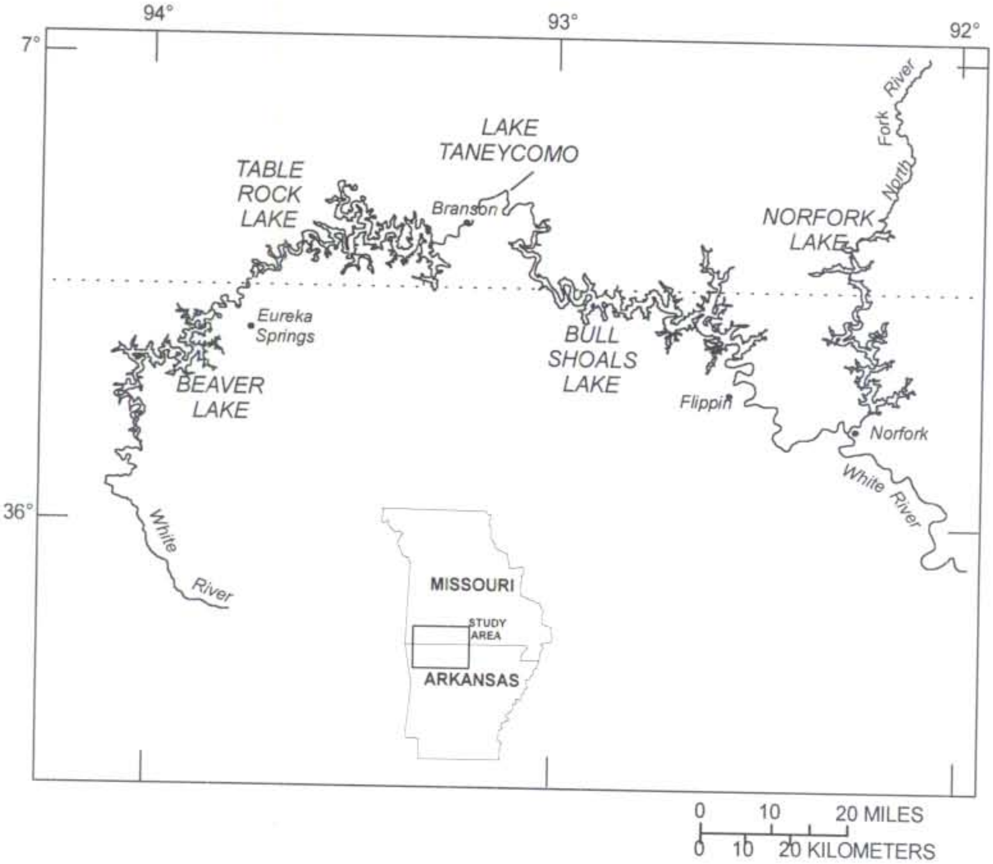
# White River Forum II

## ABSTRACTS

## Technical Session: Water Quality and Conservation Issues in the White River Basin

### Mountain Home, Arkansas
### November 2, 2000




*(map provided by USGS)*


**Publication No. MSC-287**

**Arkansas Water Resources Center**
**112 Ozark Hall**
**University of Arkansas**
**Fayetteville, Arkansas 72701**

**White River Forum II**
**Mountain Home, Arkansas**
**Nov 2, 2000**

## Technical Session: Water Quality and Conservation Issues in the White River Basin

Preface

This second annual meeting of the White River Forum is proof of widespread interest in the water quality of the Upper White River watershed. The participation of numerous elected officials, state and federal agencies, universities, businesses, and local citizens indicates that interest in understanding policy issues crosses political boundaries and occupations.

During last year's meeting, we discussed the need for better communication among scientists working in the region and proposed that this symposium take place. The response to our call for abstracts was encouraging, with 19 individuals indicating an interest in presenting a paper. These individuals represent four universities and three different government agencies. Their papers have been are distributed into oral and poster presentations, as listed in the schedule. As you can see, the research ranges from water chemistry to fisheries management, in streams and in lakes of the basin.

John Havel, Ph.D.
Bull Shoals Field Station
Southwest Missouri State University
email: jeh694f@smsu.edu

Ken Steele, Ph.D.
Water Resources Center
University of Arkansas
e-mail ksteele@mail.uark.edu

**OTHER SPONSORS OF THE**
**White River Forum II**
**Mountain Home, Arkansas**

Mountain Home ARKANSAS
Welcome To
Mountain Home
Arkansas
Gateway to the Ozark Mountains

MOUNTAIN HOME AREA ARKANSAS
Mountain Home, Arkansas
*Area Chamber of Commerce*

Missouri Department of Natural Resources

ADEQ
ARKANSAS
Department of Environmental Quality

ASWCC
ARKANSAS SOIL AND WATER CONSERVATION COMMISSION

## ORAL PRESENTATIONS

### White River Basin 2000 – Technical Session
### Water Quality And Conservation Issues In The White River Basin
### November 2, 2000

**9:00-9:10**
**WELCOME-Ken Steele and John Havel**

**9:10-9:30**
**WATER QUALITY SAMPLING ON THE KINGS RIVER NEAR BERRYVILLE, ARKANSAS**
Thomas S. Soerens, Department of Civil Engineering, University of Arkansas, Fayetteville, AR 72701, and Marc A. Nelson, Arkansas Water Resources Center, University of Arkansas, Fayetteville, AR 72701

**9:30-9:50**
**PASTURELAND AND STORM IMPACTS ON WATER QUALITY OF SIX SMALL STREAMS IN THE WHITE RIVER BASIN**
K.F. Steele, P.F. Vendrell, M.A. Nelson, Arkansas Water Resources Center and Department of Geosciences, David Mott, National Buffalo River, Harrison, Arkansas, and, R.G. Roggio, Department of Geosciences, Arkansas Water Resources Center, University of Arkansas, Fayetteville

**9:50-10:10**
**KARST CAVE SYSTEMS AS NONPOINT SOURCES OF PHOSPHORUS AND METALS**
Robert T. Pavlowsky, Department of Geography, Geology, and Planning, Southwest Missouri State University, Springfield, MO 65804-0089

**10:10-10:30**
**NONPOINT POLLUTION MONITORING USING BED SEDIMENT SURVEYS IN THE JAMES RIVER WATERSHED**
Brian Fredrick and Robert T. Pavlowsky, Department of Geography, Geology, and Planning, Southwest Missouri State University, Springfield, MO 65804-0089

**10:30:11:00**
**BREAK**

**11:00-11:20**
**THE USE OF AQUATIC MACROINVERTEBRATES TO GRADE STREAM ECOSYSTEM HEALTH AROUND SPRINGFIELD, MISSOURI.**
Norman W. Youngsteadt, Central Laboratory, City Utilities of Springfield, P.O. Box 551, Springfield, MO 65801-0551

**11:10-11:40**

**WATER QUALITY AND BIOLOGICAL COMMUNITIES OF STREAMS OF THE WHITE RIVER BASIN AND OTHER AREAS OF THE OZARK PLATEAUS**

James C. Petersen, U.S. Geological Survey, 401 Hardin Road, Little Rock, AR 72211

**11:40-12:00**

**ECOLOGICAL INTEGRITY ASSESSMENT OF OZARK RIVERS TO DETERMINE SUITABILITY FOR PROTECTIVE STATUS**

Andrea Radwell, Department of Biological Sciences, University of Arkansas, Fayetteville, AR 72701, and Thomas J. Kwak,, U.S. Geological Survey, North Carolina Cooperative Fish and Wildlife Research, North Carolina State University, Raleigh, NC 27695

**12:00-1:00**
**Lunch**

**1:00-2:00**
**POSTER SESSION**

**2:00-2:20**

**RECONSTRUCTION OF SUMMER LOW FLOWS IN THE WHITE RIVER FROM TREE RINGS**

Malcolm K. Cleaveland, Geosciences Department, University of Arkansas, Fayetteville, AR 72701

**2:20-2:40**

**WHITE RIVER RESERVOIR MODELING -- TOOLS FOR ASSESSING WATER QUALITY**

W. Reed Green and Brian E. Haggard, U.S. Geological Survey, 401 Hardin Rd. Little Rock, AR 72211

**2:40-3:00**

**EUTROPHICATION IN THE UPPER WHITE RIVER LAKES: PRELIMINARY ANALYSIS OF BULL SHOALS LAKE**

John E. Havel, Kristen Pattinson, and Russell G. Rhodes, Department of Biology, Southwest Missouri State University, Springfield, MO 65804

**3:00-3:20**
**BREAK**

**3:20-3:40**

**LAKES OF MISSOURI VOLUNTEER PROGRAM : DATA FROM THE WHITE RIVER BASIN**

Dan V. Obrecht, Fran Pope and John.R. Jones, Department of Fisheries and Wildlife Sciences, University of Missouri, Columbia, MO 65211

**3:40-4:00**

**The White River: A Case History of Man's Effects on a Big River**

Kenneth E. Shirley, AR. Game and Fish Commission, Mountain Home, AR 72653

**4:00-4:20**

**DISCUSSION AND CONCLUSIONS**

John Havel and Ken Steele

## POSTER PRESENTATIONS

### White River Basin 2000 – Technical Session
### Water Quality And Conservation Issues In The White River Basin
### November 2, 2000

**A WEB-BASED DATBASE ON THE UPPER WHITE RIVER WATERSHED**

Michael R. Dickerson, John E. Havel, and Russell G. Rhodes, Bull Shoals Field Station, Department of Biology, Southwest Missouri State University, 901 S. National Ave., Springfield, MO 65804

**A 20-YEAR HISTORY OF LANDCOVER CHANGE IN THE UPPER WHITE RIVER BASIS**

Jason M. Kuhlman, Robert C. Weih, Spatial Analysis Laboratory, Arkansas Forest Resources Center, School of Forest Resources, University of Arkansas, Monticello, AR, Philip A. Tappe, and Hal O. Liechty, Arkansas Forest Resources Center, School of Forest Resources, University of Arkansas Monticello, AR 71656

**CURRENT UNIVERSITY OF MISSOURI WATER QUALITY PROJECTS WITHIN THE WHITE RIVER BASIN**

Daniel V. Obrecht, John R. Jones and Fran Pope, Department of Fisheries and Wildlife Sciences, University of Missouri, Columbia, MO 65211

**HISTORICAL MINING POLLUTION AND OVERBANK SEDIMENTATION ALONG THE PEARSON CREEK AND JAMES RIVER, SPRINGFIELD, MO**

Marc R. Owen and Robert T. Pavlowsky, Department of Geography, Geology, and Planning, Southwest Missouri State University, Springfield, MO 65804-0089

**HOST UTILIZATION AND SUITABILITY AMONG *VENUSTACONCHA* POPULATIONS IN DIFFERENT RIVER DRAINAGES**

Frank A. Riusech and M. Christopher Barnhart
Department of Biology, Southwest Missouri State University, Springfield, MO 65807

**ASSESSING NONPOINT POLLUTION USING BED SEDIMENT SURVEYS IN THE KINGS RIVER BASIN, NW ARKANSAS**

Jason White and Robert T. Pavlowsky, Department of Geography, Geology, and Planning, Southwest Missouri State University, Springfield, MO 65804-0089

**BANK EROSION RATE ESTIMATION USING HISTORICAL AERIAL PHOTOGRAPHY ANALYSIS AND GIS, JAMES RIVER, SPRINGFIELD, MO**

Ryan Wyllie, Department of Geography, Geology, and Planning, Southwest Missouri State University, Springfield, MO 65804-0089

# ORAL PRESENTATIONS

## WATER QUALITY SAMPLING ON THE KINGS RIVER NEAR BERRYVILLE, AR

Thomas S. Soerens, Department of Civil Engineering, University of Arkansas, Fayetteville, AR 72701, and Marc A. Nelson, Arkansas Water Resources Center, University of Arkansas,
Fayetteville, AR 72701

A water quality sampling station has been established on the Kings River near Berryville, AR. The river was intensively sampled during storms in 1999 to measure nutrient and sediment loads in the river and to provide data to establish an ongoing sampling plan. In 1999, a total of 213 samples were taken and analyzed for nitrate ($NO_3$-N), total phosphorus (T-P), ammonium ($NH_4$), total Kjeldahl nitrogen (TKN), soluble reactive phosphate ($PO_4$) and total suspended solids (TSS). This station was coordinated with a USGS gauging station at the same location. Grab samples were taken during base flow and an automatic sampler was programmed to take frequent samples during storm flow. Initially the sampler was programmed to take samples at thirty-minute intervals for the first twenty-four samples and sixty-minute intervals for the next twenty-four samples of each storm event. Also, the AWRC in conjunction with the USGS conducted cross-section sampling to determine the relationship between AWRC autosampler concentrations and USGS cross-section concentrations. Sampling results for 1999 showed flow-weighted mean concentrations (load/discharge) of nitrate 0.84 mg/L, total phosphorus = 0.31 mg/L, ammonium = 0.025 mg/L, total Kjeldahl nitrogen = 0.75 mg/L, soluble reactive phosphorus = 0.075 mg/L, and total suspended solids = 179 mg/L. Much or most of the pollutant load in a stream is carried during storms; thus intensive storm sampling is needed to make accurate load calculations. We are using the data to develop an ongoing sampling scheme at the site. Accurate determination of stream nutrients and sediment is critical for future determinations of TMDLs, effectiveness of best management practices and trends in water quality.

## PASTURELAND AND STORM IMPACTS ON WATER QUALITY OF SIX SMALL STREAMS IN THE WHITE RIVER BASIN, ARKANSAS

K.F. Steele, M.A. Nelson, P.F. Vendrell, Arkansas Water Resources Center and Department of Geosciences, R.G. Roggio, Department of Geosciences, Arkansas Water Resources Center, University of Arkansas, Fayetteville, and David Mott, Buffalo National River, Harrison, Arkansas,

Two second-order streams in the Upper White River Basin about 16 miles southwest of Fayetteville and four third order tributaries to the Buffalo River, in the headwaters and at mid-length of the Buffalo River were monitored to determine the effect of pastureland on water quality. Pastures comprise 11 to 50% of the watershed area with the remainder comprised of forest for five of the watersheds. The sixth stream in the headwaters of the Buffalo River serves as a control stream with essentially all of the land cover being forest. Storms contribute significantly to the stream loads. Seasons with high stream discharge (spring and fall) typically transport higher loads. Concentrations of TP, TKN, fecal coliform and TSS increase and decrease in relation to the rise and fall of the storm-discharge curve and these relationships indicate phosphorus transport by surface runoff. Nitrate did not mimic the TSS concentration or discharge curves, which is consistent with nitrate-nitrogen being transported to the streams predominantly by ground water rather than runoff.

The two streams in the Upper White River Basin have poultry litter and swine lagoon waste applied to the pastures with Shumate Creek, a 589-hectare watershed (22% pasture), receiving four times the amount of animal waste than Cannon Creek, a 628-hectare watershed (11% pasture). Shumate Creek has greater nutrient concentrations and mass transport, especially during storms. For example, the mean flow-weighted concentrations of nitrate-nitrogen for the month of May 1996 were 1.25 and 0.30 mg/L for Shumate and Cannon creeks, respectively. In less than four days in April 1996, storm flow in Shumate Creek transported more than 30% of the annual total phosphorus (TP) load.

Comparison of the data for three agriculturally influenced tributaries of the Buffalo River, Bear, Calf and Tomahawk creeks with that of the pristine site show that for some storms, it would require 4,800 years of base flow to equal the fecal coliform load, 53 years for $NO_3$ and 15 years for TP. Peak storm discharge concentrations for fecal coliform and nutrients are as much as 1600x and 4-260x greater than base flow, respectively; whereas, peak storm discharge loads for fecal coliform and nutrients are as much as 6 and 2-5 orders of magnitude greater than base flow loads, respectively.

## KARST CAVE SYSTEMS AS NONPOINT SOURCES OF PHOSPHORUS AND METALS

Robert T. Pavlowsky, Department of Geography, Geology, and Planning, Southwest Missouri State University, Springfield, MO 65804-0089.

One of the unique aspects of the Ozarks Plateaus is the presence of extensive karst areas in many of its watersheds. Karst acts to directly link the surface with ground water systems so that runoff may quickly enter streams via sinkholes, caverns, and springs. In terms of water quality assessments, karst decreases the residence time of pollutants on the watershed surface and in the soil so that the natural filtering capacity of the watershed may be reduced to some extent. Further, the underground conduit system may occasionally intercept septic fields, storm water drainage systems, and landfills or illegal dumps thus increasing the supply pollutants for transport to downstream receiving waters. Presently, very little is known about the nature of pollution transport and storage in karst cave systems. This study evaluates the role of caves as a supplier and transporter of phosphorus and lead to the James River and its tributaries. Sediments are used as sampling media to measure the concentration and spatial distribution of these contaminants in several cave systems. One of the cave systems studied is being used to drain stormwater from an urban area, while the others represent of gradient of land use intensity. Cave sediments apparently accumulate phosphorus from nonpoint and autocthonous sources. Some of the highest sediment-phosphorus levels observed in the James River Basin have been found in caves, often in areas with relatively low land use intensity, with concentrations sometimes exceeding 5,000 ppm. Lead concentrations in cave sediments tend to follow urban land use trends and may exceed 100 ppm. In some caves, the occurrence of Fe-Mn oxide coatings on sand-sized particles tends to correlate with lead levels. This study demonstrates that cave sediments can contain high concentrations of phosphorus and other nonpoint pollutants. However, the significance of these pollutant storages as nonpoint sources to stream s has not yet been determined.

# NONPOINT POLLUTION MONITORING USING BED SEDIMENT SURVEYS IN THE JAMES RIVER WATERSHED

Brian Fredrick and Robert T. Pavlowsky, Department of Geography, Geology, and Planning, Southwest Missouri State University, Springfield, MO 65804-0089.

Eutrophication and degradation of water quality in Table Rock Lake over the past decade has raised concerns about the loading rates and locations of phosphorus sources in the James Watershed. To date, most of the management efforts to control pollution have focused on sewage treatment plant effluents and other point sources. However, there is concern among the managers and communities in the region over the relative influence of nonpoint source inputs to nutrient pollution problems. At present, the relative influence of urbanization, cattle grazing, and crop farming on water quality in the watershed is unknown. This study uses a bed sediment survey to identify the patterns of phosphorus and metal transport in the James watershed. Results of the survey are combined with GIS-based watershed land use and hydrologic variables for each site to develop a spatial regression model of nonpoint pollution concentrations at the sub-watershed scale. Toxic metal concentrations tend to be highest in streams draining urban and historical mining areas. Phosphorus concentrations are highest below sewage treatment plants and in the lower reaches of Wilson Creek. Sediment-P concentrations are relatively low in the lower James River immediately above Table Rock Lake, but tend to increase in the James River Arm.

## THE USE OF AQUATIC MACROINVERTEBRATES TO GRADE STREAM ECOSYSTEM HEALTH AROUND SPRINGFIELD, MISSOURI.

Norman W. Youngsteadt, Central Laboratory, City Utilities of Springfield, P.O. Box 551, Springfield, MO 65801-0551.

The EPT index (number of Ephemeroptera, Plecoptera, and Trichoptera taxa) was used to grade steam ecosystem health around Springfield. Grades were lower for stream reaches associated with the city.

For example, in Pearson Creek, which borders the east side of Springfield, grades dropped from roughly "B" above the urbanized Jones spring branch watershed to "D" below it. Pearson Creek then enters the James River where grades dropped from roughly "B" upstream to "D" below Pearson Creek in the vicinity of the City Utilities James River water intake.

Historical data from 1964-65 gathered by the Missouri Clean Water Commission indicate that the decline in ecosystem health in lower Pearson Creek occurred since that time. Thus, it appears that watershed management as currently practiced has not prevented the decline of stream ecosystem health resulting from urbanization around Springfield.

## WATER QUALITY AND BIOLOGICAL COMMUNITIES OF STREAMS OF THE WHITE RIVER BASIN AND OTHER AREAS OF THE OZARK PLATEAUS

James C. Petersen, U.S. Geological Survey, 401 Hardin Road, Little Rock, Ark. 72211

An ongoing study of water quality of the Ozark Plateaus, part of the USGS's National Water-Quality Assessment Program, included several sites in the White River Basin of Arkansas and Missouri. Results to date indicate that agricultural and urban activities are important factors affecting water quality and biological communities of streams. In the Ozark Plateaus, fecal-indicator bacteria and nutrients were elevated in streams in basins with higher percentages of agricultural or urban land use (agriculture and urban streams) and lower percentages of forested land use (forest streams). Median fecal-coliform bacteria concentrations ranged from about 10 to 20 colonies per 100 mL (milliliters) in forest streams and from about 60 to 460 colonies per 100 mL in agriculture streams. Median bacteria concentrations in urban streams ranged from about 60 to 100 colonies per 100 mL. Median nitrate concentrations ranged from about 0.05 to 0.2 mg/L (milligrams per liter, nitrate as nitrogen) in forest streams, from 0.3 to 2.5 mg/L in agriculture streams, and from 0.3 to 3.1 mg/L in urban streams. Among a group of samples collected during the summers of 1993-95, orthophosphorus concentrations from the Kings River downstream of Berryville, Ark. (0.10 to 0.80 mg/L as phosphorus) and from the James River downstream of Springfield, Mo. (0.79 mg/L as phosphorus) were among the highest detected. These sites are downstream from wastewater treatment plants. Pesticide and other organic compound concentrations in streams were relatively low (and seldom exceeded standards or criteria) but were detected more often in agriculture or urban streams. The largest number of organic compounds (39) detected in bed sediment was in a sample from the James River downstream from Springfield, Mo. Pesticides were seldom detected in clam or fish tissue, however three chlordane compounds were detected (sum of 0.0223 milligrams per kilogram) in a sample from the James River.

Overall compositions of periphyton and fish communities are affected by natural factors such as stream size and alkalinity and land-use related factors such as nutrient concentration and riparian shading. Relative to forest streams, periphyton communities of agriculture and urban streams usually had larger percentages of eutrophic species of algae and often had higher biomass of periphyton. Fish communities in streams with higher nutrient concentrations and less riparian shading were typified by a shift in community structure towards higher percentages of stonerollers (a type of periphyton-grazing minnow).

Monitoring of nutrients, bacteria, and pesticides continues at two streams in the White River Basin. Intensive water-quality and biological sampling throughout the Ozark Plateaus is planned to resume beginning in 2004.

## ECOLOGICAL INTEGRITY ASSESSMENT OF OZARK RIVERS TO DETERMINE SUITABILITY FOR PROTECTIVE STATUS

Andrea Radwell, Department of Biological Sciences, University of Arkansas, Fayetteville, AR 72701, and Thomas J. Kwak,, U.S. Geological Survey, North Carolina Cooperative Fish and Wildlife Research, North Carolina State University, Raleigh, NC 27695

The Wild and Scenic Rivers Act of 1968 was passed to protect free-flowing rivers with outstanding ecological and social values and requires suitability studies as part of the designation process. An objective, quantitative method to determine suitability based on ecological integrity was developed and tested using 10 Ozark rivers, five with Wild and Scenic status (Big Piney Creek, Hurricane Creek, Mulberry River, Richland Creek, and Upper Buffalo River), and five without designation (Middle Fork Illinois Bayou, North Fork Illinois Bayou, Kings River, War Eagle Creek and White River). Thirty-four variables representing macroinvertebrate and fish assemblage characteristics, instream habitat, riparian vegetation, water quality, and watershed attributes were quantified for upper headwater reaches of each river. Data were analyzed using two multivariate approaches. Cluster analysis identified two groups, and discriminant analysis identified only one variable (% forested watershed) that reliably distinguished groups. The second approach compared variables for each river to conceptually ideal conditions that were developed as a composite of the optimal conditions among the 10 rivers, which may serve as least-disturbed ecoregion reference conditions. The composite distance of each river from ideal was then calculated using multidimensional scaling. Two rivers without Wild and Scenic designation (Middle Fork and North Fork Illinois Bayou) ranked highest in ecological integrity, and two others, also without designation (White River and War Eagle Creek), ranked lowest in ecological integrity. Fish density, number of intolerant fish species, and invertebrate density were influential biotic variables for scaling. Contributing physical variables included riparian forest cover, nitrate concentration, turbidity, percentage of forested watershed, percentage of private land ownership, and road density. This research may provide a framework for refinement and application in other regions to facilitate the process of identifying rivers for protection, use as least-disturbed reference streams in biomonitoring, or providing benchmarks for restoration efforts.

## RECONSTRUCTION OF SUMMER LOW FLOWS IN THE WHITE RIVER FROM TREE RINGS

Malcolm K. Cleaveland, Geosciences Department, University of Arkansas, Fayetteville, AR 72701; mcleavel@uark.edu

An average of three baldcypress (Taxodium distichum) ring width chronologies was used to reconstruct total summer (JJA) mean daily flow of the White River at Clarendon, Arkansas, for 1023-1985. A quadratic transformation of the tree-ring data accounted for 68% of the streamflow variance 1931-1985. The distributions (mean, skew, kurtosis) of the observed and reconstructed series matched well. The model was validated by comparing regression estimates against gauged data not used in the regression procedure. Years with summer flow below the 25th percentile occur nonrandomly, i.e., they tend to cluster in both the reconstructed and gauged data. Hydrologic regimes have apparently varied considerably in the past on annual to century timescales, with extended dry and wet periods that exceeded anything in the gauged record. The frequency of both wet and dry extremes has varied considerably over the last millennium. The eleventh through thirteenth centuries were not analyzed due to reduced replication, but the well-replicated fourteenth and twentieth centuries both have large numbers of extreme values. The twentieth century appears to have more extreme low flows than previous centuries and also to have a large number of high flows. The practical consequences for society of variation in extemes and persistence of low flows may be considerable. Climatic change or anthropogenic changes to the watershed, such as widespread clearing of uplands for agriculture and logging of bottomland forests, may be responsible for the change in hydrologic regime during the twentieth century.

## WHITE RIVER RESERVOIR MODELING -- TOOLS FOR ASSESSING WATER QUALITY

W. Reed Green and Brian E. Haggard, U.S. Geological Survey, 401 Hardin Rd. Little Rock, AR 72211

The U.S. Geological Survey in cooperation with the Arkansas Game and Fish Commission, Arkansas Soil and Water Conservation Commission, Beaver Water District, and Missouri Department of Conservation is developing and calibrating 2-dimensional laterally averaged hydrodynamic and water quality models for Beaver, Table Rock, Bull Shoals, and Norfork Lakes to assess above dam impacts to proposed changes in minimum releases through the dams. Proposed increases in minimum flows through the dams are designed to enhance the downstream (tailwater) trout fishery. Information is needed to determine if enough cold oxygenated water will remain in the bottom water of these reservoirs (above the dam), through the stratification season, when increased minimum flows become operational.

The software code used in model development is the U.S. Army Corps of Engineers CE-QUAL-W2 model. CE-QUAL-W2 is a longitudinal-vertical hydrodynamic and transport model designed for long-term, time-varying water quality-simulations of lakes, reservoirs, and estuaries. CE-QUAL-W2 is based on the laterally averaged equations of momentum, continuity, and transport. CE-QUAL-W2 accurately reproduces vertical and longitudinal water quality gradients and includes water quality routines for 22 parameters: suspended solids, coliforms, total dissolved solids, labile and refractory dissolved organic matter, algae, detritus, phosphorous, ammonia, nitrate-nitrite, dissolved oxygen, carbonaceous biochemical oxygen demand, sediment, inorganic carbon, alkalinity, pH, carbon dioxide, bicarbonate, carbonate, iron, and a numerical tracer.

In the present scenario, the models are calibrated for temperature and dissolved oxygen simulations to assess changes in parameters above the dams after minimum flow implementation. Preliminary simulations suggested that increases in minimum flows will alter temperature and dissolved oxygen dynamics within the bottom water above the dams resulting in warmer water with lower dissolved oxygen concentrations being released during the stratification season. Once hydrodynamics (temperature) are calibrated for each reservoir, these models can be modified to calibrate nutrient and algal dynamics to assess assimilative capacity, cause and effect, and dose-response scenarios.

## EUTROPHICATION IN THE UPPER WHITE RIVER LAKES: PRELIMINARY ANALYSIS OF BULL SHOALS LAKE

John E. Havel, Kristen Pattinson, and Russell G. Rhodes, Department of Biology, Southwest Missouri State University, Springfield, MO 65804

Eutrophication of lakes has been a concern over the past several decades and has achieved local attention through the deterioration in water quality of Table Rock Lake. Because reservoirs occur in a series along the upper White River, nutrient loading may be transmitted downstream. The SMSU Bull Shoals Field Station has recently begun a long-term project investigating the link between lake fertility and plankton blooms. We are reviewing existing literature and developing web-based databases (see poster by Dickinson, Havel, and Rhodes), as well as beginning a monitoring program on Bull Shoals Lake. To investigate spatial patterns, we have established 18 sampling stations for yearly surveys. To investigate dynamics, we sample two of the stations every two-four weeks. At each station and date, we collect depth profiles of temperature and dissolved oxygen; transparency (Secchi depth); samples for total nitrogen, total phosphorus, and chlorophyll-a; and samples of algae and zooplankton. The algae samples are being counted by genera and zooplankton by higher taxonomic group. During this talk, we will present preliminary results from the initial surveys. This project is being supported by Southwest Missouri State University and the Missouri Water Resources Research Center. We acknowledge the University of Missouri and City Utilities of Springfield for their assistance with the water chemistry analyses.

## LAKES OF MISSOURI VOLUNTEER PROGRAM : DATA FROM THE WHITE RIVER BASIN

Dan V. Obrecht, Fran Pope and John.R. Jones, Department of Fisheries and Wildlife Sciences, University of Missouri, Columbia, MO 65211

The Lakes of Missouri Volunteer Program began collecting water quality data on Table Rock Lake and Lake Taneycomo in 1992. Bull Shoals Lake was added to the program the following year. During the summer of 2000, volunteers were collecting samples from 28 sites across the three lakes. Volunteers generally collect eight samples during the period April through September. This sampling effort, combined with the large number of sites, produces a data base that can be used to answer a number of research questions. Volunteer generated data have been used to investigate correlations among water quality parameters, examine spatial patterns among lakes, document spatial patterns within individual lakes, analyze water quality trends during a sample season, and monitor for changes in water quality over a period of years. These data are also used to educate local citizens, who have vested interests in their lake, about water quality issues and lake ecology.

## THE WHITE RIVER: A CASE HISTORY OF MAN'S EFFECTS ON A BIG RIVER

Kenneth E. Shirley, AR. Game and Fish Commission, Mountain Home, AR 72653

The 1159 km. White River drains 71,911 sq. km., of Southern Missouri and Northern and Eastern Arkansas. The Ozark highlands make up 3/4 of its basin, the Mississippi Alluvial plain the rest. The White River basin originally contained 164 native fish (126 from the mainstream) and 58 mussel species. Nine fish and three mussel species are endemic to the basin. Significant agriculture began in the mid-1800s driving one fish and one mussel to extinction. Log clearing and construction of three locks and dams for navigation were completed by 1880. Seven multipurpose reservoirs totaling 96,500 ha have since been built in the basin. They eliminated a world famous smallmouth bass float fishery replacing it with warm water reservoirs and the country's best tailwater trout fishing. Man's influences have caused one other fish and three other mussels to be placed on the Federal Endangered Species List. However, the energy and recreation provided by these waters have changed the Ozarks from one of the poorest, most isolated regions of the country to a wealthy, rapidly growing industrial region and tourist mecca.

Man's influences on the delta portion of the basin were also severe. Ninety percent of its natural timberlands have been cleared for agriculture. Many delta streams have been channelized decimating their fishery. These and other influences impacted the important commercial fishery and mussel harvest industries of the early 1900's. In the 1920's, 9,100,000 kg. of commercial fish were shipped from Clarendon in a 20 month period. Now the harvest for the entire basin is only about 4,300,000 kg per year. The White and its major tributary, the Black, were once the most important national source of mussels for the button industry. In 1912, 4,650,000 kg. of shell was harvested from the 2 rivers. Now the White is not even the most important river in Arkansas producing only 7.6% of the state's mussel harvest in 1990. Conversion of this land to some of the finest agricultural land in the world has not resulted in positive benefits to the economy and quality of life in the delta. Modern agriculture no longer needs many employees. This region is one of the poorest in the nation. It is rapidly losing population and has fewer people than when Hernando DeSoto became the first Caucasian to explore the region. Still, there are positives even in the delta. The timber remaining is almost all in one block, the largest contiguous corridor of bottomland hardwoods left in the U.S. It is designated as a "Wetland of International Importance" by the RAMSAR convention. Nearly 300,000 acres in the delta are protected in three national wildlife refuges and seven state wildlife management areas. Timbered acreage is more likely to increase rather than fall in the future. The associated old river lakes in this region remain the best natural warm water fishery in the state. The Lower White River is also a classic example of an environmentally benign flood control project. With the levee system outside the meander region of the river, the bottom land lakes are still influenced by river level fluctuations. More importantly, the river is largely unstabilized. It remains free to wander across its floodplain creating new oxbow lakes at about the rate the old ones fill in through sedimentation and revert to forest. If man does nothing else to stabilize the river, these old river lakes will continue to produce fish and wildlife for generations.

# POSTER PRESENTATIONS

## A WEB-BASED DATBASE ON THE UPPER WHITE RIVER WATERSHED

Dickerson, Michael R., Bull Shoals Field Station, Southwest Missouri State University, 901 S. National Ave., Springfield, MO 65804
John E. Havel, and Russell G. Rhodes, Department of Biology, Southwest Missouri State University, 901 S. National Ave., Springfield, MO 65804

The World Wide Web has improved the capability for free and open exchange of information. We have developed a web-based database to facilitate information exchange concerning the upper White River watershed. The database has been constructed using Microsoft Front Page for web-interface design, and Microsoft Access for data storage and retrieval. Dynamic web pages respond to web-queries, such that all data are up-to-the-minute. Several types of databases are accessible, including literature citations and abstracts, and information about ongoing research programs (with links to the web). This database is meant to assist users in locating the information they are seeking, and does not contain data from the other research programs. However, data from cooperative research at the Bull Shoals Field Station are being posted for a variety of users. A species list is being developed for the Drury/Mincy Conservation Area and water quality data for Bull Shoals Lake. These activities are being supported by Southwest Missouri State University and the Missouri Water Resources Research Center. For more information, our website is http://www.cnas.smsu.edu/bullshoals/Default.htm.

## A 20-YEAR HISTORY OF LANDCOVER CHANGE IN THE UPPER WHITE RIVER BASIN.

Jason M. Kuhlman, Robert C. Weih, Spatial Analysis Laboratory, Arkansas Forest Resources Center, School of Forest Resources, University of Arkansas, Monticello, AR, Philip A. Tappe, and Hal O. Liechty, Arkansas Forest Resources Center, School of Forest Resources, University of Arkansas Monticello, AR 71656

A historical perspective of landcover patterns at various spatial and temporal scales, as well as the rates of change of landcover characteristics, is critical for making informed decisions regarding a variety of natural resource issues. The composition and development of vegetation following disturbances (anthropogenic and non-anthropogenic), as well as the juxtaposition of these disturbances influence landcover patterns. There is a paucity of information regarding these patterns and processes across large-scale landscapes. To date no large-scale changes in landcover composition and structure have been documented in Arkansas. An increased knowledge of landscape patterns and structure is urgently needed to make management decisions in ecologically and sociologically complex ecosystems. It is important for land managers to gain an understanding of what types of vegetation are being lost and gained as well as the spatial distribution of vegetation patches. Indicators such as fluctuations in fragmentation and edge indices over time may provide greater insight into causalities of habitat selection and use by various wildlife species or species groups.

This project was initiated to investigate landcover changes in the Bull Shoals Lake, Middle White, and Upper White-Village drainage basins and the associated factors influencing temporal and spatial distributions of vegetative characteristics. A 20-year history of landcover change is being compiled using Arkansas GAP data (1991) and Landsat MSS data (1972 – 1976, 1984 – 1986, and 1990 – 1992). Eight landcover classes (water, urban, bare ground, grass, coniferous forest, deciduous forest, mixed forest, and mixed shrub) are being derived from the satellite imagery to quantify what landcover types have been gained and lost over this time period using a binary mask technique. Several patch, class, and landscape level indices, such as total edge, percent of landscape, and mean patch size, are being calculated at several spatial scales to relate landcover changes to fluxes in patch complexity characteristics. Results are being used to investigate recent trends in wildlife population fluctuations and species-specific habitat availability/distribution.

## CURRENT UNIVERSITY OF MISSOURI WATER QUALITY PROJECTS WITHIN THE WHITE RIVER BASIN

Daniel V. Obrecht, John R. Jones and Fran Pope, Department of Fisheries and Wildlife Sciences, University of Missouri, Columbia, MO 65211

The University of Missouri's Department of Fisheries and Wildlife Sciences is currently involved in four projects collecting lake water quality data in the White River Basin.

1) The focus of the Table Rock Lake Long-term Monitoring Project is to collect water quality data from nine sites across the lake. Data will be used to monitor for spatial and temporal trends in water quality.

2) The Hydrological Examination of Table Rock Lake Project has the goal of determining how inflows mix into the lake. Nutrient rich inflows entering the lake during the summer stratification period may not readily mix with the surface layer, thus having a limited or delayed impact on discernible water quality. Sampling occurs during stratified and mixed periods in the Roaring River, Kings River, James River and White River arms of the lake.

3) The Statewide Lake Assessment Program collects data from approximately 60 lakes in the state including Table Rock Lake. This data set allows for the analysis of water quality trends from a regional perspective.

4) The Lakes of Missouri Volunteer Program has volunteers collecting data and samples form 28 sites on Table Rock, Taneycomo and Bull Shoals lakes. Volunteers generally sample eight times each year providing the state with a large data base on water quality throughout the White River Basin. This project also allows for outreach to local citizens who are educated about water quality issues and lake ecology.

## HISTORICAL MINING POLLUTION AND OVERBANK SEDIMENTATION ALONG THE PEARSON CREEK AND JAMES RIVER, SPRINGFIELD, MO

Marc R. Owen and Robert T. Pavlowsky, Department of Geography, Geology, and Planning, Southwest Missouri State University, Springfield, MO 65804-0089.

Agricultural land clearing during European settlement in the $19^{th}$ century was responsible for accelerated rates of overbank sedimentation in many watersheds located in the upper Midwest and Eastern United States. However, few studies have attempted to look for similar geomorphic relationships in the Ozarks Plateaus of Missouri. This study examines the thickness and timing of historical overbank deposits using mining contaminant profiles as stratigraphic markers to date sedimentary layers along the James River (650 $km^2$). Forest and prairie lands in the James watershed were cleared for agriculture and logged for railroad ties between 1860 and 1920. The mining contaminants were released between 1890 and 1925 from a series of small carbonate-hosted Pb-Zn sulfide mines located one kilometer from the river along a major tributary, Pearson Creek, just east of Springfield, MO. Channel sediments from streams draining the mining areas are heavily contaminated with zinc to concentrations >5,000 ppm. The evaluation of zinc profiles in cutbank exposures indicate that historical overbank deposits along the James River are typically <1 meter thick on upper floodplain surfaces. However, contaminated sediment depths may exceed 2 meters on lower elevation point bar features. These results suggest that relatively minor land use changes can increase floodplain deposition rates in Ozark-type streams. Further, plans for urbanization in the Pearson Creek watershed may lead to the release of high concentrations of toxic metals to the environment via the erosion of contaminated historical deposits by increased storm water discharges.

## HOST UTILIZATION AND SUITABILITY AMONG *VENUSTACONCHA* POPULATIONS IN DIFFERENT RIVER DRAINAGES.

Frank A. Riusech and M. Christopher Barnhart
Department of Biology, Southwest Missouri State University,
Springfield, Missouri 65807.

Little is known of variation in host-specificity among closely related unionids. We compared host utilization and suitability among populations of Pleas' mussel (*Venustaconcha pleasii*) in the James River (White River drainage) and the Spring River (Arkansas River drainage) in southern Missouri. Fish were inspected for natural glochidia infections in May of 1998. In the James River, the primary host of Pleas' mussel was rainbow darter (*Etheostoma caeruleum*). The infection rate of this species was 64% (51 of 80 fish examined). The mean number of glochidia attached to each infected fish was 16 ± SD 16.7 (range 1-73 glochidia per fish). Encysted glochidia were also observed on banded sculpin, yoke darter, and greenside darter. In the Spring River, glochidia primarily infected orangethroat darters (*Etheostoma spectabile*). The infection rate was 37% (17 of 46 fish examined). The mean number of glochidia attached was 25.6 ± SD 50.1 (range 1-203 glochidia per fish). Encysted glochidia were also observed on redfin darter, greenside darter, and banded sculpin. Artificial infections were used to test suitability of James River rainbow darters as hosts of both James River and Spring River *V. pleasii*. Transformation success of the host-sympatric population of James River Plea's mussel (31%) was significantly higher than that of Spring River *V. pleasii* (3%) and also significantly higher than Meramec River *V. ellipsiformis* (6%). These results indicate that closely related unionid taxa may exhibit different host specificity.

## ASSESSING NONPOINT POLLUTION USING BED SEDIMENT SURVEYS IN THE KINGS RIVER BASIN, NW ARKANSAS

Jason White and Robert T. Pavlowsky, Department of Geography, Geology, and Planning, Southwest Missouri State University, Springfield, MO, 65804-0089

Arkansas is second only to Texas as the nation's top broiler production state. It is presently unknown to what extent broiler operations act as nonpoint sources of phosphorus to streams in NW Arkansas. P-rich litter is re-applied as fertilizer to adjacent fields and adsorbs to sediment particles that may be transported from the terrestrial to the aquatic environment. Once in the stream, P stimulates algae growth that competes with fish for oxygen and decreases recreational desires. This study uses bed sediment monitoring to examine the affects of broiler operations on sediment-P concentrations in the Kings River watershed. Bee, Clabber, and Osage Creeks were selected for monitoring because they represent varying degrees of land use intensity of forested, agricultural (broilers), and mixed land uses, respectively. Sediment surveys may be preferred over water column surveys due to their ability to concentrate a range of pollutants, to be less affected by sampling error, and to incur fewer processing costs. Few studies have used streambed sediment surveys to spatially detect total phosphorus (TP) levels at the watershed scale. Twelve sediment survey sites were located with a GPS unit and then integrated with GIS coverages of soils, geology, land use, and broiler operation locations. Laboratory procedures included the EPA Method 3050 and an ICP machine on the campus of SMSU, Springfield, MO. Coverages were layered and survey results were graphed for the purpose of quantifying TP levels and their relationships with the sediment composition parameters of organic matter, Fe, and Al percentages in each survey. The highest TP concentration of 970 mg/kg was found in a sediment survey collected from Clabber Creek sub-watershed and the greatest range of TP concentrations was found in surveys collected from Osage Creek sub-watershed.

**BANK EROSION RATE ESTIMATION USING HISTORICAL AERIAL PHOTOGRAPHY ANALYSIS AND GIS, JAMES RIVER, SPRINGFIELD, MO**

Ryan Wyllie, Department of Geography, Geology, and Planning, Southwest Missouri State University, Springfield, MO 65804-0089.

Bank erosion can release significant amounts of sediment to river systems. Sometimes these remobilized sediments may also contain additional pollutants such as nutrients, metals, and organic matter that are also detrimental to water quality. Sediment TMDLs require estimates of bank erosion inputs relative to the watershed soil erosion and sediment transport budget. This study reports on the temporal variability of bank erosion along a meander bend located immediately upstream of the confluence of Pearson Creek with the James River near Springfield, Missouri. Channel and bank changes were monitored for a 43 year period with historical aerial photographs taken in 1953, 1975, 1982, 1990, and 1996. The images were digitized and rectified with ER Mapper software and then analyzed in ArcView. Dendrochronology was also used to evaluate the deposition rates of the adjacent point bar that is accreting in the direction of cut bank migration. The bank erosion rates averaged 5.8 meters/year throughout the study period with a minimum rates of 4.5 meters/year during 1953-1975 and maximum rate of 7.2 meters/year during 1982-1990. The cause of the drastic change in channel erosion rates and increased instability may be related to historical cycles of gravel transport, removal of riparian buffer vegetation, or gravel mining. It also appears that channel erosion rates are not related to single extreme flood events, but more to the duration of relatively high base flows or in-channel floods. More frequent saturation of the steep bank materials and pore water pressure gradient changes can lead to bank failure. Implications of the significance that the observed bank erosion rates have on the sediment budget for the river are described.