Water Resources Research Institute
Annual Technical Report
FY 2002

Introduction

The FY 2002 Annual Technical Report of the Mississippi Water Resources Research Institute provides a summary of USGS-supported research, education, and information/technology transfer activities. Brief descriptions of four research projects, which completed funding in February 2003 are included in this summary along with a project that was funded the previous year and granted an extension to September 2002.

Research Program

Functional Assessment of Moist-Soil Management Impact on Wetland Impoundments Created as Part of an Agricultural Lands Reclamation Plan

Basic Information

Title:	Functional Assessment of Moist-Soil Management Impact on Wetland Impoundments Created as Part of an Agricultural Lands Reclamation Plan
Project Number:	2002MS1B
Start Date:	3/1/2002
End Date:	2/28/2003
Funding Source:	104B
Congressional District:	Third
Research Category:	Biological Sciences
Focus Category:	Wetlands, Management and Planning, Water Quality
Descriptors:	wetlands, wetland function, land use, water quality
Principal Investigators:	Gary N. Ervin, Darrel W. Schmitz

Publication

1. Ervin, G.N., J.T. Bried, B.D. Herman, and D.W. Schmitz, 2002, Assessing functional integrity of moist-soil managed wetlands by comparison with nearby non-managed systems. Proceedings of the 32nd Mississippi Water Resources Conference, April 23-24, 2002, Mississippi Water Resources Research Institute, Mississippi State University, Mississippi State, MS, pages 242-252.
2. Ervin, G.N., J.T. Bried, B.D. Herman, and D.W. Schmitz, 2002, Assessing functional integrity of moist-soil managed wetlands by comparison with nearby non-managed systems. A poster was provided to the Strawberry Plains Audubon Center.

PROBLEMS AND RESEARCH OBJECTIVES:

The proposed project will be conducted in cooperation with the National Audubon Society to evaluate effects of moist-soil habitat management practices on water quality and wetland function. The study site is part of a 1000-ha farm near Holly Springs, MS, presently undergoing conversion from agricultural land to wildlife habitat under the supervision of Audubon personnel. Mississippi State University was solicited as an institutional partner in examining the success of management practices and effects of habitat manipulations on environmental quality in this headwaters region of the Coldwater River.

This project will address Mississippi water research priorities by monitoring water quality, sedimentation, and biological community development in wetlands managed as habitat for local and migratory wildlife, in comparison to natural wetland ecosystems. The proposed research will evaluate effects of habitat management practices on nutrient and sediment removal, sediment accumulation, and plant community development in three artificial impoundments on lands currently under reclamation from more than 150 years of agricultural use. South Atlantic-Gulf Region priorities to be addressed also include water quality and management during the functional assessment of created and actively managed wetland impoundments. Standard monitoring techniques will be used to evaluate effects of facilities construction and biotic community development in reference to unimpacted natural wetlands located within the same

METHODOLOGY:

Strawberry Plains Audubon Center is a 1000-ha farm located in Holly Springs, MS that entered the care of Audubon in 1998 under its original owners' wishes that it be restored to a more natural landscape, with a focus on birds and other wildlife species. Part of the management plan of Strawberry Plains is the enhancement of riparian areas for bird and other wildlife use. In addition to a number of streams that make up a substantial portion of the Coldwater River headwaters, aquatic resources on the reserve include numerous farm ponds installed to aid in erosion control. Center managers plan to install or enhance water control structures along one major stream and around the two farm ponds in order to increase moist-soil resources for waterfowl and other aquatic animal species, such as amphibians, fish, and mammals.

The aim of moist-soil management is to recreate more-or-less natural hydrologic cycles in managed wetlands to increase the diversity and production of plant and animal species for wildlife food and habitat (Anderson and Smith, 2000). Under moist-soil manipulation, water levels are lowered during the growing season to stimulate seed germination of wetland-adapted plants and to increase the oxygenation of soils to stimulate plant productivity. In autumn, water levels are raised to discourage establishment of non-wetland plant species and increase habitat diversity for invertebrate animals that serve as food for waterfowl and other aquatic wildlife, in addition to seeds that are produced by the moist-soil plant community. These water level manipulations are often accompanied by soil manipulations, such as tilling or disking, that maintain high plant species diversity and high seed production for wildlife (Gray et al., 1999). Moist-soil management practices at Strawberry Plains will include mowing, tilling, and planting in shallow areas of each of three man-made impoundments to enhance early-successional herbaceous plant species for increased seed and invertebrate production.

SIGNIFICANCE:

Strawberry Plains Audubon Center managers installed water control structures in two areas to be managed as moist-soil habitat and repaired the levee on the third managed area. Water control structures were to be donated by Ducks Unlimited. Audubon has installed stage height gages in two of the six sites selected for continued monitoring during 2003-2004.

Monitoring data continue to be collected, at bi-monthly intervals for general field parameters, less frequently for other variables, such as suspended solids, chlorophyll, and nutrient concentrations. In addition to vegetation analyses, further biotic data are being collected on amphibians and macroinvertebrates during the 2003 field season. Audubon is purchasing four automated recorders for collecting data on amphibian use of the sites, and Brook Herman is collecting macroinvertebrate samples as part of her thesis research.

Results to date were presented in a poster at the annual Mississippi Water Resources meeting in April 2003, which also was submitted for publication in the Proceedings. The presentation was entitled, “Assessing functional integrity of moist-soil managed wetlands by comparison with nearby non-managed systems.”

Screening of Environmental Contaminants Detected in Mississippi Sediments as Inducers and/or Inhibitors of CYP1B1 Expression in Channel Catfish - Continuation

Basic Information

Title:	Screening of Environmental Contaminants Detected in Mississippi Sediments as Inducers and/or Inhibitors of CYP1B1 Expression in Channel Catfish - Continuation
Project Number:	2002MS2B
Start Date:	3/1/2002
End Date:	2/28/2003
Funding Source:	104B
Congressional District:	First
Research Category:	Water Quality
Focus Category:	Toxic Substances, Sediments, Agriculture
Descriptors:	pesticides, toxic substances, bioindicator
Principal Investigators:	Kristine L. Willett

Publication

1. Butala, H., Metzger, C., Rimoldi, J., and Willett, K.L. (submitted) 2003, Microsomal estrogen metabolism in channel catfish. Marine Environmental Research.
2. Metzger, Christine U., and Kristine L. Willett, 2002, Environmental contaminants that affect CYP1B gene expression in channel catfish (Ictaluras punctatus). Proceedings of the 32nd Mississippi Water Resources Conference, Mississippi Water Resources Research Institute, Mississippi State, MS, page 126 (Abstract)

PROBLEMS AND RESEARCH OBJECTIVES:

This project is specifically aimed at characterizing the utility of a recently discovered cytochrome, CYP1B1, as a marker of exposure to contaminants that have been reported by the USGS NAWQA and BEST programs in Mississippi sediments and fish samples. Because channel catfish (*Ictalurus punctatus*) are such an abundant and economically significant species in Mississippi, they are being used as the test organism in these studies.

METHODOLOGY:

There are three aspects of our **Laboratory Studies** ongoing.

1) Cloning: Last quarter we had dosed an additional channel catfish with 20 mg/kg BaP for 4 days in order to get a large supply of total RNA and ultimately mRNA in order to try a new 5' RACE cloning protocol. This mRNA was reverse transcribed with a new high temperature protocol using both universal and gene specific primers. 5'RACE PCRs are ongoing to clone the full length sequence.

2) Quantitative Real-Time RT PCR (qRT/RT-PCR): This quarter we have several difficulties (cold weather, building maintenance etc) which affected our catfish culture. We lost several animals, and we had to put the remaining animals on an antibiotic treatment. Because we do not want to use fish until they return to normal physiological conditions, we have not done any primary cell culture experiments this quarter. The catfish, though are now healthy again and we can resume our experiments exposing liver and gill cells to PCB 77, PCB 126, PCB 153, p,p'-DDT, and TCDD.

3) Estrogen metabolism in control and benzo(a)pyrene exposed and wild channel catfish: All samples have now been assayed for their ability to metabolize estrogen. Mammalian CYP1B1 is involved in metabolism of estradiol to 4-hydroxyestradiol whereas CYP1A1 forms predominantly the 2-hydroxyestradiol. Microsomes of liver, gill and gonad tissues of control, dosed, and Delta catfish (gill and liver only) were made. These samples were incubated for two hours with estradiol, and the estrogen metabolites formed were quantitated by a GC-MS method that we have optimized. The liver microsomal formation of 2- and 4-hydroxyestradiol are shown in Figure 1. Bars with the same symbol are not significantly different from each other ($p<0.05$ by ANOVA). In the liver microsomes, BaP treatment induced formation of both the 2- and 4-hydroxyestradiol metabolites relative to control laboratory fish. The amount of 2-hydroxyestradiol metabolite formed by Lake Roebuck liver microsomes was also statistically higher compared to controls. In contrast, the 2-hydroxyestradiol formed by Bee Lake and Sunflower River fish liver microsomes was statistically lower than laboratory controls. Like the 2-hydroxyestradiol metabolite, 4-hydroxyestradiol was induced in the BaP exposed samples, but the trends in 4-hydroxyestradiol formation in Delta fish did not follow the same trends as the 2-hydroxyestradiol formation. The gill microsomes (Figure 2) had far less estrogen metabolic capability than either the liver or gonad microsomes, and only 2-hydroxyestradiol was detected following gill incubations. Furthermore, there were significant differences between all five gill microsome preparations in their ability to form the 2-hydroxyestradiol metabolite. In gonad microsomes there was no significant difference between laboratory control and BaP-dosed fish. Because the testis is a much smaller tissue, we were unable to do multiple replicates, and the protein concentrations were much lower. Therefore, there was higher variability in metabolite production by gonad microsomes compared to the other two tissues. Future experiments are going to use a CYP1A antibody in the incubation. It is hoped that the antibody will knock out any CYP1A enzyme activity, and in this way we will be able to determine the relative contribution of CYP1A in the metabolism of estradiol (and hence hypothesize on the role of CYP1B).

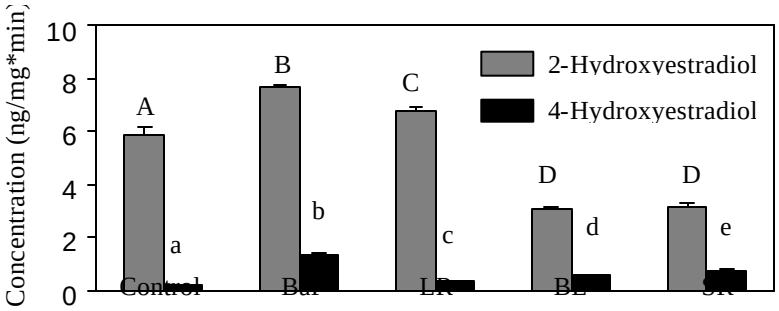

Figure 1

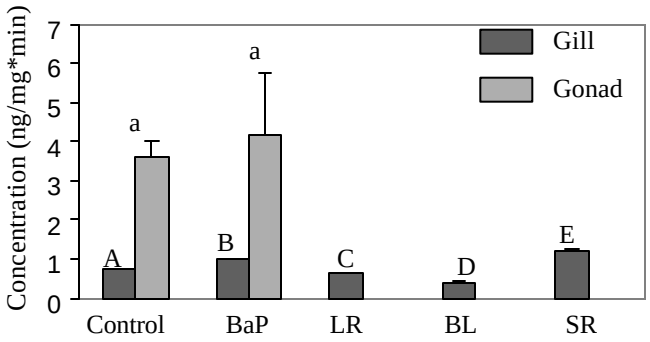

Figure 2

SIGNIFICANCE/PRESENTATIONS:

Overall, these results aim to characterize utility of CYP1B1 as a biomarker of exposure to environmental contaminants in channel catfish collected from Mississippi lakes and rivers. As mentioned, we will continue to compare the results from laboratory animals to those collected from Mississippi waterways.

These results "Microsomal Estrogen Metabolism in Channel Catfish" were submitted for presentation at the Pollutant Responses in Marine Organisms Meeting (May 9-13th, 2003, Tampa FL), and we are currently writing the results in paper form to be submitted for publication in Marine *Environmental Research*.

Hydrologic Controls on Wetland Tree Growth: Determining the Origin, Residence Time and Water Quality of Groundwater in the Root Zone

Basic Information

Title:	Hydrologic Controls on Wetland Tree Growth: Determining the Origin, Residence Time and Water Quality of Groundwater in the Root Zone
Project Number:	2002MS3B
Start Date:	3/1/2002
End Date:	2/28/2003
Funding Source:	104B
Congressional District:	First
Research Category:	Climate and Hydrologic Processes
Focus Category:	Wetlands, Groundwater, Ecology
Descriptors:	wetlands, surface-groundwater relationships, isotopes, plant-water relationships
Principal Investigators:	Gregg R. Davidson

Publication

1. Galicki, S., G. Davidson, S. Threlkeld and B. Laine, 2002, Role of wetland sedimentation, precipitation, agricultural runoff, and subsurface flow on bald cypress growth. North-Central Section (36th) and Southeastern Section (51st), GSA Annual Conference, GSA Abstracts with Programs, Lexington, KY, April 3-5, 2002, 34:A-106.

PROBLEMS AND RESEARCH OBJECTIVES:

Preservation of natural wetlands is a national priority, but there is still much to be learned concerning the impact of human activity on wetland systems. In areas of intensive agricultural production, nearby wetlands often serve as collection points for agricultural chemicals and sediments eroded from fields. Construction of roads and drainages alter the hydrologic regime in ways that can enhance or diminish the water supply in the wetland. The response of wetland organisms to these alterations are likely caused by multiple factors, not all of which may even be recognized. The end result is that the response of an organism to changes in wetland dynamics is often *observed* rather than *understood*. Effective management of natural wetlands requires an understanding of how changes in the wetland influence specific organisms.

The bald cypress (*Taxodium distichum*) is a dominant wetland tree species throughout the southeastern United States, and is prolific in the wetlands of Mississippi. The primary control on growth has often been linked to precipitation, but the link is poorly understood. Trees growing in continuously flooded soils still appear to respond to precipitation with higher rates of growth, which means precipitation may often be an indirect cause of growth. The true stimulus may be the flushing of nutrient-rich or oxidizing water through the root zone, or the delivery of nutrients via transported sediments during precipitation runoff events. Proactive management of bald cypress dominated wetlands requires a more thorough understanding of the hydrologic variables that potentially impact this population.

METHODOLOGY:

Funds for the current study were provided in May, 2002. At that time, three sets of nested piezometers were placed in Sky Lake to monitor hydraulic head and water chemistry changes over time. Shortly after placement, unseasonably high water levels in the lake rose above the tops of the piezometers, which compromised future water sampling at these sites. Water levels soon dropped below the tops of the piezometers, but remained unseasonably high through June. As soon as the water level returned to its normal summer low, the piezometers were pulled and moved to new locations. The top of each piezometer was extended to ensure that they will not be submerged again. Data-logging pressure transducers were placed in two piezometers at each nest and set to record water levels every hour. An additional transducer was placed in the lake to record lake level. Continuous monitoring of hydraulic head in the newly placed piezometers began in August. Time was allowed for water levels in the piezometers to equilibrate before sampling for chemical and isotopic analyses beginning in September.

An example of the hydraulic head data is provided in Figure 1. During the Fall, a substantial downward gradient existed at all three nests. The horizontal gradient was more complex. The hydraulic head in the piezometers completed at 1.8 m consistently declined toward the south suggesting flow toward the lake. The deeper piezometers showed a hydraulic high in the middle nest. This apparent anomaly was persistent throughout the period of monitoring. Figure 1 also demonstrates that the hydraulic conductivity of the sediments in the root zone is very low. Water levels do not have time to recover between the water-quality sampling intervals. A second set of 3.8-cm diameter piezometers have now been purchased and are scheduled for installation before the new year. The existing 2.5-cm piezometers will be devoted solely to monitoring hydraulic head. At present, the two deeper piezometers at each site are equipped with data-logging pressure transducers. Three more transducers have now been ordered for the shallow piezometers at each nest.

Oxygen isotope data are now available for two sampling rounds. This is not yet enough data to make assessments of residence time, but several processes are already clear from the limited data set. First, substantial evaporation from the lake is evident from the elevated summer $?^{18}O$ values for lake water (+3‰ VSMOW) relative to stream inflow values (-1.3 to -4.9‰). Second, the influence of Hurricane Lili (Sept. 21, 2002) was apparent from a significant drop in the precipitation $?^{18}O$ value. Normal values during this time of year have been in the range of –3 to –6‰. Hurricane Lili delivered water with a $?^{18}O$ of –11‰. Lastly, the $?^{18}O$ of groundwater in the root zone is more similar to inflowing stream water than to the enriched summer lake-water, which is consistent with the hydraulic gradient observed in the 1.8 m piezometers. Changes will be monitored with time to determine if the isotopic signature approaches lake values during the winter months when the lake level is high.

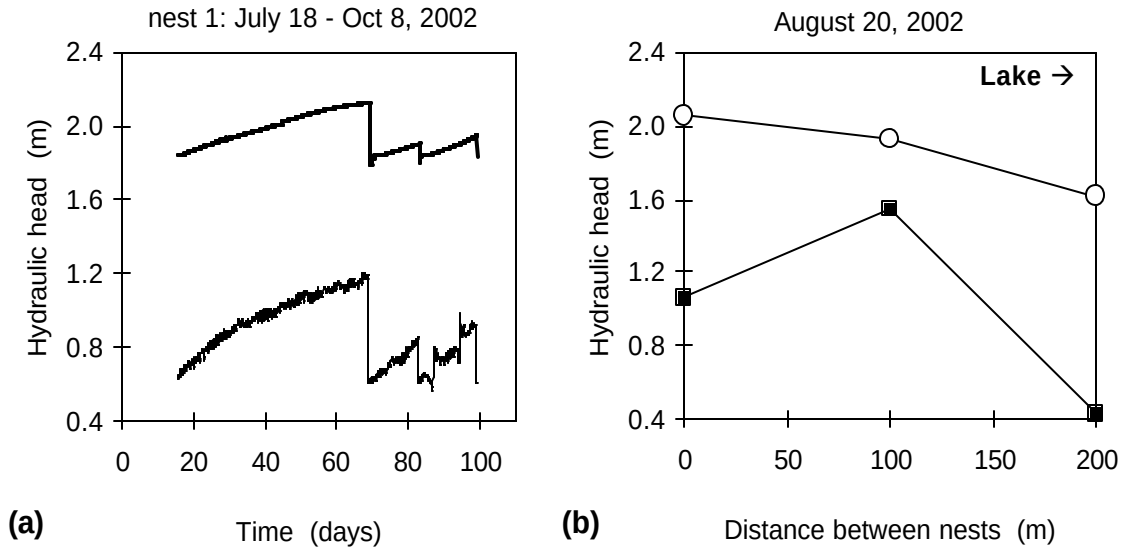

Figure 1. (a) Continuous hydraulic head measurement in piezometer nest 1 (highest elevation). Upper curve is for 1.8 m depth, lower curve is for 3.0 m depth. Sudden drops represent water removal for water-quality sampling. (b) Hydraulic head in the 1.8 m piezometers (open circles) and 3.0 m piezometers (filled squares) in all three nests on August 20, 2002.

SIGNIFICANCE:

Completion of this project will yield two end products. First, the results will enhance our understanding of the hydrologic controls on the health of a dominant wetland tree species: the bald cypress. This will in turn lead to an improved ability to manage the natural wetlands of the southeastern United States, particularly regarding issues of sediment accumulation and alterations to the hydrologic regime. Specific information gained from the project for a specific wetland will include characterization of nutrient availability associated with precipitation events, identification of the origin of shallow subsurface water, and quantification of shallow groundwater residence time at variable depths.

The second product will be a general characterization of wetland hydrology for a type of wetland in a geographical area that is under-represented in the published literature. The study site is in the Delta region of Mississippi, characterized by low relief and many oxbow-lake wetlands. These wetlands are unique in that they often lie near streams or other lakes that can fill quickly during high stream flows, sometimes reversing shallow groundwater gradients.

A Single Technology for Remediating PNAs, Nitro/Nitrate Residues, PCBs, CAHs, Herbicides and Pesticides from Soils and Sludges with Na/NH3(l)

Basic Information

Title:	A Single Technology for Remediating PNAs, Nitro/Nitrate Residues, PCBs, CAHs, Herbicides and Pesticides from Soils and Sludges with Na/NH3(l)
Project Number:	2002MS6B
Start Date:	3/1/2002
End Date:	2/28/2003
Funding Source:	104B
Congressional District:	Third
Research Category:	Ground-water Flow and Transport
Focus Category:	Toxic Substances, Groundwater, Treatment
Descriptors:	water quality, groundwater treatment, hazardous wastes, toxic substances, chlorinated aliphatic hydrocarbons, polychlorinated biphenyls, declorination, pesticides, herbicides, soil decontamination, reductions, sludge, subsurface drainage, water treatment
Principal Investigators:	Charles U. Pittman, Jr.

Publication

PROBLEMS AND RESEARCH OBJECTIVES:

The key goal of this project is to develop Na/NH_3 solvated electron reductions as a technology to rapidly remediate soils and sludges which have been contaminated with one or more of the following classes of polluting compounds:

(a) polychlorinated biphenyls (PCBs)
(b) chlorinated aliphatic hydrocarbons (CAHs)
(c) nitro/nitrate wastes (military wastes)
(d) pesticides and herbicides (chlorinated/brominated and phorphorous compounds)
(e) polynuclear aromatic hydrocarbons (PNAs)

This single technology has the potential to remove all these classes of toxic compounds from contaminated soils simultaneously. Over the past three years we have thoroughly investigated and demonstrated the rapid destruction of neat PCBs, CAHs and several pesticides as well as soils (with up to 20%wt. water) contaminated with these three classes of pollutants [1-12]. Furthermore, several samples from superfund sites, which were contaminated with PCBs, CAHs, dioxins and nitro compounds, were successfully remediated to very low (or nondetectable) pollutant levels [8,10].

METHODOLOGY:

Based on this highly successful research we began to test the reduction of a large series of polynuclear aromatic hydrocarbons (PNAs) and showed that neat samples were essentially totally reduced, leaving almost no traces of the residual PNAs [8,12]. Thus, the focus of the work turned towards identifying the reduction products produced in these neat reactions and examining the remediation of model PNA-contaminated soils [12,13]. The key findings are summarized as follows without going into the details.

1. With the exception of naphthalene and anthracene, very complex mixtures of reduction products result with more complex PNAs such as phenanthrene, chrysene, benzo-substituted anthracenes, pyrene etc [12,13].
2. Determining the reduction product distribution in treated soils was very difficult or impossible.
3. The product distribution changes with reduction time, soil makeup, water content in the soil and subsequent exposure of the remediated soil to air [13].
4. Environmental samples contaminated with PNAs typically contain complex mixtures of these pollutants. Therefore, after treatment with Na/NH_3, the product distributions of reduction products are extremely complex. Accurate analysis of these distributions in the remediated soils is too complex to be tractable.
5. The amount of sodium consumption required to remediate the contaminated soils was far greater than that required to remediate neat samples to the same low PNA residue concentrations (1ppm for example) [12,13].
6. The high sodium consumptions required during soil treatments (relative to treating pure PNAs) are due to the relatively slow PNA reduction kinetics in Na/NH_3 media. Therefore, water and other impurities in soil are able to complete with the PNA reductions and consume more sodium. Thus, higher amounts of sodium are required.

RESULTS/DISCUSSION:

In our most recent work, we have demonstrated that soils containing PNA mixtures (for example napthalene, anthracene, pyrene, chrysene and benzo["]anthracene) may be successfully remediated. Thus, all of the PNA species in the soils can be reduced to low levels using excess sodium in NH_3. Since, this generates very complex, unanalyzable product mixtures in the soil, there is a requirement that one demonstrate that these product mixtures are safe to leave in the soils. Each particular PNA mixture will give a unique product distribution and this distribution will be different for every different soil composition encountered (even if the PNA contaminate mixture's composition is held constant). Thus, we have started to work with Professor Shiao Wang at the University of Southern Mississippi to develop an evaluation method to see if the PNA-contaminated soils are safe to return to the

environment after Na/NH_3 remediation treatments [14]. This project is now combining the recent methods of *biotechnology* with *chemical reduction methods*.

A series of individual PNA-contaminated soils were reduced with Na/NH_3. We have also reduced soils contaminated with PNA mixtures. These samples, along with samples of the reduction products from pure PNA compound reductions, have been sent to Professor Wang at USM. Professor Wang will expose water to these samples individually. This water will then be used as a medium to grow both minnows and/or freshwater mussels. The same species of freshwater mussels and minnows will also be raised, simultaneously, in identical tanks, using pristine water (which never encountered the PNA reduction product or remediated soils with the PNA reduction products). Then, DNA-chip technology will be employed to do scans of a large series of genes to see which genes have been activated (e.g. gene expression turned on). By sampling hundreds or thousands of genes, a general DNA expression array will be obtained for these organisms when living in the pristine water versus that when living in the water exposed to the PNA reduction products. These organisms will serve as environmental sentinels by comparing the up-regulation versus down-regulation of their gene expression as shown by the DNA arrays on a chip. Early indications of environmental stresses placed on the organisms will be revealed by these patterns of gene expression. This will occur long before these species exhibit signs of sickness or die. This should be a far more sensitive technique than looking at organism death rates.

Experiments with minnows are going on at USM now. The DNA-chip technology is in a start-up phase in Professor Wang's lab. His students have about 10 samples from our laboratory waiting to be studied. A chip-reader at the Army Corp of Engineers (WES) in Vicksburg will be employed. We can do nothing at MSU to speed up this progress. We are significantly in front of USM in accomplishing our portion of this work.

While waiting for the USM experiments to begin producing results, we are conducting experiments on PNA model compounds and model mixtures, which are mixed with PCBs, or a model nitroaromatic compound. Then these mixtures are being subjected to dry Na/NH_3 or Na/NH_3 with 2%wt. water added. For example, when the PNA, phenanthrene, and dinitrobenzene were mixed and subjected to Na/NH_3 treatment, these two pollutants were reduced from concentrations of 2000 ppm each to levels below 5 ppm when 2%wt. water was present.

Spatial Pattern in Land Use: Its Role in Determining Surface Water Quality

Basic Information

Title:	Spatial Pattern in Land Use: Its Role in Determining Surface Water Quality
Project Number:	2001MS2601B
Start Date:	3/1/2001
End Date:	9/30/2002
Funding Source:	104B
Congressional District:	Fifth
Research Category:	Water Quality
Focus Category:	Surface Water, Non Point Pollution, Conservation
Descriptors:	Land Use, Nonpoint Source, Water Quality, Surface Water, Forestry, Agriculture, Urban Growth, Landscape Ecology
Principal Investigators:	Glenn Randall Matlack

Publication

1. Schweizer, P.E., and G.R. Matlack, 2002, A predictive model for land use planning at the watershed scale based on fish community composition. Proceedings of the 32nd Mississippi Water Resources Conference, April 23-24, 2002, Mississippi Water Resources Research Institute, Mississippi State, MS, pages 136-148.

PROBLEMS AND RESEARCH OBJECTIVES:

Mississippi streams flood often and destructively. Our goal is to understand factors controlling this phenomenon at the landscape scale. In the hydrological cycle, water runs through the entire landscape, so it is reasonable to expect land alterations anywhere in the landscape to influence the amount and character of surface water runoff. It is unclear, however, to what extent streams actually integrate land use alterations over the whole watershed. There is abundant evidence that stream condition reflects the character of adjacent stream banks. Whole-watershed effects are less-commonly described, but the few empirical studies available suggest collective impacts at the scale of watersheds. We seek to compare local and landscape effects in a variety of stream parameters, both physical and biotic.

The issue is of practical concern because land use may radically alter the rate, volume, and chemical composition of runoff. Paralleling the suburbanization of south-Mississippi communities is an increase in the rate of catastrophic floods in suburban streams and a degradation of biological communities, implying causation by human manipulation of the landscape. We hope to clarify the linkage between specific land use events in a watershed and impacts in the stream that drains the area. Our results will be presented as a model allowing the impacts of a particular land use alteration to be predicted before development. Ultimately, such insight may be used to control flooding and protect aquatic diversity.

METHODOLOGY:

Models will be constructed by regression of physical and biotic parameters on geomorphological and land use parameters weighted in various ways reflecting competing models of watershed function. Land use is determined by supervised classification of aerial images recorded in October 2000, provided to us NASA. Models will be constructed using the buffer function in ARC/INFO and applied to landuse data layers imported from the remote imagery.

Stream parameters will be used as the response variables. These include physical/chemical/hydrological variables such as temperature, dissolved oxygen, conductivity, flood ratio, dissolved nutrients, sediment load, sediment texture, bank erosion, and turbidity, and biotic/habitat variables such as accumulation of woody debris, algal growth, an fish abundance, diversity, and community composition. To lend statistical power to our analysis, we are comparing 26 replicate watersheds in urban/suburban Hattiesburg. Simultaneity of sampling will be accomplished by use of a team of trained field workers.

SIGNIFICANCE:

Progress to September 2002

At the end of the WRRI grant (September 2002) we have collected data sets covering all stream variables in all replicate watersheds in low-flow conditions and several storm events. Although the State financial crisis caused us considerable discomfort, we were able to maintain the scientific integrity of the project and make reasonable progress.

To describe the effect of runoff on the stream biota, we have expanded our sampling to include the fish community. Fish were collected at each sample point by closing a 50m section of stream with small-mesh nylon nets, and hand seining between the nets. Streams were sampled in May and, again, in October to account for seasonal behavior in fish populations. All fish caught were preserved in formalin, and were identified to species and counted in Winter and Spring 2002.

Variation in fish composition will be described by Detrended Correspondence Analysis, a multivariate method summarizing abundances of all species. Scores on the first two DCA axes will be used as dependent variables in regressions on topographic and land use features. Fish sampling was repeated in Spring 2002, and a final census will be conducted in Spring 2003.

In an attempt to get samples of early runoff during storm events, we devised our own automatic samplers. These were built and mounted in streams by late October 2001. Over the Spring and Summer of 2002 they remained standing through several heavy storms, providing valuable data on stream conditions during flooding events. For reasons of safety, such data could not be collected in any other way. We are proud to note that these samplers cost no more than $50 apiece.

Comparison of watersheds was frustrated by the small size and patchiness of summer thunderstorms in the summer of 2001, leading to unequal rainfall in our replicate watersheds. To work around this problem, we set out an array of nine rain gauges across the study area. Data in 2002 were only accepted from rainfall events varying by < 1cm among all gauges. Rainfall proved to be more evenly distributed in winter 2001-2002 storms.

In winter and spring 2002 gathered complete data sets in several more storm events and collected another set of fish community data. Field work was completed by late summer 2002. The remainder of 2002 was dedicated to identifying fish, collating and entering stream data, remote image analysis, and acquisition of topographic and hydrological data layers.

Project Coordination of the MS Delta Management Systems Evaluation Areas Project

Basic Information

Title:	Project Coordination of the MS Delta Management Systems Evaluation Areas Project
Project Number:	2001MS14S
Start Date:	4/25/2001
End Date:	8/31/2004
Funding Source:	Supplemental
Congressional District:	Third
Research Category:	Water Quality
Focus Category:	Water Quality, Non Point Pollution, Surface Water
Descriptors:	Best Management Practices, Watersheds, TMDLs
Principal Investigators:	Jonathan Woodrome Pote

Publication

1. Rebich, Richard, 2002, The effects of best management practices on agricultural runoff in the Mississippi Delta, 1996-2000. Proceedings of the 32nd Mississippi Water Resources Conference, April 23-24, 2002, Mississippi Water Resources Research Institute, Mississippi State, MS, page 117.

PROBLEM AND RESEARCH OBJECTIVES

The Mississippi Delta Management Systems Evaluation Areas (MDMSEA) Project began in 1995 with two purposes: 1) to assess how agricultural activities affect water quality; and 2) to evaluate Best Management Practices (BMPs) that mitigate agricultural nonpoint source pollution. The project is located in the northwestern portion of Mississippi, an area of intense agriculture referred to as the Mississippi Delta. The project is administered by a Technical Steering Committee comprised of representatives from the U.S. Geological Survey (USGS), the U.S.D.A. Agricultural Research Service (ARS), Mississippi State University (MSU), Mississippi Department of Environmental Quality (MDEQ), U.S.D.A. Natural Resources Conservation Service (NRCS), U.S.D.A. Farm Service Agency, Mississippi Soil and Water Conservation Service, Yazoo-Mississippi Delta Joint Water Management District, and the Pyrethroid Working Group. The primary research agencies in the MDMSEA project are the USGS, ARS, and MSU.

METHODOLOGY

The MDMSEA project focused on oxbow lake watersheds, in which, the lakes served as biological endpoints for improvements made in the watershed. Since 1995, findings from ARS and USGS indicated that sediment was the primary pollutant in runoff and in the lakes: sediment limits visibility in the lake water, which in turn, limits primary productivity necessary for sustaining a healthy aquatic habitat. BMP systems were installed in the oxbow lake watersheds to determine whether a watershed could be improved enough to sustain fish production in the lakes. Edge-of-field BMPs (slotted-board risers and inlet pipes, filter strips, etc.) did not improve lake water quality enough to sustain fish populations. However, conservation tillage systems, with winter cover, were shown to improve lake quality and aquatic habitat to the point of sustaining fish populations.

PRINCIPAL FINDINGS

Within the next decade, agricultural communities like the Mississippi Delta could be faced with greater restrictions on farming to reduce nonpoint source pollution from agricultural fields. Total Maximum Daily Loads (TMDLs) are one such tool that regulatory agencies could use to limit the amount of pollutant loads to streams, rivers, and lakes. MDMSEA data and research findings will play a key role in helping both the Delta agricultural community and Mississippi regulatory agencies adapt protective measures that will meet potential TMDL loading restrictions without excessive impacts to overall profitability and productivity.

The future direction of the MDMSEA project will include two primary objectives. The first objective will be for MDMSEA scientists to expand BMP research and to provide more BMP options for farmers – in other words, to provide a "catalogue" of BMPs that a farmer can tailor to specific landscapes. The second objective will be to provide economic analyses such as construction and maintenance costs, crop yields and profit, and environmental benefits for each BMP studied.

As part of the MDMSEA project extension, the ARS and USGS will be the primary agencies to evaluate the catalogue of BMPs. ARS efforts are more research-oriented and include study of BMPs such as agricultural drainage ditches, slotted-board risers with grass hedges, winter cover

crops, constructed wetlands, and conservation tillage practices. ARS will continue to monitor BMP systems in the oxbow lake watersheds but will expand their efforts to include replicated plot studies located at a nearby ARS Field Station. The USGS will also continue monitoring runoff from most of the BMP demonstration fields in the oxbow lake watersheds. However, the USGS proposes to construct new sites in nearby stream watersheds to assess BMPs in watersheds that are more typical of Delta landscapes than were previously studied. The proposed USGS BMP demonstration sites include: 1) a revised slotted-board riser site; 2) an NRCS Wetlands Reserve Program (WRP) landscape; and 3) a conservation tillage site without a planted winter cover. MSU will be the primary agency providing the economic analyses of the BMPs studied. MSU will also provide leadership in generating BMP reports for Delta resource managers.

Information Transfer Program

Information Transfer Program - Conferences

Basic Information

Title:	Information Transfer Program - Conferences
Project Number:	2002MS15B
Start Date:	3/1/2001
End Date:	2/28/2003
Funding Source:	104B
Congressional District:	Third
Research Category:	Not Applicable
Focus Category:	Surface Water, Models, Wetlands
Descriptors:	Bioassessment, water policy, surface water, contaminants, models, social impacts, TMDL, coastal wetlands,
Principal Investigators:	Jeffery A. Ballweber

Publication

1. 2002, Mississippi Water Resources Conference Proceedings, Mississippi Water Resources Research Institute, Mississippi State, MS, 285 pgs.
2. 2002, Mississippi Water Resources Conference Program and Abstracts, Mississippi Water Resources Research Institute, Mississippi State, MS, 56 pgs.

INFORMATION TRANSFER PROGRAM - CONFERENCES

PROBLEM AND RESEARCH OBJECTIVE

Need to provide interactions among water resources researchers and federal, state, and local agencies, policy makers and the interested public. Likewise, there is a need for researchers to present their current and ongoing research to this diverse group.

METHODOLOGY

The Mississippi Water Resources Research Institute is the lead sponsor of an annual Mississippi Water Resources Conference which is co-sponsored by the Mississippi Department of Environmental Quality's Office of Land and Water Resources, the Mississippi District Office of the USGS, and the Mississippi Water Resources Association. The Conference provides a forum for the interaction referenced above.

SIGNIFICANCE

The Conference provides a well-known and respected opportunity for researchers, students, agencies, and the interested public to formally discuss current water resources research and informally critique the applicability of that research to priority water resources research needs in Mississippi, the Southeastern United States, and the Nation. The conference's proceedings, which are distributed to all conference attendees and available for sale to others, are perhaps the preeminent source of current information about the diversity of water and related land resources research in Mississippi.

Information Transfer Program - Newsletter

Basic Information

Title:	Information Transfer Program - Newsletter
Project Number:	2002MS16B
Start Date:	3/1/2001
End Date:	2/28/2003
Funding Source:	104B
Congressional District:	Third
Research Category:	Not Applicable
Focus Category:	None, None, None
Descriptors:	Newsletter
Principal Investigators:	Jeffery A. Ballweber

Publication

1. LORE (Lakes, Oceans, Rivers & Estuaries) Newsletter published quarterly (February, May, August, November), Mississippi Water Resources Research Institute, Mississippi State, MS, 4 pgs.

INFORMATION TRANSFER PROGRAM - NEWSLETTER

PROBLEM AND RESEARCH OBJECTIVE

The need to inform researchers, policy makers, and the interested public about the Institute's activities, the annual conference, and funding opportunities.

METHODOLOGY

The Mississippi Water Resources Research Institute's quarterly newsletters – LORE – include 1) request for proposals for USGS competitive grants, 2) a "call for abstracts" for the annual conference, 3) the conference program and 4) summarizes activities at the conference.

SIGNIFICANCE

The newsletter is one of the Institute's primary mechanisms to inform federal, state, and regional agencies in Mississippi and the interested public about the Institute's activities.

Information Transfer Program - Publications

Basic Information

Title:	Information Transfer Program - Publications
Project Number:	2002MS17B
Start Date:	3/1/2001
End Date:	2/28/2003
Funding Source:	104B
Congressional District:	Third
Research Category:	Not Applicable
Focus Category:	None, None, None
Descriptors:	Publications
Principal Investigators:	Jeffery A. Ballweber

Publication

1. 2002, "In Review" for Fiscal Year 2001-2002, Mississippi Water Resources Research Institute, Mississippi State, MS, 28 pgs.
2. 2002, "Annual Report: 2001-2002", Mississippi Water Resources Research Institute, Mississippi State, MS, 28 pgs.

INFORMATION TRANSFER PROGRAM - PUBLICATIONS

PROBLEM AND RESEARCH OBJECTIVE

It is necessary for Mississippi State University, political and administrative decision-makers, and the interested public to have a mechanism to evaluate the Institute's effectiveness.

METHODOLOGY

These mechanisms take two related but separate forms: 1) a Mississippi State University reporting requirement which encompass a variety of other multi-disciplinary water and related land management research funded through the Institute and related information about the extent and sources of the Institute's funding; and 2) a discretionary annual report that includes a summary of these assorted projects, their accomplishments, researchers associated with the Institute, and students supported by these projects.

SIGNIFICANCE

The MSU report is necessary for the University to evaluate the effectiveness of the Institute in meeting its mission and goals. The *In Review* publication is discretionary but has historically provided a timely concise overview of the Institute's activities and associated researchers and students. This discretionary publication is undoubtably the Institute's most widely distributed publication and informs key political and administrative offices about the Institute's direction, goals and accomplishments as reflected by the breadth of researchers, students and projects associated with the Institute.

Student Support

Student Support					
Category	**Section 104 Base Grant**	**Section 104 RCGP Award**	**NIWR-USGS Internship**	**Supplemental Awards**	**Total**
Undergraduate	6	0	0	0	6
Masters	6	0	0	0	6
Ph.D.	2	0	0	0	2
Post-Doc.	0	0	0	0	0
Total	14	0	0	0	14

Notable Awards and Achievements

Ervin - Strawberry Plains Audubon Center managers installed water control structures in two areas to be managed as moist-soil habitat and repaired the levee on the third managed area. Water control structures were to be donated by Ducks Unlimited. Audubon has installed stage height gages in two of the six sites selected for continued monitoring during 2003-2004.

Ervin - Monitoring data continue to be collected, at bi-monthly intervals for general field parameters, less frequently for other variable, such as suspended solids, chlorophyll, and nutrient concentrations. In addition to vegetation analyses, further biotic data are being collected on amphibians and macroinvertebrates during the 2003 field season. Audubon is purchasing four automated recorders for collecting data on amphibian use of the sites, and Brook Herman is collecting macroinvertebrate samples as part of her thesis research.

Ervin - Results to date were presented in a poster at the annual Mississippi Water Resources meeeting in April 2003, which also was submitted for publication in the Proceedings. The presentation was entitled, "Assessing functional integrity of moist-soil managed wetlands by comparison with nearby non-managed systems." Results to date also were presented at the monthly meeting of the Oktibbeha Audubon Society on March 13, 2002. The presentation was entitled, "Wetlands research at the Strawberry Plains Audubon Center: Monitoring ecosystem integrity of managed areas."

Willett - Research is ongoing to the characterize the utility of a recently discovered cytochrome, CYP1B1, as a marker of exposure to Mississippi sediment contaminants in channel catfish. A research paper has been submitted to Marine Envrionmental Research for peer-review and publication.

Willett - Four platform or poster presentations have been made at regional and national scientific meeetings (including one by a student who received a 3rd place presentation award).

Davidson - (Wetland at Sky Lake, Mississippi) Tracked the isotopic and chemical composition of precipitation, surface water and groundwater over one year. Documented very low hydraulic conductivity of sediments in the range of 1.8 to 3.0 m. Documented that changes in water chemistry between 0.6 and

3.0 m do not respond quickly to precipitation or changes in lake level. Installed a second set of three piesometer nests with piezometers completed at depths of 0.25, 0.50, 0.75, 1.0, 2.0 and 3.0 m. (The three shallow piezometers will be used for chemical and isotopic sampling to measure changes closer to the sediment surface. The l.0, 2.0 and 3.0 m piezometers will be used only for monitoring hydraulic head, and all contain dedicated data-logging pressure transducers.)

Publications from Prior Projects