Mississippi Water Resources Research Institute Annual Technical Report FY 2007

Introduction

The Mississippi Water Resources Research Institute (MWRRI) provides a statewide center of expertise in water and associated land use and serves as a repository of knowledge for use in education, research, planning, and community service.

The MWRRI goals are to serve public and private interests in the conservation, development, and use of water resources; to provide training opportunities in higher education whereby skilled professionals become available to serve government and private sectors alike; to assist planning and regulatory bodies at the local, state, regional, and federal levels; to communicate research findings to potential users in a form that encourages quick comprehension and direct application to water related problems; to assist state agencies in the development and maintenance of a state water management plan; and to facilitate and stimulate planning and management that:deals with water policy issues, supports state water agencies' mission with research on problems encountered and expected,and provides water planning and management organizations with tools to increase efficiency and effectiveness.

Research Program Introduction

The Mississippi Water Resources Research Institute (MWRRI) conducts an annual, state−wide competitive grants program to solicit research proposals. Proposals are prioritized as they relate to the research priorities established by the MWRRI Advisory Board and by their ability to obtain Letters of Support or External Cost Share from non−federal sources in Mississippi. The MWRRI's External Advisory Board then evaluates all proposals. Based on the most current list of research priorities, these would include: water quality, surface and groundwater management, water quality management and water resources development, contaminant transport mechanisms, wetlands and ecosystems, groundwater contamination, as well as other issues addressing coastal and marine issues linking water associations through the state, and institutional needs that include capacity building and graduate student training.

Assessing the effectiveness of streamflow augmentation in the Sunflower River to maintain water quality and wetland integrity

Basic Information

Title:	Assessing the effectiveness of streamflow augmentation in the Sunflower River to maintain water quality and wetland integrity
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Descriptors:	
Principal Investigators:	Gary N. Ervin, Todd Tietjen

Publication

1. Ervin, G.N. and M.J. Linville (2006). The landscape context of plant invasions in Mississippi wetlands. Pgs. 34−41 in Proceedings of the 36th Annual Mississippi Water Resources Conference, Jackson, MS.
2. Tietjen, T. and G.N. Ervin (2007). Water Quality and Floristic Quality Assessments of the Big Sunflower River Following Streamflow Augmentation using Groundwater. CD ROM. 37th Annual Mississippi Water Resources Conference, Jackson, MS.
3. Tietjen, T.E. and G.N. Ervin (2007) Stream restoration in the Mississippi alluvial valley: Streamflow augmentation to improve water quality in the Sunflower River, Mississippi, USA. Ecological Society of America/Society for Ecological Restoration International Conference, San Jose, CA, August 5−10, 2007.
4. Tietjen, T.E. and G. Ervin (2008). Big Sunflower River Water Quality Assessments Following Streamflow Augmentation. 38th Annual Mississippi Water Resources Conference, Jackson, MS. Book of Abstracts, p. 21.

Final Report

Project title: ***Assessing the effectiveness of streamflow augmentation in the Sunflower River to maintain water quality and wetland integrity.***

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Abstract

An evaluation of the ecological and water quality effects of groundwater supplementation into the Big Sunflower River in Coahoma and Sunflower Counties in the Mississippi Alluvial Valley was undertaken. This project consisted of monitoring water quality and vegetation data in a small set of target wetlands and stream reaches along a longitudinal gradient from just upstream of groundwater augmentation wells to just north of Indianola, MS. Basic water quality data, including temperature, dissolved oxygen, specific conductance, pH, and turbidity, were measured along these transects to collect data in relation to groundwater supplementation cycles and normal daily fluctuations. These integrative measures complemented both the basic water quality data and the floristic assessments, providing information on intermediate time frame effects. Vegetation in floodplain wetlands and within the riparian areas immediately surrounding the river at each sampling point along the upstream to downstream transect were also evaluated throughout the growing season, during periods of water quality data collection.

Overall the findings suggest that there are modest improvements in the overall system associated with augmented stream flow. Water quality parameters generally remained in an acceptable range during periods of flow augmentation and there were indications of improved riparian vegetation communities in reaches of the river which have received supplemental flow for many years. While flow augmentation does not address the underlying problem of over pumping of groundwaters, it does provide some value in remediating these withdrawals.

Project title: ***Assessing the effectiveness of streamflow augmentation in the Sunflower River to maintain water quality and wetland integrity.***

Statement of critical regional water problems to be addressed:

This project was focused on the wetland and water quality impacts of groundwater supplementation to a major stream in the Lower Mississippi Alluvial Valley (LMAV). *The research addressed Mississippi water research priorities by directly quantifying water quality and wetlands health in the Sunflower River basin*, a river whose base flows have been supplemented for a number of years as a result of aquifer withdrawals for agricultural use. The Yazoo Mississippi Delta Joint Water Management District (YMD) has been managing both surface and groundwater supplies in an effort to balance the needs of agricultural water resources use with maintenance of adequate ecosystem quality in the Sunflower River and adjacent floodplains, guided to a large extent by Mississippi DEQ TMDL guidelines for the Sunflower system.

This research has benefited YMD directly as a result of a partnership that has been formed between investigators at Mississippi State University and YMD personnel. The needs of YMD include a quantitative evaluation of the ecological effects of their water management efforts and guidance on how to best plan future activities.

Statement of results, benefits, and information provided:

This project enhanced the capacity of water district managers to optimize loading of supplemental groundwater to surface streams during critical periods by providing: (1) an assessment of in-stream and floodplain ecological condition during markedly different hydrologic regimes in the Big Sunflower drainage system, (2) simultaneous quantitative evaluation of the effects of streamflow augmentation on aquatic resources and adjacent wetlands, and (3) an initial quantification of the response of biotic and abiotic parameters to a range of discharge augmentation (from no supplementation to maximal rates with existing infrastructure). As such, this project increased the efficacy with which water district managers can plan and implement programs to augment surface water flows and storage within the LMAV in an effort to balance societal and ecological needs.

Nature, scope, and objectives of the research

The Big Sunflower River in west Mississippi is listed on the EPA Section 303(d) list of Impaired Waterbodies for Mississippi. Substantial decreases in the Sunflower River's late summer/early autumn base flows, as a result of agricultural withdrawals from the Mississippi River Valley Alluvial Aquifer (MRVAA), likely have contributed to the degraded condition of the river (Holmes 2004, YMD 2005). Prior to 1975-1980, minimum discharge rates recorded in the Big Sunflower River at Sunflower, MS seldom fell below 100 cubic feet per second (cfs). During the next ten years, however, minimum base flow averaged approximately 35cfs, and did not exceed 20cfs from 1986 to 1990 (Fig. 1).

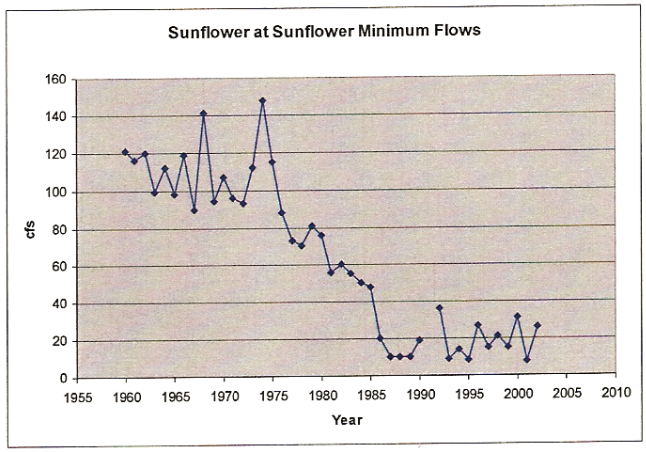

Figure 1. Minimum base flows in the Big Sunflower at Sunflower, MS. Data from YMDJWMD, 2005.

A critical period of low base flow occurs annually during late summer and early autumn (YMD 2005). Prior to this period, discharge in the Sunflower River is augmented by irrigation runoff from surrounding agriculture, which comprises about 78% of the Sunflower drainage (MS DEQ 2003). Following the critical September – November period, discharge typically increases as a result of greater precipitation and decreased evapotranspiration during the winter/spring seasons (USGS data and Dean Pennington, YMD, personal communication). Supplementation of base flows from mid-September through November with discharges of cooling water from the Clarksdale Public Utilities' Wilkins power plant helped to increase minimum base flows from the 1986-1990 average of about 14cfs to just over 20cfs during 1991 through 2004. In 2005, however, a new well field came online near the head of Whittaker Bayou in Coahoma County that is planned with an eventual capacity to maintain a base flow of 50 to 60cfs in the Big Sunflower River, south of Clarksdale – a level that is less than half the long-term mean for that section of the river (Fig. 2). During its initial year of operation (2005), flows were augmented by approximately 30cfs with only six of the eleven wells in operation, and flows during mid to late October thus were maintained above 60cfs (Fig. 2).

Although the new well field has the physical capacity to contribute to improved base flow rates in the Sunflower River, it is not yet clear how this surface water supplementation will affect water quality and associated biota. Furthermore, it is not known whether potential improvements of water quality or biota will depend on the degree of flow supplementation. That is, should flows be maintained at the expected maximum of 60cfs – or are there other optimal flow regimes that could be managed through augmentation, thus permitting additional water to be pumped into nearby wetlands for surface storage?

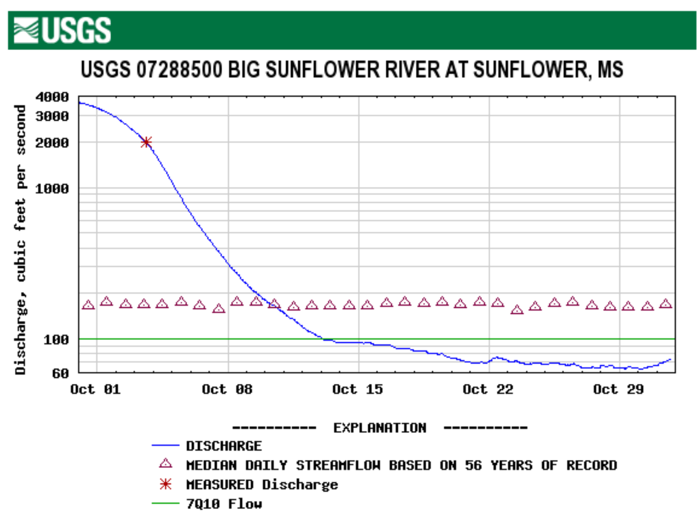

Figure 2. October discharge at the USGS Sunflower, MS gaging station. Note that base flows of 60cfs are less than half the long-term mean for this station. Data from USGS http://waterdata.usgs.gov/nwis/rt

The objectives of the project were to evaluate the effects of groundwater supplementation to the Big Sunflower River in Coahoma, Bolivar, and Sunflower Counties with respect to water quality parameters, and adjacent floodplain wetlands. *Specifically, we evaluated a suite of biotic and abiotic parameters during three hydrologically distinct periods in the Sunflower system, and at three levels of base flow supplementation during one of those periods.* Base flow manipulation during the September – November low-flow period will be carried out by the Yazoo Mississippi Delta Joint Water Management District (YMD), using the well field at Friars Point/Whittaker Bayou (Coahoma County).

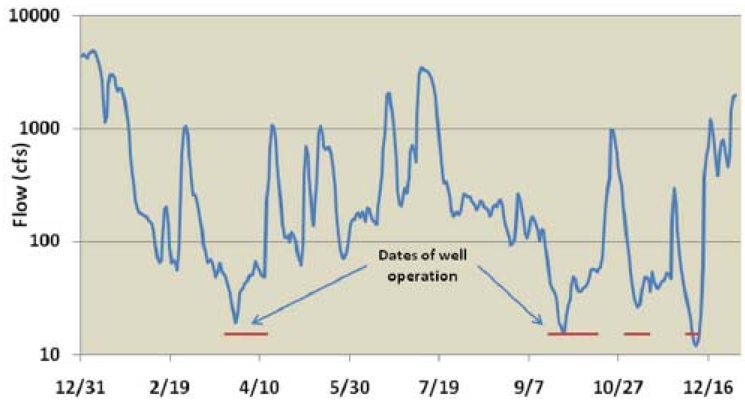

Figure 3. Periods during 2007 when wells were used to augment natural flows of the Big Sunflower River.

The results of this research will enhance management of LMAV surface waters for human use, wildlife value, and water quality by providing: (1) an assessment of in-stream and floodplain ecological condition during markedly different hydrologic regimes in the Big Sunflower watershed, (2) simultaneous quantitative evaluation of the effects of streamflow augmentation on aquatic resources and adjacent wetlands, and (3) an initial quantification of the response of biotic and abiotic parameters to a range of discharge augmentation (from no supplementation to maximal rates possible with existing infrastructure). As such, this project will increase the efficacy with which water district managers can plan and implement programs to augment surface water flows and storage within the LMAV in an effort to balance societal and ecological needs.

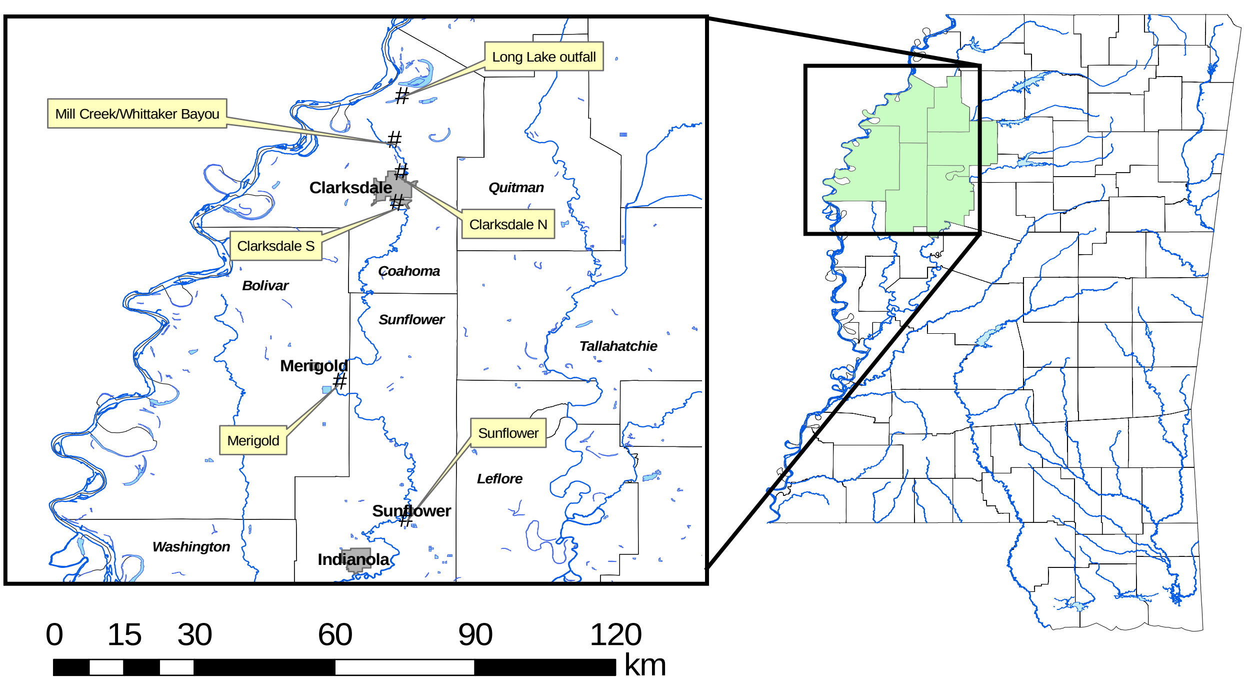

Figure 4 Location of sampling sites along the Sunflower low-flow supplementation route, from the Long Lake outfall to south of Sunflower, MS. Labeled symbols represent the 6 sampling locations.

Methods, procedures, and facilities

Study Sites

In cooperation with the YMD Executive Director, Dr. Dean Pennington, six sampling sites were selected along the Big Sunflower River, in Coahoma, Bolivar, and Sunflower Counties for riparian vegetation analysis. These sites were selected such that we could quantify aquatic and wetland attributes at the (1) outfall from Long Lake (through which groundwater is fed on its way to the Sunflower River), (2) junction of Mill Creek and Whittaker Bayou/Big Sunflower River, (3) Sunflower just north of Clarksdale (the first urban area through which the Sunflower passes; population approx. 21,000), (4) Sunflower just south of Clarksdale, beyond the outfall of the Clarksdale treatment facility, (5) Sunflower just south of Merigold, and (5) USGS gaging station (#07288500) south of Sunflower, MS (Fig. 4).

Additionally, 13 water quality sampling sites (Fig. 5) were selected between the well field receiving stream and Indianola, MS. All sampling locations were located at road/bridge crossings of the Big Sunflower River or its tributaries. Sites were selected to include water soon after being pumped out of the ground, downstream of Long Lake, upstream and downstream of Clarksdale, and at additional sites downstream to north of Indianola.

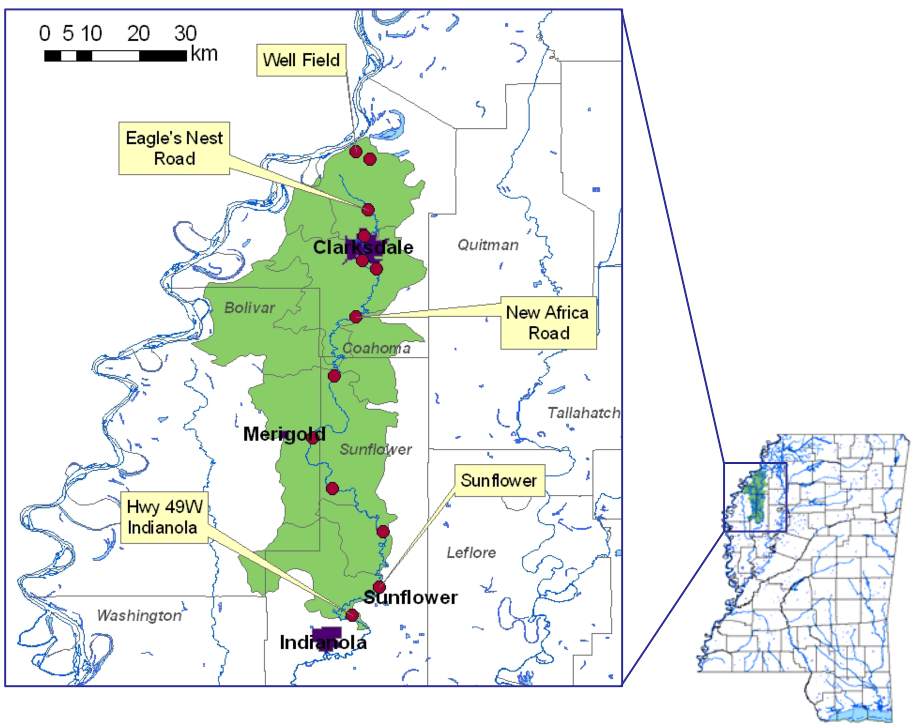

Figure 5. Location of water quality sampling sites on the Sunflower River, the YMD well field outlet, and Long Lake.

Sampling period

Treatment intervals were defined by the prevailing discharge conditions that occur at different times during the year. During the winter and spring flow is maintained naturally in the Sunflower River by a combination of rainfall and groundwater discharge. Beginning in the late spring and continuing through the summer months river discharge is maintained primarily by runoff of irrigation water being applied to the surrounding agricultural lands. Following the reduction in agricultural irrigation discharge decreases dramatically during September. It is during this period that streamflow augmentation occurs. Three different experimental regimes are proposed: no augmentation, low level augmentation (~10 cfs or 0.28 $m^3 s^{-1}$), and a high level augmentation (~60 cfs or 1.7 $m^3 s^{-1}$). Sampling will occur once during the winter-spring period, once during the summer period, and during the 3 different augmentation periods in the fall.

Table 1. Water quality sampling location details.

Site Name	GPS Coordinates	River km Downstream from Well field
Well Field	N34 22.7460 W90 35.3160	0
Friars Point Road	N34 21.8661 W90 33.7140	4.42
Eagles Nest Road	N34 16.0753 W90 33.9579	17.82
Lee Drive, North Clarksdale	N34 13.1218 W90 34.3933	28.47
Hwy 61 bypass, South Clarksdale	N34 10.3138 W90 34.6184	36.06
Hopson Road crossing	N34 09.3590 W90 33.0020	39.61
New Africa Road	N34 03.8471 W90 35.3565	58.51
Shelby Road	N33 57.0049 W90 37.7763	85.57
Drew-Merigold Road	N33 49.9155 W90 40.2789	107.72
Dockery Plantation	N33 44.0805 W90 38.0567	124.64
Hwy 442	N33 39.1131 W90 32.2515	145.16
Torry Road, Sunflower	N33 32.8300 W90 32.6488	166.02
Hwy 49W, Indianola	N33 29.5472 W90 35.7874	192.58

Data collection

Water quality

Chemical measures of water quality – Water quality has been evaluated in the Sunflower River at the sites described above. Additionally samples of the pumped water were collected before and after passage through Long Lake. These sampling sites enabled us to differentiate the effects of several different ecosystem components: the effect of water passage through Long Lake, the effect of streamflow augmentation on the Sunflower River baseflow conditions, and the combined effects of flow augmentation and wastewater effluent.

Instrument-based water quality sampling was carried out using Eureka Environmental's, Manta water quality system. This instrument will be used to record temperature, pH, dissolved oxygen concentrations, specific conductance and turbidity. These parameters are useful in assessing the changes in water quality following the addition of well water to the stream, as well as changes that occur as the water moves downstream in the Sunflower River. Specific conductance (i.e. salinity) is particularly useful for tracing the movement of water parcels as the groundwater used to supplement river flow has significantly higher specific conductance (~700 $\mu S\ cm^{-1}$) than do many of the surface waters of the Mississippi Delta region (~400 $\mu S\ cm^{-1}$). Using specific conductance as a surrogate allows for the prediction of other the travel of other potential contaminants. By diluting the inputs from wastewater treatment facilities discharging to the Sunflower River it is believed that the depletion of dissolved oxygen will be reduced. Measuring dissolved oxygen at different times during the day allowed a more comprehensive analysis of the benefits of this management approach as the effects can be integrated over longer periods of time than are possible using time-specific grab samples and analysis for biochemical oxygen demand.

Vegetation

The ecological "quality" of wetland vegetation was assessed with an approach termed Floristic Assessment Quotients for Wetlands (FAQWet indices). Vegetation in each wetland was surveyed by walking transects such that all readily discernible vegetation zones were included. All vascular plant species observed along these transects will be recorded. Representatives of all species which could not be identified on site were collected for positive identification in consultation with botanical keys, herbarium specimens, or regional taxonomists. For each species identified, the wetland indicator status was determined in consultation with Reed (1988) and native status determined by consulting the PLANTS database (USDA NRCS 2005), along with other appropriate keys when possible (e.g., FNAEC 1993+).

For calculation of FAQWet values, wetland indicator status will be represented on a scale of -5 to +5, values referred to as "wetness coefficients" by Herman et al. (1997). Species assigned the UPL indicator status (occur in wetlands with only a 1% probability) are assigned a values of -5, OBL species (99% probability of occurring in wetlands) are scored as +5, and other intermediate levels of indicator status are scored accordingly (Ervin et al. 2005). The FAQWet values then will be calculated as:,

$$\frac{\sum WC}{\sqrt{S}} \times \frac{N}{S}$$

where *WC* is the wetness coefficient, *N* is the number of native species, and *S* is total plant species richness.

This equation is a modification of the Floristic Quality Assessment Index (FQAI), which has been used extensively in the Midwest (Andreas and Lichvar 1995; see *Related research: Wetlands vegetation assessment*). Rather than using wetness coefficients, the FQAI requires data on coefficients of conservatism for all plant species recorded. Coefficients of conservatism represent regional plant species conservation value, and usually are determined through consultation with panels of regional botanists or other taxonomic experts. Such values have been determined for the flora of areas of the US which have been extensively documented (e.g., Ohio, Illinois, Indiana), but are lacking for most of the nation. Coefficients of conservatism were developed for the 400+ species encountered during our work in 2004, but many more species occur within the state for which coefficients are unavailable. Thus, the FAQWet is currently the only such method available for widespread use in much of the United States and was developed and tested in Mississippi wetlands. The efficacy of this method is discussed below (*Related research: Wetlands vegetation assessment*).

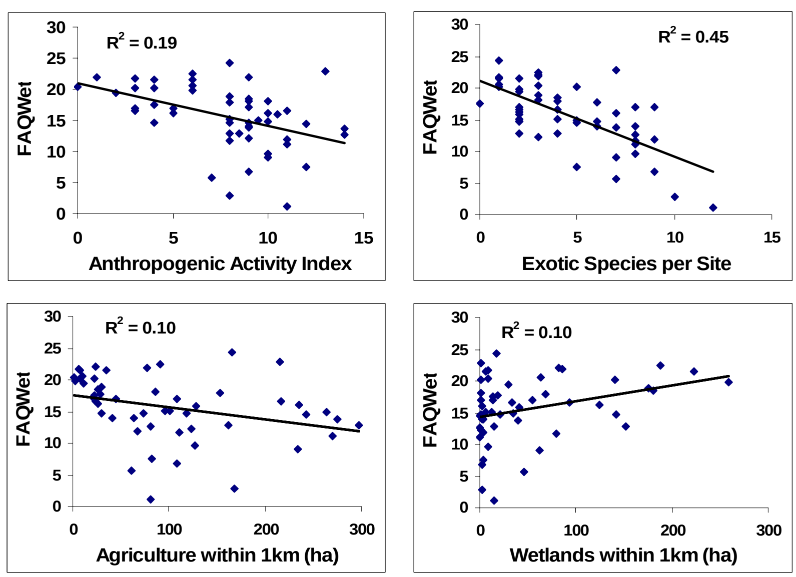

Figure 6. Correlations of FAQwet Scores with properties of Mississippi wetlands and surrounding landscapes. Anthropogenic Activity Index, a modification of methods used in Michigan and Ohio, ranges from 0 (unimpacted wetlands) to 15 (heavily impacted wetlands). Agriculture and wetland land cover were derived from MS GAP data (Vilella et al. 2003).

<u>Related research</u>

Stream flow augmentation

The supplementation of natural levels of stream discharge is emerging as a management option for effectively mitigating a number of environmental conditions. This technique has been used by others to mitigate human induced changes in aquatic conditions for fish, invertebrates, and in rare circumstances plant communities (Henszy et al 1991, Harris et al 1991, Travnichek at al 1995, Cereghino and Lavandier 1998, Propst and Gido 2004).

The most common application of this technique has been to supplement streamflows by modifying hydropower discharge in order to provide a more stable physical environment. While the means of flow augmentation is clearly different in this proposal the positive effects are likely to be repeated. The addition of water in order to stabilize the environment has been demonstrated to benefit plant communities, native fish populations and sportfish communities.

The augmentation of streamflow in order to derive the water quality benefits anticipated through in this study is far less common. There are numerous uncited, unformalized examples of streamflow augmentation utilizing treated wastewater effluent to increase disharge. In these cases the quality of the water has typically been degraded to such an extent that treated wastewater is adequate. As noted above a second common practice is to alter the discharge from impoundments in order to stabilize flows. While these studies have demonstrated positive results, they are not analgous to the conditions of the Sunflower River. Studies which employed high quality groundwater as the supplemental flow source are uncommon.

Wetlands vegetation assessment

Assessment of wetlands vegetation has lagged far behind other components of bioassessment in wetland and aquatic systems. The primary method that has been used for assessing wetlands vegetation is the Floristic Quality Assessment Index (FQAI). This approach was developed and has been used widely in mid-western states whose flora are well-studied (Illinois: US EPA 2002; Wisconsin: Nichols 1999; US EPA BAWWG 2005; Ohio: Andreas and Lichvar 1995; Lopez and Fennessy 2002; and Michigan: Herman et al. 1997), and more recently in Florida in the southeast (US EPA BAWWG 2005). Vegetation assessment indices are attractive management and assessment tools because herbaceous plants respond rapidly to both improvement and degradation of ecosystem health, plants integrate disturbance at numerous biological scales (from point-source pollutant discharge to non-point sources such as urbanization and siltation), and numerous regional keys exist for relatively efficient species-level plant identification (vs. identification of aquatic invertebrates, difficult even to the level of Family in some cases) (Lopez et al. 2002).

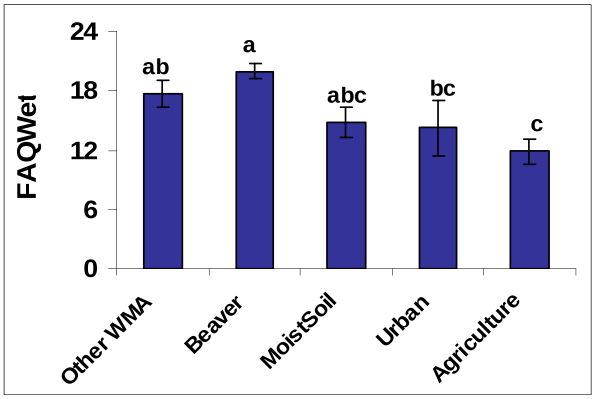

Figure 7. Relative quality of wetland vegetation by wetland type, based on FAQWet scores. Moist-soil wetlands are managed actively for waterfowl, "Other WMA" wetlands are those not intensively managed.

Modifications to the FQAI (termed Floristic Assessment Quotients for Wetlands, or FAQWet indices) have proven successful at representing landscape- and local-scale human disturbance to Mississippi wetlands (Ervin and Herman 2005, Ervin et al. 2005). These FAQWet indices incorporate wetland adaptedness and proportional dominance of native plant species of wetland plant assemblages, two traits suggestive of ecological "health" in wetland ecosystems. Values for FAQWet assessments were negatively correlated with human activities in and around wetlands, especially agriculture, and with exotic species richness in the wetlands (Fig. 6). On the other hand, increasing density of wetlands in the surrounding landscape was correlated with higher FAQWet scores (Fig. 6). Perhaps more telling of the efficacy of the FAQWet Index as an assessment tool were patterns of FAQWet scores among wetland categories (Fig. 7).

Evaluation of the FAQWet index was carried out with data collected primarily in herbaceous-dominated depressional wetlands. The predominant natural wetland types in the LMAV are beaver-created wetlands along stream channels and wetlands associated with oxbow within the river floodplains. Both types of wetland frequently are dominated by an herbaceous plant assemblage, and beaver wetlands comprised a large fraction of wetlands used to develop the FAQWet approach. Oxbow wetlands were not tested in the previous work, thus this project will additionally serve as an initial demonstration of the effectiveness of FAQWet in oxbow ecosystems.

Results and Discussion

Riparian vegetation assessment on the Sunflower River during 2006 used the FAQWet Index (Ervin et al. 2005, 2006) as one of several means of assessing riparian vegetation. These analyses suggested the FAQWet was not the most sensitive metric for use with riparian vegetation in the Delta. Parameters that did indicate vegetation differences between the Sunflower River upstream, versus downstream, of the city of Clarksdale (where streamflow augmentation has occurred for a number of years, via discharges of cooling water from the Clarksdale Public Utilities' Wilkins Power Plant) included life history parameters such as monocot versus dicot species, growth form, and species classified as invasive by the Southern Weed Science Society (Figure 8). Plant assemblages north of Clarksdale typically contained weedy, early successional suites of species dominated by herbaceous plants. The differences observed are suggestive of greater impacts of disturbance on riparian areas north of Clarksdale; it is not known whether that disturbance resulted from increased effects of drought in areas that have not received supplemental streamflows, increased buffering against agricultural activities by wider downstream riparian zones, or other factors.

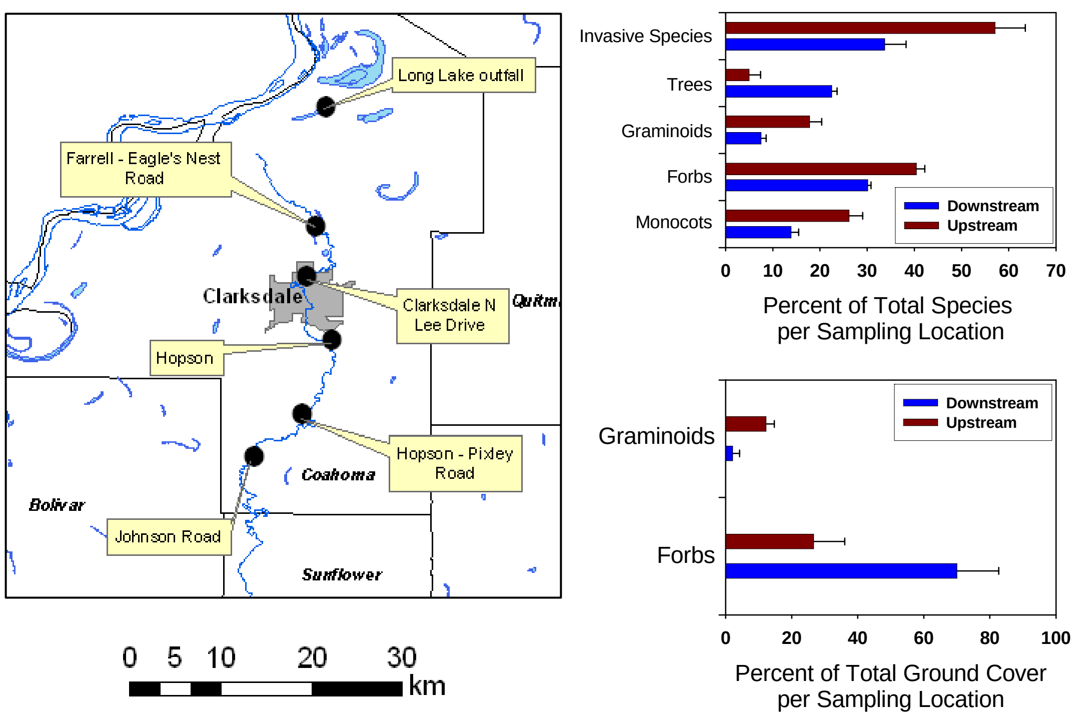

Figure 8. Riparian vegetation data from the Sunflower River during 2006. Data represent comparisons with significant differences between sites upstream of and downstream from Clarksdale. Sites were located as symmetrically as possible upstream and downstream of the center of Clarksdale.

Results were very similar for vegetation data collected in 2007 (Figure 9). Areas upstream of Clarksdale were occupied by more invasive species, fewer perennials (especially trees), and more broad-leafed herbaceous vegetation (forbs). The consistency in these data between years suggests that real differences may exist in vegetation in the upper reaches of the Sunflower, in comparison to lower reaches. However, those differences could be caused by any one or more of numerous factors, as mentioned above.

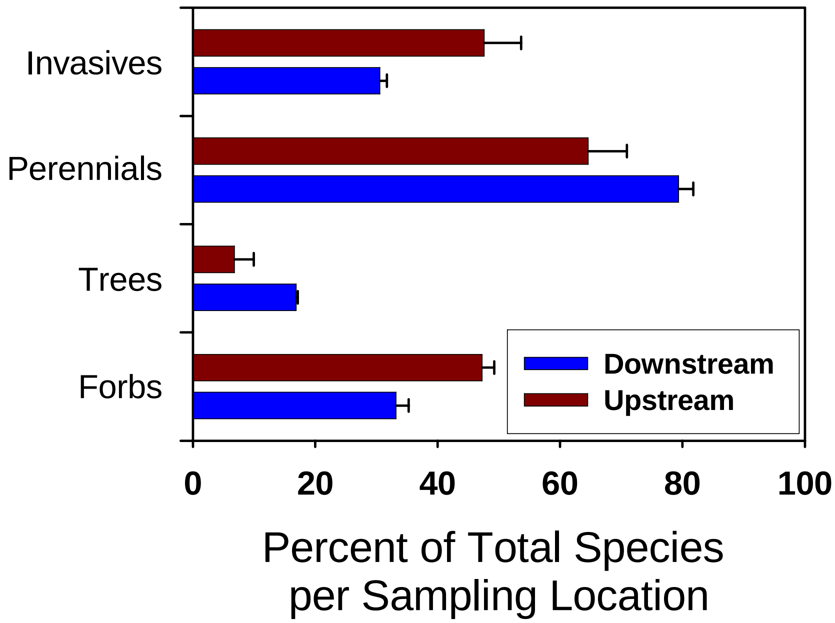

Figure 9. Riparian vegetation data from the Sunflower River during 2007. Data represent comparisons that exhibited significant differences between sites upstream of and downstream from Clarksdale. Except for Hopson-Pixley Road, all sites were located at the same river position in 2006 and 2007. The 2006 sampling site at Hopson-Pixley Road was inaccessible in 2007, and the nearest accessible riparian area was substituted.

Water quality showed similar trends across parameters; in general conditions were dictated by the time of year, secondarily by the impact of rainfall/discharge events, and thirdly by discharge from the City of Clarksdale, MS.

Temperature data (Fig. 10) demonstrates the seasonal impact most profoundly with cooler temperatures during the winter months (blue colors) and warmest temperatures during the summer months (red colors). The warming influence of winter storms, December of both years. Also during the summer of 2007 "pockets" of cool water can be identified downstream of the City of Clarksdale, likely associated with releases from their power plant cooling operations. Overall patterns of temperature were consistent across the entire length of the river sampled. While it is difficult to ascertain from this data set it is unlikely that streamflow augmentation will have an impact on river temperatures given the high inputs of solar radiation.

Dissolved oxygen concentrations (Fig. 11) showed a similar level of consistency seasonally but greater variation along the length of the river. It is clear that dissolved oxygen conditions are primarily driven by river temperatures, as warmer water has a reduced capacity to "retain" dissolved oxygen. This pattern is evident in the winter months dominated by high dissolved oxygen conditions and the spring and summer months when concentrations decline. As with the temperature data the impact of the December 2006 inflow event is visible along the length of the river, resulting in decreased oxygen concentrations. The impact of the City of Clarksdale wastewater treatment plant effluent is observed through the reduced dissolved oxygen concentrations between river kilometers ~35 and 50. As with the overall trend this pattern is exaggerated during the warm spring and summer months. A second region of reduced oxygen waters appears several times in the lower 100 river kilometers. This region is not associated with any specific population center and likely is a result of diffuse inputs from agricultural production in the region. It is likely that the streamflow augmentation activities decreased the number of fall low dissolved oxygen events by keeping more water in the river, keeping this water moving (facilitating atmospheric exchange), and by maintaining a more stable aquatic environment for primary producers.

Specific conductance (Fig. 12) was included in the suite of analytical parameters to evaluate the downstream impacts of the augmentation water on the overall system. As indicated by figure 12 there was a slight increase in specific conductance at the augmentation site, but this impact was reduced in the first 10-15 km of river travel. A larger, more persistent impact was associated with the City of Clarksdale wastewater treatment plant effluent. The effluent typical increased specific conductance by several hundred units, though as with the augmentation water this impact was diluted within 10-15 km. As with the other parameters overall patterns were fairly consistent along the length of the river for any given sampling date and rose and fell with discharge events, evaporative concentration of salts, and diffuse inputs from the watershed.

Turbidity (Fig. 13) is the parameter least impacted by seasonal patterns, instead being controlled more closely by recent rainfall and runoff conditions. Several significant input events can be observed in the data during November of 2006 and February, May, and September of 2007. The September 2007 sampling event apparently occurred before the impact of this input had extended throughout the sampling reach as turbidity values decreased over the last 80-100 km of river. Unfortunately this data does not provide insight into the source of turbidity that is being measured. During storm events and other inflows the turbidity will be primarily of inorganic nature, consisting of fine clay and silt particles. During extended periods of low flow it is possible for significant phytoplankton populations to develop. These phytoplankton will have a the same result on measured turbidity as the inorganic particles, dramatic increases, though the phytoplankton would be expected to persist until temperatures cooled, there was a significant “flushing” of the water, or nutrient limitation reduced their productivity. Overall the streamflow augmentation probably had the smallest impact on turbidity of all of the parameters considered, as it is most likely to be regulated by local rather than system wide conditions. A notable example of this, as has been noted for other parameters, is the influence of the City of Clarksdale wastewater treatment plant. Several times during the sampling period increased values were obtained downstream of this site, sometimes producing the highest measured turbidity for the date.

Overall streamflow augmentation has been demonstrated to provide long term benefits to the riparian plant communities and it is expected that these benefits would impact the overall system if flows were maintained for many years. The increase in riparian plant quality will lead to increased habitat, food resources, and shoreline stability for the system overall. The water quality benefits of augmentation are more difficult to quantify as, under the most extreme conditions, without augmentation there would not have been water to sample. It is clear that the augmentation does not negatively impact water quality in the overall system as any impacts of the groundwater are rapidly reduced (within 10-25 km of stream travel) and it is likely that the addition volume of water traveling through the system reduces the impact of wastewater introduction at Clarksdale and non-point source introduction from agriculture through the drainage.

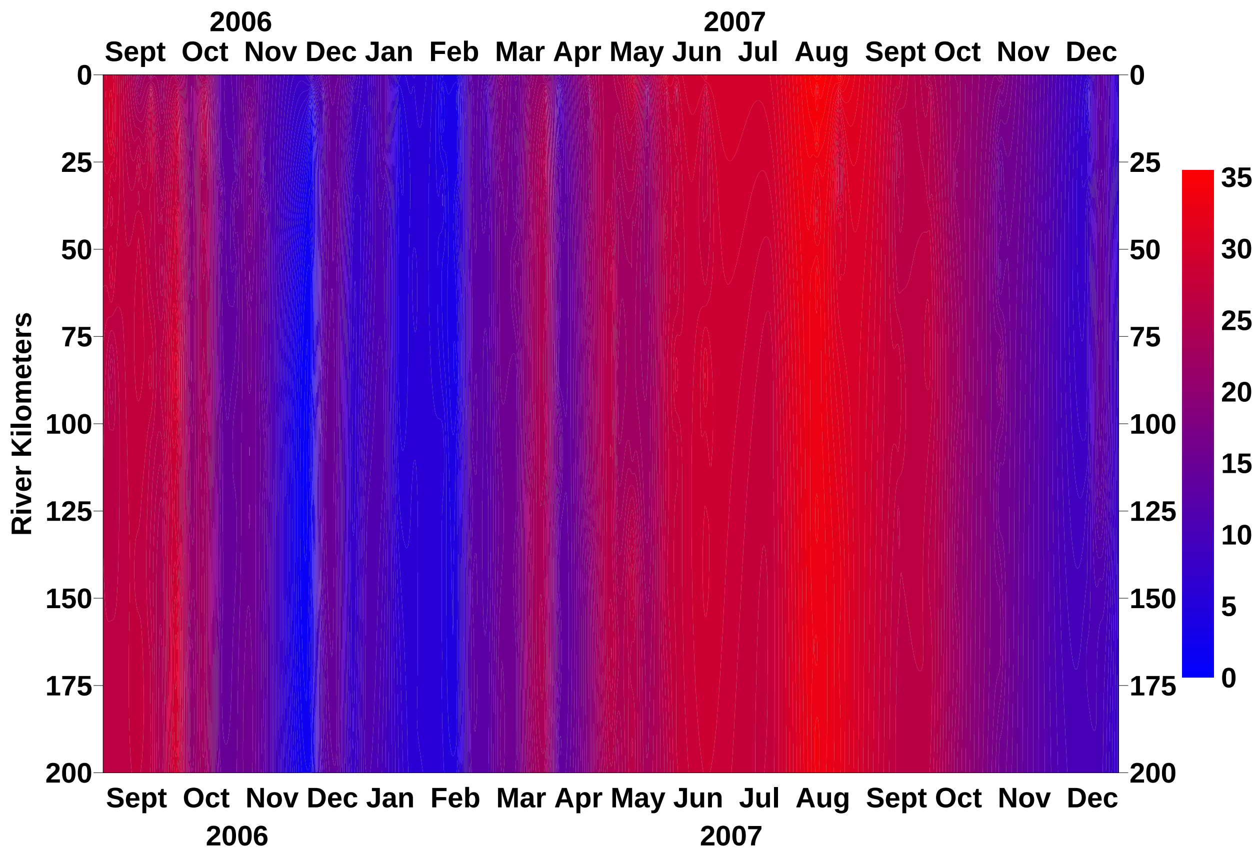

Figure 10. Temperature (°C) patterns in the Big Sunflower River.

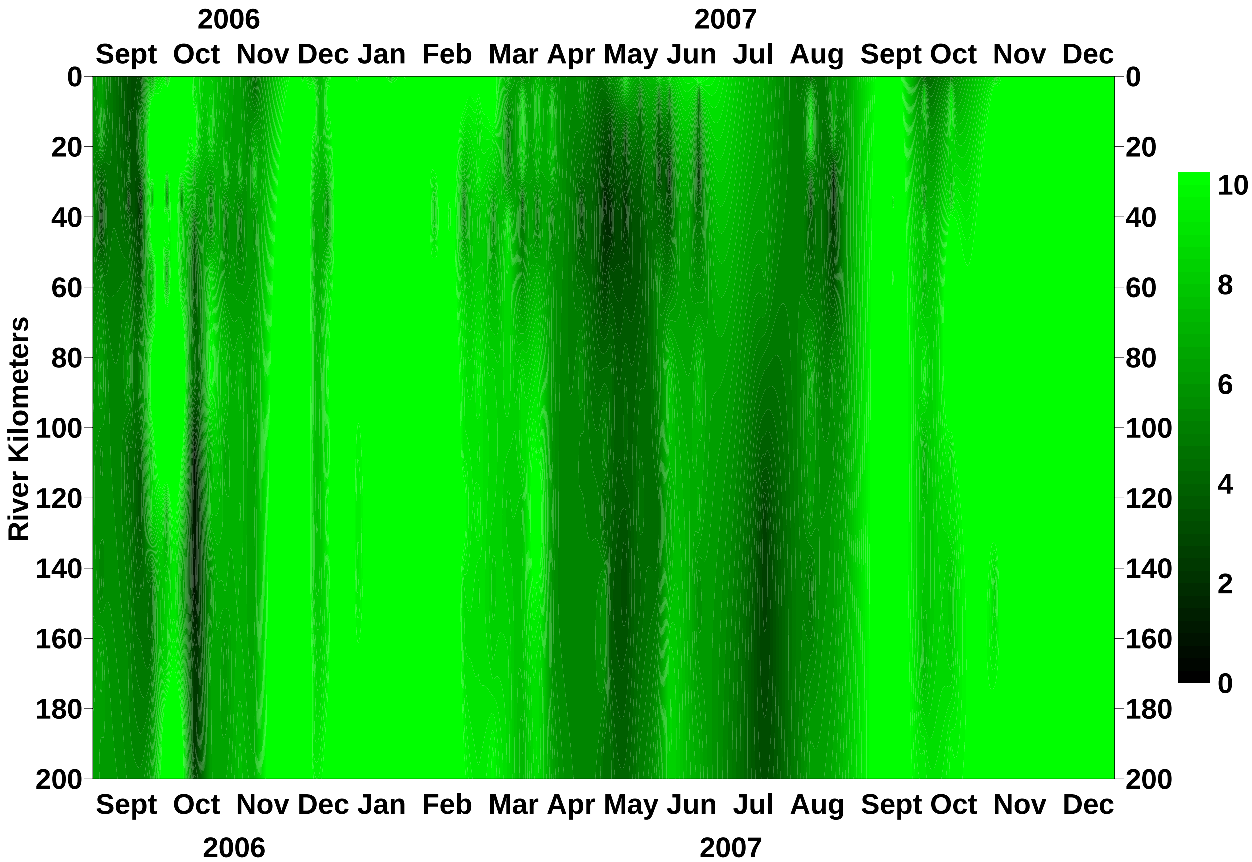

Figure 11. Dissolved oxygen (mg O_2 L^{-1}) patterns in the Big Sunflower River.

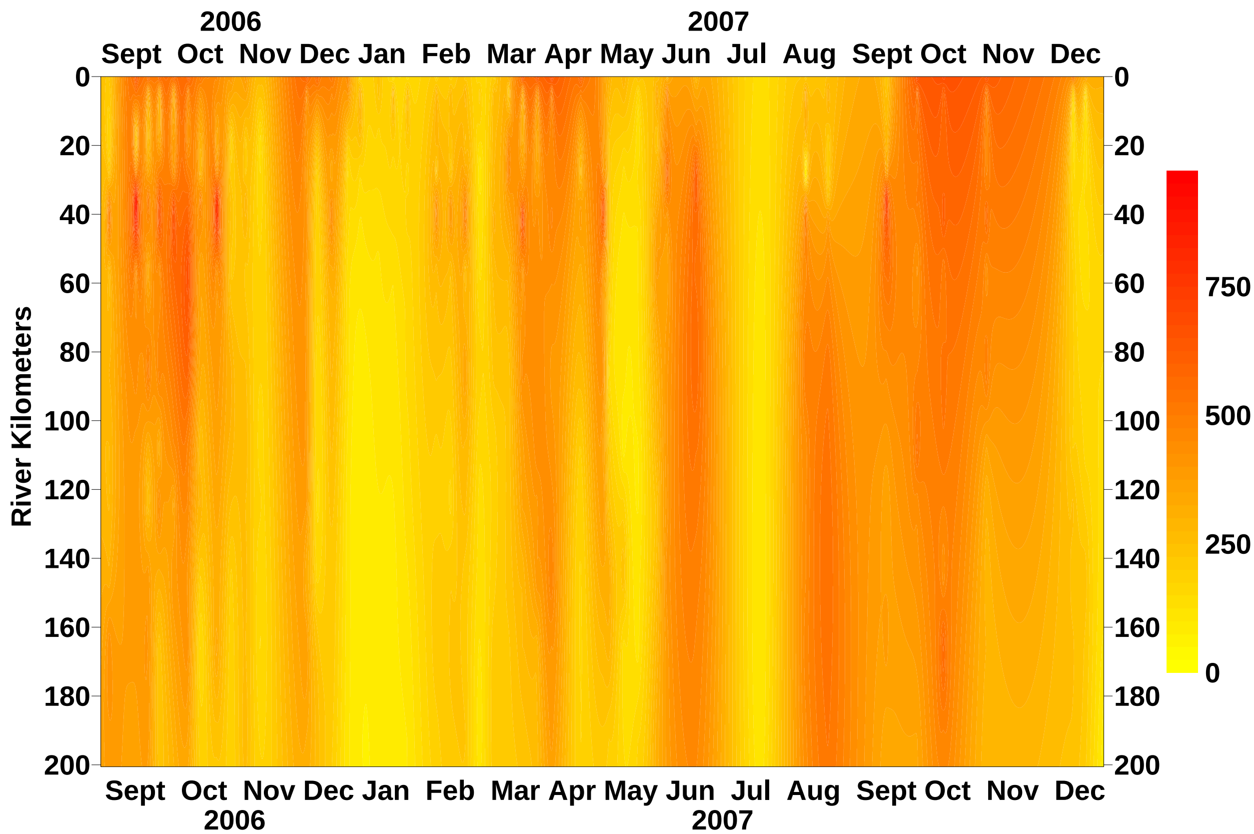

Figure 12. Specific conductance (μS cm^{-1}) patterns in the Big Sunflower River.

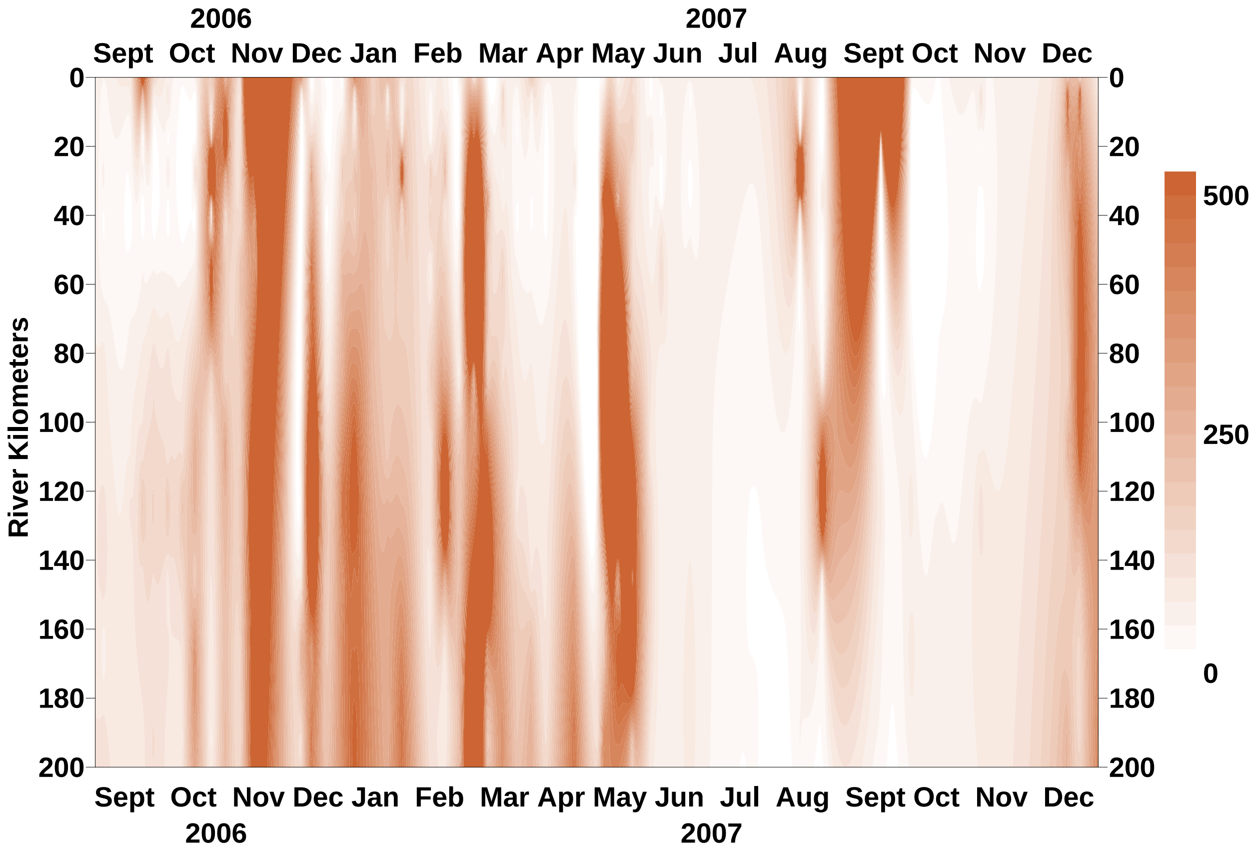

Figure 12. Turbidity (NTU) patterns in the Big Sunflower River.

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Students Trained

D. Christoper Holly worked on his Ph.D. degree in Biological Sciences
Lucas C. Majure worked on his M.S. degree in Biological Sciences and graduated in August, 2007
Dustin Whitehead is working on his B.S. degree in Wildlife and Fisheries
Hawken Brackett is working on his B.S. degree in Wildlife and Fisheries

Interagency Cooperation

This research benefited the Yazoo Mississippi Joint Water Management District (YMD) as a result of a partnership between the investigators at Mississippi State University and YMD personnel.

Information Transfer

Results of this work have produced professional publications and conference presentations:

Ervin, G.N. and M.J. Linville (2006) The landscape context of plant invasions in Mississippi wetlands 36th Annual Mississippi Water Resources Conference, April 25-26, 2006, Jackson, MS.

Tietjen, T.E. and G.N. Ervin (2007) Water quality and floristic quality assessments of the Big Sunflower River following streamflow augmentation using groundwater, CD ROM from the 37th Annual Mississippi Water Resources Conference, April 24-25, 2007, Jackson, MS.

Tietjen, T.E. and G.N. Ervin (2007) Stream restoration in the Mississippi alluvial valley: Streamflow augmentation to improve water quality in the Sunflower River, Mississippi, USA. Ecological Society of America/Society for Ecological Restoration International Conference, San Jose, CA, August 5-10, 2007.

Tietjen, T.E. and G.N. Ervin (2008) Big Sunflower River water quality assessments following streamflow augmentation, Book of Abstracts, 38th Annual Mississippi Water Resources Conference, April 15-16, 2008, Jackson, MS.

Developing a Reliable Method for Identifying Pre−settlement Wetland Sediment Accumulation Rates: 14 C Dating on Bulk Lake Sediments and Extracts

Basic Information

Title:	Developing a Reliable Method for Identifying Pre−settlement Wetland Sediment Accumulation Rates: 14 C Dating on Bulk Lake Sediments and Extracts
Project Number:	2006MS46B
Start Date:	3/1/2006
End Date:	2/28/2008
Funding Source:	104B
Congressional District:	1st
Research Category:	Water Quality
Focus Category:	Wetlands, Sediments, Methods
Descriptors:	
Principal Investigators:	Gregg R. Davidson

Publication

1. Walker, W.G., G.R. Davidson, T. Lange and D. Wren (2007) Accurate lacustrine and wetland sediment accumulation rates determined from 14C activity of bulk sediment fractions. Radiocarbon. 49:983−992.
2. Wren, D.G., G.R. Davidson, W.G. Walker and S.J. Galicki (2008) The evolution of an oxbow lake in the Mississippi alluvial floodplain. Journal of Soil and Water Conservation. May/June, 2008, Vol.3(3), p. 129−135.
3. Wren, D.G. and G.R. Davidson (2008) Practical Implications of Quantifying Ancient Sedimentation Rates in Lakes. Journal of Soil and Water Conservation. May/June 2008, Vol. 3(3), p. 89.

March 31, 2008

Final report for WRRI/USGS grant:
Developing a reliable method for identifying pre-settlement wetland sediment accumulation rates: ^{14}C dating on bulk lake sediments and extracts

Gregg Davidson, University of Mississippi

Students trained
William Walker - completing an MS degree in Hydrology with an expected graduation date of May 2008

Interagency Cooperation
The project facilitated and benefited from cooperation with the Yazoo Joint Water Management District (YMD) who performed a survey of Sky Lake, and the USDA National Sedimentation Laboratory in Oxford, MS.

Information Transfer
Results of this work have produced three regional and international professional conference presentations, and three published manuscripts:

peer-reviewed journal publications

Daniel G. Wren and Gregg R. Davidson (in press) Practical Implications of Quantifying Ancient Sedimentation Rates in Lakes. *Journal of Soil and Water Conservation.*

Wren, D.G., G.R. Davidson, W.G. Walker and S.J. Galicki (in press) The evolution of an oxbow lake in the Mississippi alluvial floodplain. *Journal of Soil and Water Conservation.*

Walker, W.G., G.R. Davidson, T. Lange and D. Wren (2007) Accurate lacustrine and wetland sediment accumulation rates determined from ^{14}C activity of bulk sediment fractions. *Radiocarbon*. 49:983-992.

conference presentations

Gregg R. Davidson , W.G. Walker, Todd Lange , Daniel Wren (2007) Pre-settlement sediment accumulation rates in lake-wetland systems in the Mississippi Delta region using the ^{14}C activity of bulk sediment fractions, WRRI Conference, April 24-25, 2007.

Davidson, G., W.G. Walker, D. Wren and S. Galicki (2007) The evolution of an oxbow lake in the ancestral floodplain of the Mississippi River: changes in sediment accumulation rates inferred from ^{210}Pb, ^{137}Cs, and the ^{14}C activity of bulk sediment fractions. 56th SE Geological Society of America annual meeting, Savannah, GA, March 29-30, 2007, Paper No. 3-1.

Walker, W.G., G.R. Davidson, T. Lange and D. Wren (2006) Estimating sediment accumulation rates in low-organic lacustrine sediments using ^{14}C. 19th International Radiocarbon Conference, Oxford, England, April 3-7, Abstracts & Programme, 255-256.

Financial report

A detailed accounting has been provided by the Accounting department at the University of Mississippi. In summary:
$5,000 worth of assistance was provided by YMD in the form of a survey of Sky Lake, documentation was provided earlier.
Of the $14,830 provided through federal funds, approximately $14,000 was spent on supplies and travel as per the revised and approved budget.
Approximately $25,000 was matched through a combination of waived indirect costs, summer salary and fringe benefits, and tuition.

Report of scientific results

The results of this work are summarized well by a manuscript about to come out in the *Journal of Soil and Water Conservation* that maps the full history of sediment accumulation in Sky Lake from the time it was abandoned by the Mississippi River to the present. A pre-print follows.

Pre-print: accepted by the Journal of Soil and Water Conservation

The evolution of an oxbow lake in the Mississippi alluvial floodplain

Daniel G. Wren, Gregg R. Davidson, William G. Walker, Stanley J. Galicki

Key words: lake, sedimentation, carbon dating, oxbow

ABSTRACT

The history of sediment accumulation in an oxbow lake located on the Mississippi alluvial floodplain was reconstructed based on sedimentation rates determined using ^{14}C activities from bulk sediment fractions, and from ^{210}Pb and ^{137}Cs measurements. Higher rates of sediment accumulation consistent with frequent flooding when first abandoned 3800-5000 yr before the present were followed by slower sedimentation rates consistent with migration of the Mississippi river away from the oxbow and less frequent flooding. This low sedimentation rate persisted for several thousand years until the surrounding land was cleared for agricultural use in the late 19th century. A 50-fold increase in the rate of sediment accumulation has persisted from the time of land clearing to the present, doubling the total mass of accumulated sediment in a single century.

INTRODUCTION

Radiometric methods, such as those utilizing ^{14}C, ^{210}Pb, or ^{137}Cs, can be used to date stored sediments, making it possible to quantify rates of sediment accumulation. Lakes that are at the downstream limit of watersheds receive and store some fraction of sediment eroded from the watershed, creating a record that can yield information on historical watershed erosion rates (Morris and Fan, 1997). Such information is valuable since it allows the erosion history of watersheds to be studied, including the effects of civilization and cultivation on erosion rates (e.g. Dendy and Bolton, 1976; Brooks and Medioli, 2003).

Sediments accumulated within the last century are often dated using ^{137}Cs and ^{210}Pb. The ^{137}Cs technique takes advantage of radioactive fallout resulting from the peak in atmospheric nuclear bomb testing that occurred in 1963. In many sediment cores, a clear spike in ^{137}Cs can be used to positively identify the sediment horizon laid down near 1963 (Appleby, 2001). A sediment accumulation rate can then be inferred from the age of the dated horizon and the thickness of sediment above it.

The ^{210}Pb method yields accumulation rates, from which the age of a specific horizon may be inferred from its depth. ^{210}Pb is a naturally occurring radionuclide in the ^{238}U decay series and is delivered to the atmosphere when ^{222}Rn diffuses from the subsurface and decays. Atmospheric ^{210}Pb that reaches a lake through precipitation or dry-fall is readily adsorbed to sediment particles and deposited on the bed of the lake. This ^{210}Pb is referred to as "excess" to differentiate it from the in situ ^{210}Pb that is continuously produced in the subsurface. Deposited and buried ^{210}Pb decays over time resulting in a decrease in ^{210}Pb activity with depth, with slower sediment accumulation rates reflected by larger changes in activity over a given depth interval. The method ceases to be informative at the depth where excess ^{210}Pb activity cannot be detected above the background activity (typically sediments older than 50 to 100 yr).

Sediments older than 100 years are often dated using ^{14}C. Ideally, discrete macrofossils of terrestrial origin are selected for dating (Björck and Wohlfarth, 2001). Measured ^{14}C activities are used in conjunction with datasets of ancient atmospheric-^{14}C activity to calculate calibrated age-probability distributions for each sampled horizon. For estimating sediment accumulation rates, a series of age-probability distributions may be plotted as a function of depth. If accumulation rates have been relatively constant, the slope of a best fit line through the regions of highest probability will yield the average rate of sediment accumulation (Yeloff et al., 2006; Ramsey, in press). Modern accumulation rates can also be determined using ^{14}C if a sufficient number of samples are analyzed to identify the maxima associated with peak atmospheric testing of nuclear weapons (similar to ^{137}Cs).

Where macrofossils are difficult to find, Walker et al. (in press) demonstrated that the ^{14}C activity of bulk sediments can be used to determine sediment accumulation rates from which ages of specific layers can be inferred. Bulk sediments are not generally used for ^{14}C dating because they include organic material of a variety of ages and sources, and often yield erroneously old apparent ages (Olsson,1991; Björck et al., 1994, 1998; Pessenda, et al., 2001). Bias may result from the inclusion of reworked organic material, or due to reservoir effects such as the incorporation of ancient carbon from dissolved limestone or coal. Where the bias appears consistent, however, an accurate and reproducible sedimentation rate can be determined from the raw ^{14}C activity of bulk sediment fractions even if the magnitude of the bias remains unknown.

The methods previously described were tested and employed to decipher a partial history of sediment accumulation in Sky Lake, an oxbow lake in northwestern Mississippi (Davidson et al. 2004, Walker et al. 2007). In the current study, improved precision from incorporating ^{14}C activities from bulk sediment samples and collection of deeper cores from the open water region of the lake (figure 1) have allowed a complete mapping of the history of sedimentation in the lake from the time it was abandoned as an active meander bend to the present. Results indicate that the 10-fold increase in the rate of accumulation following land clearing reported by Davidson et al. (2004), based primarily on macrofossil samples and calibrated ^{14}C-ages, was an underestimate.

Sky Lake has been identified as a remnant of the Mississippi-Ohio River system within the Stage 2 meander belt (Thorne and Curry, 1983). The lake currently resides within a 1860 ha watershed approximately 10 km (6.2 mi) north of Belzoni, Mississippi, USA (Figure 1). The watershed was cleared for agricultural use beginning in the late 19th century, leaving a forested wetland up to 1 km in width surrounding the lake. Low relief within the watershed results in low-energy inflows through ephemeral and semi-perennial streams that cease to flow during mild droughts. All streams discharge into the wetland surrounding the lake. The lake surface often drops below the outlet elevation during the summer. During high flow events in the Yazoo River, water can backflow through Wasp Lake into Sky Lake.

METHODS AND MATERIALS

One core for ^{210}Pb and ^{137}Cs analyses was collected from the open water area of Sky Lake (Figure 1; Table 1 - core MS15) in 1998 by pushing a 10 cm diameter (4 in) PVC pipe to a depth of approximately 1 m (3.3 ft) and digging a hole next to the pipe to facilitate removal. Three cores for ^{14}C and particle size analyses were collected to depths in excess of 3 m (10 ft) from a transect across the northern end of the open water area in 2006 (cores SL2, SL3, SL4). These cores were collected using a commercially available vibracoring system with 7.6 cm (3 in) diameter aluminum irrigation pipe. The vibracoring method has been shown to extract relatively undisturbed samples of bottom sediments due to liquefaction of the sediment at the vibrating interface between the sample pipe and sediment (Lanesky et al., 1979; Smith, 1984; Fisher, 2004).

All cores were collected when the water level in the lake was less than 1.0 m (3.3 ft) deep. This allowed assessment of core compaction by measuring the distance between the lake bottom and the top of the core inside the core barrel before removal from the lake bed. Compaction was assumed to be linear with depth. Pipes were cut to match the length of the core upon removal from the lake bed, capped, and stored at 4° C (40° F) until processed.

Cores for ^{14}C and particle size analyses were cut lengthwise, sectioned into 1.0 cm (0.39 in) intervals in the upper fine-grained deposits (upper 2 m (6 ft)), and 2 to 5 cm (0.8 to 2 in) intervals in the lower sands. Cores for ^{210}Pb and ^{137}Cs analysis were sectioned into 2.3 cm (0.91 in) intervals. The different interval lengths came about in part because the earlier cores were collected and analyzed as part of a separate unpublished study. Finer intervals were utilized in the more recent work to give better resolution. All sample intervals were weighed and dried at 105° C (221° F) shortly after collection. The particle size distribution was determined using a laser particle size analyzer for 12 equally spaced intervals from core SL3.

Identifiable macrofossils were not common in the open water sediments, so a bulk sediment fraction was used for ^{14}C measurement. One core was selected for higher resolution sampling (11 samples from SL4). Approximately half as many samples were selected from each of the other two cores (SL2 and SL3). Selected intervals were rewetted and sieved to remove particulate matter larger than 250 μm (0.0098 in). Removal of large particulate matter was done to ensure that a single large organic fragment would not disproportionately bias the ^{14}C activity. Samples were not pretreated because previous work at Sky Lake demonstrated that ^{14}C activities of bulk sediment fractions in this system are not significantly different with and without pretreatment (Walker et al., in press).

Sieved samples were combusted in the presence of O_2 at 400° C (750° F). The low combustion temperature avoids release of carbon that may be incorporated into the mineral structure of the clays (McGeehin et al. 2001; Delqué-Količ 1995). Gases released during combustion were passed along with residual O_2 through quartz-chips heated to 1000° C (1830° F) to convert CO to CO_2, and through copper beads heated to 450° C (840° F) to convert nitrogen oxides to N_2. CO_2 for all combustions was purified cryogenically and split into fractions for ^{13}C and ^{14}C analyses. Graphite targets for ^{14}C analysis were prepared by conversion of CO_2 to graphite in the presence of powdered Zn and Fe (Slota et al., 1987), and analyzed by Accelerator Mass Spectrometry (AMS) at the NSF-Arizona AMS facility.

When using bulk sediment fractions, a composite ^{14}C activity is obtained that cannot be converted into a meaningful calibrated age distribution because each sample represents a collection of particles of many different actual and apparent ages. Average sediment accumulation rates for different phases of the lake's history were estimated by plotting the natural log of ^{14}C activity verses depth, calculating best fit lines for linear segments of data, and multiplying the slope by the ^{14}C-decay constant. Data from all three cores were used to establish the best fit lines for each phase of the lake's history. The duration of a particular sedimentation rate was determined by dividing the thickness of the sediment interval by the calculated accumulation rate.

For comparison purposes, calibrated ages were determined for a few samples using CALIB 5.0 (Stuiver and Reimer, 1993 - revision 5.0: http://radiocarbon.pa.qub.ac.uk/calib). "Radiocarbon ages" are reported by convention as years before 1950. Calibrated ages are corrected for historical variation in atmospheric ^{14}C activity in the Northern Hemisphere (Reimer et al., 2004) and reported here as years before present (BP) (before the sampling date of 2006).

^{210}Pb and ^{137}Cs activities were determined at the University of South Carolina on powdered, bulk sediment samples using a low-energy planar germanium detector calibrated using NIST soil standards (Dukat and Kuehl, 1995). The supported (background) level of ^{210}Pb was determined by monitoring the level of ^{226}Ra gamma peaks. Corrections were made for self-absorption of low-energy gamma rays (Cutshall et al., 1983). Sedimentation rates based on ^{210}Pb assumed a constant rate of sediment accumulation and rate of atmospheric ^{210}Pb fallout over the period of interest (Appleby, 2001).

RESULTS AND DISCUSSION

Two sedimentation regimes were readily recognized from visual observation of the 3-m cores, with a transitional zone between the two. Sediments from the bottom of each core consisted of relatively clean sands (99%>0.063 mm (0.0025 in), median size=0.35 mm (0.014 in)) (Figure 2). Sediments in the upper 2 m (6.6 ft) consisted of dark gray, fine-grained material with no visible layering or changes in texture. An intermediate transition zone containing a mix of sand and fine grained material was encountered at depths of 215, 227 and 242 cm (85, 89, and 95 in) in cores SL2, SL3 and SL4, respectively.

Additional changes in sedimentation regimes were revealed by the radioisotope data (Figures 3 and 4; Table 1). Zone A in Figure 3 represents samples collected within or just below the transitional layer. Zones B, C, and D are all from the overlying fine-grained sediment. The depth of the transition zone separating Zone A from the rest varied as mentioned above; the dividing line in Figure 3 was drawn at the average depth. Steeper slopes indicate higher rates of sediment accumulation.

The stratigraphic and radioisotope data correspond well with the generally accepted model for a neck-cutoff oxbow-lake cycle. A typical cycle includes active meander bend, neck cutoff, lacustrine, and terrestrial stages (Gagliano and Howard, 1984). The four zones in Figure 3 appear to correspond to the first 3 stages. The large scatter in the ^{14}C activity within and below the transitional layer (Zone A; $R^2 = 0.56$), with all values plotting to the left of the overlying points, is consistent with an interpretation of these sediments as deposits in an actively flowing system. These could be point bar deposits forming as the meander was first becoming isolated (neck cutoff stage), or channel deposits from an active meander bend, though the depth is shallow for channel sands from the Mississippi River system (Rittenour et al., 2007). Sediments deposited in a point bar or stream channel potentially include organic material that was recently living (^{14}C activity representing the time of deposition) and much older material that was exhumed upstream and deposited at the sampling point (^{14}C activity representing dates much older than time of deposition) resulting in a large range of ^{14}C activities that do not necessarily reflect the age of deposition.

A typical neck-cutoff period is relatively brief (approximately 2-10 years (Gagliano and Howard, 1984)). In these cores, it is likely represented by or within the transitional layer and is approximately represented by the line in Figure 3 dividing Zones A and B. Sky Lake presently appears to be near the end of the lacustrine phase. The lake normally contains water throughout the year, but occasionally goes dry during prolonged droughts (observed twice in the last decade). Zones B and C are both consistent with a lacustrine stage with changing proximity to the parent stream. These two zones can be characterized as (B) recently abandoned oxbow with close proximity to the river, frequent flooding, and a relatively high sediment accumulation rate (1.1 mm/yr (0.04 in/yr)), and (C) migration of the river away from the lake resulting in a reduction in flooding frequency and a much lower sediment accumulation rate (0.2 mm/yr (0.008 in/yr)).

The accumulation rate in the lake over the past century was determined based on a combination of ^{14}C, ^{210}Pb and ^{137}Cs data (Figures 3 and 4). Changes in ^{14}C activity cannot be used as described in this study in sediments deposited during the last 70 years because of the large atmospheric influx of anthropogenic ^{14}C introduced by surface testing of nuclear weapons. As a result, only the upper two ^{14}C values in Figure 3 fall within Zone D. ^{210}Pb and ^{137}Cs are well suited for dating these recent deposits. The slope of excess ^{210}Pb activity vs depth, and the depth of the ^{137}Cs peak yield a recent sedimentation rate of 10 to 11 mm/yr (0.39 to 43 in/yr) (Figure 4). This rate is also consistent with the rate manually measured in recent years at a site in the northern wetland (5 cm of sediment accumulated on top of a mesh in 5 yr).

A line representing changes in ^{14}C activity with an accumulation rate of 10 mm/yr (0.39 in/yr) is drawn in Figure 3 and projected to a depth of 110 cm (3.6 ft). The uppermost ^{14}C samples, at depths of 79 cm (2.6 ft) and 99 cm (3.2 ft), fall very close to the projected line suggesting that the rate of 10 mm/yr (0.39 in/yr) has persisted since land clearing first began near the end of the 19th century.

The modern accumulation rate is consistent with the rate calculated by Davidson et al. (2004) within the wetland on the northern edge of Sky Lake (Figure 1), but the rate prior to land clearing reported in the present study is significantly lower. Davidson et al. (2004) applied a best fit line to calibrated age distributions for discrete terrestrial macrofossils in sediment predating land clearing to estimate an accumulation rate of 1.0 mm/yr (0.04 in/yr). These data exhibited relatively poor linearity, however, and lines representing considerably lower accumulation rates could also reasonably represent the data. (If end-member dates from each age-range are used as discrete values and plotted as a function of depth, $R^2 = 0.73$.) R^2 values for ^{14}C activity vs depth in the present study within Zone C are 0.94 to 0.99 for data from all three cores (Table 2), with slopes indicating a rate of 0.2 mm/yr (0.008 in/yr). The change in the rate of sediment accumulation following land clearing thus appears to be closer to a 50-fold increase than the 10-fold increase reported by Davidson et al. (2004).

Particle size analyses were performed on 12 samples from core SL3 (Figure 2). When viewed in light of the zones delineated by the radioisotope data, it is apparent that each transition in the history of the lake was accompanied by a decrease in the percent sand delivered to the lake, an increase in the percent silt, and a gradual increase in the percent clay content. Excluding the 244 cm interval, the D_{50} (particle size for which 50% of the particles, by volume, are finer) decreases from 30 μm (0.0012 in) near the bottom, to 7.5 μm (0.0003 in) near the top. The changes reflect a decreasing contribution of sediments from flood events, and an increased contribution from erosion within the watershed.

Based on interval thickness and calculated sedimentation rate, the period immediately following abandonment (Figure 3; Zone B) lasted between 190 and 580 yr. The large range is due to uncertainty in the exact breakpoint in the data, variability in interval thickness between the three cores, and variability in slope for data from each core (Table 2). The second interval was the longest (Zone C), lasting between 3460 and 4280 yr. This sedimentation regime would presumably have continued to the present, but was interrupted by land clearing approximately 110 years ago (Zone D). Summing these three periods yields an age of the oxbow lake itself (rounded to century values) between 3800 and 5000 yr BP.

If calibrated ages are determined using the ^{14}C activities from samples just above the transition zone, the age of abandonment is 6250±80 yr (1σ) BP. This age reflects a probable bias of uncertain magnitude due to incorporation of reworked material (Walker et al., in press), making it useful only as an upper limit on the possible age rather than the actual age of abandonment. A cultural resources survey by Thorne and Curry (1983) included several radiocarbon dates from Sky Lake sediment, but the reported ages varied widely without meaningful correlation with depth. Saucier (1994) considered these ages along with geomorphological data to estimate a likely time of abandonment in excess of 7000 yrs BP (note that Saucier (1994) appears to have placed Sky Lake in meander belt 4 while Thorne and Curry (1983) place it in meander belt 2). The range of ages obtained here using sedimentation rates and interval thicknesses (3800-5000 yr BP) is in agreement with the estimated age and duration of the Stage 2 meander belt (Thorne and Curry, 1983).

SUMMARY AND CONCLUSION

The sedimentation history of Sky Lake, Mississippi, was reconstructed using a variety of radiometric techniques. Four separate sedimentation regimes were identified: A) sand deposition while still part of an actively flowing system, B) abandonment from the river system with a relatively high sediment accumulation rate from seasonal flooding, C) migration of the river away from the lake with a subsequent drop in the rate of accumulation, and D) post land clearing with a 50-fold increase in the rate of sediment accumulation. The calculated age of abandonment of 3800 to 5000 yr BP, based on sediment accumulation rates and interval thicknesses, is considerably younger than previous estimates (Saucier, 1994), but is a better fit with geomorphological evidence linking Sky Lake to the Mississippi River Stage 2 meander belt (Thorne and Curry, 1983).

The time interval prior to land clearing represents at least 97% of the lake's history. This period lasted upwards of 3600 yr during which time approximately 120 cm of sediment accumulated in the lake. In the last 110 to 120 yr since land began to be cleared, an equivalent thickness of sediment has been added, doubling the total sediment thickness. Radioisotope data and recent observations of sediment accumulation over the past 5 years indicate that the 50-fold increase in sediment accumulation rate continues unabated.

Acknowledgements

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Table 1. Data used in current study. fmc = fraction modern carbon, dpm = disintegrations per minute, and $ex^{210}Pb$ = excess ^{210}Pb.

Core:	Interval #	ln fmc	Corrected depth (cm):	^{137}Cs (dpm/gm)	ln $ex^{210}Pb$ (dpm/gm)
SL2	1	-0.158	112	N/A	N/A
SL2	2	-0.249	135	N/A	N/A
SL2	3	-0.398	157	N/A	N/A
SL2	4	-0.553	181	N/A	N/A
SL2	5	-0.587	200	N/A	N/A
SL3	1	-0.102	131	N/A	N/A
SL3	2	-0.246	152	N/A	N/A
SL3	3	-0.408	173	N/A	N/A
SL3	4	-0.577	194	N/A	N/A
SL3	5	-0.592	215	N/A	N/A
SL3	6	-0.667	229	N/A	N/A
SL3	7	-1.204	238	N/A	N/A
SL4	1	-0.063	79	N/A	N/A
SL4	2	-0.063	99	N/A	N/A
SL4	3	-0.086	119	N/A	N/A
SL4	4	-0.192	139	N/A	N/A
SL4	5	-0.327	164	N/A	N/A
SL4	6	-0.570	182	N/A	N/A
SL4	7	-0.582	209	N/A	N/A
SL4	8	-0.616	223	N/A	N/A
SL4	9	-0.621	241	N/A	N/A
SL4	10	-0.812	251	N/A	N/A
SL4	11	-1.698	267	N/A	N/A
MS15	1	N/A	3.1	1.67	2.60
MS15	2	N/A	7.7	1.71	2.58
MS15	3	N/A	10.7	1.75	2.53
MS15	4	N/A	13.8	1.77	2.48
MS15	5	N/A	16.9	1.92	2.40
MS15	6	N/A	20.0	2.04	2.22
MS15	7	N/A	23.0	2.15	2.18
MS15	8	N/A	26.1	2.61	2.23
MS15	9	N/A	29.2	2.90	1.94
MS15	10	N/A	32.2	3.21	1.75
MS15	11	N/A	35.3	3.69	2.06
MS15	12	N/A	38.4	5.75	1.77
MS15	13	N/A	41.5	3.76	1.57
MS15	14	N/A	44.5	2.61	1.69
MS15	15	N/A	47.6	1.01	1.43
MS15	16	N/A	50.7	0.46	1.24

Table 2 Slopes, R^2 values, and calculated sediment accumulation rates for data shown in Figures 3 and 4. R^2 values are not reported where only two points are within a zone. Interval numbers are the same as in Table 1. Equal sediment accumulation rates for different slopes (Zone C) are due to rounding.

Zone	Data	Core (Intervals)	Slope (cm/ln activity)	R^2	Sed. rate (mm/yr)
D	^{210}Pb	SG1 (all)	-33	0.94	11
C	^{14}C	SL2 (1-4)	-170	0.99	0.2
		SL3 (1-4)	-133	0.99	0.2
		SL4 (3-6)	-129	0.94	0.2
		all 12	-140	0.89	0.2
B	^{14}C	SL2 (4-5)	-553	na*	0.7
		SL3 (4-5)	-1376	na	1.7
		SL4 (6-9)	-931	0.89	1.1
		all 8	-860	0.90	1.0
A	^{14}C	SL3 (6-7)	nc**	na	nc
		SL4 (10-11)	nc	na	nc
		all 4	nc	0.56	nc

* na – not applicable; only two data points

** nc – not calculated for Zone A sand

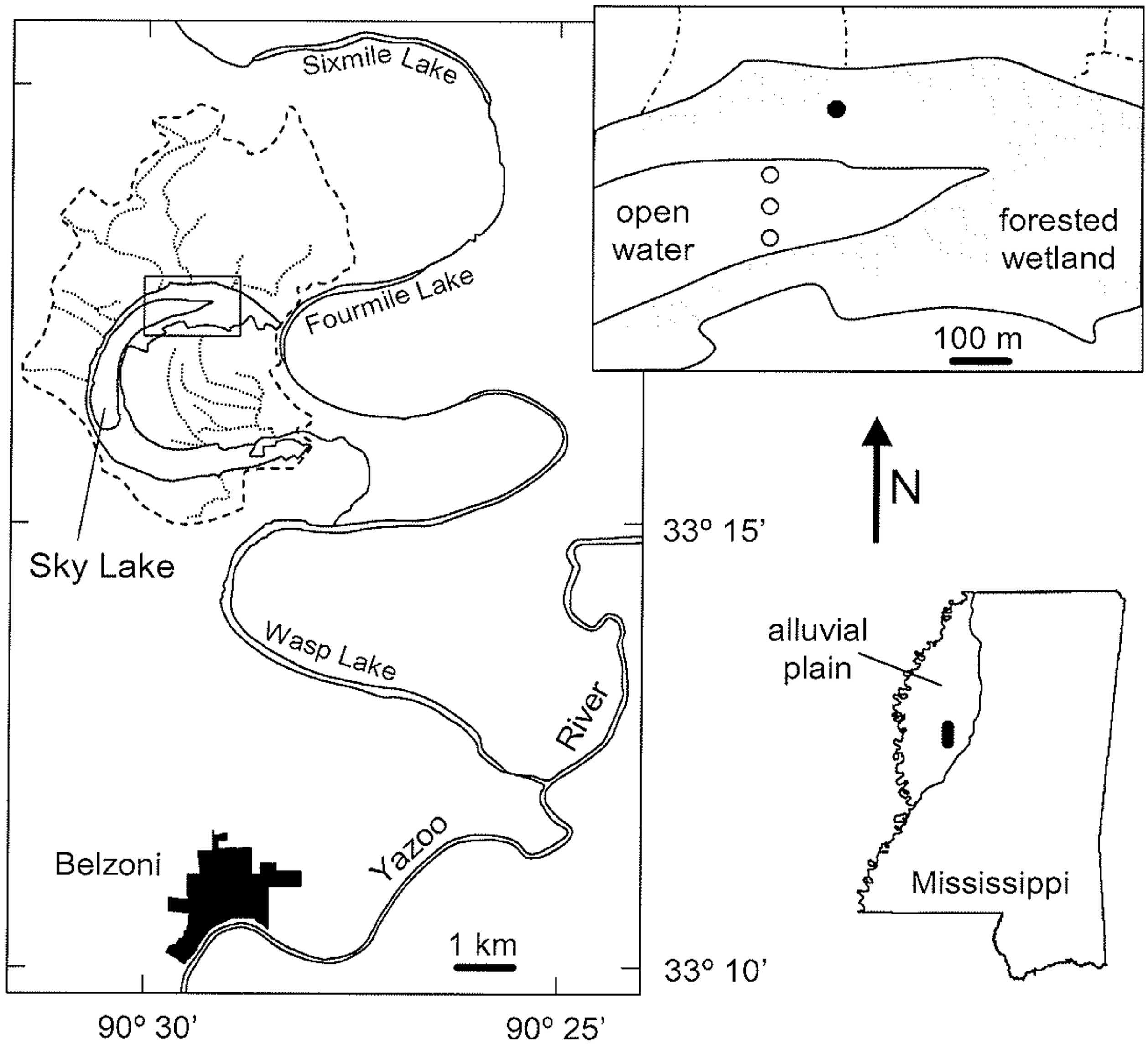


Figure 1. Sky Lake, Mississippi, USA. The watershed boundary for Sky Lake is shown as a dashed line. Ephemeral streams within the watershed are shown as dotted lines. Only the longer streams on the north side are semi-perennial. The northern end of the lake is enlarged in the inset; shaded areas represent forested wetlands that are fully inundated when lake level is high. Open circles represent location of the 3-m cores collected for ^{14}C and particle size analyses. A 1-m core for ^{210}Pb and ^{137}Cs was collected near the middle circle. The location of cores reported by Davidson et al. (2004) and discussed in the text appears as a filled circle in the wetland. The alluvial plain identified on the state map is part of the ancestral floodplain of the Mississippi River system.

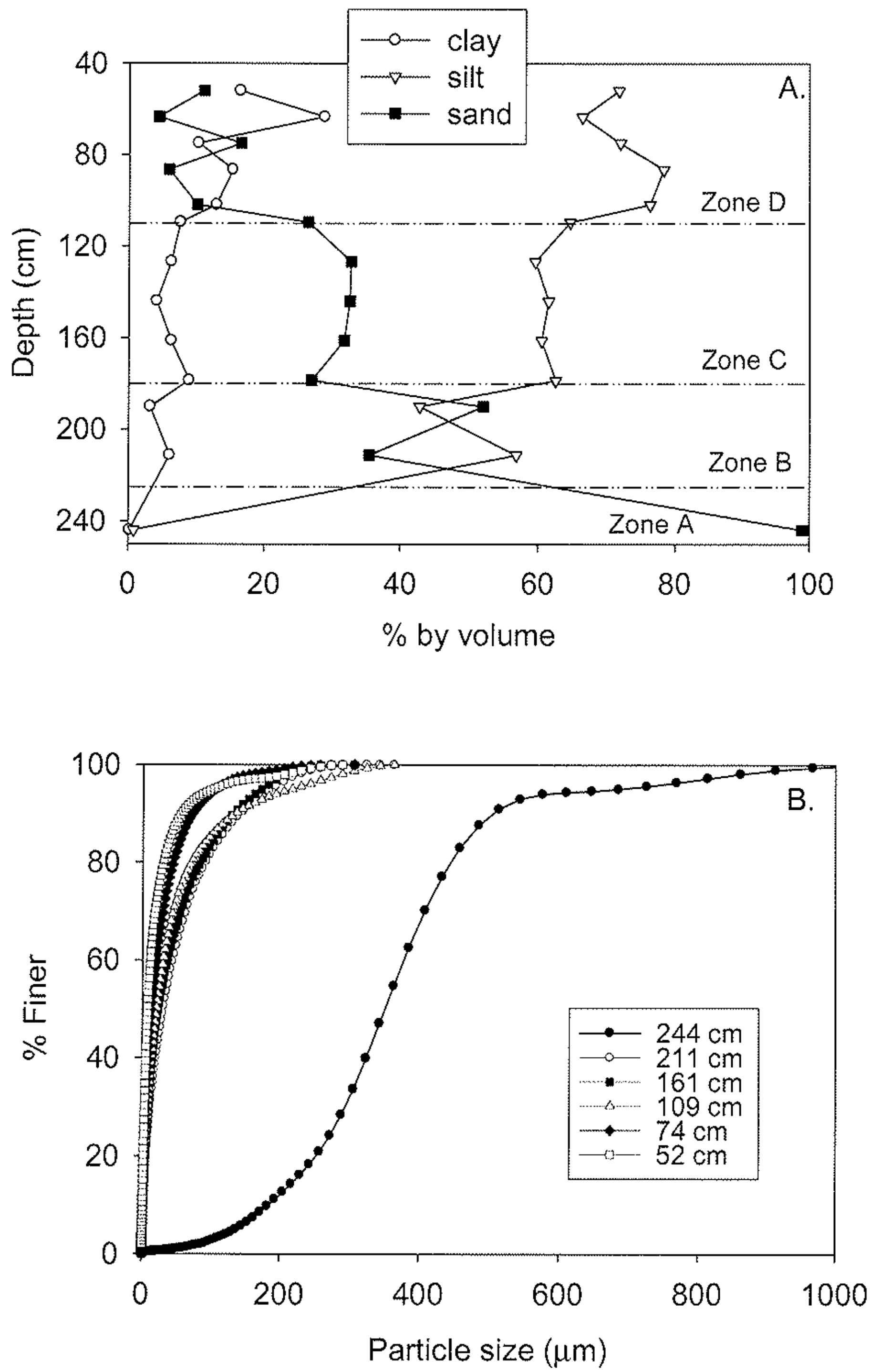


Figure 2. A. Particle size analysis from selected intervals of core SL3 by size class and B. cumulative % finer. Depths were measured from the top of the core down and corrected for core compression. Zones refer to different periods of sedimentation history identified from the radioisotope data (Figure 3).

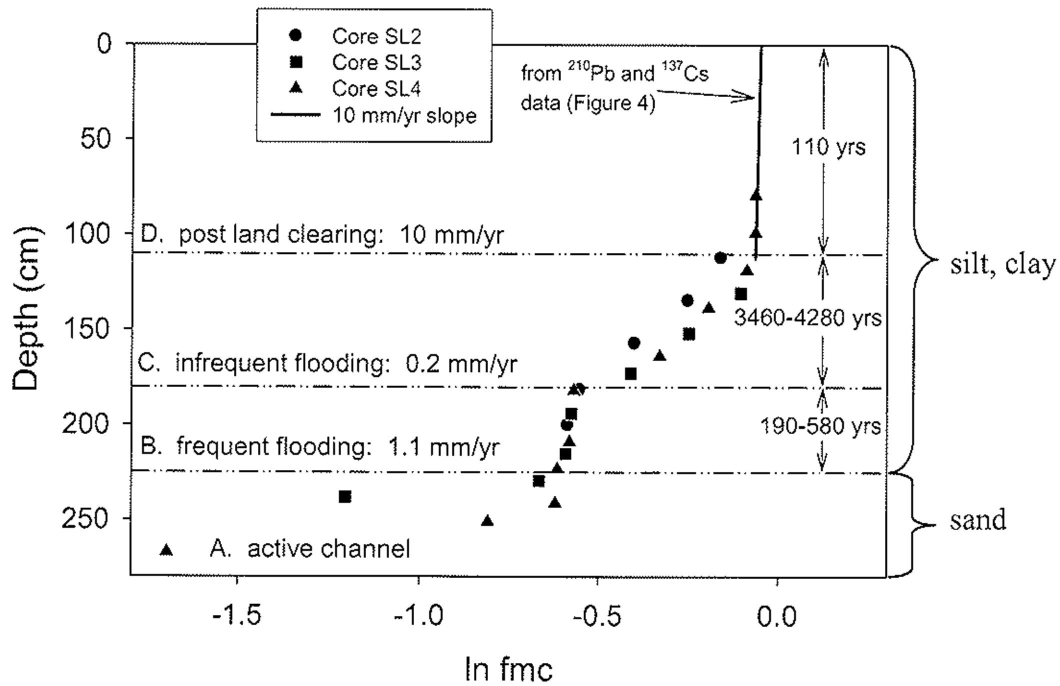


Figure 3. ^{14}C profile from 3 Sky Lake sediment cores collected in 2006. Lines dividing each zone represent average depths (see Table 2 for exact division of samples between zones). Line dividing Zones A and B represents average depth of the transitional sand-silt-clay layer. See text for description of 10 mm/yr line drawn in Zone D. Analytical uncertainty for ^{14}C activity (1σ) is less than the size of the data markers. (ln fmc – natural logarithm of fraction modern carbon)

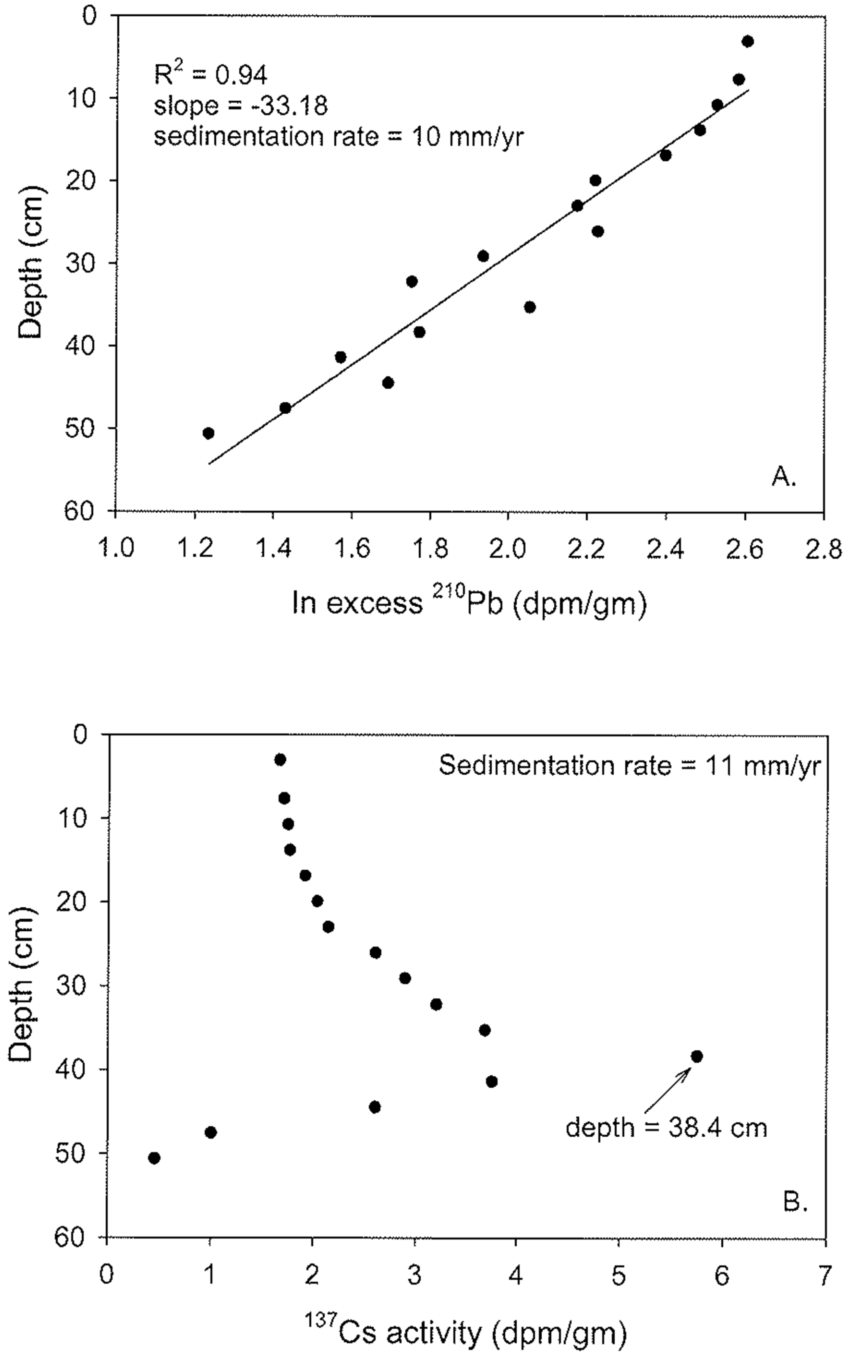


Figure 4. A. ^{210}Pb and B. ^{137}Cs data from Sky Lake and calculated sedimentation rates. Sampling and analysis was performed in 1998. (dpm/gm – disintegrations per minute per gram)

Natural Enhanced Transport of Agricultural Pb and As Through Riparian Wetlands

Basic Information

Title:	Natural Enhanced Transport of Agricultural Pb and As Through Riparian Wetlands
Project Number:	2007MS61B
Start Date:	3/1/2007
End Date:	2/28/2009
Funding Source:	104B
Congressional District:	1st
Research Category:	Ground−water Flow and Transport
Focus Category:	Wetlands, Sediments, Non Point Pollution
Descriptors:	
Principal Investigators:	Gregg R. Davidson

Publication

1. Davidson, G.R., D.G. Wren, W.G. Walker and S.G. Utroska (2008). Contaminant transport through riparian wetlands. University of MS for the MS Water Resources Research Institute's annual conference, April 15−16, 2008. Book of Abstracts, p. 39.

Mississippi Water Resources Research Institute (MWRRI)

Quarterly Report – 7/1/07 – 3/31/08

Reports due: 1st (March 31); 2nd (June 30); 3rd (Sept. 30); 4th (Dec. 31)

Note: Please complete form in 11 point font and do not exceed two pages. You may reference and append additional material to the report.

SECTION I: Contact Information

Project Title: Natural enhanced transport of agricultural Pb and As through riparian wetlands

Principal Investigator: Gregg Davidson
Institution: University of Mississippi
Address: Geology & Geol. Eng., Carrier 118, University, MS 38677
Phone/Fax: 662-915-5824
E-Mail: davidson@olemiss.edu

SECTION II: Programmatic Information

Approximate expenditures during reporting period:

Federal: $5,600, Non-Federal: $11,200, Cost Share: 2:1

Equipment (and cost) purchased during reporting period: none

Progress Report (Where are you at in your work plan):

Hampton Lake, an oxbow lake in the Delta, was selected based on satellite imagery and ground reconnaissance for sediment sampling. Several 3-m cores were collected, and one was divided into 1-cm intervals for chemical analysis. 180 samples were digested in Aqua Regia and analyzed for a suite of element concentrations. When no Pb or As spike was observed, several samples were analyzed for ^{210}Pb to determine if the target dates might lie below the sampled depths. The isotope data confirmed that deeper samples were needed. Additional 5-m cores were collected in November. The bottom two meters of one core has been sectioned and dried, and samples are currently being crushed in preparation for digestion and analysis.

Equipment for sequential leaching of high and low Pb zones has been purchased and is in the process of being set up.

A second suite of cores from Hampton Lake have been sectioned, dried, digested and analyzed for element concentrations. Elevated As, Co, Cu, and Ni are all found at the same depth, though Pb is not elevated within the same zone. Samples below this zone were contaminated during sample preparation and are being reprocessed for analysis again. The sampling equipment for the sequential analysis has been fabricated and initial testing is underway.

Problems Encountered:

Contamination of most recent round of samples – samples are being reanalyzed.

Publications/Presentations (Please provide a citation and if possible a .PDF of the publication or PowerPoint):

Submitted abstract, "Contaminant transport through riparian wetlands," for presentation at the 38th Annual Mississippi Water Resources Conference, April 15-16, 2007, Jackson, MS.

Student Training (list all students working on or funded by this project)

Name	Level	Major
William Walker	MS student	Hydrology
Steven Utroska	BS student	Geological Engineering

Next Quarter Plans:

Sediment core collection within the wetland surrounding Hampton Lake.
Sequential extraction of high and low trace element concentration intervals.

Section III. Signatures

Project Manager **Date**

March 31, 2008

Water Quality and Floristic Habitat Assessments in the Coldwater and Sunflower River Basins: Comparing traditional measures of water and habitat quality to Index of Biotic Integrity findings

Basic Information

Title:	Water Quality and Floristic Habitat Assessments in the Coldwater and Sunflower River Basins: Comparing traditional measures of water and habitat quality to Index of Biotic Integrity findings
Project Number:	2007MS62B
Start Date:	3/1/2007
End Date:	2/28/2009
Funding Source:	104B
Congressional District:	3rd
Research Category:	Water Quality
Focus Category:	Wetlands, Water Quality, Management and Planning
Descriptors:	
Principal Investigators:	Todd Tietjen, Gary N. Ervin

Publication

1. Tietjen, T.E. (2008). Stream Water Quality in the Mississippi Delta: Rankings Based on Index of Biotic Integrity Scores and Limnological Measures. Joint Meeting of the Mississippi and Arkansas Chapters of the American Fisheries Society. Tunica, MS.
2. Tietjen, T.E. and G.N. Ervin (2008). Comparing Index of Biotic Integrity Scores to Traditional Measures of Water Quality: Exploring the Causes of Impairment in Streams of the Mississippi Delta. Mississippi Water Resources Conference. Jackson, MS. Book of Abstracts, p. 50.

Mississippi Water Resources Research Institute (MWRRI)

Quarterly Report – (From) 7/1/07 – (To) 3/31/08

Reports due: 1st (March 31); 2nd (June 30); 3rd (Sept. 30); 4th (Dec. 31)

Note: Please complete form in 11 point font and do not exceed two pages. You may reference and append additional material to the report.

SECTION I: Contact Information

Project Title: **Water Quality and Floristic Habitat Assessments in the Coldwater and Sunflower River Basins: Comparing traditional measures of water and habitat quality to Index of Biotic Integrity findings.**

Principal Investigator: Todd Tietjen and Gary Ervin
Institution: Mississippi State University
Address: Department of Wildlife and Fisheries, Mail Stop 9690
Phone/Fax: 662-325-2996
E-Mail: ttietjen@cfr.msstate.edu

SECTION II: Programmatic Information

Approximate expenditures during reporting period:

Federal: $5,957.09, Non-Federal: 0, Cost Share: 66,000

Equipment (and cost) purchased during reporting period: None

Progress Report

The identification of a subset (20 sites) of the overall MDEQ Delta region IBI sites has been completed. Sites with sufficient access and predictable water have been selected to span the range of IBI values calculated by MDEQ.

These 20 sites have been sampled twice for instrument based water quality parameters (Temperature, pH, dissolved oxygen, specific conductance, and turbidity) during the site identification process.

Water samples from the 20 site subset are currently being analyzed for a variety of nutrient and water quality parameters.

In conjunction with the Yazoo Mississippi Delta Joint Water Management District chlorophyll samples have been collected and analyzed for >35 sites and continuous temperature and dissolved oxygen measurements have been collected from ~6 additional sites.

Water quality sampling is continuing periodically. Vegetation monitoring has been completed and the data is being analyzed. A water quality sampling planning meeting has been scheduled with YMD, the Department of Wildlife and Fisheries, and MAFES personnel.

Problems Encountered: None this quarter. A no cost extension has been requested and approved to continue this project.

Publications/Presentations

Tietjen, T.E. 2008. Stream Water Quality in the Mississippi Delta: Rankings Based on Index of Biotic Integrity Scores and Limnological Measures. Joint Meeting of the Mississippi and Arkansas Chapters of the American Fisheries Society. Tunica, MS

Submitted for presentation and publication, Tietjen, T.E., G. Ervin. 2008. Comparing Index of Biotic Integrity Scores to Traditional Measures of Water Quality: Exploring the Causes of Impairment in Streams of the Mississippi Delta. 38th Annual Mississippi Water Resources Conference, April 15-16, 2008. Jackson, MS.

Submitted for presentation, Tietjen, T.E., G. Ervin. 2008. Big Sunflower River Water Quality and Floristic Quality Assessments following Streamflow Augmentation. 38th Annual Mississippi Water Resources Conference, April 15-16, 2007. Jackson, MS.

Student Training (list all students working on or funded by this project)

Name	Level	Major
Christopher Doffitt	Ph.D.	Biological Sciences
D. Christopher Holly	Ph.D.	Biological Sciences
Lucas C. Majure	M.S. (graduated August, 2007)	Biological Sciences
Hawken Brackett	Undergraduate	

Next Quarter Plans:

Continue water quality sampling, present year 1 results at Mississippi Water Resources Conference.

Section III. Signatures

Project Manager **Date**

Climatological and Cultural Influences on Annual Groundwater Decline in the Mississippi Delta Shallow Alluvial Aquifer: Identifying the Causes and Solutions

Basic Information

Title:	Climatological and Cultural Influences on Annual Groundwater Decline in the Mississippi Delta Shallow Alluvial Aquifer: Identifying the Causes and Solutions
Project Number:	2007MS63B
Start Date:	3/1/2007
End Date:	8/31/2008
Funding Source:	104B
Congressional District:	3rd
Research Category:	Climate and Hydrologic Processes
Focus Category:	Climatological Processes, Groundwater, Water Use
Descriptors:	
Principal Investigators:	Charles Wax, Jonathan Woodrome Pote

Publication

1. Wax, C.L., J.W. Pote, and T.L. Merrell (2008). Climatological and cultural influences on annual groundwater decline in the Mississippi Delta shallow alluvial aquifer. 38th Annual Mississippi Water Resources Conference, April 15−16, 2008, Jackson, MS, Book of Abstracts, p. 24.

Mississippi Water Resources Research Institute (MWRRI)

Quarterly Report – (From) 7/1/07 – (To) 03/31/08

Reports due: 1st (March 31); 2nd (June 30); 3rd (Sept. 30); 4th (Dec. 31)

Note: Please complete form in 11 point font and do not exceed two pages. You may reference and append additional material to the report.

SECTION I: Contact Information

Project Title: Climatological and cultural influences on annual groundwater decline in the Mississippi Delta shallow alluvial aquifer: identifying the causes and solutions

Principal Investigator: Charles L. Wax, PI (co-PI Jonathan Pote, Joe Massey)
Institution: Department of geosciences, Mississippi State University
Address: P.O. Box 5448, Mississippi State, MS 39762
Phone/Fax: (662) 325-3915
E-Mail: wax@geosci.msstate.edu

SECTION II: Programmatic Information

Approximate expenditures during reporting period:

Federal:_$13,940, Non-Federal:_$8,000____, Cost Share: ____0_______

Equipment (and cost) purchased during reporting period: none

Progress Report (Where are you at in your work plan):

Water use from the delta aquifer has been quantified by crop, acreage, and irrigation method. A relationship between growing season rainfall and irrigation water use has been developed to link interannual variations in water use to variations in climate (rainfall). A complete prototype water use model has been completed using acreages, irrigation methods, and management strategies in place during 2006 in Sunflower County to predict annual water demand for cotton, rice, soybeans, corn, and catfish.

The growing season climate data for the last 45-years were used to run the water demand model for a 45-year (2008-2053) period into the future to assess aquifer drawdown and recharge characteristics annually and cumulatively over the long-term period. Changes in acreages of the major crops, specific irrigation methods, and water management strategies were used to create various scenarios, then conduct multiple model runs to assess the effects of the instituted changes on aquifer drawdown and recharge characteristics over the long-term period.

Problems Encountered:

Identifying controls of aquifer recharge rates has not been successful. Attempts to relate recharge to Mississippi River stage on the west, to Grenada Lake stage on the east, and to non-growing season precipitation totals on both east and west sides of the delta have not been successful. Changes in cultural practices adopted for the various model run scenarios are not known to be practical or economically feasible—these need to be confirmed as valid possibilities before rigid recommendations are developed.

Publications/Presentations (Please provide a citation and if possible a .PDF of the publication or PowerPoint):

1. Presentation of preliminary results to Mississippi Department of Environmental Quality, October 15, 2007.
2. Presentation of preliminary results to Yazoo-Mississippi Delta Joint Water Management

District Board of Directors, October 17, 2007.
3. Presentation of nearly-complete results to Groundwater Management Districts Association conference, Tallahassee, FL, January 7, 2008.
4. Presentation of nearly-complete results to Office of Land and Water, Mississippi Department of Environmental Quality, Jackson, MS, February 12, 2008.
[The PowerPoint slides used in these presentations are sent as a separate file along with this report.]
5. Submitted abstract, "Climatological and cultural influences on annual groundwater decline in the Mississippi Delta shallow alluvial aquifer," for 38th Annual Mississippi Water Resources Conference to be held April 15-16, 2008 in Jackson, MS.

Student Training (list all students working on or funded by this project)

Name	Level	Major
Tia L. Merrell	M.S.	Geosciences

Next Quarter Plans:
Complete final computer simulations for year 1 and begin gather data to refine the model and conservation recommends for year 2.
Write a paper for presentation at and publication in the Proceedings, Mississippi Water Resources Conference.
Begin writing an article for publication in the Transactions of the American Society of Agricultural and Biological Engineers or a similar journal.

Section III. Signatures

Project Manager **Date**

Charles L. Wax March 28, 2008

Information Transfer Program Introduction

The Mississippi Water Resources Research Institute (MWRRI) maintains a web site (http://www.wrri.msstate.edu) and hosts a MWRRI Water List Server for general information transfer purposes. The MWRRI also has two Information Transfer Projects: 1) an annual Mississippi Water Resources Conference, and 2) Publications.

Information Transfer Program−Publications

Basic Information

Title:	Information Transfer Program−Publications
Project Number:	2006MS69B
Start Date:	3/1/2006
End Date:	2/28/2009
Funding Source:	104B
Congressional District:	3rd
Research Category:	Not Applicable
Focus Category:	None, None, None
Descriptors:	
Principal Investigators:	George M. Hopper

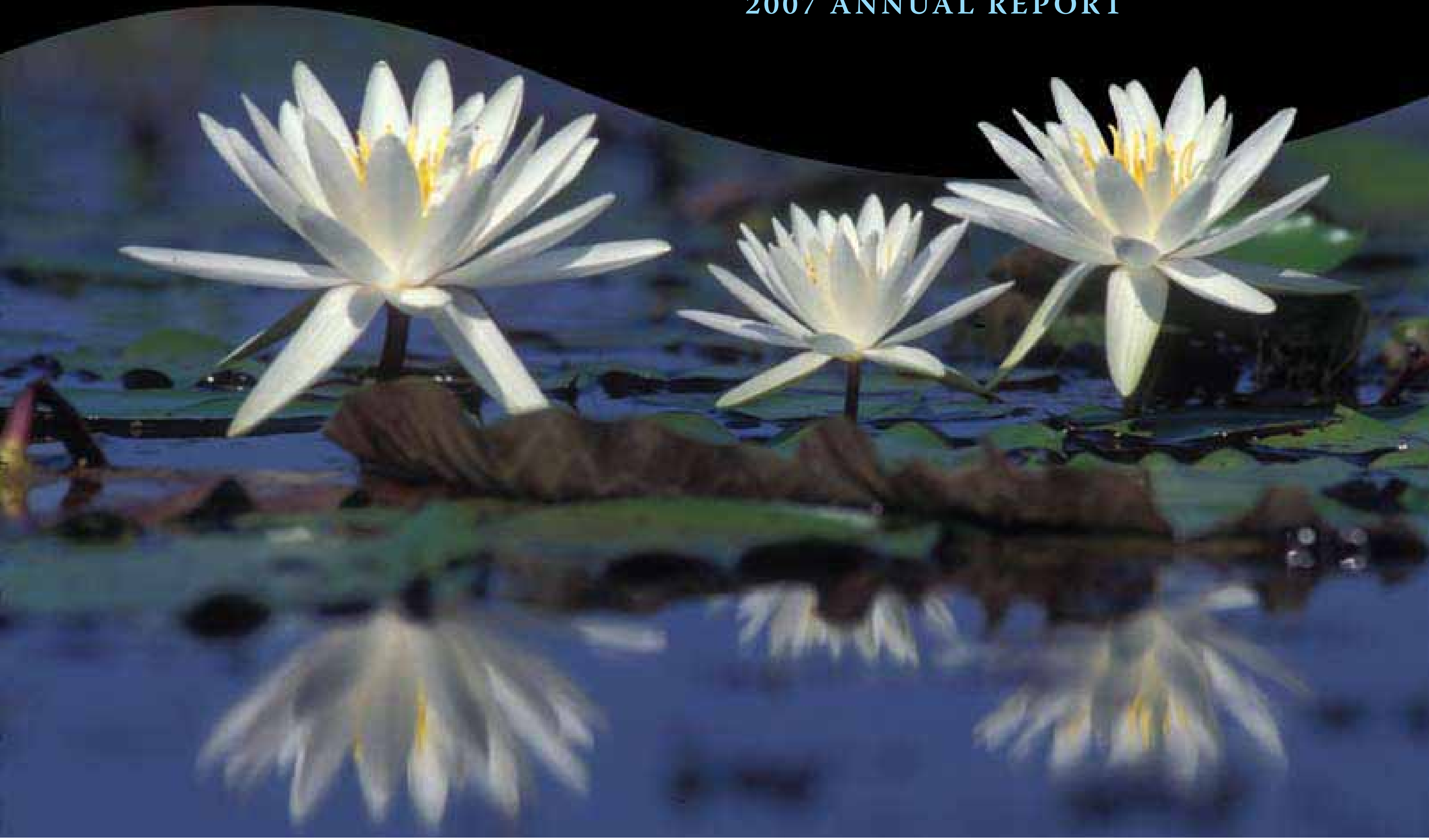
Publication

1. Mississippi Water Resources Research Institute. 2006. 2006 Annual Report. Mississippi Water Resources Research Institute. Mississippi State University, Mississippi State, MS, 24 pages.
2. Mississippi Water Resources Research Institute. 2007. 2007 Annual Report. Mississippi Water Resources Research Institute. Mississippi State University, Mississippi State, MS, 28 pages.

MISSISSIPPI

WATER RESOURCES RESEARCH INSTITUTE

2007 ANNUAL REPORT

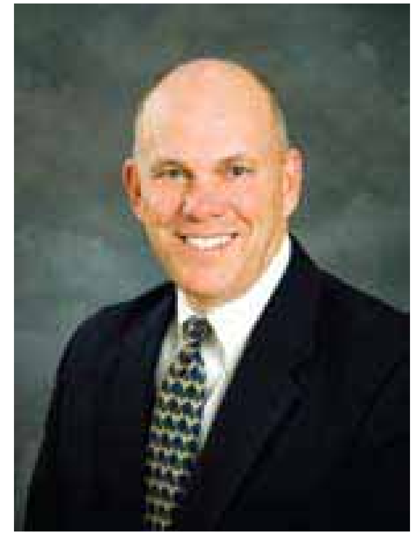


MISSISSIPPI

WATER RESOURCES RESEARCH INSTITUTE

2007 ANNUAL REPORT

Director's notes



Mississippi is truly blessed with plentiful supplies of clean water. Our state has water on three sides and most of our water supply is obtained from ground water resources. Consequently, the need to maintain contaminant-free, plentiful groundwater is essential to our quality of life.

The Mississippi Water Resources Research Institute addresses research and outreach efforts targeted at maintaining plentiful, quality water supplies throughout the state. The institute is a hub for information and expertise on water resources issues within the state and region.

Water is not only important to our quality of life, abundant supplies provide for economic growth. The Northeast Mississippi Daily Journal recently reported that the new Toyota Mississippi plant will require about one million gallons of water daily. Fortunately, there is plenty to meet that demand, which was critical in locating the plant in the state.

The Mississippi Water Resources Research Institute is committed to providing public outreach, educational opportunities, and assisting with economic development activities. This report details many of the activities the institute is addressing on the most pressing water-related problems.

Water represents a critical natural resource to sustain economic success in our towns and cities, our fields and forests, and among our industries. We must provide a clear understanding of the activities that impact our water quantity and quality into the future. Thank you for your participation in these endeavors.

George M. Hopper

Mississippi Water Resources Research Institute

The Mississippi Water Resources Research Institute (MWRRI) provides a statewide center of expertise in water and associated land use and serves as a repository of knowledge for use in education, research, planning, and community service.

The MWRRI goals are to serve public and private interests in the conservation, development, and use of water resources; to provide training opportunities in higher education whereby skilled professionals become available to serve government and private sectors alike; to assist planning and regulatory bodies at the local, state, regional, and federal levels; to communicate research findings to potential users in a form that encourages quick comprehension and direct application to water related problems; to assist state agencies in the development and maintenance of a state water management plan; and to facilitate and stimulate planning and management that:

- deals with water policy issues,
- supports state water agencies' missions with research on problems encountered and expected,
- provides water planning and management organizations with tools to increase efficiency and effectiveness.

The Mississippi Water Resources Research Institute is a unit of the Forest and Wildlife Research Center, Mississippi State University.

MWRRI-funded projects

These projects reflect the success of the institute to facilitate strong relationships between university researchers and Mississippi's state agencies and other organizations to identify and address priority water resource issues. These projects all include partial cost share from a participating non-federal agency or organization.

Developing a Reliable Method for Identifying Pre-settlement Wetland Sediment Accumulation Rates: ^{14}C Dating on Bulk Lake Sediments and Extracts

Gregg Davidson, Geology and Geological Engineering, University of Mississippi

Knowledge of changes in time and the thickness of sediment accumulated over that interval of time allow calculation of the rate of sediment accumulation. Carbon-14 is often used to date specific layers in lake sediments, but there are many problems that can result in erroneous calculated ages. Terrestrial macrofossils are generally the most desirable material to date, but they are often difficult to find. In the absence of macrofossils, pollen may be extracted and dated, but separation is tedious and requires use of toxic chemicals. Bulk sediment fractions contain a mixture of material of various ages, and may be subject to reservoir effects that usually add apparent age to samples. A single ^{14}C measurement from a bulk sediment sample is thus unlikely to yield the true age of deposition. If inputs into the system have been relatively constant over an interval of time, however, changes in ^{14}C activity with depth should represent accurate changes in time, even if the absolute dates remain uncertain. In this study, three bulk sediment fractions were compared with three macrofossil (or "subfossil") types. The ^{14}C activity of all sample types was compared from a wetland core. The bulk sediment fractions yield highly linear plots with respect to depth, and all yield very similar sedimentation rates. The subfossil results are much more scattered and yield slightly lower sedimentation rates. The linearity of the bulk sediment fractions suggests they are more reliable than the subfossil samples for rate determination. Samples from three cores collected from the open water area were used to test how reproducible calculated sedimentation rates are using a bulk sediment fraction model. Data from the three cores demonstrated a high degree of reproducibility. This data shows great promise for the use of biased ^{14}C activity from bulk sediment fractions to accurately estimate sediment accumulation rates. In this project, data and observations of sediment accumulation over the past five years indicate that the 50-fold increase in sediment accumulation rate continues unabated, in spite of improved agricultural practices designed to minimize soil loss.

MWRRI-funded projects

Assessing the effectiveness of streamflow augmentation in the Sunflower River to maintain water quality and wetland integrity

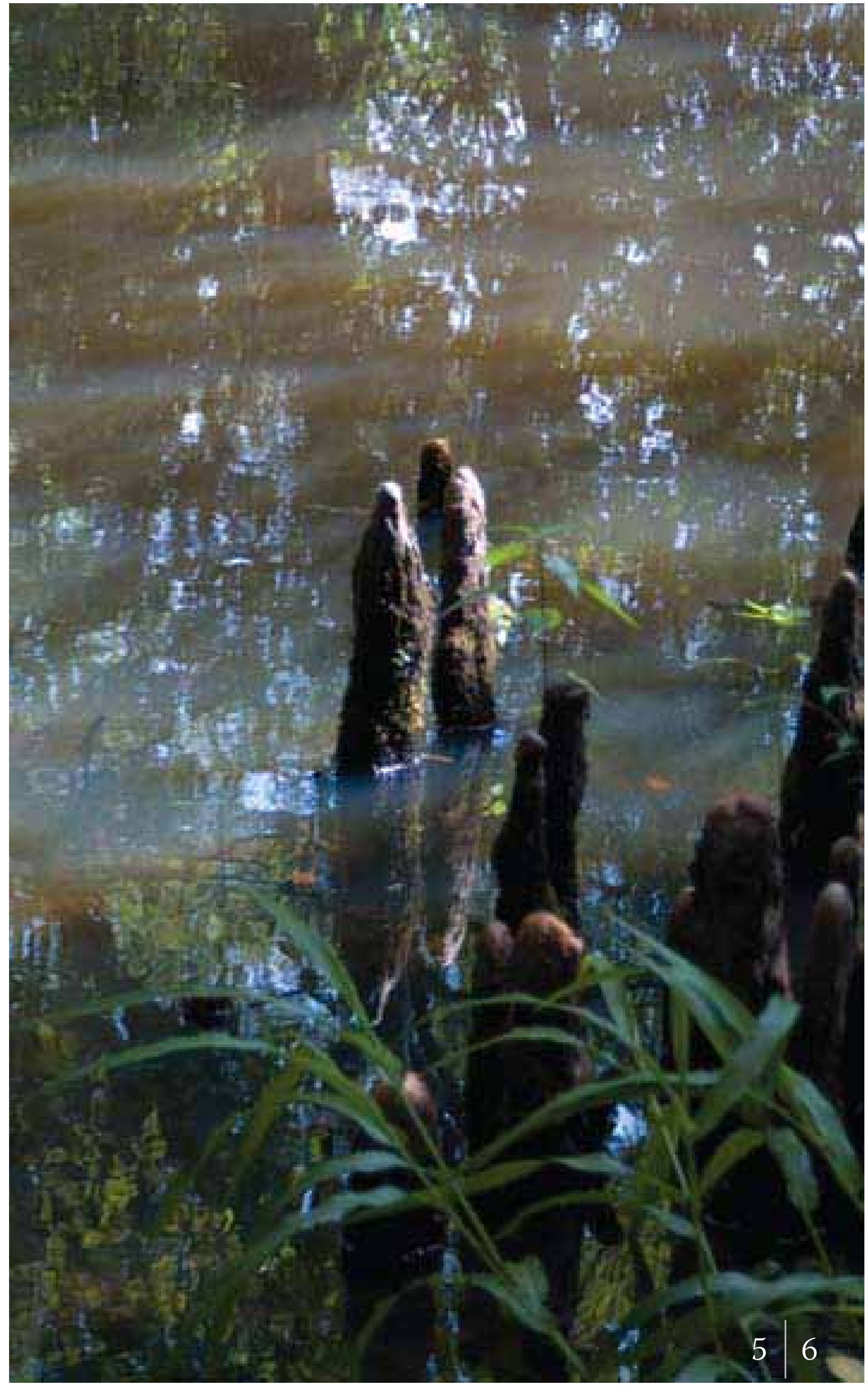
Gary Ervin, Biological Sciences; Todd Tietjen, Wildlife and Fisheries, Mississippi State University

The Big Sunflower River is listed on Mississippi's Clean Water Act 303(d) as an impaired waterbody. Substantial decreases in the Sunflower River's late summer/early autumn base flows, as a result of agricultural withdrawals from the Mississippi River Valley Alluvial Aquifer, contribute to the river's impairment. The objective of this project is to provide a quantitative ecological evaluation of wetland and water quality impacts resulting from groundwater supplementation to a major stream in the Lower Mississippi Alluvial Stream. During the past six months, a range of water quality parameters were sampled in support of the Sunflower River augmentation project. These data were collected to assess the benefits of enhanced flow in this river system, but they also demonstrated the importance of traditional measures of water quality. The wide range in variability continues to be evident at any of the sampling sites throughout the testing period and along the entire length of the river from Indianola to north of Clarksdale. In general, there is some evidence that supplemental flows have improved water quality in the river. There is a visual correlation between periods with increased streamflow, decreased water temperatures and higher dissolved oxygen concentrations. A complete data set will be necessary before statistical assessments are attempted. The Yazoo-Mississippi Delta Joint Water Management District has found the water quality data collected to be of considerable benefit.

Natural Enhanced Transport of Agricultural Lead and Arsenic through Riparian Wetlands

Gregg Davidson, Geology and Geological Engineering,
University of Mississippi

Riparian wetlands are widely regarded as efficient scavengers of a broad range of contaminants. Confidence in the ability of riparian zones to buffer anthropogenic inputs has derived primarily from studies of active inflow and outflow of chemical-laden water and sediment entering and exiting riparian systems. While such studies document short-term scavenging of specific chemicals, they tell little about the permanence of sequestration. In Sky Lake, an oxbow lake-wetland in the Delta region of Mississippi, sediment cores representing 100 years of accumulation contain evidence that inorganic pesticides applied in the past were not permanently sequestered in the wetland surrounding the lake. Lead and arsenic spikes clearly present in open water sediments deposited approximately 75 years ago are entirely absent in the wetland sediments. The age of these sediments and elevated concentrations match historical records of lead arsenate used for boll weevil control in surrounding cotton



Natural Enhanced Transport of Agricultural Lead and Arsenic through Riparian Wetlands (continued)

crops. The geomorphology, sediment distribution, and hydrology of the lake suggest that these contaminants could not have reached the lake without depositing a significant mass of contaminated sediment within the wetland. Secondary processes appear to have remobilized and flushed lead and arsenic from the wetland into the open water environment where deposition and burial resulted in permanent sequestration. If lead and arsenic were indeed flushed from the riparian wetlands of Sky Lake, then it is conceivable that modern agricultural contaminants may behave in a similar fashion over time. Organic compounds that are resistant to decomposition may be only temporarily scavenged in a riparian zone, and later reintroduced into the aquatic environment.

The primary purpose of this study is to determine if the apparent flushing of contaminants from the wetland at Sky Lake is common in other lake-wetland systems, or if Sky Lake has a unique history created by a currently unknown phenomenon. If a similar history of lead and arsenic deposition is found in other lakes, then a follow-up study will be proposed to explore the possibility that persistent organic pesticides or herbicides share a similar fate.

A secondary purpose is to determine if the complete absence of anthropogenic lead in the wetland sediments of Sky Lake is due to its occurrence in a more mobile phase.

Water Quality and Floristic Habitat Assessments in the Coldwater and Sunflower River Basins: Comparing Traditional Measures of Water and Habitat Quality to Index of Biotic Integrity Findings

Todd Tietjen, Wildlife and Fisheries; Gary N. Ervin, Biological Sciences, Mississippi State University

The Coldwater and Sunflower Rivers in Northwest Mississippi are listed on the EPA Section §303(d) list of Impaired Waterbodies for Mississippi. Different river segments and tributaries in the basin are listed as impaired for Aquatic Life Support and Secondary Contact caused by biological impairment, nutrients, low dissolved oxygen, organic enrichment, pesticides, pathogens, and sediments. Total maximum daily loads have been developed for impaired reaches in the Coldwater and Sunflower River Basins, and water quality improvements are being implemented. Stream quality reference conditions are also being established based on industrial and engineering inspection scores rather than the narrative standards used in the past. These water bodies are extremely low gradient, naturally turbid, and have been impacted by agriculture for many years. The fish-based index of biotic integrity and the invertebrate-based rapid bioassessment protocol are two of the most frequently used techniques for assessing water quality. The rationale is that the resident fish community is reflective of long-term water quality. If water quality conditions are typically poor, this would be reflected by a limited fish community comprised of tolerant species; if water quality conditions are typically good, this would be reflected by a diverse fish community of pollution intolerant species. This project will refine the development of water quality standards in the Lower Mississippi Alluvial Valley using a combination of additional measures of system status. Specifically, scientists will evaluate the incorporation of traditional measures of water quality and stream/river habitat quality measurements, such as floristic quality assessments of riparian areas, with the fish-based data that has already been collected to improve the establishment

MWRRI-funded projects

Water Quality and Floristic Habitat Assessments in the Coldwater and Sunflower River Basins: Comparing Traditional Measures of Water and Habitat Quality to Index of Biotic Integrity Findings (continued)

of appropriate water quality standards. The combination of approaches provides the best opportunity to evaluate these unique aquatic systems. It is expected that this research will enhance management of Lower Mississippi Alluvial Valley surface waters for human use, wildlife value, and water quality, as well as facilitate the administrative determination of water quality standards. This project will entail simultaneous quantitative evaluation of the water and habitat quality to be coupled with existing data on fish community composition and resulting inspection score calculations. As such, this project will increase the efficacy with which water district managers can plan and implement programs to preserve and enhance water quality in an effort to balance societal and ecological needs.

Climatological and Cultural Influences on Annual Groundwater Decline in the Mississippi Delta Shallow Alluvial Aquifer: Identifying the Causes and Solutions

Charles L. Wax, GeoSciences; Jonathan W. Pote, Agricultural and Biological Engineering; Joseph Massey, Plant and Soil Sciences, Mississippi State University; and Dean Pennington, Yazoo Mississippi Delta Joint Water Management District

The purpose of this research is to determine causes of short-term aquifer declines, primarily cultural water uses and climatological processes, with a conscious effort to exclude the effects of river recharge or extraction. The spatial scope of the research is the central part of the Delta, and the temporal scope is a period from 1980-2006. Primary objectives are to assess the effects of agricultural demands/uses and climatological variability on withdrawal of water from the shallow alluvial aquifer. The main concern is to evaluate the long-term drop in water level in the aquifer, stemming from growing season uses exceeding recharge rate year after year. The approach to be taken is to determine what each year's annual decline has contributed to the multi-year decline. The pattern presently identified is one in which declines in the water level occur seasonally during wet years with almost complete recovery, but the decline during drought years is much more substantial and recovery is negligible. Over the past 30 years, this has resulted in an overall decline in water level in the aquifer. There is little that can be done to reduce the water demand of agriculture in dry years, but in years with at least normal or above normal rainfall, maximizing use of that rain to substitute for groundwater is a preferred alternative. Once the size of the demand is known, the research will attempt to determine alternatives needed to offset the demand. Since drought years inevitably will cause groundwater level decline, in years of normal or surplus rainfall, the precipitation must be used to make up any declines in water level from cultural uses. The nature of this research is to determine if the amount of precipitation used in lieu of groundwater in wet years is sufficient to offset the combined decline of both that year and drought years.

Watershed Alliances

Geospatial Technologies as a Foundation to Organize a Voluntary Bi-State Luxapalila Creek Watershed Alliance to Pursue Luxapalila Creek's Watershed Implementation Plan

Jeff Ballweber and Mary Love Tagert, Mississippi Water Resources Research Institute; William McAnally, Civil and Environmental Engineering; and Rita Jackson, GeoResources Institute, Mississippi State University

The Luxapalila Creek Watershed Alliance was formed to use geographic information systems (GIS) technology to help bring stakeholders together. The main goal of the project is to provide a broad local perspective to refine and begin implementing and expanding a preliminary Luxapalila Creek Watershed Implementation Plan that was developed by the Tennessee-Tombigbee River Basin Team to protect water quality in the Luxapalila Creek Watershed. The MWRRI has organized an expanded group of local and regional stakeholders to discuss the water quality issues in light of new industrial development in the watershed. The MWRRI also has developed high resolution imagery for much of the watershed to use in refining a water quality protection strategy. The imagery and data have been distributed to local stakeholders who are actively participating in the project.

The MWRRI has been assisting interested stakeholders organize comprehensive watershed management organizations since the mid-'90s. Regardless of the geographic size of the watershed or the scope of interests, watershed management organizations are increasingly important nationally and in Mississippi because they can integrate and coordinate various federal and state environmental, agricultural, natural resource, emergency management, and economic development programs to develop and implement plans for environmentally sustainable economic development. The MWRRI has a proven record in engaging local stakeholders and federal and state agencies to create watershed organizations and to identify and prioritize issues and projects to address those issues.

Linking Coastal Watersheds: A Pilot Project on Collaboration Linking Inland and Coastal Water Resources Management Systems in the Tennessee-Tombigbee and Mobile Bay Basin

Mary Love Tagert and Jeff Ballweber, Mississippi Water Resources Research Institute; and William McAnally, Civil and Environmental Engineering, Mississippi State University

Because of success on previous watershed alliances, the National Oceanic and Atmospheric Administration's Coastal Services Center provided the MWRRI funding to expand the Luxapalila project. The MWRRI used geospatial data to engage stakeholders from Mississippi and Alabama located in the Tennessee-Tombigbee and Mobile Bay Watersheds. The MWRRI facilitated meetings between upstream and downstream/coastal stakeholders to identify available GIS data and tools, relevant GIS-based Decision Support Systems, and technical and financial assistance support for watershed management. Based on the meetings, the MWRRI organized several workshops to present detailed information on available data, tools, and decision support systems. The MWRRI documented the project approach, including lessons learned, so that this approach to multi-state watershed cooperation can be replicated in other priority watersheds across the nation.

Economic Development

Following the lead of many private developers, a number of Mississippi's rural counties are exploring the feasibility of developing multi-purpose lakes to spur economic development while protecting their unique quality of life. The MWRRI is involved in many of these efforts in various capacities. In all of these projects, the MWRRI has actively participated with the Mississippi Development Authority, the private sector and local governmental sponsors to define the work plan and secure the funding for project activities.

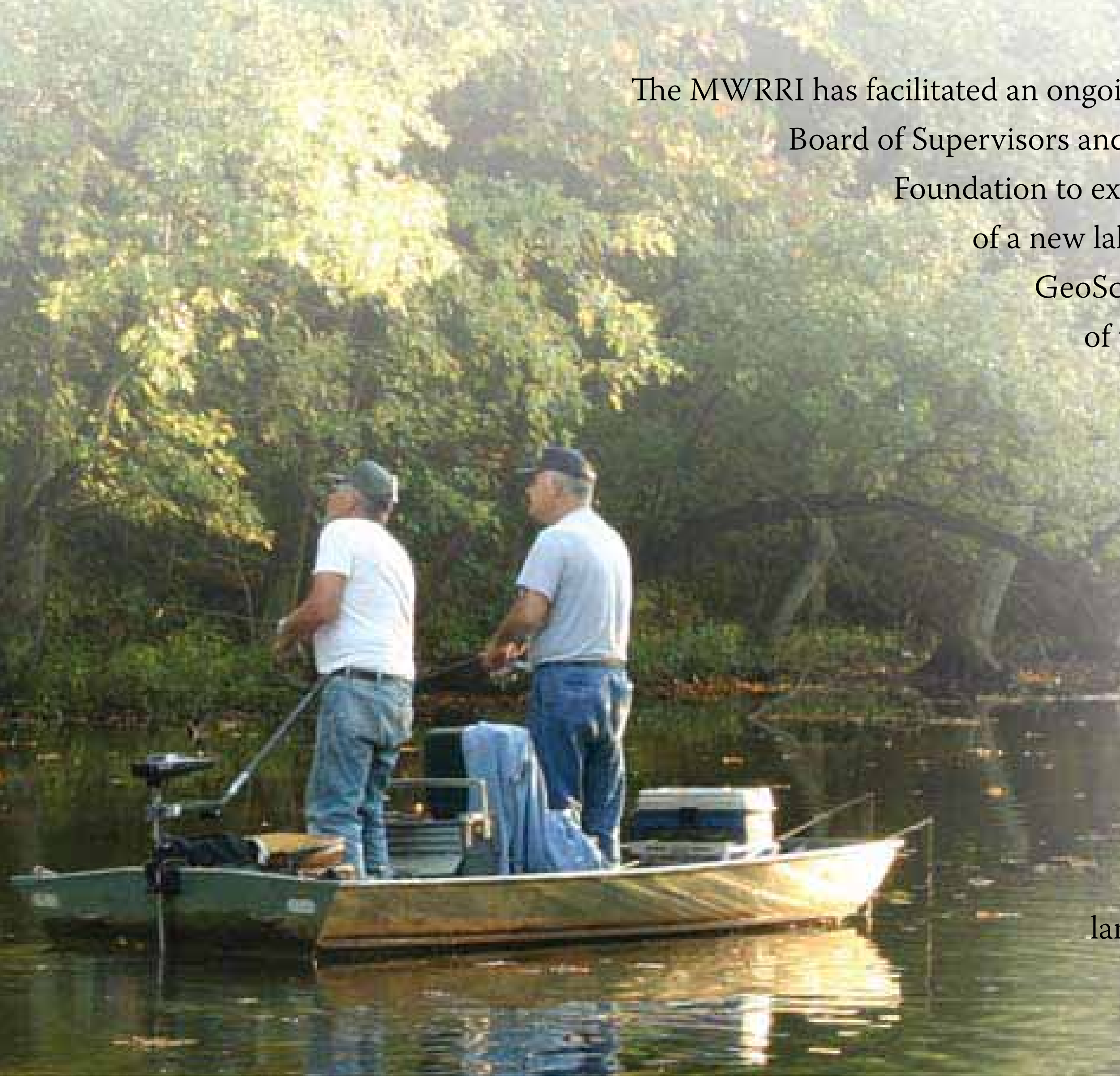
Madison County Lake: Civic Engagement and Economic Impact

Jeff Ballweber and Mary Love Tagert, Mississippi Water Resources Research Institute; Jonathan Pote, Agricultural and Biological Engineering; Jon Rezek, Finance and Economics; Steve Grado, Forestry; Garren Evans and Darren Hudson, Agricultural Economics, Mississippi State University

Economic development and its associated benefits have fallen behind in Northern Madison County as compared to development in the southern part of the county. The MWRRI led a civic engagement task that included 1) organizing a tour of the Tellico Reservoir in Tennessee for a diverse group of Northern Madison County citizens and 2) conducting public meetings to discuss possible economic development alternatives with county residents. In addition, the MWRRI organized a multidisciplinary team of researchers to conduct a preliminary economic feasibility study of selected development alternatives. The final report has been presented to the Madison County Economic Development Authority and the Madison County Board of Supervisors for their consideration.

Marketing & Economic Impacts of a Potential Choctaw County Multi-use/Multi-purpose Impoundment

Jeff Ballweber and Mary Love Tagert, Mississippi Water Resources Research Institute; Jon Rezek, Finance and Economics; Darrel Schmitz and Charles Wax, GeoSciences, Mississippi State University



The MWRRI has facilitated an ongoing relationship with the Choctaw County Board of Supervisors and the Choctaw County Economic Development Foundation to explore the feasibility and economic impact of a new lake in Choctaw County. The Department of GeoSciences has conducted a geohydrological analysis of two potential lake sites to ensure that they will fill and hold water. A multi-disciplinary team of researchers has conducted a preliminary economic impact and economic feasibility study of a proposed lake. The research team benefited from the services of two master's of business administration graduate students who studied the lake project. The MWRRI has analyzed alternative institutional management alternatives for the lake project and identified various mechanisms to fund and organize the land acquisition stage of the project.

Economic Development

Smith County Lake Study

Jeff Ballweber and Mary Love Tagert, Mississippi Water Resources Research Institute; Jonathan Pote, Agricultural and Biological Engineering; Jon Rezek, Finance and Economics; Steve Grado, Forestry; Garen Evans and Darren Hudson, Agricultural Economics; and Darrel Schmitz and James May, GeoSciences, Mississippi State University

Working closely with the U.S. Forest Service and the Bienville Natural Resources Council (an interlocal agreement between Covington, Smith, Jasper, Rankin, and Simpson counties), this project is identifying and evaluating sites in Smith County that could be developed into a multi-purpose lake. As part of a master planning effort, the project is also evaluating facilities and amenities that could be directly or indirectly associated with the lake to make it a regional economic development hub for all counties participating in the council. Amenities that were evaluated include water-related structures such as docks and piers, marinas, and boat ramps; land-based facilities such as cabins, camping areas, and structures for recreational activities; residential areas; a conference center; a lodge(s); and complementary commercial establishments. In the last year, the MWRRI contracted with Pickering Inc. to prepare a preliminary master plan to assist in an economic feasibility study of the lake performed by PriceWaterhouseCoopers through a contract with the Forest Service. Currently, a multi-disciplinary research team are expanding that limited study to identify the project's regional economic impact and feasibility.

Economic Impact Study of the LeFleur Lakes Flood Control Plan

Jeff Ballweber and Mary Love Tagert, Mississippi Water Resources Research Institute; Jonathan Pote, Agricultural and Biological Engineering; and Michael Seymore, Landscape Architecture, Mississippi State University

The MWRRI is a subcontractor to the Mississippi Engineering Group, the entity conducting an economic impact study of the controversial LeFleur Lakes Flood Control Plan. This study is totally separate from an earlier cost/benefit analysis conducted by the U.S. Army Corps of Engineers. As part of the overall team, the MWRRI is coordinating MSU's participation in the project. Specifically, the researchers actively participated in a planning charette held earlier this year in Jackson to develop a conceptual master plan for the project. The MWRRI is supporting the economic analysis portion of the study by gathering, processing and providing access to GIS data in the project area and broader region to be impacted by the project. In addition, the MWRRI has a primary role in examining the project's environmental justice issues.

Water Quality

St. Johns Bay and Jacksonville, FL On-site Wastewater System Assessment

Mary Love Tagert, Mississippi Water Resources Research Institute; Jonathan Pote, Department of Agricultural and Biological Engineering; James Martin, Department of Civil and Environmental Engineering, Mississippi State University

Numerous waterbodies in the St. Johns watershed and Duval County, in particular, are frequently impaired by nonpoint source water pollution from unsewered communities and failing on-site wastewater treatment systems. The city of Jacksonville, Fla. (located in Duval County) is exploring ways to address these water quality concerns. To qualify for federal funding mechanisms to enlarge a municipal wastewater treatment plant, the city must quantify the water quality impacts of unsewered communities and failing on-site wastewater treatment systems on surface waters within the watershed. The MWRRI has organized a multi-disciplinary team of researchers to work with Jacksonville University and the private sector to achieve this task. The MWRRI team had three primary objectives: 1) review previous total maximum daily load studies and other studies related to failing on-site wastewater treatment systems that have been performed in the study area; 2) compile and review data on permits issued for on-site wastewater treatment systems in Duval County; and 3) incorporate geospatial technologies to help develop a water quality sampling plan and analyze potential data trends. Jacksonville University led the sampling effort by implementing a plan to analyze samples collected at three baseline sites and approximately seven potentially impacted sites for total Kjeldahl nitrogen and phosphorous, as well as temperature, salinity and dissolved oxygen. The results from this project are being incorporated into a larger report to justify and support a follow-up grant proposal to the Florida Department of Environmental Protection.

Increasingly, good water quality is critical to attracting new industries to an area. As county and local governments begin to take a more active role in addressing nonpoint sources of water pollution, it is important to accurately and fully quantify the potential water quality benefits of various non-regulatory management alternatives. The MWRRI is collaborating with governments, the Environmental Protection Agency, the Mississippi Department of Environmental Quality and other state and regional agencies to design projects to meet these needs.

Water Quality

Spatial Technology and High-Performance Computing for Improved Prediction of Surface Water Quality

Mary Love Tagert, Mississippi Water Resources Research Institute

The MWRRI is participating in a multidisciplinary project funded by the National Oceanic and Atmospheric Administration to develop and demonstrate the use of advanced spatial technology and high-performance computing in predicting surface water quality. The main objectives of this project are to 1) demonstrate the application of advanced spatial data analysis and display technology in water quality management; 2) improve the performance of surface water quality models and linkage of surface water quality and landscape interactions for use in water quality management; 3) enhance the evaluation and interpretation of model results for decision support; and 4) promote improved use of available technologies in support of surface water quality management and control. The MWRRI is focusing primarily on geospatial data support and processing for the modeling effort, stakeholder outreach and interaction, management recommendations based on model results, technology transfer to decision makers within the watershed, and training and outreach to the user community.

Southeastern Regional Small Public Water Systems Technical Assistance Center (SE-TAC)

Jeff Ballweber and Kim Steil, Mississippi Water Resources Research Institute; Jonathan Pote, Department of Agricultural and Biological Engineering, Mississippi State University

The need to assist small (10,000 or fewer customers) and even the smallest (3,400 or fewer customers) public water systems in Mississippi and the Southeastern United States develop financial, managerial and technical capacity remains an MWRRI priority. Recent events have greatly expanded the reach of capacity development to encompass elements of system security and emergency preparedness; source water protection; infrastructure maintenance; and regulatory compliance. The MWRRI's Southeastern Regional Small Public Water Systems Technical Assistance Center (SE-TAC) was funded initially by the Environmental Protection Agency in 2000 to develop capacity-building tools and programs in the Southeastern United States that will assist small public water systems in understanding and complying with new regulatory requirements under the Safe Drinking Water Act. The SE-TAC has made tremendous contributions towards resolving issues faced by the region's small public water systems. In its first six years, the SE-TAC has provided approximately $1.3 million on over 35 projects that have directly assisted small systems across the region. The SE-TAC projects have benefited hundreds of small systems in the region, providing technical assistance to more than 97 systems, training more than 2,000 water system personnel, and saving small water systems more than $3 million in water loss and energy costs.

Water Quality

Aquatic Plant Management Support for the Pearl Valley Water Supply District

Mary Love Tagert, Mississippi Water Resources Research Institute; John D. Madsen, GeoResources Institute, Mississippi State University

The Ross Barnett Reservoir is Mississippi's largest surface water impoundment (33,000 acres) and serves as the primary drinking water supply for the city of Jackson, Mississippi's capital city. The Pearl River Valley Water Supply District manages the reservoir, which is surrounded by approximately 50 residential subdivisions with over 4,600 homes. The reservoir provides recreational opportunities in the form of five campgrounds, 16 parks, 22 boat launches, three handicapped-accessible trails, and two multi-purpose trails. In recent years, invasive species have become an increasing problem in the reservoir by clogging navigation channels, reducing recreational

fishing opportunities, and reducing access for users of the reservoir. The Pearl River Valley Water Supply District contacted the MWRRI to develop a long-term aquatic plant management plan for the Ross Barnett Reservoir. The first step in development of a management plan was to assess the reservoir's plant community by mapping the distribution of aquatic plant species throughout the reservoir. A total of 19 plant species were observed during the initial survey in 2005. Alligatorweed was located most frequently, followed by American lotus, and hydrilla. An aquatic plant survey was also performed in 2006, but this survey covered the littoral zone only. Alligatorweed was still the most frequently detected species in 2006. In general, the occurrence of aquatic plants increases where water depths are shallower in the northern portion of the Ross Barnett Reservoir and in Pelahatchie Bay. Species occurrence has been low where water depths are deeper in the middle and southern end of the reservoir. Other components of the study included the evaluation of current management efforts as well as the creation of GIS data layers to aid in long-term aquatic plant management efforts. This project is continuing to monitor the aquatic plant distribution in the reservoir to assess changes and spread in nuisance species populations. Techniques are also being implemented to control nuisance species and promote the growth of more desirable native plants.

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Pickering Incorporated

Mr. Jamie Crawford
Mississippi Department of Environmental Quality

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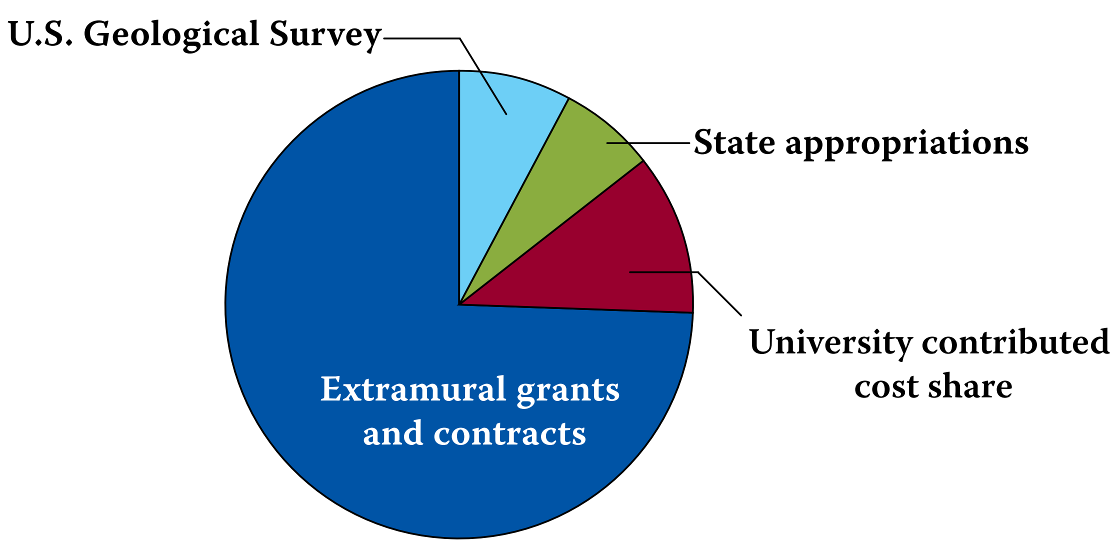
Environmental Protection Agency, Office of Ground Water and Drinking Water
Madison County Economic Development Authority
Mississippi Department of Environmental Quality
Mississippi Engineering Group
National Oceanic and Atmospheric Administration, Coastal Services Center
Pearl River Valley Water Supply District
Pickering Incorporated
United States Forest Service, National Forests of Mississippi

Pictures provided by:

Dave Ammon
Russ Houston
Joe Mac Hudspeth Jr.
Matt Ladner
Louie Miller

Financial Summary

Program Component	Federal	Non-Federal	Total
U.S. Geological Survey grant	$92,335		$92,335
State appropriations		$76,496	$76,496
University contributed cost share		$128,331	$128,331
Extramural grants and contracts	$609,452	$246,825	$856,277
TOTAL	$701,787	$451,652	$1,153,439



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Information Transfer Program−Conferences

Basic Information

Title:	Information Transfer Program−Conferences
Project Number:	2006MS70B
Start Date:	3/1/2006
End Date:	2/28/2009
Funding Source:	104B
Congressional District:	3rd
Research Category:	Not Applicable
Focus Category:	None, None, None
Descriptors:	
Principal Investigators:	George M. Hopper

Publication

1. 2006, Mississippi Water Resources Conference Proceedings, Mississippi Water Resources Research Institute, Mississippi State, MS, CD ROM.
2. 2006, Mississippi Water Resources Conference Program and Abstracts, Mississippi Water Resources Research Institue, Mississippi State, MS, 66 pg.
3. 2007, Mississippi Water Resources Conference Proceedings, Mississippi Water Resources Research Institute, Mississippi State, MS, CD ROM.
4. 2007, Mississippi Water Resources Conference Program and Abstracts, Mississippi Water Resources Research Institute, Mississippi State, MS, 67 pg.

37[TH] ANNUAL MISSISSIPPI

WATER

RESOURCES CONFERENCE

APRIL 24-25, 2007

JACKSON, MS

PROGRAM

Tuesday, April 24

Time	Event	Location
7:30 a.m.	Continental Breakfast	Penthouse
8:30 a.m.	Opening Plenary Session ***Overview of Water Issues: Now and In the Future*** **George Hopper,** Moderator Director, Mississippi Water Resources Research Institute	Diplomats I and II
8:45 a.m.	**Brandon Presley** Mayor of Nettleton	
9:05 a.m.	**Colonel Alfred Bleakley** Deputy Commander U.S. Army Corps of Engineers - Mississippi Valley District	
9:25 a.m.	**Ted Leininger** Supervisory Research Plant Pathologist USDA Forest Service	
9:45 a.m.	**Trudy Fisher** Executive Director Mississippi Department of Environmental Quality	
10:05 a.m.	**Bill Walker** Executive Director Mississippi Department of Marine Resources	
10:30 a.m.	Break	Regency Hallway
10:45 a.m.	Poster Session	Regency Hallway

Ardeshir Adeli and Dennis E. Rowe, Broiler litter management affects on soluble constituents in leachate and runoff from bermudagrass forage based system

Trey Cooke, Bee Lake watershed restoration project

Charlie Cooper, Sammie Smith Jr., Henry Folmar, Sam Testa III, Pesticide presence and concentrations In surface waters of selected lakes and reservoirs (<500 acres) of Mississippi

Shelby Fortune and Todd Tietjen, Comparison of automated versus manual monitoring of levels of dissolved oxygen in aquaculture ponds

Cyle Keith, H. Borazjani, S.V.Diehl, M.L. Prewitt, Y.Su, Fengxiang Han and B.S. Baldwin, Aquatic phytoremediation of CCA and copper contaminated water

Marcus B. Matallo, Claudio A. Spadotto, Marco A.F. Gomes, Luiz C. Luchini and Antonio L. Cerdeira, Use of mathematical model to study tebuthiuron leaching in sandy soil of a recharge area of Guarany Aquifer in Brazil

Jeremy Murdoch, Kim Collins and Timothy J. Schauwecker, Conservation planning integrating site assessment and hydrologic modeling at the Mississippi State University Dairy Unit, Sessums, MS

M. Lynn Prewitt, Celina Phelps, Mike Cox, Rick Evans and **Susan Diehl,** Bacterial source tracking of a watershed impacted by cattle pastures

John J. Read, Geoffrey E. Brink, Steve L. McGowen and Jim G. Thomas, Effect of Swine Effluent Application Rate and Timing on Nitrogen Utilization and Residual Soil Nitrogen in Common Bermudagrass

Peter E. Schweizer, Conservation planning for fish assemblages based on land cover distribution

John Storm, Real-time pier scour monitoring on the Pascagoula River at Interstate 10

PROGRAM

Tuesday, April 24 (continued)	
11:45 a.m.	Luncheon **Bo Robinson**, Invocation and Introduction Northern District Public Service Commissioner **Leonard Bentz**, Keynote Speaker Southern District Public Service Commissioner
1:00 p.m.	Session A: **Delta Groundwater - Jamie Crawford**, Moderator (Concurrent Session)
1:00 p.m.	**Shane Powers**, Agricultural water use in the Mississippi Delta
1:20 p.m.	**Claire E. Rose**, Determining Potential for Direct Recharge in the Mississippi River Alluvial Aquifer Using Soil Core Analyses, Washington County, Northwestern Mississippi
1:40 p.m.	**Mark Stiles**, Changes in water volume in the Mississippi River Valley Alluvial Aquifer in Northwest Mississippi
2:00 p.m.	Break
2:15 p.m.	Session A: **Delta Groundwater - Jamie Crawford**, Moderator (Concurrent Session continued)
2:15 p.m.	**Patrick C. Mills**, Potential for infiltration through the fine-grained surficial deposits of the Bogue Phalia Watershed, Mississippi
2:35 p.m.	**Charlotte Bryant Byrd**, Mississippi River Valley Alluvial Aquifer geology of the central Delta (East Central Sunflower County and West Central Leflore County)
2:55 p.m.	**James E. Starnes**, Mississippi River floodplain "Delta" - Bluff margin alluvial fax complexes
1:00 p.m.	Session B: **Modeling - Greg Jackson**, Moderator (Concurrent Session)
1:00 p.m.	**J. N. Diaz**, Evaluation of HSPF streamflow uncertainty bounds due to potential evapotranspiration bias and parameter variability
1:20 p.m.	**Peter E. Schweizer**, Spatial distribution of land cover and their influences on watershed condition
1:40 p.m.	**Peter Ampim**, Pesticide runoff from bermudagrass: Effects of plot size and mowing height
2:00 p.m.	Break
2:15 p.m.	Session B: **Modeling - Greg Jackson**, Moderator (Concurrent Session continued)
2:15 p.m.	**William H. McAnally**, Modeling Mobile Bay sediments and pollutants with new technologies
2:35 p.m.	**Zhiyong Duan**, Integration of impact factors of gas-liquid transfer rate
2:55 p.m.	**Richard A. Rebich**, Activities of the U.S. Geological Survey related to total nitrogen and total phosphorus trends and modeling in surface waters of the Lower Mississippi and Texas-Gulf River rasins
3:15 p.m.	Break
3:30 p.m.	Session C: **Invasives - Jake Schaefer**, Moderator (Concurrent Session)
3:30 p.m.	**John D. Madsen**, Ecologically-based invasive aquatic plant management: Using life history analysis to manage aquatic weeds
3:50 p.m.	**Joshua C. Cheshier**, Common reed: Phragmites Australis (CAV.) Trin. Ex Steud: Life history in the Mobile River Delta, Alabama
4:10 p.m.	**Ryan M. Wersal**, Littoral zone plant communities in the Ross Barnett Reservoir, MS
4:30 p.m.	**Wilfredo Robles**, The invasive status of giant salvinia and hydrilla in Mississippi
3:30 p.m.	Session D: **Agriculture - Dean Pennington**, Moderator (Concurrent Session)
3:30 p.m.	**John P Brooks**, Antibiotic resistant and pathogenic bacteria associated with rain runoff following land application of poultry litter

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Tuesday, April 24 (continued)	
3:50 p.m.	**Antonio L. Cerdeira**, Agriculture and ground water quality in a sugarcane area in São Paulo State, Brazil
4:10 p.m.	**Bill Branch**, Irrigation of soybeans and cotton on level-basin fields
4:30 p.m.	**Robbie Kröger**, Drainage ditches as components of an integrated best management strategy for mitigating agricultural non-point source pollution
4:50 p.m.	Adjourn

Wednesday, April 25	
7:00 a.m.	Continental Breakfast
8:00 a.m.	Session E: **Sedimentation - Dave Johnson**, Moderator (Concurrent Session)
8:00 a.m.	**Michael S. Runner**, Sediment monitoring of Mill Creek, Rankin County, Mississippi
8:20 a.m.	**William G. Walker**, Pre-settlement sediment accumulation rates in lake-wetland systems in the Mississippi Delta region using the ^{14}C activity of bulk sediment fractions
8:40 a.m.	**Chioma G. Nzeh**, Effects of sitation on some aquatic animals communities in a man-made lake in Ilorin, Nigeria
9:00 a.m.	**Humberto Avila**, Experimental design analysis applied to factors related to migration of sediment out of a stormwater catchbasin sump
8:00 a.m.	Session F: **Wastewater and Water Treatment - Dallas Baker**, Moderator (Concurrent Session)
8:00 a.m.	**Mary Love M. Tagert**, Water quality impacts of failing septic systems in a coastal area
8:20 a.m.	**Richard H. Coupe**, Occurrence and persistence of pesticides, pharmaceutical compounds, and other organic contaminants in a conventional drinking-water treatment plant
8:40 a.m.	**Jejal Reddy Bathi**, Standardization of thermal desorption GC/MS analysis for polycyclic aromatic hydrocarbons and comparison of recoveries for two different sample matrices
9:00 a.m.	**Afrachanna D. Butler**, Phytomanaging firing range soils using *Cyperus esculentus*
9:20 a.m.	Break
9:40 a.m.	Session G: **Surface Water Quality - LaDon Swann**, Moderator (Concurrent Session)
9:40 a.m.	**Todd Tietjen**, Water quality and floristic quality assessments of the Big Sunflower River following streamflow augmentation using groundwater
10:00 a.m.	**Brianna Zuber**, Fluctuating asymmetry and condition in fishes exposed to varying levels of environmental stressors
10:20 a.m.	**Mansour Zakikhani**, Water quality modeling in support of the Mississippi Sound Coastal improvement program
10:40 a.m.	**Matthew Hicks**, Mississippi benthic macroinvertebrate tolerance values for use in surface water quality assessment
9:40 a.m.	Session H: **Flooding and Water Supply - Mike Davis**, Moderator (Concurrent Session)
9:40 a.m.	**K. Van Wilson, Jr.**, Mapping Hurricane Katrina peak storm surge in Alabama, Mississippi, and Louisiana
10:00 a.m.	**David B. Reed**, National Weather Service expansion of hydrologic services in Mississippi
10:20 a.m.	**Philip Songa**, Supply and demand: The effects of development on the hydrology of Lake Victoria

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Wednesday, April 25 (continued)	
10:40 a.m.	**David T. Dockery**, The geology of ground water in Mississippi revised
11:00 a.m.	Closing Plenary Session **Mickey Plunkett**, Moderator Director, USGS - Mississippi Water Science Center
11:10 a.m.	**Joy Foy** Director, Asset Development Division Mississippi Development Authority
11:40 a.m.	**LaDon Swann** Director Mississippi-Alabama Sea Grant Consortium
12:20 p.m.	Luncheon and Awards Ceremony **Mike Davis**, Invocation and Introduction Pearl River Basin Development District The **Honorable Jamie Franks**, Keynote Speaker (invited) Mississippi House of Representatives

Student Support

Student Support					
Category	**Section 104 Base Grant**	**Section 104 NCGP Award**	**NIWR−USGS Internship**	**Supplemental Awards**	**Total**
Undergraduate	4	0	0	0	4
Masters	3	0	0	0	3
Ph.D.	3	0	0	0	3
Post−Doc.	0	0	0	0	0
Total	10	0	0	0	10

Notable Awards and Achievements

Publications from Prior Years

1. 2006MS46B ("Developing a Reliable Method for Identifying Pre−settlement Wetland Sediment Accumulation Rates: 14 C Dating on Bulk Lake Sediments and Extracts") − Other Publications − Walker, W.G., G.R. Davidson, T. Lange and D. Wren (2006) Estimating sediment accumulation rates in low−organic lacustrine sediments using 14C. 19th International Radiocarbon Conference, Oxford, England, April 3−7, Abstracts &Programme, 255−256.