities with soil factors and potential denitrification. The length and direction of the arrow corresponds to the relative correlation between environmental factor and ordination.

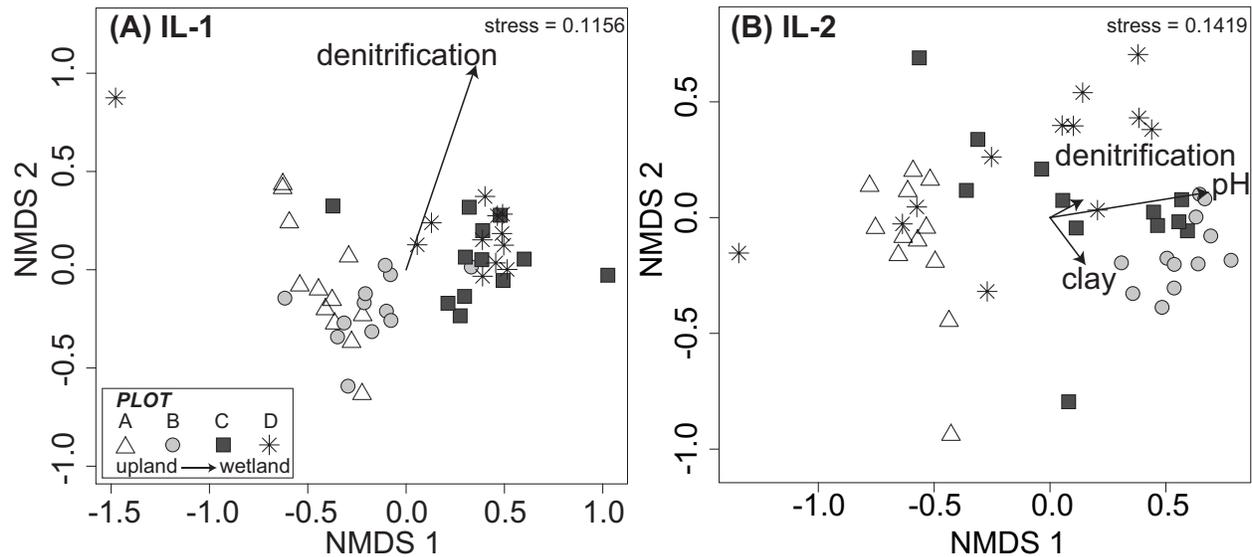


Figure 3. Non-metric multidimensional scaling plot of ammonia oxidizer community composition. Symbols are colored white to black and differ in shape to represent samples along an upland to wetland gradient at St. Joseph Wetland (IL-1) and Emiquon Preserve (IL-2). Each point represents the community composition of the ammonia oxidizers based on T-RFLP relative fluorescence at different wetland sites. Arrows on plots relate ammonia oxidizer communities with soil factors and potential nitrification. The length and direction of the arrow corresponds to the relative correlation between environmental factor and ordination.

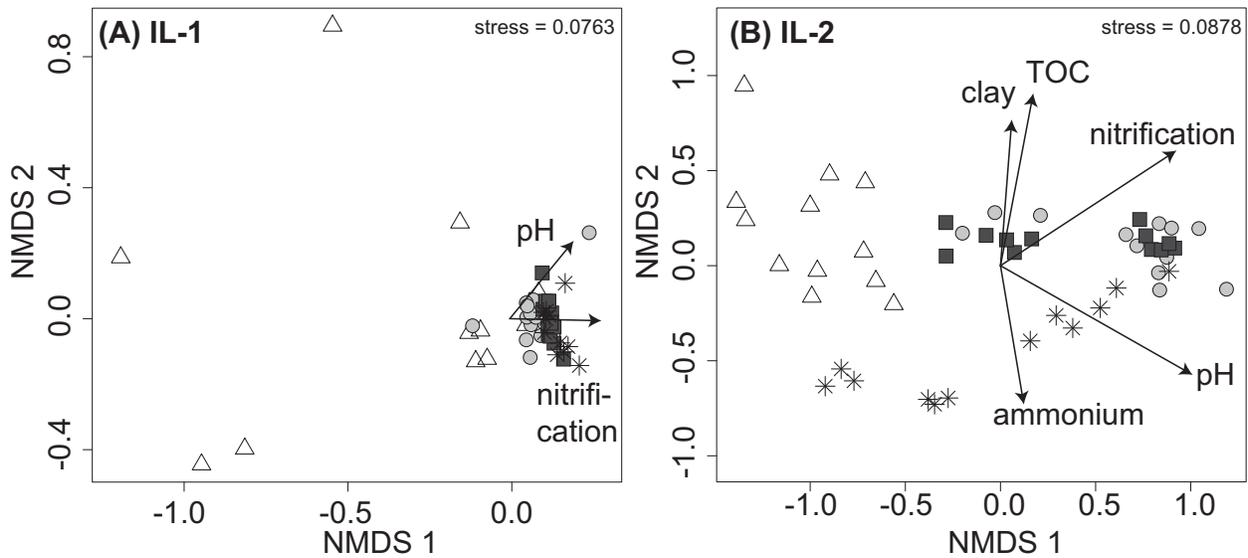


Table 1. Summary of soil factors (mean \pm SD) along the upland to wetland gradient (plots A – D) at St. Joseph Wetland. Soil texture (%sand, %silt, %clay), pH and soil organic matter (total organic C – TOC, total nitrogen – TN, and C:N ratio – CN) were averaged along the gradient over all sampling months (A). Soil moisture and inorganic N (ammonium-N, nitrate-N) were averaged along the upland to wetland gradient for each sampling month (B).

(A)

soil factor	A			B			C			D		
sand	50	\pm	10	45	\pm	11	31	\pm	5	21	\pm	6
silt	29	\pm	6	33	\pm	8	42	\pm	4	47	\pm	4
clay	21	\pm	4	22	\pm	4	27	\pm	1	33	\pm	2
pH	7.68	\pm	0.79	8.14	\pm	0.45	8.10	\pm	0.34	8.05	\pm	0.31
TOC	14.59	\pm	2.49	19.18	\pm	1.99	27.07	\pm	1.99	32.38	\pm	2.86
TN	1.16	\pm	0.20	1.42	\pm	0.21	1.86	\pm	0.16	2.22	\pm	0.37
CN	12.73	\pm	2.21	13.67	\pm	1.18	14.60	\pm	0.56	14.77	\pm	1.40

(B)

June												
soil factor	A			B			C			D		
moisture	17.84	\pm	4.08	26.75	\pm	2.65	42.06	\pm	2.75	44.48	\pm	6.08
ammonium	0.838	\pm	0.025	1.088	\pm	0.325	2.425	\pm	0.807	2.700	\pm	0.634
nitrate	1.650	\pm	0.311	2.000	\pm	0.204	3.025	\pm	0.301	2.500	\pm	0.381
July												
soil factor	A			B			C			D		
moisture	17.00	\pm	2.46	24.08	\pm	3.19	37.25	\pm	5.90	40.17	\pm	7.44
ammonium	0.350	\pm	0.108	0.325	\pm	0.087	0.475	\pm	0.206	0.438	\pm	0.197
nitrate	3.963	\pm	0.634	3.550	\pm	0.917	5.675	\pm	1.796	4.975	\pm	1.019
August												
soil factor	A			B			C			D		
moisture	10.89	\pm	2.03	19.44	\pm	4.61	34.28	\pm	4.27	35.98	\pm	2.83
ammonium	0.500	\pm	0.183	0.400	\pm	0.147	0.575	\pm	0.132	0.788	\pm	0.284
nitrate	1.925	\pm	0.272	2.200	\pm	0.358	3.350	\pm	0.402	4.238	\pm	0.686

(UNITS: sand, silt, clay: %; TOC: mg C kg⁻¹ soil; TN: mg N kg⁻¹ soil; CN: wt/wt; moisture: %; ammonium: $\mu\text{g NH}_4^+\text{-N g}^{-1}$ soil; nitrate: $\mu\text{g NO}_3^-\text{-N g}^{-1}$ soil)

Table 2. Summary of soil factors (mean \pm SD) along the upland to wetland gradient (plots A – D) at Emiquon Preserve. Soil texture (%sand, %silt, %clay), pH and soil organic matter (total organic C – TOC, total nitrogen – TN, and C:N ratio – CN) were averaged along the gradient over all sampling months (A). Soil moisture and inorganic N (ammonium-N, nitrate-N) were averaged along the upland to wetland gradient for each sampling month (B).

(A)

soil factor	A		B		C		D	
sand	26	\pm 6	33	\pm 5	33	\pm 3	45	\pm 8
silt	50	\pm 4	42	\pm 4	43	\pm 2	35	\pm 5
clay	25	\pm 2	25	\pm 1	25	\pm 2	20	\pm 3
pH	5.72	\pm 0.31	7.56	\pm 0.22	7.38	\pm 0.49	7.17	\pm 0.18
TOC	14.13	\pm 1.10	14.84	\pm 3.08	14.24	\pm 3.14	7.17	\pm 1.38
TN	1.27	\pm 0.09	1.15	\pm 0.07	1.30	\pm 0.21	0.73	\pm 0.12
CN	11.17	\pm 0.64	12.88	\pm 2.30	10.86	\pm 0.82	9.87	\pm 0.69

(B)

June								
soil factor	A		B		C		D	
moisture	23.95	\pm 2.68	24.63	\pm 2.12	30.81	\pm 4.03	30.02	\pm 3.60
ammonium	3.675	\pm 3.960	3.138	\pm 0.687	5.788	\pm 0.757	10.313	\pm 4.920
nitrate	1.338	\pm 0.609	2.025	\pm 1.317	1.438	\pm 0.184	1.300	\pm 0.082
July								
soil factor	A		B		C		D	
moisture	30.58	\pm 6.79	26.10	\pm 3.14	33.61	\pm 4.70	30.44	\pm 2.26
ammonium	1.575	\pm 0.444	2.963	\pm 1.998	6.950	\pm 3.992	17.438	\pm 6.427
nitrate	3.300	\pm 1.340	2.988	\pm 0.899	2.663	\pm 1.430	2.763	\pm 1.274
August								
soil factor	A		B		C		D	
moisture	20.21	\pm 3.73	24.01	\pm 2.62	30.92	\pm 2.45	26.01	\pm 0.97
ammonium	0.700	\pm 0.261	3.588	\pm 1.920	4.625	\pm 1.963	11.763	\pm 2.464
nitrate	2.113	\pm 0.206	2.238	\pm 0.206	2.175	\pm 0.545	1.850	\pm 0.238

(UNITS: sand, silt, clay: %; TOC: mg C kg⁻¹ soil; TN: mg N kg⁻¹ soil; CN: wt/wt; moisture: %; ammonium: μ g NH₄⁺-N g⁻¹ soil; nitrate: μ g NO₃⁻-N g⁻¹ soil)

Table 3. Summary of potential denitrification and nitrification rates (mean \pm SD) along the upland to wetland gradient (plots A – D). Microbial activity was averaged across transects along the gradient for each sampling month at St. Joseph Wetland (A) and Emiquon Preserve (B).

(A) St. Joseph

June	A		B		C		D	
nitrification	2.461	\pm 1.041	4.358	\pm 1.448	6.793	\pm 1.450	8.172	\pm 1.655
denitrification	897	\pm 126	1539	\pm 431	3455	\pm 1202	3286	\pm 1473
July	A		B		C		D	
nitrification	2.553	\pm 1.440	3.835	\pm 1.393	5.399	\pm 0.994	6.301	\pm 0.940
denitrification	114	\pm 56	109	\pm 43	91	\pm 50	50	\pm 23
August	A		B		C		D	
nitrification	2.562	\pm 1.161	4.060	\pm 1.547	6.481	\pm 0.733	6.972	\pm 0.914
denitrification	33	\pm 11	76	\pm 50	195	\pm 84	249	\pm 180

(B) Emiquon

June	A		B		C		D	
nitrification	0.119	\pm 0.055	3.749	\pm 1.211	2.852	\pm 1.205	0.596	\pm 0.683
denitrification	486	\pm 326	660	\pm 412	650	\pm 438	179	\pm 150
July	A		B		C		D	
nitrification	0.048	\pm 0.062	3.758	\pm 0.396	1.944	\pm 1.502	0.809	\pm 0.596
denitrification	103	\pm 19	174	\pm 47	535	\pm 188	402	\pm 147
August	A		B		C		D	
nitrification	0.033	\pm 0.026	3.163	\pm 0.619	1.471	\pm 1.042	0.588	\pm 0.657
denitrification	22	\pm 7	38	\pm 19	35	\pm 12	18	\pm 7

Table 4. Summary of analysis of variance (ANOVA) results. ANOVA of the main effects (plot along gradient and month) and the interactions of main effects were carried out on potential denitrification and nitrification rates at St. Joseph Wetland (A) and Emiquon Preserve (B). Effects were considered significantly different at $P < 0.05$.

(A) St. Joseph

denitrification			
effect	df	<i>F</i> -value	<i>P</i> -value
plot	3, 33	10	<0.0001
month	2, 33	259.89	<0.0001
month*plot	6, 33	8.37	<0.0001

nitrification			
effect	df	<i>F</i> -value	<i>P</i> -value
plot	3, 33	14.52	<0.0001
month	2, 33	5.93	0.0063
month*plot	6, 33	1.5	0.2084

(B) Emiquon

denitrification			
effect	df	<i>F</i> -value	<i>P</i> -value
plot	3, 33	6.28	0.0017
month	2, 33	18.02	<0.0001
month*plot	6, 33	2.55	0.0384

nitrification			
effect	df	<i>F</i> -value	<i>P</i> -value
plot	3, 33	24.04	<0.0001
month	2, 33	4.66	0.0165
month*plot	6, 33	2.03	0.0892

Information Transfer Program Introduction

The Illinois Water Resources Center strives to communicate with and engage decision makers, agency representatives, academic institutions, and local citizens to assist in making optimal decisions related to water use in the state.

IWRC Web Site

Basic Information

Title:	IWRC Web Site
Project Number:	2005IL156B
Start Date:	1/1/2005
End Date:	1/1/2011
Funding Source:	104B
Congressional District:	15th
Research Category:	Not Applicable
Focus Category:	Education, None, None
Descriptors:	web site, outreach, education
Principal Investigators:	Lisa Merrifield, Lisa Merrifield

Publications

1. Fackler, Jennifer, ed., 2006, Illinois Water Resources Center Web Site, www.viron.uiuc.edu/iwrc.
2. Fackler, Jennifer, ed., 2006, Illinois Water Resources Center Web Site, www.viron.uiuc.edu/iwrc.
3. Fackler, Jennifer, ed., 2006, Illinois Water Resources Center Web Site, www.viron.uiuc.edu/iwrc.
4. Fackler, Jennifer, ed., 2007 Illinois Water Resources Center Web Site, www.extension.uiuc.edu/iwrc.
5. Fackler, Jennifer, ed., 2006, Illinois Water Resources Center Web Site, www.viron.uiuc.edu/iwrc.
6. Fackler, Jennifer, ed., 2007 Illinois Water Resources Center Web Site, www.extension.uiuc.edu/iwrc.
7. Lisa Merrifield, ed., 2008. Illinois Water Resources Center Web site,
<http://web.extension.uiuc.edu/iwrc/>.
8. Lisa Merrifield, ed. 2008. University Council on Water Resources 2009 Conference Web Site.
<http://www.isws.illinois.edu/hilites/confinfo/ucowr/>

The IWRC web site has long been an access point for people seeking information about water resources in Illinois. In 2008, our primary website focus has been digitizing our library of publications and making them available as PDFs via the site. Users can now visit http://web.extension.uiuc.edu/iwrc/scientists_research.html to download research reports 1-240. Special publications, such as conference proceedings and reports are currently being digitized and should be available in the coming year.

In addition to making the publications available via the IWRC website, we are working with the University of Illinois to be included in their efforts to digitize University collections. The publications will be available via the IDEALS web site in the coming year which can be accessed at <http://www.ideals.uiuc.edu/>. The benefits to participating in this effort include a guarantee that the publication format will be updated as software changes and the addition of our publications to a searchable database that will allow users to find these materials more easily.

IWRC Newsletter

Basic Information

Title:	IWRC Newsletter
Project Number:	2005IL157B
Start Date:	1/1/2005
End Date:	1/1/2011
Funding Source:	104B
Congressional District:	15th
Research Category:	Not Applicable
Focus Category:	Education, None, None
Descriptors:	newsletter, education, outreach
Principal Investigators:	Lisa Merrifield, Jennifer Fackler

Publications

1. Miles, Irene, Jennifer Fackler, Lisa Merrifield, eds., Fall 2005, Illinois Water Resources Center Newsletter.
2. Illinois Water Resources Center, 2006, Illinois Water Resources Center Newsletter, Illinois Water Resources Center, Urbana, Illinois, 4 pages.
3. Miles, Irene, Jennifer Fackler, Lisa Merrifield, eds., Fall 2005, Illinois Water Resources Center Newsletter.
4. Illinois Water Resources Center, 2006, Illinois Water Resources Center Newsletter, Illinois Water Resources Center, Urbana, Illinois, 4 pages.
5. Miles, Irene, Jennifer Fackler, Lisa Merrifield, eds., Fall 2005, Illinois Water Resources Center Newsletter.
6. Illinois Water Resources Center, 2006, Illinois Water Resources Center Newsletter, Illinois Water Resources Center, Urbana, Illinois, 4 pages.
7. Merrifield, Lisa, ed., Fall 2007, Illinois Water Resources Center Newsletter, p. 4.
8. Miles, Irene, Jennifer Fackler, Lisa Merrifield, eds., Fall 2005, Illinois Water Resources Center Newsletter.
9. Illinois Water Resources Center, 2006, Illinois Water Resources Center Newsletter, Illinois Water Resources Center, Urbana, Illinois, 4 pages.
10. Merrifield, Lisa, ed., Fall 2007, Illinois Water Resources Center Newsletter, p. 4.
11. Merrifield, Lisa, ed, Fall 2008, Illinois Water Resources Center Newsletter, p. 4.

Once per year, usually in late summer, the Illinois Water Resources Center publishes a newsletter detailing our research and outreach activities over the previous year. The newsletter is distributed to over 700 people on our mailing list and is made available on our website. Following is a copy of the 2008 newsletter.

Dates to Remember

October 8-9, 2008	Illinois Water, Champaign, Illinois. See cover page.
October 24, 2008	Proposals due for IWRC funding. See page 2.
December 4, 2008	UCOWR Papers submissions due. See page 3.
July 7-9, 2009	UCOWR Meeting, Chicago, Illinois. See page 2.
October 20-22, 2009	Governor's Conference on Management of the Illinois River System, Peoria, Illinois.



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Illinois Water Resources Center

S u m m e r 2 0 0 8 B u l l e t i n

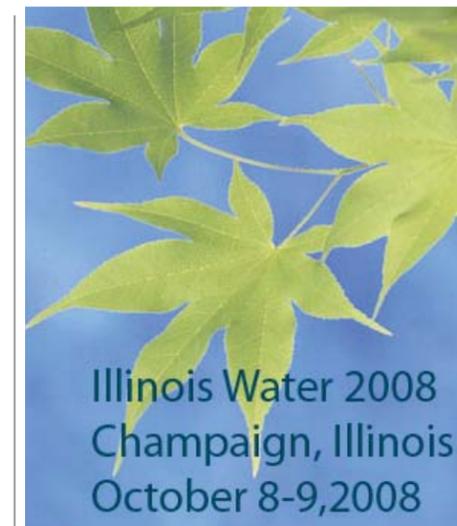
Illinois Water Conference Celebrates 10 Years of Water Science

IWRC will host our 10th anniversary biennial Conference on Illinois Water, October 8-9 in Champaign, Illinois. Begun in 1998, the mission of the conference is to showcase the latest research findings and policy issues related to Illinois waters.

This year's conference provides opportunities to reflect on the past and look to the future. What has changed in the last ten years, what are our successes, and what problems do we still face? To help out the past decade, we have invited Richard Sparks, former director of the Illinois Water Resources Center and founder of this conference series, to give us his perspective on the changes that have occurred in the past ten years and the issues he sees on the horizon. Now the director of research for the National Great Rivers Research and Education Center, Dr. Sparks is actively involved in preserving and restoring our waterways.

Also on the conference agenda are plenary sessions on the Water Resources Development Act, climate change, nutrients, water supply, and energy/biofuels.

Papers have been submitted by about 40 scientists and students and will include topics such as groundwater research, technology, water quality, watershed-scale science, planning, and environmental



measurements.

"We invite all members of the water community in Illinois to join us at the Illinois Water 2008 conference," says conference coordinator Lisa Merrified. "Topics will define the critical issues currently facing Illinois waters and explore the current research advancements in our scientific communities."

If you are interested in learning more about this year's conference or attending, please visit www.iisgcp.org/ilwater/.

Conference early registration fees are \$155 (\$85 for one day). After September 7, rates increase to \$185 for the full conference and \$105 for a single day.

Student rates and scholarships are available.

Researchers Shed Light on Groundwater in Northeastern Illinois

Managing water resources in northeastern Illinois is complicated by interstate treaties and multiple demands on available supply. The aquifers underlying much of the region do not make the situation any easier. They are characterized



as fractured dolomite aquifers which means that the water flows through cracks in the rocks. The cracks are highly variable, making the rate of flow and transportation of contaminants difficult to understand. It is not unusual for neighboring wells to produce very different amounts of water due to the number of fractures the well intersects. Further, as the water flows through the fractures in the rock, very little filtration occurs, making it possible for surface contaminants to travel long distances with little alteration.

This year, two IWRC funded researchers completed projects to help us better understand the aquifer structure and function in the region.

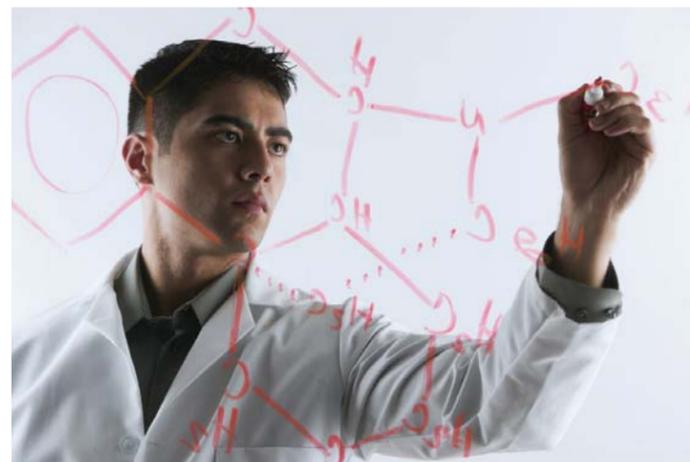
With funding from the National Institutes of Water Resources program, Researchers Yu-Feng Lin and Albert Valocchi, University of Illinois, and Randall Hunt, USGS Wisconsin Water Science Center, have developed a tool that can more quickly and easily allow decision makers to understand the implications of

different options on the aquifer. They have developed a GIS plug-in called Pro Grade that can quickly generate aquifer recharge and discharge rates using widely available data. The tool is available online at www.sws.uiuc.edu/gws/sware/prograde.

Researcher Douglas Walker, University of Illinois, with funding from IWRC's base grant program, has spent the last two years looking at how to model the flow rates from these aquifers. As the aquifers are highly variable, determining impacts is difficult. Given the high demand on water in the region, more accurate methods for modeling these types of aquifers are critically needed. Dr. Walker's revised models now show markedly different flow rates than those more commonly used. His findings, while preliminary, have created a great deal of interest and discussion within the groundwater community and could lead to new interpretations of how water flows under the Chicago area.

IWRC Seeks Graduate Students

In the early fall, look for IWRC's latest call for proposals. "Encouraging and supporting new scientists is one of the most important tasks our center does," says research coordinator, Dr. Phil Mankin. "During this RFP cycle, our focus will be on supporting students with a strong interest in water issues."



This year IWRC requests proposals to fund a graduate student who is conducting research on topics of importance to Illinois water resources. We will provide one 50 percent, nine- to twelve-month research assistantship to an MS or PhD student at a university in Illinois whose work is in support of a thesis.

Funding will begin as early as May 2009 and end by August 2010. Faculty members should submit a plan of work that describes the problems, methods, role for the graduate student, and expected outcomes. Proposals will be evaluated on the strength of the science as well as the academic record of the student. They are due October 24, 2008.

IWRC is issuing this call on a trial basis. With sufficient interest, Mankin expects to make this an annual funding opportunity. "We hope that many professors and graduate students around the state will see this as an opportunity to help reach their research and career goals," Mankin says.

A full request for proposals is available at web.extension.uiuc.edu/iwrc/.

Urban Water Management Conference Comes to Chicago; Seeks Papers

The University Council on Water Resources (UCOWR) has selected Chicago for its annual conference to be held during the summer of 2009. The conference theme will be urban water management and IWRC will serve as the local host.

IWRC director, Dr. Richard Warner, said "We are very excited to help host this conference and to showcase research and outreach related to the complexities of water management in densely populated coastal settings."

With Chicago as a backdrop, the location provides abundant opportunities to showcase our successes and challenges as we deal with infrastructure decay, pharmaceuticals and other chemicals in waterways, climate change, water supply planning, energy, and other critical issues.

UCOWR director, Dr. Christopher Lant is enthusiastic about bringing this annual conference to Chicago. "Following annual conferences in Santa Fe, New Mexico, Boise, Idaho, and Durham, North Carolina, the 2009 UCOWR conference in downtown

Chicago promises to draw from public and private sectors as well as academic participants in a dynamic exchange of ideas, issues, and solutions to urban water management problems in an exciting environment with good food and good fun," Lant said.

Conference organizers are currently soliciting papers from anyone interested in presenting.

Topics include:

- Urban water quality
- Urban water quantity
- Pharmaceuticals and other pollutants
- Urban stream restoration
- Climate change
- Urban flash flooding
- Storm water management
- Monitoring
- Water reuse/gray water
- Public education and participation
- Water security/disaster preparedness
- Water and energy: biofuels, thermoelectric use
- Local, regional and watershed planning and economics

Abstracts are due December 4, 2008. Guidelines are available at www.ucowr.org.

Papers due
December 4, 2008

Conference coming
Summer of 2009



Illinois Water Resources Center

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Midwest Technology Assistance Center

Basic Information

Title:	Midwest Technology Assistance Center
Project Number:	2005IL158B
Start Date:	1/1/2005
End Date:	1/1/2011
Funding Source:	104B
Congressional District:	15th
Research Category:	Water Quality
Focus Category:	Water Supply, Water Quantity, Water Quality
Descriptors:	small water systems, Midwest
Principal Investigators:	Richard E. Warner, Jennifer Fackler, Lisa Merrifield

Publications

1. Lau, Boris L. T., Gregory W. Harrington, Marc. A. Anderson, 2006, Arsenic and Bacteriophage MS2 Removal from Groundwater by Nanoparticulate Aluminum Oxide Coated Granular Filter Media: A Pilot-Scale Evaluation on the Effect of pH and Coating Density, Illinois State Water Survey, (FS06-01).
2. Moore, Michelle, 2006, Chlorine's Effect on Corrosion in Drinking Water Systems, Illinois State Water Survey, NDWC, Tech Brief #3, Item # DWBRPE52.
3. Winstanley, Derek, James R. Angel, Timothy P. Bryant, H. Vernon Knapp, Michael A. Palecki, Amy M. Russell, H. Allen Wehrmann, 2006, Drought Planning for Small Community Water Systems, Illinois State Water Survey,(FS06-02).
4. Lau, Boris L. T., Gregory W. Harrington, Marc. A. Anderson, 2006, Arsenic and Bacteriophage MS2 Removal from Groundwater by Nanoparticulate Aluminum Oxide Coated Granular Filter Media: A Pilot-Scale Evaluation on the Effect of pH and Coating Density, Illinois State Water Survey, (FS06-01).
5. Moore, Michelle, 2006, Chlorine's Effect on Corrosion in Drinking Water Systems, Illinois State Water Survey, NDWC, Tech Brief #3, Item # DWBRPE52.
6. Winstanley, Derek, James R. Angel, Timothy P. Bryant, H. Vernon Knapp, Michael A. Palecki, Amy M. Russell, H. Allen Wehrmann, 2006, Drought Planning for Small Community Water Systems, Illinois State Water Survey,(FS06-02).
7. Lau, Boris L. T., Gregory W. Harrington, Marc. A. Anderson, 2006, Arsenic and Bacteriophage MS2 Removal from Groundwater by Nanoparticulate Aluminum Oxide Coated Granular Filter Media: A Pilot-Scale Evaluation on the Effect of pH and Coating Density, Illinois State Water Survey, (FS06-01).
8. Moore, Michelle, 2006, Chlorine's Effect on Corrosion in Drinking Water Systems, Illinois State Water Survey, NDWC, Tech Brief #3, Item # DWBRPE52.
9. Winstanley, Derek, James R. Angel, Timothy P. Bryant, H. Vernon Knapp, Michael A. Palecki, Amy M. Russell, H. Allen Wehrmann, 2006, Drought Planning for Small Community Water Systems, Illinois State Water Survey,(FS06-02).
10. Lau, Boris L. T., Gregory W. Harrington, Marc. A. Anderson, 2006, Arsenic and Bacteriophage MS2 Removal from Groundwater by Nanoparticulate Aluminum Oxide Coated Granular Filter Media: A Pilot-Scale Evaluation on the Effect of pH and Coating Density, Illinois State Water Survey, (FS06-01).

Midwest Technology Assistance Center

11. Moore, Michelle, 2006, Chlorine's Effect on Corrosion in Drinking Water Systems, Illinois State Water Survey, NDWC, Tech Brief #3, Item # DWBRPE52.
12. Winstanley, Derek, James R. Angel, Timothy P. Bryant, H. Vernon Knapp, Michael A. Palecki, Amy M. Russell, H. Allen Wehrmann, 2006, Drought Planning for Small Community Water Systems, Illinois State Water Survey,(FS06-02).

The Midwest Technology Assistance Center for Small Public Water Systems (MTAC) is a consortium led by the University of Illinois and the Illinois State Water Survey, in partnership with the land grant universities of Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, Ohio, and Wisconsin. MTAC serves small public water systems and public systems serving Native American Tribes. The participation of each state is led by its Water Resources Research Institute (WRRRI), established under authority of the Water Resources Research Act of 1964 on the campus of the land grant university as a federal-state partnership to conduct applied research and technology transfer.

The Center cooperates closely with other regional technology assistance centers established by the USEPA, and with other partner agencies and organizations in order to ensure efficient response to the highest priority needs of small public water systems and Native American Tribal systems in the Midwest.

Beginning in January, 2009, MTAC was awarded a grant to build an online tool to help small water supply system operators connect to online resources designed for them. Research has shown that many do not have access to the internet at their place of work and thus do not utilize the materials available to them.

IWRC's role in this effort is to identify the 20 operators to test and use the site, get them set up with laptops and internet access, and collect information for the website.

Transferring Water Resources Information to the People of Illinois

Basic Information

Title:	Transferring Water Resources Information to the People of Illinois
Project Number:	2010IL201B
Start Date:	3/1/2010
End Date:	2/28/2011
Funding Source:	104B
Congressional District:	15th
Research Category:	Not Applicable
Focus Category:	Education, None, None
Descriptors:	
Principal Investigators:	Lisa Merrifield

Publication

1. Blue, Carla, ed., 2010, Illinois Water 2010 Conference Proceedings, http://web.extension.illinois.edu/iwrc/scientists_presentations2010.html

The following activities have been conducted by IWRC related to information transfer in Illinois.

Electronic Newsletter

In our proposal, IWRC committed to publishing an electronic newsletter to be emailed to our subscriber list of approximately 500 between July and September. Because of diminishing resources and the need for more frequent communication, IWRC staff elected to send more frequent, less formal updates as information distribution opportunities arose. Such opportunities included RFP distribution, conference and call for paper announcements, significant news or research stories, and other events and news items of interest to our subscribers. We received better responses to this mode of information distribution than we received to our published newsletter and will likely share information and results this way in the future.

Illinois Water Conference

The 2010 Illinois Water Conference was held on October 3-5, 2010 in Champaign, Illinois. In preparation for the conference, we worked with students in a University of Illinois Art and Design class to provide a more sustainable and accessible format for the printed materials. We designed a one page brochure, see publications, and referred people to a web site for abstracts and a mobile site for agenda and speaker information during the conference. Attendee surveys showed that 33% of participants accessed materials via their phone or laptop during the conference.

Approximately 175 people attended Illinois Water 2010. Key features included sessions on water supply sustainability, green infrastructure, water planning in Illinois, and Asian carp. The keynote address was given by Robert Glennon, Professor of Law at the University of Arizona and author of *Unquenchable*. A day long preconference workshop on water resources modeling drew about 40 people. Sponsors included the Illinois Environmental Protection Agency, Illinois State Water Survey, Illinois-Indiana Sea Grant, Illinois State Geological Survey, Metropolitan Water Reclamation District of Greater Chicago, the Illinois Water Authority Association, and the Illinois Farm Bureau.

Student activities include student papers and posters, student registration scholarships, and a student career panel hosted by the Illinois Water Resources Association.

Co-Sponsor the Governor's Conference on the Illinois River

IWRC staff serve on the planning committee for this conference. The conference will be held October 2011 in Peoria, Illinois. In 2010 planning was still in the preliminary stages, but IWRC staff have committed to designing the abstract book, providing a place to upload conference presentations, and producing the electronic conference proceedings.

IWRC Web Site

Staff update the IWRC web site with conference and proposal information as needed.

Information transfer to students and the general public

In 2010, IWRC information transfer to students and the public occurred primarily at the Illinois Water conference and through the proposals we funded.

The water conference provided scholarships so students could attend. Approximately 30 students took advantage of these scholarships. Students were also given opportunities to present papers and posters and to participate in a student career panel.

In recent years, we have geared our request for proposals towards graduate education. Research projects have to go to support a graduate student's dissertation research. This year we funded a student in engineering and a student in natural resources and environmental sciences.

Developing outreach tools for the University of Illinois

When we drafted this proposal, there was significant push from University of Illinois administrators to bring together the water community on the University of Illinois campus. IWRC committed to survey parties interested in water resource issues and to help compile a needs assessment for the campus. Unfortunately, budget constraints and leadership changes did not allow this effort to go forward. Thus, IWRC was not able to produce materials as expected.

Electronic Newsletter

Basic Information

Title:	Electronic Newsletter
Project Number:	2010IL247B
Start Date:	3/1/2010
End Date:	2/28/2011
Funding Source:	104B
Congressional District:	15th
Research Category:	Not Applicable
Focus Category:	None, None, None
Descriptors:	information transfer, outreach
Principal Investigators:	Lisa Merrifield

Publications

There are no publications.

Electronic Newsletter

In our proposal, IWRC committed to publishing an electronic newsletter to be emailed to our subscriber list of approximately 500 between July and September. Because of diminishing resources and the need for more frequent communication, IWRC staff elected to send more frequent, less formal updates as information distribution opportunities arose. Such opportunities included RFP distribution, conference and call for paper announcements, significant news or research stories, and other events and news items of interest to our subscribers. We received better responses to this mode of information distribution than we received to our published newsletter and will likely share information and results this way in the future.

USGS Summer Intern Program

None.

Student Support					
Category	Section 104 Base Grant	Section 104 NCGP Award	NIWR-USGS Internship	Supplemental Awards	Total
Undergraduate	1	0	0	0	1
Masters	0	0	0	0	0
Ph.D.	2	0	0	0	2
Post-Doc.	0	0	0	0	0
Total	3	0	0	0	3

Notable Awards and Achievements

Graduate student research explored whether bioenergy crops that have been shown to reduce nitrogen run off from Illinois fields are not likely to be sufficiently profitable to encourage Illinois farmers to switch from typical corn and soybean production practices.

Graduate student research examining microbial function in wetlands discovered that assumptions about functional redundancy among microbes is not accurate and can misguide the management of nutrient cycling functions within the wetland.