Indiana Water Resources Research Center
Annual Technical Report
FY 2012

Introduction

Overview: This report covers the activities of the Indiana Water Resources Research Center (IWRRC) for the period March 1, 2012 to February 28, 2013 and was developed and written by Ronald F. Turco, Director of the center. The report is provided to meet requirements and obligations under the 104 (B) of the USGS water centers program. The objectives of the fiscal year 2012 program of the IWRRC have been: (1) to continue to engage the water community in the State of Indiana as related to water research and education; (2) to chair the dedicated water community at Purdue University–the Purdue Water Community (http://www.purdue.edu/dp/water/about.php); (3) foster a research programs that encompass water issues related to: contaminants that is primarily focused on the Wabash River and in support of the projects aid in the development of grant submission for major efforts; (4) continue to support an outreach program related to water and water quality (in particular rural water protection/safety) and (5) to strengthen interactions with State regulatory agencies and Federal Agencies via active participation in a series of well water protection education programs, meetings with USGS, Indiana Department of Natural Resources and repeated direct interaction with the legislative study committees of the Indiana House of Representatives.

In the last year we have supported externally reviewed 104(B) projects, maintained a functional website (www.iwrrc.org) been involved in the development, submission and management of number of grant proposals including a record number of 104g submissions. In terms of web resources we have maintained the digital library of most of our back issues of water center reports and made them available via the Purdue University Library at “IWRRC Technical Reports”(http://docs.lib.purdue.edu/watertech/).

The IWRRC and Wabash River Enhancement Corporation (WRRC) have maintained a strong relationship over the past year. We are now in the second year of our 319 project entitled "Region of the Great Bend of the Wabash River Implementation project” where IWRRC is active with WREC in helping to evaluate projects for potential cost-share under the implementation effort and we engaged in number of new project startups. The IWRRC-WREC collaboration led to second project entitled “Deer Creek-Sugar Creek Watershed Management Plan and Implementation Program.” We are drawing on the lessons learned from our “Great Bend” effort as we move to the Northeast and provide input on the water quality issues in the adjacent counties.

The relation with WREC led to the development of student grant effort that was submitted to the Ford College Community Challenge (C3) community grant supports student-led, community-based projects around the theme “Building Sustainable Communities.” The effort has engaged a number of undergraduate and graduate students in three local water quality projects. As part of the project students have led efforts to installing urban water projects, including rain barrels, rain gardens, green roofs, and native plants in target area within the community. These projects will serve as educational demonstration sites and have been located at Oakland High School, Purdue University, and Cary Home. The IWRRC has been active with the Purdue University water community (PWC) and have facilitated a number of campus wide meetings to engage this group. We have been primarily interested in developing grant applications.

International, we are now working with Purdue’s office of global engineering on a number of water projects with efforts in China, India and Mexico. We have worked with the Purdue University Ecopartnership (http://www.purdue.edu/discoverypark/ecopartnership/) and the Purdue-Mexico project (https://engineering.purdue.edu/GEP/Programs/mexico.html). Our goal has been the development of effective partnerships leading to real improvements in water quality.

For this reporting period, we continue the strategic outreach alliance with the Purdue Pesticide Program office for the development of document and educational materials on methods to prevent water contamination. By leveraging our funds with the Purdue Pesticide Program office’s core efforts we are using the opportunity to include the IWRRC in many of their programs. Our efforts have established a constant and vital outreach effort that is associated with prevention rather than remediation of environmental problems. In the future we are increasing our support of the PPP office. The recent title: Extracting stuck equipment safely: how to avoid expensive and painful incidents. PPP-98 and Measuring pesticides: overlooked steps to getting the correct rate. PPP-96.

Research Program Introduction

Project 01: Program Administration and State Coordination

The administrative portion of the project has been used to support the management of the IWRRC's research projects and to facilitate the development of other research projects. We have also stepped up our efforts to coordinate campus level interactions (helping to create the Purdue Water Community) with state and federal agencies. All of these efforts have the ultimate goal of improving the quality of water resources in the State of Indiana. We have used a limited amount of money on the administrative portion but it has allowed the IWRRC director some means to invest time in the efforts to integrate with state and federal agencies. Most of IWRRC funds are used for projects and the director's time is contributed to the project. The IWRRC director has worked with state and federal environmental agencies, the governments of Indiana's cities and counties and key citizen groups on water education and water resources planning activities. In this way, the results from the research projects can be transferred to interested individuals in the state. The IWRRC director will participate in important national and international meetings related to water and environmental protection.

Projects Areas

1. Continued work with the "State Water Monitoring Council". (https://engineering.purdue.edu/~inwater/conference/) leading to an online inventory of projects https://engineering.purdue.edu/~inwater/. 2. Work with community projects has continued including working with the Wabash River Enhancement Corporation (WREC) on a Volunteer Water Quality Monitoring project to allow opportunities for volunteer monitors to assess water quality conditions throughout the watershed. WREC its partners conducted a fall and spring Wabash River Sampling Blitz in 2012. During spring and fall blitz, nearly 180 volunteers sampled 210 stream sites collecting water quality samples, measuring temperature and transparency in the stream, and photographing conditions present at the time of sampling. Sample filtering and analysis of samples with test strips also occurred either at staging locations or within the stream sample sites. In total, five sampling blitzes have occurred during the current grant period: September 18, 2009; April 9, 2010; September 17, 2010; April 15, 2011, September 16, 2011, April 13, 2012 and September 28, 2012. During each event, volunteer groups sampled three to four stream sites collecting field measurements for temperature and transparency, using test strips to analyze pH and nitrate at a minimum, and filling sample bottles for laboratory analysis of E. coli, nitrate+nitrite, orthophosphorus, and total organic carbon. Sample results were mapped by subwatershed drainage and posted to www.wabashriver.net as soon as possible following the event. In total 600 unique volunteers participated in the sampling blitzes. 3. We have also continued working along with the Wabash River Enhancement Corporation, our partners, and education and outreach committees to provide numerous opportunities for watershed stakeholders to learn about the Wabash River and the Region of the Great Bend of the Wabash River watershed; facilitated education-based events; and coordinated programs to recognize the opportunities and commitments made by businesses and individuals throughout the watershed. Public meetings, the Clear-Blue-Green business certification program, field days, workshops, and the Wabash Sampling Blitz are just some of the activities used to educate our stakeholders. 4. In conjunction with the Tippecanoe County soil and water conservation district office, we have been developing a theme area in the use of infield anaerobic bioreactors as a means of reducing soluble N that can be discharged to surface water. 5. The Wabash River runs some 764 km (475 mi), is situated across five 8-digit Hydrologic units (HUC), crosses 19 counties and at its full distance stretches from the Ohio border in the Northeast corner of the state to the Southwest corner where it combines with the Ohio River below Mount Vernon on its way to the Mississippi River. Our goal is simple: develop a coordinated research and management agenda for work on the Wabash River. The long-term goal of the effort is to help re-establish the Wabash River as a healthy water body that provides quality recreation and economic value to the state.

Grant Applications Submitted thorough/with IWRRC:

a. (Funded) USDA-CIG $165,000 Using cover crops to improve soil health and moisture retention. b. (Funded and ongoing) IDEM-319 $240,000 Region of the Great Bend of the Wabash River Implementation Project with L. Prokopy, S. Peel and R. Goforth.

c. (Funded and ongoing) USDA-CAP: $2,875,642 Sustainable Production and Distribution of Bioenergy for the Central USA with J. Volenec, S. Brouder, others

d. (Funded and ongoing) IDEM-319 $132,000 Deer Creek-Sugar Creek Watershed Management Plan and Implementation Program. Project with S. Peel and R. Goforth.

e. (Funded and ongoing) USDA-AFRI Tracking the survival and distribution of Mycobacterium avium subsp paratuberculosis in the agroecosystem. $375,000. E. Rizaman, C. Wu and R. Turco.

f. (Funded and ongoing) SUNGRANTS: Optimization of biomass productivity and environmental sustainability for cellulosic feedstocks: Land capability and life cycle analysis. $875,000 S.M. Brouder, PI, R.F. Turco, J.J. Volenec, D.R. Smith and G. Ejeta CoPIs

g. (Funded and ongoing) USDA NRI, Managed Ecosystems. Ecological services of agro-biofuels: productivity, soil C storage, and air and water quality. $399,999. Submitted Dec. 2007. S.M. Brouder, PI, R.F. Turco, J.J. Volenec, D.R. Smith and G. Ejeta CoPIs. h. (Closed) ALCOA 95,000 Bauxite Residue in Soil. R. Turco.

i. (Closed) IDEM-319 Development and Demonstration of Outcomes-Based Evaluation Framework for the Indiana Nonpoint Source Program. Developed with Jane Frankenberger, and Linda Prokopy.

j. (Closed) IDEM 319: Wabash River: Lafayette-West Lafayette Reach of the Wabash River Watershed Management Plan. Submitted in conjunction with the Wabash River Enchantment Corporation $700,000. L. Prokopy, L. Bowling, K. Wilson and R. Turco. Bridging grant approved for one year of additional support.

k. (Closed) USDA Conservation Effects Assessment Program. $660,000. Watershed-Scale Evaluation of BMP Effectiveness and Acceptability: Eagle Creek Watershed, Indiana. Developed with Jane Frankenberg, Lenore Tedesco, Jerry Shively, Linda Prokopy. This was an outgrowth of an effort submitted last year to EPA but note funded: Creating sustainable drinking water supplies for Central Indiana: Innovations to achieve reductions in watershed and reservoir nutrient levels

External Board of Advisors Membership: Dr. Jack Wittman, Ph.D., CGWP, Layne Hydro Bloomington IN Dr. Bill Guertal Director, USGS Indiana Water Science Center, Indianapolis IN Mr. Jeff Martin, USGS Indiana Water Science Center, Indianapolis IN

Faculty Advisory Committee: Dr. Linda Lee, Professor and Director of ESE Dr. Indrajeet Chaubey, Agriculture and Biological Engineering Dr. Larry Nies, Civil and Environmental Engineering Dr. Inez Hua, Civil and Environmental Engineering

Transport and retention of atrazine, metolachlor, carbaryl, and chlorothalonil in agricultural streams

Basic Information

Title:	Transport and retention of atrazine, metolachlor, carbaryl, and chlorothalonil in agricultural streams
Project Number:	2012IN333B
Start Date:	3/1/2012
End Date:	2/28/2014
Funding Source:	104B
Congressional District:	IN-006
Research Category:	Water Quality
Focus Category:	Agriculture, Ecology, Hydrology
Descriptors:	
Principal Investigators:	Melody J. Bernot, Daniel Elias

Publications

1. Elias, D, and MJ Bernot. 201X. In preparation. Abundance and transport of atrazine, metolachlor, carbaryl, and chlorothalonil in central Indiana streams. Microbial Ecology.
2. Elias, D, MJ Bernot. 2013. Abundance and transport of atrazine, metolachlor, carbaryl, and chlorothalonil in central Indiana streams. 18th BSU Student Symposium. Ball State University, Muncie, IN. March
3. Elias, D, MJ Bernot. 2013. Effects of atrazine, metolachlor, carbaryl and chlorothalonil on stream sediment nutrient dynamics. Seminar Series ID 705, Environmental Sciences Program. Ball State University. Muncie, IN. March
4. Elias, D, MJ Bernot. 2012. Abundance and transport of atrazine, metolachlor, carbaryl, and chlorothalonil in central Indiana streams. Ohio Valley Society of Environmental Toxicology and Chemistry.Oxford , OH. Septembe
5. Elias, D, MJ Bernot. 2012. Abundance and transport of atrazine, metolachlor, carbaryl, and chlorothalonil in central Indiana streams.Indiana Water Resources Association. Mitchell, IN. June
6. Elias, D, MJ Bernot. 2012. Abundance and transport of atrazine, metolachlor, carbaryl, and chlorothalonil in central Indiana streams. Society for Freshwater Science. Louisville, KY. May.
7. Elias, D, MJ Bernot. 2012. Abundance and transport of atrazine, metolachlor, carbaryl, and chlorothalonil in central Indiana streams. Indiana Academy of Science. Indianapolis, IN. March.

IWRRC 2012 Project Report

Title: *Transport and retention of atrazine, metolachlor, carbaryl, and chlorothalonil in agricultural streams*

Project Type: Research

Start Date: 3/01/2012 **End Date:** 2/28/2013

Congressional District: IN-006

Focus categories: AG, ECL, HYDROL, NPP, ST, SW, TS, WQL

Keywords: agricultural contaminants, nonpoint pollution, streams, toxicology

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Abstract / Summary

Agricultural pesticides have the potential to affect receiving aquatic ecosystems. However, few studies have provided direct measures of pesticide movement within freshwaters. Atrazine, metolachlor, carbaryl and chlorothalonil have high usage rates throughout the Wabash River watershed and are potentially toxic to algae, aquatic plants, invertebrates, fish, and humans. Thus, a more comprehensive understanding of their transport and fate in freshwaters is needed to effectively manage these compounds. Research provided novel and direct measures of contaminant transport and retention in central Indiana streams. Specifically, *in situ* enrichment experiments of atrazine, metolachlor, carbaryl and chlorothalonil were conducted to directly quantify dissolved and sediment movement of these agricultural contaminants. Research was guided by one primary question with related hypotheses: What factors affect transport and retention of agricultural pesticides in lotic ecosystems? Enrichment experiments were conducted in July and October of 2011 to coincide with summer and fall stream conditions. In July, nitrate uptake length was longer relative to atrazine, carbaryl and chlorothalonil. In contrast, for the month of October, atrazine and metolachlor uptake lengths were longer relative to nitrate. Changes in nutrient uptake in response to atrazine, metolachlor, carbaryl and chlorothalonil were observed for ammonium with increasing concentration of metolachlor. Also, there was a decrease in remineralization of nitrate and decrease in phosphate uptake with increasing concentration of chlorothalonil. This research enhanced our understanding of atrazine, metolachlor, carbaryl and chlorothalonil transport and retention in freshwaters and provided data necessary for effective management of these agricultural chemicals and freshwater resources.

Problem:

This study will be conducted in the Upper White River Watershed, a tributary to the Wabash River and **one of the most degraded watersheds in the country** (USEPA 2002). This watershed is ideal for studying the influence of agricultural activity on aquatic ecosystems as the watershed is >70% agricultural land. Since the Clean Water Act was passed by Congress in 1972, environmental managers and policy makers have made substantial headway in identifying and reducing point source discharge in the nation's waterways (USEPA 2002). Yet, >40% of these water bodies remain impaired, often because of nonpoint source pollution (Carpenter et al. 1998, USEPA 2002). Nonpoint source pollution from agricultural activity poses a particular problem for water quality management because the responsibility is spread among entire populations, complicating source identification and reduction. Further, nonpoint pollution often degrades freshwater integrity to a greater extent than point pollution (Atasoy et al. 2006). Agricultural pollutants include nutrients, sediments, and trace organic compounds. Of these contaminants, trace organic compounds are the least understood. Agriculturally derived trace organics can be divided into functional categories including herbicides, insecticides, and fungicides. These categories represent dozens of trace organic compounds though their potential environmental effects are likely distinctly different due to distinct chemical properties. The frequency of use, detection in freshwater, and potential toxicity varies with individual compounds (Murray et al. 2010). In the Wabash River watershed, two herbicides (atrazine and metolachlor), one insecticide (carbaryl) and one fungicide (chlorothalonil), have both high usage rates and high frequency of detection in receiving waters. Further, these compounds have peak concentrations that may adversely affect the aquatic community (Munn et al. 2006) and human health (Margni et al. 2003; Yang et al. 2006; Ochoa-Acuna et al. 2009a), as well as potential sub-lethal effects on fecundity, growth, behavior and metabolic processes (Fairchild et al. 1996; Kashian et al. 2002) of aquatic organisms at expected environmental concentrations (Hashimoto et al. 1981; Ma et al. 2006; Larson et al. 1999; Myers et al. 2000). ***A more comprehensive understanding of how agriculturally derived trace organic compounds are transported and retained in aquatic ecosystems is needed to mitigate potential impacts on freshwater integrity including impaired function.*** Without more comprehensive data to guide management programs, we may incorrectly assume that these programs are adequate for maintaining or improving water resources. The proposed research will address these concerns by **directly** quantifying trace organic movement in streams. These data are essential for managers to make informed decisions about current and future management of water resources.

Research Objectives:

Research was guided by one primary question: **What factors affect transport and retention of agricultural pesticides in lotic ecosystems?** Research incorporated *in situ* experimental enrichments of agricultural contaminants to directly quantify movement in the ecosystem. Several research hypotheses guided data analyses:

H1: Transport of pesticides will be greater with increased discharge.

H2: Transport of pesticides will decrease with organic matter availability in conjunction with increased sorption and microbial activity.

H3: Dissolved chlorothalonil transport will be lower relative to atrazine, metolachlor, and carbaryl due to higher sediment sorption.

Methodology:

Enrichment experiments were conducted July 22nd, 2011 and October 18th, 2011. Experiments were conducted on a 1 km reach of a 2nd order tributary to Jakes Creek which is located on a Ball State University owned field station and has a history of agricultural activity in the surrounding sub-watershed (Figure 1). The tributary is located in the greater Wabash River watershed. During each enrichment experiment, sampling sites were marked every 50 m along the length of the reach with one site located upstream the enrichment to serve as a reference point. Commercial grade pesticides were used to prepare an enrichment solution and include Atrazine 4L, Me-too-lachlor, Sevin and Daconil. In addition, the enrichment solution included bromide as a conservative trace and nitrate (as KNO_3) to foster comparison. The enrichment solution was made in a 25 mL carboy which was dripped into the experimental reach for ~2h (until equilibrium was achieved) at ~0.016 L/min. Atrazine, metolachlor, carbaryl and chlorothalonil concentrations achieved via the enrichment were an order of magnitude below toxicity for any aquatic organisms but representative of concentrations measured previously in aquatic ecosystems (1.0, 0.6, 0.05 and 0.005 µg/L, respectively).

Once bromide equilibrium was achieved at the most downstream station, water and sediment sampling were conducted at each station along the reach. For dissolved pesticide analyses, two filtered water samples (1000 ml) were collected at each sampling site using a 60 mm syringe connected to a glass fiber filter (0.7 mm pore size) and placed into amber baked glass bottles. These samples were delivered within 12h to the Indiana State Department of Health (ISDH) Environmental Laboratories, Indianapolis for analyses. Atrazine, metolachlor and chlorothalonil were analyzed following method 525.2. These pesticides were extracted from water samples by passing 1 liter of sample water through a disk containing a solid matrix with a chemically bonded C18 organic phase (liquid-solid extraction, LSE). The compounds were eluted from the LSE disk with small quantities of ethyl acetate followed by Methylene Chloride. The sample components were separated, identified, and measured by a gas chromatography/mass spectrometry (GC/MS) system. Carbaryl analysis followed method 531.1. This pesticide was injected into a reverse phase HPLC column. Separation of carbaryl was achieved using gradient elution chromatography. After elution, carbaryl was hydrolyzed with 0.05N sodium hydroxide at 100°C. The methyl amine formed during hydrolysis was reacted with o-phthalaldehyde (OPA) and thiofluor to form a highly fluorescent derivative which was detected by a fluorescence detector. Separate filtered water samples (200 mL) were also collected at each sampling site for analysis of nutrients (nitrate, phosphate, ammonium) and bromide via ion chromatography (DIONEX 3000) and carbon via combustion (Schimadzu TOC-VS) at Ball State University following standard procedures. For sediment pesticide analyses, ~50 g homogenized sediment (top 5 – 10 cm) was collected into glass containers (150 ml) and also delivered to ISDH for analyses following extraction. For analysis of organic matter in sediments, sediment sub-samples were dried in a Model 30 GC laboratory oven for 48 h followed by combustion in a Barnstead Thermolyne FB 1400 muffle furnace and weight. Physicochemical parameters were also measured at each sampling site using a Hydrolab minisonde for oxygen, pH, temperature, turbidity, and conductivity and a Watson-Marlow flow meter to estimate discharge at each sampling site with measurements of depth, width and velocity.

Data collected in conjunction enrichment experiments were used to calculate water and sediment-bound transport metrics (uptake length, velocity, rate, retention, export) and compared among compound type and season using analysis of variance (ANOVA).

Results

Enrichment experiments were conducted in July and October (2011) in a 3rd order stream (Jakes Creek, Muncie, Indiana). Ten sites were marked 50 m apart for a total reach length of 500 m. A 25 L carboy was prepared with atrazine, metolachlor, carbaryl, chlorothalonil, and nitrate, at concentrations of 2.0, 1.0., 0.01, 0.05 µg/L, and 2 mg/l, respectively, and added to the stream reach at 0.016 l/min using a peristaltic geo-pump for 120 min (sampling at 100 min).Water and sediment samples were collected and stream physicochemical parameters were measured using a Hydrolab® and Watson-Marlow flow meter. Enrichment experiments in July quantified longer uptake rates for nitrate (312 m) and chlorothalonil (222 m) relative to carbaryl (102 m) and atrazine (30 m) (Figure 1). In October, uptake lengths for metolachlor (188 m) and atrazine (98 m) were longer, relative to nitrate (44m). Shorter uptake length for nitrate in October relative to July, suggests lower concentration of dissolved nitrate, and greater retention of nitrate relative to pesticides.

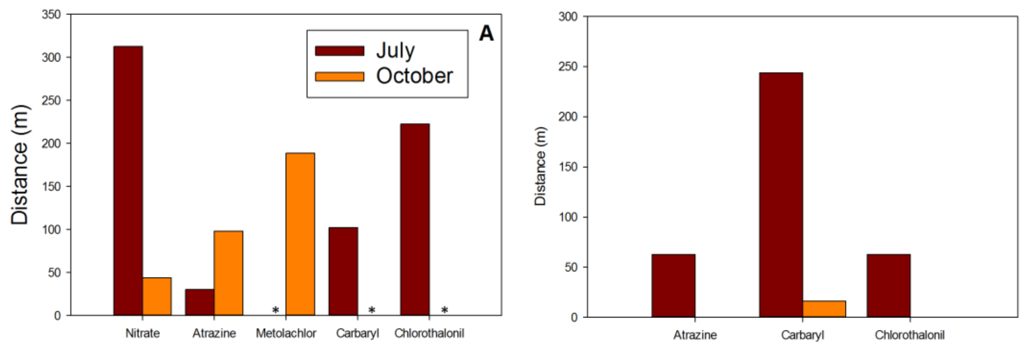


Figure 1. Uptake length of (A) dissolved pesticides; and, (B) sediment bound pesticides for atrazine, metolachlor, carbaryl, and chlorothalonil, relative to nitrate, in July and October enrichment experiments. * = Data not available.

For the sediment microbial community experiment there was little variation of ammonium, nitrate, and phosphate uptake within pesticides (Table 1). Also, there was a preferential uptake of ammonium over nitrate and a net remineralization of phosphate (Table 1). Uptake rate, loss of ammonium from the water column to the benthos, was negative correlated ($P < 0.05$) to metolachlor and was nonlinearly associated (polynomial cubic response) under increasing concentrations of this pesticide (Fig. 2). On the other hand, NH_4-N loss was not significantly correlated with increasing concentrations of atrazine, carbaryl or chlorothalonil. Nitrate uptake rate was positively correlated ($P < 0.05$) with a negative uptake (remineralization, organic forms to inorganic forms of nutrient) in response to increasing concentrations of chlorothalonil (Fig. 3). Nitrate dynamics were associated with a polynomial cubic response to chlorothalonil. In contrast, nitrate uptake of the sediment microbial community exposed to atrazine, metolachlor or carbaryl were not significantly correlated. In response to exposure to chlorothalonil, sediment microbial community phosphate uptake rate was negatively correlated with a linear response, $P < 0.0001$ (Fig. 4). No other pesticides were correlated with phosphate loss.

Table 1. Mean and range of nutrients uptake rates (mg/gdm/d)

Pesticides	Ammonium	Nitrate	Phosphate
Atrazine	0.76	0.001	-0.002
	(0.50 - 0.92)	*(0 - 0.002)*	*(-0.004 - 0.003)*
Metolachlor	0.87	0.001	-0.001
	(0.40 - 1.18)	*(0.0002 - 0.002)*	*(- 0.003 - 0.002)*
Carbaryl	0.67	0.03	-0.01
	(0.30 - 1.07)	*(0.02 - 0.03)*	*(-0.02 - 0.003)*
Chlorothalonil	0.67	0.001	-0.03
	(0.34 - 1.01)	*(-0.001 - 0.003)*	*(-0.05 - 0.003)*

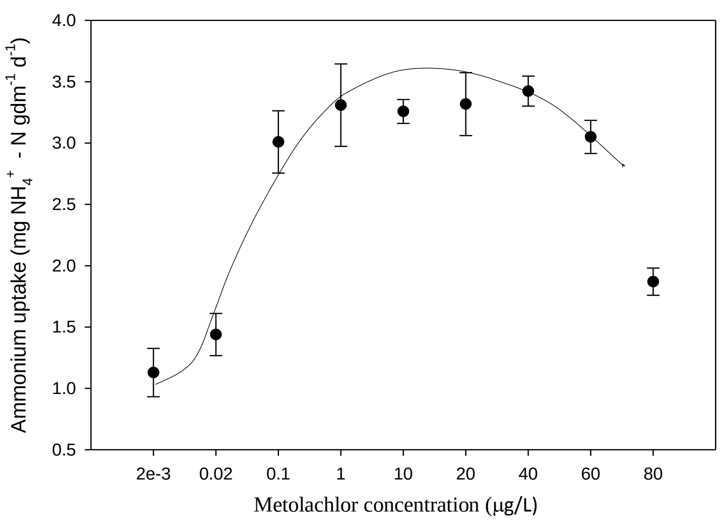


Figure 2: Mean Ammonium uptake rate after 24 h incubation (4 replicates, 10 treatments, N = 40) in response to increasing concentrations of metolachlor. Bars: SE.

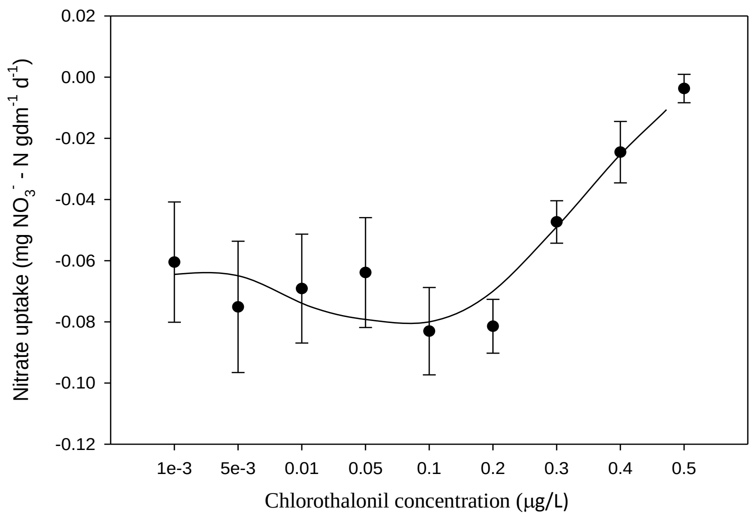


Figure 3: Mean nitrate uptake rate after 24 h incubation (4 replicates, 10 treatments, N = 40) in response to increasing concentration of chlorothalonil. Bars: SE.

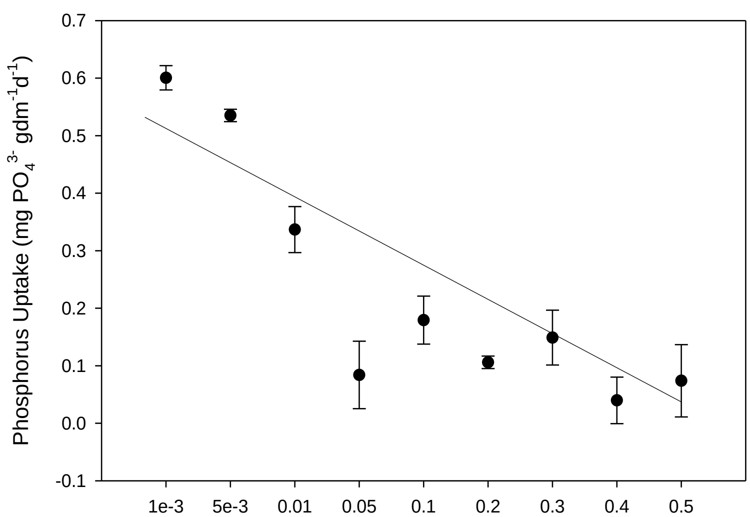


Figure 4: Mean phosphorus uptake rate after 24 h incubation (4 replicates, 10 treatments, N = 40) in response to increasing concentrations of chlorothalonil. Bars: SE.

Major Conclusions and Significance

These data suggest spatial and temporal variation in both abundance of pesticides as well as transport and retention within the ecosystem. Atrazine and metolachlor were detected in sediments suggesting accumulation from previous spraying seasons. Atrazine and metolachlor dissolved concentrations were within range of sub lethal effects on aquatic organisms. Atrazine had a shorter uptake length relative to nitrate, which could indicate a nitrate saturated stream and/or fast assimilation of the pesticide.

The different effects of atrazine, metolachlor, carbaryl and chlorothalonil on nitrogen and phosphorus uptake by sediment microbial communities are mainly influenced by chemical characteristics of pesticides (modes of action, Kow) and species present. Increasing availability of NH4-N and/or phosphorus (nutrient loss) could potentially affect stream export, reduce water quality and increase eutrophication. Remineralization of NO3-N in response to increasing concentrations of chlorothalonil could indicate energy demanding detoxification processes that require the oxidation of organic substrates. The equations generated in this research can be used to complement models of nitrogen/phosphorus availability in streams and to determine the potential changes in nutrient dynamics in the increasing presence of pesticides in lotic ecosystems.

Publications

<u>Presentations</u>

Elias, D, MJ Bernot. 2013. Abundance and transport of atrazine, metolachlor, carbaryl, and chlorothalonil in central Indiana streams. 18^{th} BSU Student Symposium. Ball State University, Muncie, IN. March

Elias, D, MJ Bernot. 2013. Effects of atrazine, metolachlor, carbaryl and chlorothalonil on stream sediment nutrient dynamics. Seminar Series ID 705, Environmental Sciences Program. Ball State University. Muncie, IN. March

Elias, D, MJ Bernot. 2012. Abundance and transport of atrazine, metolachlor, carbaryl, and chlorothalonil in central Indiana streams. Ohio Valley Society of Environmental Toxicology and Chemistry.Oxford , OH. September

Elias, D, MJ Bernot. 2012. Abundance and transport of atrazine, metolachlor, carbaryl, and chlorothalonil in central Indiana streams.Indiana Water Resources Association. Mitchell, IN. June

Elias, D, MJ Bernot. 2012. Abundance and transport of atrazine, metolachlor, carbaryl, and chlorothalonil in central Indiana streams. Society for Freshwater Science. Louisville, KY. May.

Elias, D, MJ Bernot. 2012. Abundance and transport of atrazine, metolachlor, carbaryl, and chlorothalonil in central Indiana streams. Indiana Academy of Science. Indianapolis, IN. March.

Publications

Elias, D, MJ Bernot. In preparation. Abundance and transport of atrazine, metolachlor, carbaryl, and chlorothalonil in central Indiana streams. Microbial Ecology.

Grant Submissions:

Elias, D. Transport of atrazine, metolachlor, carbaryl and chlorothalonil in freshwater ecosystems. Sigma Xi Grants in Aid of Research. Total Request: $1000.

Elias, D. Synergistic and antagonistic effects of atrazine, metolachlor, carbaryl and chlorothalonil on freshwater organisms. Ball State University ASPIRE. Total Request: $500. 2012-2013.

Elias, D. Frequency and abundance of atrazine, metolachlor, carbaryl and chlorothalonil in central Indiana freshwaters and sediment. Indiana Academy of Sciences. Total Request: $3,000.

Elias, D. Environmental fate of atrazine, metolachlor, carbaryl and chlorothalonil in central Indiana freshwaters. Environmental Protection Agency. Total Request: $42,000/annually.

Students

A total of 5 graduate students and 2 undergraduate students were involved with this project.

Monitoring and Modeling of Hydrodynamic Processes at the Wabash-Tippecanoe Confluence

Basic Information

Title:	Monitoring and Modeling of Hydrodynamic Processes at the Wabash-Tippecanoe Confluence
Project Number:	2012IN334B
Start Date:	3/1/2012
End Date:	2/28/2014
Funding Source:	104B
Congressional District:	IN-004
Research Category:	Climate and Hydrologic Processes
Focus Category:	Floods, Geomorphological Processes, Models
Descriptors:	None
Principal Investigators:	Venkatesh Merwade, Indrajeet Chaubey, Reuben R Goforth

Publication

1. None to report

Title: Monitoring and modeling of hydrodynamic processes at the Wabash-Tippecanoe Confluence

Abstract / Summary:

Flooding is the major natural disaster affecting the state of Indiana. With growing concerns related to climate and land use changes, there is a need to develop sustainable approaches towards floodplain management. The objective of this project is to set-up an instrumentation network at the confluence of Wabash and Tippecanoe rivers to monitor the hydrodynamics of high flows including velocity, stage, groundwater level and sediments. It is expected that such monitoring will create data that will enable to develop better understanding of the behavior of Wabash River for different flow conditions. This understanding will in-turn will enable addressing other environmental and ecological issues related to flooding along Indiana rivers.

Problem:

This project addresses the critical problem of flooding and its impact on other natural systems. While the past approach in handling high floods is through hard (or structural) measures (e.g., levees), there is a growing consensus that a better and more sustainable way is to propose and implement soft (or non structural) measures (sometimes in conjunction with structural measures) that will involve the usage of temporary floodplain storage to alter the flood hydrograph. Proposing and implementing soft measures involves understating the floodplain hydrodynamics and its interaction with other natural processes related to floodplain storage, ecology and geomorphology. The work proposed in this project is the first step towards accomplishing the goal of sustainable flood management through monitoring and modeling of floodplain hydrodynamics.

Research Objectives:

The objectives of this project are:

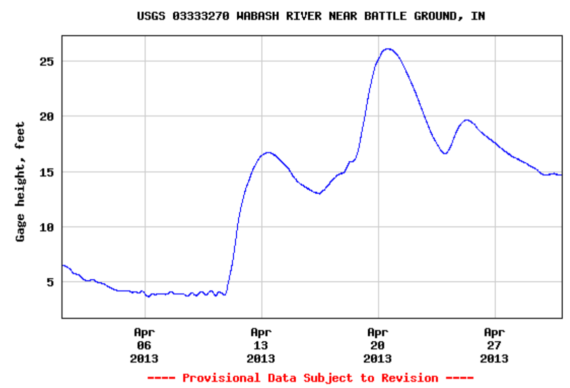
1. Install the hydrodynamic instrumentation network including acoustic dopplers and pressure transducers along the Wabash-Tippcanoe Confluence.
2. Real-time publication of data through United States Geological Survey (USGS) and WaterHUB (www.water-hub.org).
3. Develop a hydrodynamic model that uses the collected data to simulate the behavior of Wabash and Tippecanoe rivers at high flow conditions.

Methodology:

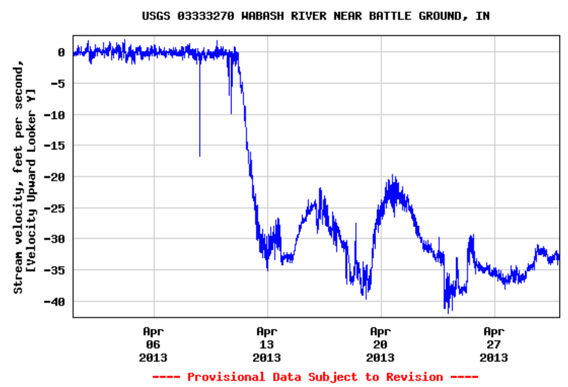
The methodology involved setting-up and installing the instruments in co-operation with the Indiana Water Science Center. This included a reconnaissance survey to determine the location of sites, getting appropriate permits, preparing the sites, and installing the instruments. The instruments were installed in November of 2012, and the data are available online since the beginning of 2013. A graduate student is now working to set-up a 1D HEC-RAS hydraulic model for calibration using the data available from the field.

Results:

The instruments are working as expected, and were able to capture the recent April 2013 flood with stage and velocity data as shown below. These data will be very useful in calibrating the model and testing some hypotheses related to river-floodplain interaction during high flow events.



Stage data from April 1 – 30 for Wabash River near Battle Near Battle Ground



Velocity data* from April 1 – 30 for Wabash River near Battle Near Battle Ground.

*Due to the orientation of the instrument, the velocity values are recorded as negative.

Major Conclusions and Significance

The instrumentation network is able to provide unprecedented hydrodynamic data hydrodynamic data that were not available for Wabash River. The results from this project will enable to: (i) investigate the role of velocity as a surrogate flood early warning signal by evaluating stage and velocity data; (ii) quantify floodplain storage for different types of flood hydrographs during different flow conditions and seasons; (iii) understand flood hydrodynamics at Wabash-Tippecanoe river confluence; (iv) determine the role of backwater flows in describing flood hydrographs and peak attenuation at downstream locations; (v) observe the effect of river hydrodynamics on fish habitat usage and community structure; and (vi) quantify the effect of river hydrodynamics on ecosystem services.

Publications: Nothing to report. The website with data is currently only accessible to Indiana Water Science Center and the PI.

Grant Submissions: Nothing to report.

Students: Nikhil Sangwan, MS student in Civil Engineering, was involved in helping with the instrumentation set-up. Currently, Siddharth Saksena, MS student in Civil Engineering, is setting-up the HEC-RAS model for the Wabash-Tippecanoe confluence.

Identifying Opportunities for Soil and Water Conservation With Indiana s County Surveyors and Drainage Boards

Basic Information

Title:	Identifying Opportunities for Soil and Water Conservation With Indiana s County Surveyors and Drainage Boards
Project Number:	2012IN335B
Start Date:	3/1/2012
End Date:	2/28/2014
Funding Source:	104B
Congressional District:	Entire State
Research Category:	Social Sciences
Focus Category:	Agriculture, Conservation, Hydrology
Descriptors:	None
Principal Investigators:	Linda Prokopy, Nathan Mullendore

Publication

1. Mullendore, Nathan and Linda S. Prokopy. 2013. Surveying the Surveyors: Exploring Awareness, Attitudes, and Behavior among Indiana's Ditch Managers. 34th Annual IWRA Spring Symposium.

Identifying Opportunities for Soil and Water Conservation With Indiana's County Surveyors and Drainage Boards

Focus Categories: AG, COV, HYDROL, LIP, M&P, NPP, WQL, WQN
Keywords: Drainage Water Management, Drainage Policy, Channelized Streams, Water Quality, Nonpoint Source Pollution, Diffusion of Innovation
Principal Investigator: Linda Stalker Prokopy, Ph.D.

May 2013 – Progress Update

Abstract/Summary

Indiana's water quality and quantity problems have been widely recognized and documented. Since more than 70% of the state's total area consists of agricultural lands, a significant portion of conservation effort has focused on farmers and the management practices they can voluntarily adopt to protect soil and water resources. Comparatively less attention has been given to the structure and maintenance of the waterways themselves. Indiana contains tens of thousands of miles of "regulated drains" that are controlled by county surveyors and county drainage boards. These lower order streams represent biotic communities that comprise the headwaters of the state's many rivers and creeks. Traditional management, however, reduces these waterways to their most basic function as conveyances, ignoring their role in the ecosystem as hosts for biotic and abiotic processes that actively regulate the fate and transport of nutrients and farm chemicals. Novel techniques and practices such as two-stage ditches, controlled drainage structures, in-ground bioreactors, and constructed in-stream wetlands represent promising alternatives to traditional management approaches. Despite extensive development and research, many of these tools remain underutilized. Drainage water management inherently involves agreements and cooperation between multiple stakeholders with different missions and goals, a factor that contributes to slow diffusion of innovation. This project seeks to better understand the primary decision makers behind drainage water management. By exploring the attitudes, knowledge, and motivations of Indiana's county surveyors and drainage board members, insights will be gained into how these groups function and make management decisions, helping to foster new collaborations and earlier adoption of conservation technology.

Problem

Indiana's rivers and streams exhibit a variety of water quality problems, many of which are attributable to erosion and runoff from agricultural lands. Anthropogenic nutrient loading, chemical contamination, and sedimentation affect aquatic systems throughout the state, causing cumulative problems downstream in local places like the Eagle Creek Reservoir and as far away as the Gulf of Mexico. In many ways, however, Indiana's water resource issues are as much a problem of *quantity* as they are of *quality*. Private landowners and other land managers have significantly modified drainage pathways to achieve agricultural production goals, protect private property, and prevent localized flooding. These actions have increased the magnitude of peak flows and the frequency of major flood events, exacerbating the water quality problems caused by land management practices.

Indiana's 92 county surveyors and 100+ drainage boards collectively oversee tens of thousands of miles of "regulated drains", which are open ditches or tile drains with precise legal and geographic definitions. While certain drain types and maintenance regimes are undeniably part of water resource problems, improvements can just as easily make them part of the solution. Techniques and practices such as two-stage ditches, controlled drainage structures, in-ground bioreactors, and constructed in-stream wetlands represent promising alternatives to traditional management approaches. This project seeks to better understand the primary decision makers behind drainage water management. By exploring the attitudes, knowledge, and motivations of Indiana's county surveyors and drainage board members, insights will be gained into how these groups function and make management decisions, helping to foster new collaborations and earlier adoption of conservation technology.

Research Objectives

- Survey county surveyors and drainage board members in Indiana to understand their awareness of and attitudes toward water quality issues and innovative drainage practices
- Analyze data and prepare one extension publication and one peer-reviewed journal article discussing results and recommendations
- Disseminate findings to conservation partners in Indiana at professional meetings and conferences

Methodology

The survey instruments employed in this research project will be distributed to all of Indiana's county surveyors by email. Reminder emails and phone calls will be used to achieve an adequate response rate. Mail surveys will be distributed to drainage board members throughout the state using a five-wave approach (Dillman 2000). Data will be analyzed using SPSS.

Progress to Date

In the early phases of this project, we reviewed the limited literature regarding the social dimensions of ditch management. We also reviewed results from previous informal surveys of

Indiana surveyors. The knowledge gained from these experiences was combined with feedback from other conservation agencies to design our survey instrument. We have worked with the Indiana County Surveyors Association, The Nature Conservancy, and other Purdue University researchers to revise the survey, with plans to distribute it in spring 2013.

Several opportunities to utilize the results arose during the design process. We will be meeting with The Nature Conservancy in June to discuss how our social dimensions data can be used to improve two-stage ditch outreach. We will also incorporate our results into an ongoing project with the Environmental Defense Fund that focuses on holistic watershed planning, including innovative in-stream filtration practices.

Publications

Mullendore, Nathan and Linda S. Prokopy. Surveying the Surveyors: Exploring Awareness, Attitudes, and Behavior among Indiana's Ditch Managers. Abstract selected for presentation at the 34th Annual IWRA Spring Symposium, June 20, 2013.

Grant Submissions

None

Students

A total of six undergraduate and graduate students have participated in this project:

Brian MacGowan (Graduate)
Patrick Freeland (Graduate)
Rebecca Perry-Hill (Graduate)
Amber Mase (Graduate)
Ziang Cheng (Undergraduate)
Liz Monell (Undergraduate)

Niche breadth variation of fish assemblages for the entire Wabash River

Basic Information

Title:	Niche breadth variation of fish assemblages for the entire Wabash River
Project Number:	2012IN341B
Start Date:	3/1/2012
End Date:	2/28/2014
Funding Source:	104B
Congressional District:	IN-006
Research Category:	Biological Sciences
Focus Category:	Ecology, Geomorphological Processes, Hydrogeochemistry
Descriptors:	None
Principal Investigators:	Mark Pyron

Publication

1. None to report

General Report Format

Report Format

Project Id:
Title: Niche breadth variation of fish assemblages for the entire Wabash River
Project Type: Research
Start Date: 3/01/2012 **End Date:** 2/28/2013
Congressional District: Indiana 6th Congressional District
Focus Categories: ECL, GEOMOR, HYDGEO, HYDROL
Keywords: Fish assemblages, geomorphology, hydrology, substrates
Principal Investigators: Mark Pyron

Abstract / Summary Understanding the species- and assemblage-habitat relationships of large river fishes has been historically limited by the large size and spatial complexity of river ecosystems. I have successfully used a Geographic Information System (GIS) database constructed with spatially explicit physical data as well as information on occurrences of individual taxa to detect habitat use patterns for complete fish assemblages at smaller scales. I tested for fish assemblage variation in the Wabash River from the upper reaches to the confluence with the Ohio River. Niche breadth and niche position were calculated using environmental variables (bathymetry, riverbed sediment composition, woody debris presence, and flow velocity) assembled in a spatially explicit GIS framework.

Problem: The stream fishes of Indiana provide the state many positive returns including benefits to anglers, for ecosystem services, and as a portion of a natural heritage. Although there are several local extinctions, the majority of fish species that were here historically are still present. However, the current fish assemblages of Indiana have higher occurrences of species that are tolerant to human disturbances (Jacquemin & Pyron 2011). There is a need to further our understanding of natural fish assemblages and how they respond to habitat changes.

The Wabash River includes the longest free-flowing stretch in the eastern U.S. and as such, is a unique system for study. Fish assemblages in the Wabash River vary spatially and temporally, and this variation appears to be caused in part by hydrologic variation. Fish assemblages change predictably from upstream to downstream (Vannote et al. 1980), with changes in river gradient and hydrology that produce increasingly smaller substrate particle sizes with decreasing gradient (Pyron & Lauer 2004). Temporal changes in fish assemblages vary with spatial scale. At local site scales, annual flood event frequency controls the substrate composition (Pyron et al. 2010) and local fish assemblage structure varies with substrate composition (Mueller & Pyron 2010). At a 230-km river distance spatial scale, the fish assemblage underwent gradual, predictable change during a 25-year period (Pyron et al. 2006). During this 25-year period, hydrologic alterations have increased (Pyron & Neumann 2008), and these alterations likely had negative impacts on stream assemblages.

The associations between stream fish species abundance, assemblage structure, and available habitat have been studied using two primary approaches (Jackson et al. 2001). The first approach relies on small-scale studies of microhabitat use or habitat partitioning and is often based on detailed measures of local habitat variation combined with subsequent observations of individual fish uses of the quantified habitats (e.g., Grossman & Freeman 1987). While useful for describing fish species distributions and assemblage structure at the scale of small stream reaches, Jackson et al. (2001) concluded that the accumulation of such detailed information would be overwhelming for describing species- and assemblage-habitat relationships at larger spatial scales. The second approach uses large-scale studies to test for assemblage patterns that are correlated with environmental variables. Such large-scale studies examine the effects of environmental variables on fish assemblage structure at watershed or larger scales (Hoeinghaus et al. 2007). While both approaches have merits, neither is sufficient to effectively determine how fish species are distributed relative to spatially explicit habitat availability in large rivers, which are intermediate between the smaller streams studied in the first approach and the watershed scale focused on in the second approach. Consequently, our understanding of the ecology of large river taxa is relatively limited.

Understanding the species- and assemblage-habitat relationships of large river fishes has been historically limited by the large size and spatial complexity of river ecosystems. However, we have used a Geographic Information System (GIS) database constructed with spatially explicit physical data and information on occurrences of individual taxa to detect habitat use patterns for species (Pyron et al. 2011). Our pilot study successfully demonstrated the potential for testing hypotheses associated with environmental factors that have not been amenable with other analytical approaches. This current proposal is to apply the same method for collecting and analyzing fish species data for the complete Wabash River length (700 km) to identify niche breadth for all fishes, and variation in fish assemblage structure for an entire river. Niche breadth and niche position are calculated using environmental variables (bathymetry, riverbed sediment composition, woody debris presence, and flow velocity) assembled in a spatially explicit GIS framework (Knouft et al. 2011). We will use three resolutions to identify variation in niche breadth at different scales.

Methodology:

FIELD COLLECTIONS/LAB PROCESSING

I collected environmental data for the entire Wabash River length and fish samples for four 5-km reaches. I collected channel bathymetry data using sonar-based depth measurements (Pyron et al. 2011) along the Wabash River from Lafayette, IN to the confluence with the Ohio River. Sediment composition data were collected at the 5-km collection reaches using a pole method (Mueller & Pyron 2010). At each location where the pole is probed into the sediment, a water velocity observation at 60 % of depth was collected, and a GPS waypoint recorded on a GPS unit. Woody debris locations throughout the reach were recorded as presence from sonar information.

I used a boat electrofisher to sample fishes along 5-km transects at four locations to represent variation in geomorphology (Figure 1). The boat is outfitted with a electrofishing apparatus and associated booms and electrodes, and is operated at a frequency of 60 Hz and 8 AMPS. I sampled in a back-and-forth pattern from shore to shore. Electrofishing was conducted in a downstream direction with one crew member on the bow identifying stunned fish (spotter), one crew member piloting the boat, one crew member (recorder) recording species identified by the spotter and entering waypoints on a Trimble GeoXH handheld Global Positioning System (GPS), which provides locality data at sub-30 cm accuracy. Fishes stunned with the boat electrofisher were not captured; rather, spotters, selected based on their familiarity with Wabash River fish species, identified stunned fishes as they surface. This allowed efficient sampling for multiple reaches during a few days while at the same time maintaining species-level identification for most sampled fishes. The GPS unit was used to record waypoints representing the positions (latitude and longitude) of each fish or group of fishes identified by the spotters as the boat was piloted in a downstream direction at < 4 km / h. For each waypoint entered, the recorder noted all species identified by the spotters for that waypoint. Thus, waypoints provide spatially explicit data describing the locations in the river where one or more individual fishes were observed so that these data can be incorporated into a GIS for calculation of species-habitat associations.

ANALYSES

Habitat data from sidescan sonar images were converted to GIS point layers. These data were used with an inverse distance weighting interpolation method in ArcGIS (version 9.3) to estimate values of bathymetry, sediment, and water velocity of the area that was not surveyed within the stream channel of the study reach (Dinehart & Burau 2005, Knouft et al. 2011). Resulting GIS datasets from the interpolation routine are a set of raster files containing continuous bathymetry, sediment, and water velocity data. Because habitat data often co-vary, I reduced the GIS environmental data using Principal Components Analysis (PCA). Habitat use by each species in each sampling period was calculated from mean PC scores for occupied locations (Knouft et al. 2011). The degree of specialization (niche breadth) and marginality (niche position) of the habitat occupied by a species can be quantified by comparing the mean and variance occupied by a species to the mean and variance of the global range of available habitats. Niche breadth is quantified as the standard deviation of the global habitat divided by the standard deviation of the species habitat, and measures the relative range of habitat in which a population occurs (Hirzel et al. 2002). Species with low scores (high niche breadth) are habitat generalists that occupy habitats with relatively high variance compared to the global habitat variance, while species with high scores (low niche breadth) are habitat specialists that occupy narrow ranges of habitat with a low variance compared to the global habitat variance (Doledec et al. 2000). Niche position is the deviation of the species habitat from the global habitat mean and is quantified as the absolute difference between the global habitat mean and the species habitat mean, divided by 1.96 standard deviations to remove bias associated with variance in the global distribution (Hirzel et al. 2002), allowing comparisons across sites or sampling periods. Niche position scores can range from 0 to 1, with a score of 0 indicating a species mean at the global mean, while a score of 1 indicates a species that occupies habitats relatively far from the global mean.

Niche specialization and niche position estimates were generated for each species using global mean and standard deviation values calculated from each GIS-based PC dataset and the mean and standard deviation measures of species habitat use (Knouft et al. 2011). Population density (individuals/collection site) for each species was calculated as the total number of individuals collected divided by the total number of collection sites. Multivariate analysis (Canonical Correspondence Analysis) was used to test hypotheses for the relationship between niche measures and population density: 1) niche specialization is negatively correlated with population density among species; 2) niche position is negatively correlated with population density among species; and, 3) a model incorporating measures of niche specialization and niche position to predict variation in population density.

Preliminary Results. We captured 3,520 individuals in 51 species of fishes at 1,713 GPS coordinates, in the four 5-km reaches (Table 1). We used a Canonical Correspondence Analysis (CCA) to examine patterns in species abundances with environmental variables. The CCA resulted in two significant axes ($P < 0.01$) based on randomizations of eigenvalues and species-environment correlations (Figure 2). Latitude and longitude locations, substrate size, mean water depth, and presence of woody debris provided explanation of fish assemblage variation in the CCA.

My laboratory is currently analyzing these data for a final report that will be submitted before Sep 2013.

Figure 1. Locations of four 5-km reaches on the Wabash River.

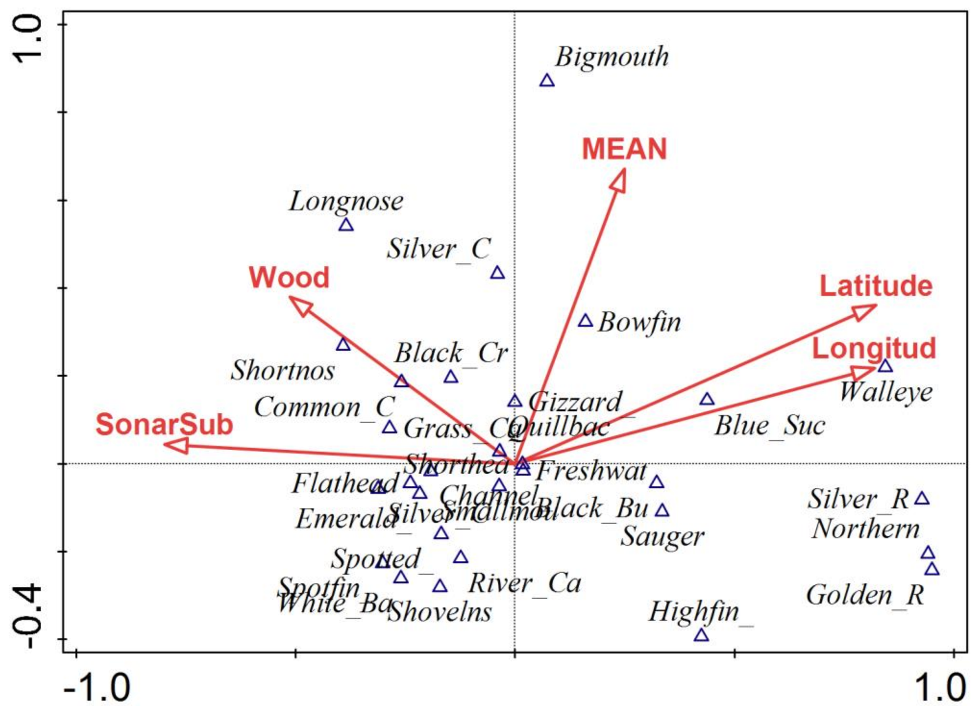


Figure 2. First two axes of a Canonical Correspondence Analysis for fish and environmental variables at four 5-km reaches of the Wabash River. Vectors represent significant environmental predictors of fish abundance.

Major Conclusions and Significance. Our GIS analyses resulted in the ability to predict Wabash River fish assemblage variation using several environmental variables. The results demonstrated that river location was the strongest variable explaining variation in fish assemblages. Fish assemblages are expected to change predictably from upstream to downstream (Vannote et al. 1980), with changes in river gradient and hydrology that produce increasingly smaller substrate particle sizes with decreasing gradient (Pyron & Lauer 2004). The downstream locations had larger substrates, increased woody debris, and similar mean depth than upstream sites.

Fish assemblages change temporally with human effects and resulting in local or regional extinctions (Matthews 1998). The Wabash River is not a pristine ecosystem and has multiple current anthropogenic impacts, including altered hydrologic regime, agricultural effects, and urbanization (Pyron et al. 2006). The altered hydrology likely contributes strongly to variation in substrate composition in the river. The altered hydrology of Wabash River includes increased minimum flows, decreased maximum flows, and increased fall rates that are a result of agricultural management of water drainage, and dam releases from upstream reservoirs. Local effects of increased fall rates are bank erosion, especially in locations lacking riparian vegetation. Sloughing of banks that are composed of fine sediments results in increased silt substrates and wider, shallow channel form. Potential improvements to the hydrology and stability of the Wabash River include modification of dam releases to more closely mimic natural precipitation events

(Richter & Thomas 2007), and reducing the rapid drainage of water in agricultural subwatersheds, allowing water to reach groundwater tables.

References

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Jacquemin, S. & Pyron, M. 2011. Fishes of Indiana streams: current and historic assemblage structure. Hydrobiologia 665:39-50.

Knouft, J.H., Caruso, N.M., Dupre, P.J., Anderson, K.A., Trumbo, D.R. & Puccinelli, J. 2011. Using fine-scale GIS data to assess the relationship between intra-annual environmental niche variability and population density in a local stream fish assemblage. Methods in Ecology and Evolution 2:303-311.

Matthews, W.J. 1998. Patterns in Freshwater Fish Ecology. New York: Chapman & Hall.

Mueller, R. & Pyron, M. 2010. Fish assemblages and substrates in the middle Wabash River, USA. Copeia 2010:47-53.

Pyron, M. & Lauer, T.E. 2004. Hydrological effects on patterns of fish assemblage structure in the middle Wabash River. Hydrobiologia 525: 203-213.

Pyron, M., Lauer, T.E. & Gammon, J.R. 2006. Stability of the Wabash River fish assemblages from 1974 to 1998. Freshwater Biology 51: 1789-1797.

Pyron, M. & Neumann, K. 2008. Hydrologic alterations in the Wabash River watershed. River Research and Applications 24:1-10.

Richter, B.D. & Thomas, G.A. 2007. Restoring environmental flows by modifying dam operations. Ecology and Society 12:12 online URL: http:www.ecologyandsociety.org/vol12/iss1/art12/

Vannote, R.L., Minshall, G.W., Cummins, K.W., Sedell, J.R. & Cushing, C.E. 1980. The river continuum concept. Canadian Journal of Fisheries and Aquatic Sciences 37:130-137.

Publications I expect to submit a manuscript in fall 2014 using these current data. My lab group has published the following manuscripts from IWRRC funded research:

Pritchett, J. and M. Pyron. 2012. Fish assemblages respond to habitat and hydrology in the Wabash River, Indiana. River Research and Applications 28:1501-1509.

Pyron, M., R. Goforth, J. Beugly, S. Morlock and M. Kim. 2011. A GIS approach for explanation of fish assemblage structure in a large river. River Systems 19:239-247.

Pritchett, J. and M. Pyron. 2011. Predicting fish assemblages from substrate variation in a turbid river: grab samples compared with pole probing. North American Journal of Fisheries Management 31:574-579.

Grant Submissions: na

Students The project included two graduate students (Luke Etchison, Julie Backus) and one undergraduate student (Adam Garza).

Connectivity & Functioning of Wetlandscapes: A Complex Network Modeling Analysis

Basic Information

Title:	Connectivity & Functioning of Wetlandscapes: A Complex Network Modeling Analysis
Project Number:	2012IN342B
Start Date:	3/28/2012
End Date:	2/1/2014
Funding Source:	104B
Congressional District:	IN-004
Research Category:	Climate and Hydrologic Processes
Focus Category:	Wetlands, None, None
Descriptors:	None
Principal Investigators:	Suresh Rao

Publication

1. Logan, L. et al. 2013. Freshwater Wetlands: Balancing Food and Water Security with Resilience of Ecological and Social Systems. In: CLIM Book Chapter (in press).

IWRRC Project Update (May 31, 2013)

P.S.C. Rao

School of Civil Engineering & Agronomy Department

Purdue University

Abstract / Summary

Wetlands occupy a small fraction of the land area, and yet constitute an important element of landscapes by providing multiple, essential ecological services. Wetlands play a vital role as landscape elements, providing ecological, biogeochemical, and hydrological benefits as well as socioeconomic, food, and freshwater security. Large-scale alterations to landscapes and the hydrologic cycle to meet demands of growing increasingly affluent populations have left wetlands impaired. Typically viewed as single units, we conceptualize wetlands as hydrologically and ecologically connected self-organized, dynamic, complex networks. Wetland networks and their many functions are linked to produce persistent self-emergent patterns and landscape resilience. Through this viewpoint, wetland restoration and recreation efforts can move toward optimization strategies that preserve landscape resilience while promoting socioeconomic, food, and freshwater water security

Hydrologic temporal dynamics of wetlands, as governed by hydro-climatic forcing (i.e., rainfall patterns; ET losses) and anthropogenic modifications to land use and management (e.g., artificial surface and subsurface drainage networks; urbanization; croplands) have profound impacts on the spatial structure, hydrologic and ecological connectivity, and ecological functioning of inland wetlands. This project focuses on various approaches to modeling the spatial and temporal dynamics of wetlands, as an approach to exploring the patterns evolving at multiple scales as a result of anthropogenic and hydro-climatic variability.

Problem:

Wetlands play diverse roles in providing multiple ecosystem services (e.g., as hydrologic and biogeochemical buffers and filters; as ecological habitats for aquatic vegetation and animals). Wholesale loss of wetlands because of land use change and clime change is a major problem across the globe. In addition, environmental heterogeneity (e.g., spatial and temporal variability in rainfall and ET loss patterns) introduces another element of variability in how the structure and functioning of wetlands evolves in diverse landscapes. The resilience of aquatic species that thrive in wetlands and the spatial/temporal patterns that evolve are then dependent to a large extent on the hydrologic variability within a given wetland and its connectivity to all other wetlands distributed across the landscape of interest.

Research Objectives:

The primary goal of this project is to develop new modeling techniques to understand eco-hydrological spatial and temporal dynamics of wetlands. Wetlands are conceived as water bodies of different sizes and shapes, and spatially organized in particular patterns across the wetlandscapes. Temporal dynamics of the spatial distribution and eco-hydrologic connectivity of these wetlands is of specific interest. Various stochastic modeling approaches and network analysis tools are being used to understand the role of hydro-climatic forcing, landscape topography, pedologic and vegetation features.

Methodology:

Research approaches used include the following:

1. Stochastic analytical and numerical modeling approaches for modeling water balance in wetlands
2. Critical analysis and synthesis of published data on spatial distribution and organization of wetlands in the U.S.
3. Preliminary analysis of wetlands in a region to explore vulnerability of ecological networks with the each network serving as a node.
4. Preliminary network analysis of species dispersal in a wetland ecological network.
5. Review and critical assessment of published papers related to wetlands structure and functions
6. Develop research collaborations with colleagues at Purdue and universities in other locations

Results:

1. A parsimonious stochastic numerical model was developed (Matlab codes) to describe temporal dynamics of water depth and storage in geographically and hydrologically isolated wetlands. Major drivers of hydrologic variability in wetlands have been now identified through model simulations [in collaboration with Prof. Gianluca Botter at the University of Padua, Italy].
2. This model was extended to consider geographically isolated but hydrologically connected (via shallow groundwater) wetlands distributed across a landscape [with Dr. Jeryang Park, former PhD student; now Asst. Prof. at Hongik University, Seoul, South Korea]
3. Analysis of frequency distribution of wetland sizes in U.S. 50 states, and spatial analysis in selected regions (e.g., North Dakota; North Carolina; etc.) [with Dr. Heather Gall, post-doc at Purdue Univ., Jeryang Park & Elin Karlsson, PhD student, Purdue Univ.]
4. Preliminary analysis of wetlands as aquatic habitat nodes in an ecological network has been completed, and the vulnerability to fragmentation with removal (loss) of key nodes has been evaluated. In addition, a new stochastic modeling framework is being developed to examine the dynamics of species dispersal along a wetland ecological network [with Dr. Jeryang Park; Samueil Hassan, Ph.D. student; Prof. Satish Ukkusuri, Purdue University].
5. The role of wetlands as water bodies, spatially organized across a wetlandscape, on water and energy exchange at a regional scale is being evaluated [with Elin Karlsson; and Prof. Dev Niyogi, Purdue Univ.]

6. Work has been initiated [with Prof. Nancy Emery, Purdue University] to examine the correlations between hydrologic variability within vernal pool landscapes (in California) and the evolution and persistence of vegetation patterns.
7. Helped co-found Global Wetlands Ecohydrology Network (GWEN), an international consortium of scientists engaged in the study of wetlands as ecological habitats governed primarily of hydrologic variability [with Prof. Gia Destouni, Stockholm University].

Major Conclusions and Significance:

Size frequency distribution of wetlands, like that of lakes, follows a truncated power-law for data derived for all 50 U.S. states. Size truncation depends on the landscape changes imposed by urbanization or conversion to croplands, and of course on the topographic features of the landscapes. Hydrologic dynamics within a single wetland or multiple wetlands across a landscape are dominants controlled by the rainfall patterns (frequency and depth variations); wetland geometry (i.e., bathymetry); and degree of hydrologic connectivity with the landscape (e.g., groundwater). The model we developed can be used to forecast such hydrologic variability in wetlands, and then examine how the dynamics of multiple wetland functions are moderated by hydrologic conditions.

Wetlands serves as habitat nodes in ecological networks, and loss of nodes can lead to habitat fragmentation and impairment of aquatic species dispersal. Preliminary work completed to date has identified several approaches, based on network analysis, as being useful for this purpose. Hydrologic variability within a single wetland, and across several wetlands in a landscape, also controls the emergence of the spatial and temporal patterns of aquatic vegetation. Initial work, combining field observations with model simulations, has been initiated to understand the link between hydrologic temporal variability and distribution and persistence of vegetation in landscapes containing vernal pools.

Publications:

Logan, L. et al. 2013. Freshwater Wetlands: Balancing Food and Water Security with Resilience of Ecological and Social Systems. In: CLIM Book Chapter (in press).

Grant Submissions:

- NESS Doctoral Fellowship Application (submitted by Elin Karlsson)
- NSF Pre-proposal submitted (invited for full proposal); with Dr. Nancy Emery, Purdue University

Students & Post-Docs

- Elin Karlsson; current PhD student, ESE IGP; co-supervised by Drs. Suresh Rao & Dev Niyogi

- Jeryang Park; completed PhD (Civil Eng.), December 2012; Currently Asst Prof., Civil Engineering Dept., Hongik University, Seoul, South Korea
- Heather Gall; Post-doc (School of Civil Eng.,), Purdue Univ.; Asst Prof., Ag & Biol Eng Dept, Penn State Univ (Effective July 1, 2013)
- Bryan Otten, Junior, EEE, Purdue Univ. (COE SURF student)

Information Transfer Program Introduction

None.

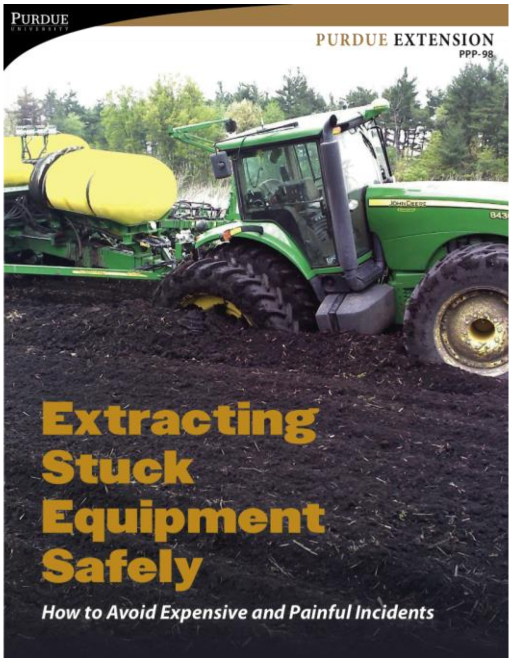
Pollution Prevention Strategies for Farmers and Commercial Input Applicator Businesses

Basic Information

Title:	Pollution Prevention Strategies for Farmers and Commercial Input Applicator Businesses
Project Number:	2012IN344B
Start Date:	3/1/2012
End Date:	2/28/2013
Funding Source:	104B
Congressional District:	IN-004
Research Category:	Water Quality
Focus Category:	Agriculture, Climatological Processes, Floods
Descriptors:	None
Principal Investigators:	Fred Whitford

Publications

1. Whitford, F., D. Nowaskie, S. Hawkins, D. Busdeker, M. Depoister, S. Queen, J. Southard, & K. Smith. 2012. Extracting stuck equipment safely: how to avoid expensive and painful incidents. PPP-98.
2. Whitford, F., P. Hipkins, D. Nowaskie, D. Linscott, A. Martin, J. Obermeyer, A. Patton, S. Gabbard, G. Beestman, & K. Smith. 2012. Measuring pesticides: overlooked steps to getting the correct rate. PPP-96.



Publication Name and Authors: Whitford, F., D. Nowaskie, S. Hawkins, D. Busdeker, M. Depoister, S. Queen, J. Southard, & K. Smith. 2012. Extracting stuck equipment safely: how to avoid expensive and painful incidents. PPP-98.

Project Accomplishments:

a. Publication. 96 pages, full color. Initially printed 10,000 in 2012 and had a second printing of 10,000 in 2013.
b. Publication Accessibility on Website: http://www.ppp.purdue.edu/Pubs/PPP-98.pdf
c. Purdue University News Release: January 28, 2013. http://www.purdue.edu/newsroom/releases/ /Q1/stuck-in-the-mud-publication-helps-farmers-extract-machinery.html
d. Hard Copy Distribution: All pesticide extension coordinators in the United States, all Indiana county extension agriculture and natural resources educators, and all licensed pesticide application businesses in Indiana.
e. PowerPoint Distribution: Numerous agencies, private businesses and associations were furnished the PowerPoint that the senior author uses at programs. In this way, others were teaching their employees or members on proper techniques for extracting stuck equipment.
f. State and National Presentations: Protecting life and the environment are the key messages behind the presentations.
    - The art and science of extracting stuck equipment. Purdue Agronomy Club. West Lafayette, Indiana.
    - The art and science of extracting stuck trucks, equipment, and sprayers and DOT rules of the road update. Four County Private Applicator Recertification Program. Mooresville, Indiana.
    - Help.....I am stuck in the mud! Montgomery, Parke, and Putnam Counties Private Applicator Recertification Program. Russellville, Indiana.
    - Extracting stuck equipment safely. The Anderson's Marketing Meeting. North Manchester, Indiana.

- Extracting stuck equipment. White County Agricultural Winter Schools. Delphi, Indiana.
- Extracting stuck equipment safely: how to avoid expensive and painful incidents. Northern Indiana Soil Management Seminar. Goshen, Indiana.
- The art and science of pulling out stuck equipment. Purdue University Crop Management Workshops. Warsaw, Alexandria, Seymour, Vincennes, and West Lafayette, Indiana.
- The art and science of pulling out stuck equipment. MacAllister Agriculture Division Ag Chem Customer Clinic. Indianapolis, Indiana.
- The art and science of pulling out stuck equipment. Aquatic Control Applicator Workshop. Indianapolis, Indiana.
- The art and science of extracting stuck trucks and equipment. West Virginia Vegetation Management Association Meeting. **Roanoke, West Virginia**.

g. Letter of Support (example)

"Morning Fred: Well your newest book out sure has everybody talking around here! Everybody that got one has made a comment to me—Hey did you get the book from Fred? I hate to say it this way but pictures of tractors—combines—and sprayers with windshields missing and broke parts sure did get everybody's attention! The article on the Angel was the show stopper, everyone of use have been in a position for that to happen to us—but luckily it didn't. that guy was so lucky! thanks Fred and your team for the wake up call!. Comment from an Indiana farmer.

Publication Name and Authors: Whitford, F., P. Hipkins, D. Nowaskie, D. Linscott, A. Martin, J. Obermeyer, A. Patton, S. Gabbard, G. Beestman, & K. Smith. 2012. Measuring pesticides: overlooked steps to getting the correct rate. PPP-96.

Project Accomplishments:

a. Publication. 52 pages, full color. Initially printed 10,000 in 2012 and had a second printing of 7,000 in 2013.
b. Publication Accessibility on Website: http://www.ppp.purdue.edu/Pubs/PPP-96.pdf
c. Purdue University News Release: August 29, 2012. http://www.purdue.edu/newsroom/releases/ /Q3/purdue-extension-publication-a-resource-for-pesticide-users.htmlhttp://www.purdue.edu/newsroom/releases/ /Q1/stuck-in-the-mud-publication-helps-farmers-extract-machinery.html
d. Hard Copy Distribution: All pesticide extension coordinators in the United States, all Indiana county extension agriculture and natural resources educators, and all licensed pesticide application businesses in Indiana.
e. PowerPoint Distribution: PowerPoint presentation provided free of charge to anyone requesting the information.
f. Information incorporated into the Indiana Commercial Pesticide Applicator Certification Program.
g. State and National Presentations:

- Revisiting the measurement of pesticides. Synergistic Solutions Annual Training Program. Greenwood, Indiana.
- Measuring pesticides Ohio Pesticide Commercial Applicator Recertification Conferences. **Columbus, Ohio**.
- Measuring pesticides: an overlooked step to getting the correct rate. University of Kentucky Turf and Landscape Management Short Course. **Louisville, Kentucky**.
- Overlooked steps to getting the correct rate and measuring of pesticides. Traylor Fertilizer Services Crop Input Meetings. Montgomery, Indiana.
- Measuring pesticides: an often overlooked step in the application business. Grant County Private Applicator Recertification Program. Marion, Indiana.

• Overlooked steps to measuring pesticides. Lake County Extension Winter Breakfast Meeting. Cedar Lake, Indiana.
• Measuring chemicals properly. Crop Production Services Private Applicator Recertification Program. Attica, Indiana.
• Measuring pesticides correctly. Clark County Private Applicator Recertification Program. Charlestown, Indiana.
• Measuring pesticides correctly. Harrison County Private Applicator Recertification Program. Corydon, Indiana.
• Measuring pesticides: overlooked steps to getting the correct rate. National Railroad Contractors Association. Indianapolis, Indiana.
• Measuring chemicals. Hendricks County Private Applicator Recertification Program. Danville, Indiana.
• Make liquids and dry products measure up. Indiana Arborist Association. Indianapolis, Indiana.
• Mixing and measuring pesticides: dry and liquid. Northern Green Expo. **Minneapolis, Minnesota**.
• What's really in your tank? Part 1. Measuring correctly. Nebraska Turf Conference. **LaVista, Nebraska**.
• Measuring pesticides correctly. Purdue Pest Management Conference. West Lafayette, Indiana.
• Measuring pesticides. Illiana Vegetable Growers Symposium. Schererville, Indiana.
• Measuring pesticides: overlooked steps to getting the correct rate. Hancock County Private Applicator Recertification Program. Greenfield, Indiana.
• Measuring pesticides is more complicated than it looks. Noble County Private Applicator Recertification Program. Kimmell, Indiana.
• How do your pesticides measure up? North Carolina Vegetation Management Association. **Raleigh, North Carolina**.
• Measuring pesticides properly. Wayne County Private Applicator Recertification Program. Richmond, Indiana.
• What's in the tank: Part 2. Measuring out the right amount. Kentuckiana Crop Production Seminar. French Lick, Indiana.
Measuring pesticides: an often overlooked step in the application process. Indiana Society of American Foresters Forest Pesticide Training Program. Greenfield, Indiana.
• Measuring herbicides: an often overlooked step in the application process. Miami County Private Applicator Recertification Program. Peru, Indiana.
• Correctly measuring pesticides. Tri-County Private Applicator Recertification Program. Wolcott, Indiana.
• The hidden pitfalls of measuring pesticides. Northeast Indiana Landscape and Turf Seminars. Fort Wayne, Indiana.
• Hidden pitfalls of measuring pesticides. Purdue Post Harvest Workshop. West Lafayette, Indiana.
• Measuring herbicides: an often overlooked step in the application. National Roadside Vegetation Management Association Annual Conference. **Branson, Missouri**.
• Accurately measuring and mixing pesticides. Terminex Annual Recertification Training Program. **Danville, Illinois**.

- Measuring right-of-way dry and liquid herbicides. Category Six Pesticide Training Committee Right-of-Way Recertification Training Program. **Auburn, New York**.
- Measuring pesticides: an often overlooked step in the application process. Oregon Vegetation Management Association. **Seaside, Oregon**.
- Make liquids and dry products measure up. Tennessee Vegetation Management Association. **Franklin, Tennessee**.
- Measuring pesticides is more complicated than it looks. Right-A-Way Applicators Training and Recertification Workshop. **Cooperstown, North Dakota**.
- Hidden pitfalls of measuring pesticides. Oklahoma Vegetation Management Association Fall Conference. **Norman, Oklahoma**.
- Water and chemicals: getting the right mix. Little Wabash River Watershed Conservation and Agricultural Technology Workshop. Huntington, Indiana.
- Measuring pesticide ounces right the first. Clinton County Private Applicator Recertification Program. Frankfort, Indiana.
- The hidden pitfalls of measuring pesticides. Falmouth Farm Supply Field Day. Falmouth, Indiana.
- Dry vs. liquid measurements. North Central Region Pesticide Education and Certification Workshop. **Grand Rapids, Michigan**.
- Are your pesticides measuring up? DeAngelo Brothers Eight Annual Vegetation Management Symposium for Senior Industry Professionals. **Louisville, Kentucky and Denver, Colorado**.
- Measuring pesticides: overlooked steps to getting the correct rate. Sullivan County Private Applicator Recertification Program. Sullivan, Indiana.
- Making liquids and dry products measure up. American Pest Control Annual Recertification Program. **Hanna City, Illinois**.
- Measuring it right the first time Pulaski County Private Applicator Recertification Program. Winamac, Indiana.
- Measuring pesticides: overlooked steps to getting the correct rate. Midwest Regional Turf Foundation Lawn Care Diagnostic Training. West Lafayette, Indiana.
- The forgotten measuring cup. The Andersons Agronomy Field Day. Waterloo, Indiana.
- Are you measuring it correctly? University of Missouri Crop Injury and Diagnostic Clinic. **Columbia, Missouri**.
- Make liquids and dry products measure up. Farm Journal Corn College. **Heyworth, Illinois**.
- Measuring it right the first time. Indiana Christmas Tree Growers Association Summer Meeting. Fortville, Indiana.
- Measuring devices. Southwest Purdue Agricultural Center Twilight Tour. Vincennes, Indiana.
- The hidden pitfalls of measuring pesticides. Hoosier Energy Herbicide Seminar. Bloomington, Indiana.
- Measuring pesticides correctly. University of Florida Aquatic Weed Control Short Course. **Coral Springs, Florida**.
- Overdosing or underdosing: the forgotten mixing cup. Florida Vegetation Management Association Annual Meeting. **Daytona Beach, Florida**.
- Mixing pesticides: when an ounce is not an ounce. Purdue Quad County Private Applicator Recertification Program. Mooresville, Indiana.

- Mixing pesticides: when an ounce is not an ounce. Madison County Private Applicator Recertification Program. Alexandria, Indiana.
- Mixing pesticides-when an ounce is not an ounce. Wabash County Soil and Water Conservation District Annual Meeting. Wabash, Indiana.
- Liquid and dry ounces: have you forgotten the difference. Northwestern Indiana Nursery and Landscaping Association Annual Educational Seminar. Merrillville, Indiana.
- Mixing pesticides—when an ounce makes a difference. Hoosier Golf Course Superintendent's Association Educational Seminar. Auburn, Indiana.
- Mixing pesticides: when an ounce is not an ounce. Boone County Private Applicator Recertification Program. Lebanon, Indiana.
- Accurate measurement = accurate application. Moss Fertilizer Service Winter Grower Meeting. Twelve Mile, Indiana.
- Mixing pesticides: when an ounce is not an ounce. Healthy Soils-Healthy Profits Workshop. Bourbon, Indiana.
- Mixing pesticides: when an ounce is not an ounce. Tenbarge Education and Trade Show. Evansville, Indiana.
- Keeping an audience interested. Bi-state Master Gardener Program. Covington, Indiana.
- Accurate measurement = accurate application rate. Union County Private Applicator Recertification Program. Liberty, Indiana.
- A little inaccuracy, perhaps a ton of explanation. Purdue University Crop Management Workshop. Valparaiso, Bluffton, Columbus, Huntingburg, and West Lafayette, Indiana.
- The right mixture for safe and accurate application. Iowa Turfgrass Conference and Trade Show. **Des Moines, Iowa.**
- When an ounce is not an ounce. Tipton County Private Applicator Recertification Program. Tipton, Indiana.
- Mixing pesticides—when an ounce is not an ounce. Midwest Regional Turf Foundation Turf and Ornamental Seminar. West Lafayette, Indiana.

g. Letter of Support (example)

"Just wanted to say I really enjoyed your presentations at the Iowa Turfgrass Conference Pesticide Recertification seminar. You gave great examples of calibration and measuring ideas that were very practical and easily implemented at our golf courses. A major eye opener was the different measuring devices for dry materials that don't work universally." Golf Course Superintendent.

USGS Award no. G12AP20092 Proposal for the Development of a Web-Based Tools Workshop

Basic Information

Title:	USGS Award no. G12AP20092 Proposal for the Development of a Web-Based Tools Workshop
Project Number:	2012IN355S
Start Date:	5/1/2012
End Date:	2/28/2013
Funding Source:	Supplemental
Congressional District:	
Research Category:	Not Applicable
Focus Category:	Education, Management and Planning, None
Descriptors:	
Principal Investigators:	Ronald F. Turco, Bernard Engel

Publication

1. Web documents are listed within the report

Final Report

THE GREAT LAKES TRIBUTARY MODELING PROGRAM 516(e) WORK PLAN FOR WEB-BASED TOOLS “TRAIN-THE-TRAINER” WORKSHOP PURDUE UNIVERSITY AND MICHIGAN STATE UNIVERSITY

Larry Theller and Bernie Engel, Agricultural and Biological Engineering, Purdue University.

May 31, 2013

Project to benefit:

U.S. Army Corps of Engineers
516e Tributary Modeling Group,
Detroit District Office
477 Michigan Avenue
Detroit, MI 48226-2523

Project Description:

The United States Army Corps of Engineers (USACE) conducts training workshops throughout the Great Lakes focused on preventing sediment from reaching the Great Lakes. Workshop instructors consist of USACE staff, and will show local stakeholders how to use web-based tools developed by MSU and Purdue University (primarily the L-THIA (Long-Term Hydrologic Impact Assessment) and HIT (High Impact Targeting) tools). MSU and Purdue University developed training materials that USACE staff use in their localized training, and conducted a “Train-the-Trainer” workshop. Three training manuals (one for Buffalo, Chicago, and Detroit USACE Districts) were developed and a joint Train-the-Trainer workshop was given by MSU and Purdue University to Buffalo, Chicago, and Detroit staff.

Deliverables:

The project is finished with all deliverables produced on time.

Purdue University and MSU were tasked to jointly prepare a training manual, to include a tutorial appendix of case studies; one for each of the Buffalo, Chicago, and Detroit USACE Districts. The training manual is used by USACE staff to train watershed groups throughout the Great Lakes on how to use the web-based tools developed by MSU and Purdue University.

The training manual includes relevant introduction, background, theory, tutorial, and other sections that cover the use of L-THIA, HIT and other web-based Decision Support System tools. The step-by-step tutorials developed for each of the three listed watersheds are the primary training tools used by USACE staff when training the local stakeholder groups. A representative tutorial was created to teach the "Train-the-Trainer" workshop that was taught by MSU and Purdue University to USACE District staff.

The training manual appendix consists of a tutorial for each of the following three watersheds:

1. Buffalo District Manual – Upper Blanchard River, Ohio
2. Chicago District Manual – Burns Ditch and/or Trail Creek, Indiana
3. Detroit District Manual – River Raisin Watershed, Michigan

On-line instructional videos

MSU and Purdue Universities developed instructional videos that were posted on-line for the respective tools. These videos were based on the materials developed for the training manual and include the following: background, theory, and limitations; walkthroughs of each tool's functions; and applied scenarios. The accessibility of these videos allows the Corps to engage potential trainers who may not be able to attend the workshop, empowers trainers to conduct their own workshops, and allows workshop participants to readily review steps in tool use.

All deliverables were created on time and used in the workshop performed in Ann Arbor in August 2012 to train USACE staff. Subsequently, USACE staff performed two hands-on workshops in the Buffalo District for several dozen interested stakeholders from local SWCDs. These efforts were described by USACE staff as a resounding success.

The bibliography and case study document is available here:
ftp://ftp.ecn.purdue.edu/abegis/COE/2012/Purdue_Training%20Manual_COE2012_5_1draft.docx

The instructional powerpoint for the workshop is available here:
ftp://ftp.ecn.purdue.edu/abegis/COE/2012/WalkthroughLthiaLID.pptx

Three tutorial (for HIT and L-THIA LID) exercises are available to USACE staff on intranet, and to the public here: ftp://ftp.ecn.purdue.edu/abegis/COE/2012/TraintheTrainer_final_Appendicies_V5.pdf

The instructional videos [example:
https://engineering.purdue.edu/mapserve/LTHIA7/movies/LTHIA_mov2/LTHIAFirstSteps.html]

are linked throughout the online model pages. The L-THIA LID model is located here:

[https://engineering.purdue.edu/mapserve/LTHIA7/lthianew/lidIntro.htm]

USGS Summer Intern Program

None.

Student Support					
Category	Section 104 Base Grant	Section 104 NCGP Award	NIWR-USGS Internship	Supplemental Awards	Total
Undergraduate	6	0	0	0	6
Masters	12	0	0	0	12
Ph.D.	3	0	0	0	3
Post-Doc.	1	0	0	0	1
Total	22	0	0	0	22

Notable Awards and Achievements

Publications from Prior Years

1. 2011IN313B ("Niche breadth variation with seasonal changes in local habitats: fish assemblages of the Wabash River ") - Articles in Refereed Scientific Journals - Pyron, M., R. Goforth, J. Beugly, S. Morlock and M. Kim. 2011. A GIS approach for explanation of fish assemblage structure in a large river. River Systems 19:239-247.
2. 2011IN313B ("Niche breadth variation with seasonal changes in local habitats: fish assemblages of the Wabash River ") - Articles in Refereed Scientific Journals - Pritchett, J. and M. Pyron. 2011. Predicting fish assemblages from substrate variation in a turbid river: grab samples compared with pole probing. North American Journal of Fisheries Management 31:574-579.
3. 2012IN341B ("Niche breadth variation of fish assemblages for the entire Wabash River") - Articles in Refereed Scientific Journals - Pritchett, J. and M. Pyron. 2012. Fish assemblages respond to habitat and hydrology in the Wabash River, Indiana. River Research and Applications 28:1501-1509.
4. 2010IN242B ("A First Assessment of Pharmaceuticals and Personal Care Products in the Middle Wabash River, Indiana ") - Articles in Refereed Scientific Journals - Veach, A, MJ Bernot. 2011. Temporal variation of pharmaceuticals in an urban and agriculturally influenced stream. Science of the Total Environment 409:4553-4563.
5. 2010IN251B ("Transport and fate of pharmaceutical compounds in an Indiana stream") - Articles in Refereed Scientific Journals - Bunch, AR, MJ Bernot. 2011. Pharmaceutical abundance in central Indiana streams and effects on microbial activity. EcoToxicology 20:97-109.
6. 2006IN196G ("Assessing the role of landscape organization on nutrient exports across scale ") - Articles in Refereed Scientific Journals - Jacinthe, P. A.; Bills, J. S.; Tedesco, L. P.; et al. 2012. Nitrous Oxide Emission from Riparian Buffers in Relation to Vegetation and Flood Frequency. Journal of Environmental Quality, 41:95-105
7. 2010IN243B ("Transport, Fate, and Effects of Pharmaceuticals derived from Animal Feeding Operations: A comprehensive assessment of central Indiana streams") - Articles in Refereed Scientific Journals - Brown, J, MJ Bernot, RJ Bernot. 2012. The influence of TCS on the growth and behavior of the freshwater snail, Physa acuta. Journal of Environmental Science and Health, Part A: Toxic/Hazardous Substances and Environmental Engineering 47(11):1626-1630.