Central Plains Aquatic Bioassessment & Biocriteria Symposium

A symposium on aquatic issues of the Central Plains

September 18 & 19 2002

The University of Kansas Lawrence, Kansas
PROGRAM AGENDA

Wednesday, September 18

8:00 a.m. Registration, Poster Setup, and Refreshments

8:30 a.m. Introductions

Session 1  Bioassessment and Biomonitoring

8:45 a.m. Response of Stream Biological Communities to Agricultural Disturbances in the Great Plains
Bob Angelo, Bureau of Environmental Field Services, Division of Environment, Kansas Department of Health and Environment, Topeka, Kansas

9:30 a.m. Developing Linkages between Clean Sediment Indices and Biological Impairment
Roger A. Kuhnle, USDA Agricultural Research Service, National Sedimentation Laboratory, Oxford, Mississippi

10:00 a.m. Biomonitoring Intermittent Streams Using Benthic Invertebrates
Charles Rabeni, U.S. Geological Survey, Missouri Cooperative Fish and Wildlife Research Unit, Department of Fisheries and Wildlife, University of Missouri, Columbia, Missouri

10:30 a.m. Big Muddy Bioassessment: Can Biocriteria Be Developed for the Lower Missouri River?
Barry Poulton, Columbia Environmental Research Center, River Studies Station, U.S. Geological Survey, Columbia, Missouri

11:00 a.m. Break

11:15 a.m. Poster Viewing and Discussions
Authors, please be present at your posters.

11:45 a.m. Banquet with Speaker
Dissolved Oxygen Flux, Nutrients, and Community Productivity in Some Central Plains Streams: What We Know and What We Think We Know!
Donald Huggins, Director, Central Plains Center for BioAssessment, Kansas Biological Survey, University of Kansas, Lawrence, Kansas

Session 2  Lakes and Wetlands

1:15 p.m. Development of a Comprehensive Lake and Reservoir Classification Strategy for Nebraska as a Model for Agricultural Dominated Ecosystems
John Holz, School of Natural Resource Sciences, University of Nebraska, Lincoln, Nebraska

2:00 p.m. An Overview of Harmful Algal Blooms (HABs): Diversity and Dynamics of Toxic Algae in Freshwater Lakes and Marine Habitats
Russell G. Rhodes, Department of Biology, Southwest Missouri State University, Springfield, Missouri

2:30 p.m. Application of Bioassessment Protocols for Making Aquatic Life Beneficial Use-Support Determinations in Montana
Randy Apfelbeck, Montana Department of Environmental Quality, Helena, Montana

3:15 p.m. Break
3:30 p.m.  **Wetlands Monitoring: The Big Picture**  
*Kathleen Mulder, Section 404/Wetlands Program, U.S. Environmental Protection Agency, Region 7, Kansas City, Kansas*

4:00 p.m.  **The Kansas Wetland Survey**  
*Ed Carney, Kansas Department of Health and Environment, Topeka, Kansas*

4:30 p.m.  **Using Aerial Photography and Satellite Imagery to Monitor Changes in the Vegetation of Cheyenne Bottoms Wildlife Area**  
*Michael Houts, Kansas Applied Remote Sensing Program, University of Kansas, Lawrence, Kansas*

5:00 p.m.  **Announcements and Adjournment**

**Thursday, September 19**

**Session 3  Rivers and Streams**

8:00 a.m.  **Food Webs of the Great Rivers of the Central Basin: Application of Stable Isotopes in Bioassessment**  
*Michael D. Delong, Large River Studies Center, Biology Department, Winona State University, Winona, Minnesota*

8:45 a.m.  **An Assessment of Freshwater Biodiversity in the Central Mixed-Grass Prairie Ecoregion**  
*Mary Lammert, The Nature Conservancy, Freshwater Initiative, Chicago, Illinois*

9:15 a.m.  **Classification of Oklahoma Rivers and Preliminary Development of an Index of Biotic Integrity**  
*Michael Barbour, Tetra Tech, Inc., Owings Mills, Maryland*

9:45 a.m.  **Break**

10:00 a.m.  **Assessment of Ecological Condition in Headwater Streams of the Central Plains**  
*Will Bouchard, Department of Entomology, University of Minnesota, St. Paul, Minnesota*

10:30 a.m.  **Volunteer Stream Monitoring in Northeastern Nebraska**  
*Barbara Hayford, Wayne State College, Wayne, Nebraska*

11:30 a.m.  **Discussion and Conclusion**

**TECHNICAL POSTERS**

**Gypsum Creek Stream Restoration Project**  
*Nate Davis, Department of Biology, Wichita State University, Wichita, Kansas*

**Development of a Multimetric Aquatic Stressors Index for the Central Mixed-Grass Prairie Ecoregion**  
*Paula Gagnon, The Nature Conservancy, Freshwater Initiative, Chicago, Illinois*

**Reservoir Classification in Agriculturally Dominated Ecosystems**  
*Aris Severn, School of Natural Resources, University of Nebraska, Lincoln, Nebraska*

**Environmental Impact Assessment of Three Anti-Microbial Chemicals**  
*Brittan A. Wilson, Department of Ecology and Evolutionary Biology, University of Kansas, Lawrence, Kansas*
BOOTHS

**BioDevices Corporation**, Ames, Iowa
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**Kansas StreamLink**, Lawrence, Kansas
Kansas StreamLink is a growing network of K–12 watershed and stream study teams that provides training and support for watershed education throughout Kansas. The program’s goals include providing a means for students to explore their immediate watershed, helping to build lifelong relationships with water resources, and strengthening communities’ understanding of watershed concepts. Ultimately, StreamLink is a community-based water resource literacy program focused on creating and sharing outdoor watershed studies and explorations.

Through the StreamLink Participant Program, students have contact with local streams and experience firsthand what a creek looks like, what lives there, and what affects the water and all living things that depend on it. In doing so, students improve their understanding of stream systems and the importance of water as a resource. They develop a connection to the land, begin to realize that they can make a difference, and gain a sense of stewardship.

The StreamLink Stewardship Program builds on these concepts by providing service-oriented education and exposure to land use and land management practices.

For more information about Kansas StreamLink, visit [www.streamlink.org](http://www.streamlink.org) or phone 785-840-0700.

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CENTRAL PLAINS CENTER FOR BIOASSESSMENT

The Central Plains Center for BioAssessment (CPCB), which is nested within the Kansas Biological Survey at the University of Kansas, was created in 1998 to be a center of aquatic expertise and to facilitate the exchange of information among individuals and organizations involved with aquatic issues within the Central Plains.

Much of our work is concentrated within U.S. EPA Region 7 (Kansas, Iowa, Missouri, and Nebraska). However, we work on an ecoregional basis. Since ecological trends transcend geopolitical boundaries, our focus extends into the Central Plains area of the Great Plains region of Canada and the United States.

As a nonregulatory scientific entity, one of our primary goals is to facilitate cooperation among academicians, scientists, the states, native tribes, and other public entities in the region, resulting in collaborative research on issues of aquatic ecology and water quality. To this end, we host workshops to encourage open exchange of information and ideas, and make the workshop proceedings available over our Web page.

We also participate in two workgroups—the CPCB Biological Criteria Workgroup and the U.S. EPA Region 7 Nutrient Criteria Workgroup—and coordinate meetings for the members of these groups. We are involved with research projects that include the analyses of historical lake and stream data to determine ecoregional trends in water quality; supplementation of this data through collection of biological, physical, and chemical data from streams and lakes in Kansas, Iowa, Missouri, and Nebraska; and modeling of lake/watershed interactions to estimate potential effects of nutrient loads on eutrophication.

We can be reached through our Web site, [www.cpcb.ku.edu](http://www.cpcb.ku.edu).
Response of Stream Biological Communities to Agricultural Disturbances in the Great Plains (paper)
R.T. Angelo1*, D.G. Huggins2, and M.S. Cringan1

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Most streams draining the grassland interior of North America were typified historically by braided channels, shifting sand bottoms, adjoining riparian wetlands, strong groundwater connections, low ambient nutrient levels, and wide seasonal fluctuations in flow. The advent of large-scale agriculture exerted a profound impact on many of these features by altering the original hydrology, diminishing native aquatic habitat, accelerating rates of soil erosion and stream siltation, and prompting a general decline in surface water quality.

These changes sharply reduced the geographical range and abundance of many regionally endemic species. In the more heavily impacted watersheds, streams experienced radical shifts in biological community composition, the loss of original trophic pathways and nutrient cycling relationships, and uncharacteristically large oscillations in aquatic biomass and productivity.

This presentation examines these historical and ongoing developments from the conceptual perspective of an agricultural disturbance gradient and biological response continuum. Consideration is given to appropriate stream biological indicators, ecoregional reference conditions, numeric biological criteria, and tiered aquatic life uses in the Great Plains and other grassland regions impacted by agricultural development.

Application of Bioassessment Protocols for Making Aquatic Life Beneficial Use-Support Determinations in Montana (paper)
Randy Apfelbeck

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In Montana, all state waters are classified in accordance with their designated beneficial uses. State waters that are determined to be impaired are placed on the 303(d) list of water-quality-limited segments and require Total Maximum Daily Load (TMDL) plans to control pollutants.

The Montana Legislature has directed our agency to evaluate all available chemical, physical, and biological water quality information when making beneficial use-support determinations (BUDs). The information that we receive is often difficult to assess because it comes to us in diverse forms and from many sources. For this reason, we have developed guidelines to screen the information to determine whether it provides sufficient credible data (SCD) for making BUDs.

We have also developed decision tables that help the reviewer consistently interpret and apply numeric and narrative water-quality standards when making BUDs. The guidelines and decision tables incorporate the use of bioassessment data for making aquatic life use-support (ALUS) determinations for all state waters, including wetlands.

All data we receive are categorized as chemical, physical, or biological data. The data within each data category are individually assessed and scored. The cumulative score of all three data categories is evaluated to determine whether there are SCD for making ALUS determinations.

More than 400 streams and lakes, and eight wetlands, were placed on Montana’s 2000 303(d) list using this decision process. Biological data and information were used to assess 94 percent of these waters. Biological assessments are also being used to assess the status and trends of Montana’s aquatic resources. During the past year, we have initiated the development of a comprehensive watershed assessment program to determine whether aquatic life uses are at risk within targeted watersheds. The program includes the use of a random study design, bioassessments, and rapid field and landscape assessments.
Classification of Oklahoma Rivers and Preliminary Development of an Index of Biotic Integrity (paper)
Michael T. Barbour¹*, Jeroen Gerritsen¹, and Charles A. Potts²

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²Oklahoma Water Resources Board

The Oklahoma Department of Environmental Quality has monitored fish in Oklahoma rivers annually since 1976 with standardized beach seining methods at 12 to 80 fixed sites. Multivariate analysis of the species abundance data suggested three classes or types of Oklahoma rivers related to size and geography: (1) large rivers, including the Arkansas and lower Red rivers; (2) prairie rivers, including most of the North Canadian, Canadian, Washita, and upper Red rivers; and (3) saline prairie rivers, including most of the upper Cimarron and upper North Canadian (Beaver) rivers and some upper Red River tributaries.

Each river basin traverses several ecoregions across the state. Neither ecoregion nor river basin adequately accounted for differences among Oklahoma fish assemblages. Our analyses indicated that fish community composition is best explained by mean annual flow and salinity.

Metrics were selected for development of an index of biotic integrity (IBI) by comparison of reference sites believed to be least stressed, with known impaired sites. The IBI metrics were responsive only in the large-river sites, and an IBI was derived from seven metrics (numbers of total taxa, darter species, intolerant species, sucker species, and sunfish species; percent insectivorous cyprinids; and total individuals). Further analysis of IBI scores in all three river types showed that several sites had consistently high or consistently low scores throughout the 20-year period of record, but no apparent temporal trends were found.

Results of this study are being used by Oklahoma to expand its fish sampling methods in nonwadeable rivers, defined by criteria of greater than 1.25 m depth and 10 cfs, and to develop a technically sound framework for large-river biocriteria. Ongoing efforts focus on evaluating the use of ecoregions in Oklahoma and the river classes suggested by this study.

Assessment of Ecological Condition in Headwater Streams of the Central Plains (paper)
R. William Bouchard Jr.¹* and Donald G. Huggins²

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Multimetric analysis is the most common technique employed to assess the health of aquatic systems in North America. However, predictive modeling, a standard technique in the United Kingdom, has been tested in some regions of North America with promising results.

Using a watershed assessment procedure to predict stream condition, the abilities of multimetric and predictive modeling techniques to distinguish reference from impacted conditions in headwater streams within the Western Corn Belt Plains Ecoregion were compared. Eighteen reference sites were used to develop models with replicate samples from these sites and eight test sites were used to evaluate the models. Additionally, data from eight reference sites collected during a separate, independent, study were also used to evaluate the models.

Predictive modeling techniques were better at identifying impacted and reference sites in the main dataset. However, there was no difference between approaches when comparisons were made using reference samples from the independent study. Genus resolution models performed better than or as well as family models for all datasets, regardless of bioassessment approach. Due to the relatively small size of the dataset, elements of the predictive modeling approach were omitted, which could increase the predictive ability and accuracy of the models. Although predictive models performed better in this study, both approaches have strengths and weaknesses, and should be used in conjunction to provide additional capabilities and ultimately to enhance the biological assessment of streams.

Agencies responsible for the assessment of streams in the Great Plains should consider the development of a widespread and easily accessible computer program, which permits the calculation of both predictive modeling and multimetric techniques and facilitates bioassessment program standardization.
The Kansas Wetland Survey (paper)
Edward Carney

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In the early 1990s, the Kansas Department of Health and Environment was involved in an interagency project called the Wetland and Riparian Areas Project (WRAP). Based on the publicly managed wetland areas identified during WRAP, the current project was undertaken via an Environmental Protection Agency (EPA) grant.

The three-fold goal of this current project was to: (1) examine wetland trophic state and reference trophic conditions; (2) examine wetland water quality in comparison to state water quality criteria; and (3) estimate the level of wetland function for a suite of ecological and functional categories (wetland processes that contribute to the environmental infrastructure).

Out of the 32 wetland areas examined, all were surveyed for their attainment of environmental functions, but only 17 had sufficient water depth during the summer to allow consistent collection of water quality samples for analysis and comparison to criteria.

The majority (65 percent) of these wetlands were classed as hypereutrophic in terms of planktonic algae. The wetlands with the worst (highest) trophic states and nutrient levels were also dominated by blue-green algae communities. As has been postulated in years past, and as a suite of metrics suggests, nitrogen is likely to be the primary limiting factor in Kansas wetlands, with phosphorus and hydrology being likely secondary factors. Contemporary reference conditions were estimated based on published EPA methodologies. Reference (least impacted) water quality for Kansas wetlands equates with moderately low nutrient levels (around 80 ppb total phosphorus and 865 ppb total nitrogen), algae levels at the low end of the eutrophic category (around 12 ppb chlorophyll a), reasonably good water clarity, and general abundance of submersed and emersed macrophytes. Reference wetland quality would be supportive of virtually all beneficial uses recognized by Kansas law and water quality regulations (K.A.R. 28-16-28b et seq.).

The majority of water quality criteria/goal/guideline exceedences were for aquatic life uses (55 percent), with 55 percent of total exceedences due to nutrient levels, trophic status, and secondary effects of eutrophication such as low dissolved oxygen, elevated pH, and dramatic diel changes in dissolved oxygen and water chemistry. The principal sources of wetland loss and impairment in Kansas are hydrologic loss due to both agriculture and urban activities, and sediment/nutrient pollution from these same two activities.

Many Kansas wetlands either perform basic ecological functions in an adequate manner or have the potential to do so. Many others have a great deal of room for improvement. The most disturbing aspect of the estimates for wetland functions involved nutrient/sediment/toxicant retention. The majority of the wetlands exhibited high existing or potential capacity for materials retention. Combined with a generally high potential for downstream production transport, this has obvious implications for downstream water quality in streams and lakes. The suggestion is that many of these wetlands act as “sinks” for these pollutants, which will lead to their impairment, and also likely act as “transformers” of pollutants, which make them a likely source of additional downstream impacts.

Despite the popular view that wetlands are pollutant “traps,” many of these anticipated downstream impacts would not be positive for the environment or human activities that depend on water quality. Protection of these water resources becomes an important need for their future and our enjoyment of their benefits.

Gypsum Creek Stream Restoration Project (poster)
N.M. Davis1*, V. Weaver2, K. Parks1,3, and M.J. Lydy1,3

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Gypsum Creek is a second-order urban stream in Wichita, Kansas, that has been channelized in the past for flood control and has been selected as a sight for a stream restoration project. The initial phase of the project was to document the current conditions of the chemical, physical, and biological components of the stream and use it to compare to data that will be collected following restoration measures to determine whether improvements to the stream’s health and condition occur.
Three separate 300 m reaches have been chosen as collection sites along Gypsum Creek for sampling of water quality, pesticides, physical habitat, and benthic macroinvertebrate and fish communities. Data collected to date indicate that anthropogenic stressors have degraded the ecological conditions at Gypsum Creek. Monitoring documented the presence of the herbicide simazine in water samples, as well as the insecticide diazinon at levels above recommended water quality criteria for protection of aquatic life (0.08 µg/L). Planktonic chlorophyll $a$ concentrations averaged more than 12 µg/L, indicating that eutrophic conditions exist in the stream. Physical habitat assessments indicate degradation in both riparian and in-stream habitat as a result of the altered hydrology associated with flood-control management.

Analysis of macroinvertebrate communities using a family level biotic index classifies the water-quality conditions in Gypsum Creek as nonsupportive. Ichthyofaunal communities assessed with a regionally based Index of Biotic Integrity (IBI) were categorized as poor, with the majority of species and individuals collected characterized as being tolerant to anthropogenic stressors. Data indicate that Gypsum Creek would benefit from stream restoration procedures to improve the ecological conditions of the stream.

**Food Webs of the Great Rivers of the Central Basin: Application of Stable Isotopes in Bioassessment** (paper)
Michael D. Delong

Large River Studies Center, Biology Department, Winona State University, Winona, MN 55987, 507-457-5484, mdelong@winona.edu

Food webs represent an integration of organic matter processing and community interactions within an ecosystem. As such, they often can define the basic structure and functional dynamics of ecosystems. It is also because of the integrative nature of food webs that measures of trophic dynamics have been used as functional measures of ecosystem health and integrity.

One approach for developing food web models is use of the stable isotope ratios of carbon ($^{13}\text{C}/^{12}\text{C}$; reported as $\delta^{13}\text{C}$) and nitrogen ($^{15}\text{N}/^{14}\text{N}$; reported as $\delta^{15}\text{N}$) because the relative amount of the isotopes present in organismal tissues changes through selective metabolism as organic matter passes from one trophic level to the next. I will discuss how stable isotopes were used to examine trophic dynamics of the lower Missouri, lower Ohio, and upper Mississippi rivers and how this information was used to determine that the 1993 flood did not alter the major food source driving food webs of the Missouri and Mississippi rivers during this catastrophic event.

During this same study, it was also possible to conclude that the lower Ohio and Upper Mississippi rivers exhibit similar trophic dynamics. In contrast, the lower Missouri, which has been markedly altered for navigation, possessed different trophic characteristics despite geographic proximity to the other sites and the fact that all three rivers are, historically, river-floodplain systems.

In addition to these models, I will discuss how stable isotope data can be used to create practical and easily understandable food chain-based metrics for the assessment of ecosystem integrity in rivers.

**Development of a Multimetric Aquatic Stressors Index for the Central Mixed-Grass Prairie Ecoregion** (poster)
Paula Gagnon1*, Mary Lammert1, Jonathan Higgins1, Tom FitzHugh2

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Information on the types and distributions of anthropogenic stresses to aquatic biodiversity (e.g., dams, point sources, and incompatible land management) may enhance efforts to identify aquatic conservation sites with high ecological integrity, low conservation cost, and a high likelihood of conservation success. Additionally, these data may be used to identify or validate potential reference locations for biocriteria development.

We designed a multimetric index that quantified and ranked the intensity (in terms of frequency, density, or distribution) of multiple types of threats across aquatic ecosystems in the Central Mixed-Grass Prairie (CMGP) ecoregion. Component metrics in the index (e.g., catchment dam density, percent riparian agriculture land use,
catchment point source density) included threats identified by local experts as the predominant activities impairing aquatic ecosystem integrity.

To validate the index and component metrics, metric scores were compared between expert-nominated conservation areas and systems not nominated as conservation areas. Metric values between nominated and non-nominated system types differed markedly, demonstrating potential thresholds above which conservation areas may not be suitable. The effectiveness of most metrics depended on the size of the systems: distinct thresholds were observed for small systems and were not observed for large systems. The index demonstrated that nominated conservation areas may be useful reference sites for biocriteria development, based on the relatively low degree of stressors observed in these freshwater systems.

Volunteer Stream Monitoring in Northeastern Nebraska (paper)
Barbara Hayford and Mark Hammer

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Student volunteers at Wayne State College in northeastern Nebraska took part in a Service Learning Volunteer Stream Monitoring Project of the South Logan Creek Watershed. Collecting, processing, identification, and analysis protocols were modified from the U.S. Environmental Protection Agency’s Rapid Bioassessment Protocols. Most modifications were in the form of changing scientific jargon to common terms, while the methodology was little changed.

Students collected data on habitat, physical stream characteristics, dissolved oxygen, and benthic macroinvertebrates. They identified specimens to the family level using a dichotomous key created for northeastern Nebraska aquatic macroinvertebrates. Students compared total abundance, taxonomic richness, Shannon-Weaver Diversity, and the Hilsenhoff Biotic Index to reference conditions in the Western Corn Belt Plains Ecoregion. Sorted and identified material was randomly rechecked to determine Quality Assurance. Error rates were low (approximately less than 5 percent) and the Volunteer Monitoring efforts were deemed a scientific and educational success.

Development of a Comprehensive Lake and Reservoir Classification Strategy for Nebraska as a Model for Agricultural Dominated Ecosystems (paper)
John C. Holz

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In agriculturally dominated regions, land-use practices have an unusually large impact on water bodies and, therefore, may reduce the utility of current ecoregion-based approaches to lake classification by dampening the signals that underlie the ecoregion framework. This research focuses on developing a comprehensive classification scheme for agriculturally dominated ecosystems by: (1) establishing a protocol for aggregating water bodies in agricultural ecosystems into classification strata and identifying reference conditions for these classes; and (2) establishing the role of remote sensing and GIS in a classification strategy.

A water quality database for nearly 325 Nebraska lakes and reservoirs has been established, with all water bodies sampled monthly from May through September for common limnological parameters (e.g., nutrients, clarity, chlorophyll). From this database, lakes and reservoirs are being classified hierarchically, using a combination of rule-based and data-based approaches.

Thus far, lake and reservoir classes have been defined by performing a factor analysis on the limnological data and plotting the significant factors to identify groups with similar water-quality characteristics. Interestingly, the Level IV Ecoregions based on soil type, native vegetation cover, topography, and geology do not accurately represent water quality of Nebraska’s reservoirs or natural Sand Hills lakes. Limited surface water inputs, combined with local hydrology, reduce the utility of landscape classification approaches in the Sand Hills region and the dominant impact of land use minimizes the effectiveness of ecoregional classification for the reservoirs.

Improved methods are also being developed for integrating field data, data collected via airborne and close-range remote sensing, data collected via operational and near-future satellite remote sensing systems, and ancillary geospatial data in a multistage approach to lake classification. Biological indicators that integrate the lake conditions
of each stratum will be developed from summer phytoplankton and zooplankton collections, and special emphasis has been placed on developing methods to remotely sense biological indicators of water quality based on the optical phytoplankton pigment structures of lakes.

Close-range remote sensing techniques were very sensitive to even slight variation in chlorophyll concentration (as well as in turbidity and Secchi depth), with standard errors of <5 mg/m³ over a range of chlorophyll concentrations from 10 to 194 mg/m³.

Using Aerial Photography and Satellite Imagery to Monitor Changes in the Vegetation of Cheyenne Bottoms Wildlife Area (paper)
Michael E. Houts*, K. Jan Oliver, Jim Von Loh, Kevin P. Price, Keith Sexton

Kansas Applied Remote Sensing Program, University of Kansas, 2335 Irving Hill Road, Lawrence, KS 66045 (*785-864-7721, mhouts@ku.edu)

The Cheyenne Bottoms Wildlife Area (CHBWA) is a 19,857 acre wetland located in central Kansas, and is a critical stop-over point in the central flyway for approximately half of the migrating waterfowl and shorebirds of North America. In 1998, a five-year project began that used geographic information systems (GIS) technology to create a database of vegetation communities to support park personnel with management of the CHBWA.

With the maintenance of vegetation communities and water levels being critical for preserving habitat function, special emphasis was placed on monitoring the extent and condition of cattail patches. This was important because cattails were encroaching on saturated soils and shallow water areas, decreasing the area available to wading birds and waterfowl.

Each summer, near-infra-red (NIR) photography was acquired over CHBWA and processed to produce a NIR digital orthorectified photograph with a one-meter spatial resolution. Personnel collected ground truth data within the CHBWA each summer, then digitized vegetation communities from visual interpretation of the orthophotograph. Now, as the project draws to a close, the results of the project are examined, and new techniques are being explored that may assist in the continued monitoring of CHBWA.

Over the course of this study, the total area of cattail decreased from 6,841 acres in 1989 to 3,865 acres in 2001. Observations show that long-term flooding was the most effective form of cattail management, although burning, discing, herbicides, and biological control (caterpillars) also showed success in reducing the area of cattail stands. The use of multi-temporal, moderate spatial resolution (30 and 15 m) satellite images of the area were investigated as a potential way to continue monitoring CHBWA. Despite promising initial observations, the constant flux in water levels and soil moisture made it difficult to accurately classify vegetation communities using multi-temporal satellite data.

Dissolved Oxygen Flux, Nutrients, and Community Productivity in Some Central Plains Streams: What We Know and What We Think We Know! (paper)
Donald G. Huggins*, Jeffrey A. Anderson, Steve Wang

Central Plains Center for BioAssessment, Kansas Biological Survey, University of Kansas, 2021 Constant Avenue, Lawrence, KS 66047 (*785-864-2365, dhuggins@ku.edu)

The Central Plains Center for BioAssessment is studying the relationships between nutrients, primary production, and diel-dissolved oxygen flux in wadeable streams of the Western Corn Belt Plains Ecoregion. Over the last three years, we have deployed Aqua 2002® dissolved oxygen and temperature data loggers in a total of 36 study streams for time periods of 10 or more days during low-flow conditions.

In situ measures of pH, conductivity, and turbidity, as well as dissolved oxygen and temperature that were used as QA checks against concurrent logger values, were obtained at the start and finish of each deployment period. In addition, a series of physical stream measures (e.g., velocity, depth, width, discharge) and grab samples of stream water were collected at these same times for laboratory analysis of nutrients and water-column chlorophyll and phaeophytin a concentrations.

Lastly, three to five replicate periphyton samples were collected both at the beginning and end of each deployment period to determine benthic chlorophyll and phaeophytin a levels. Plots of dissolved oxygen (DO) concentrations
verses time clearly show a high degree of daily and weekly fluctuation in the DO curves. Statistically significant correlations were found that suggested strong relationships between various DO variables and in-stream nutrient concentrations and other stream variables (e.g., periphyton and chlorophyll $a$) existed in these stream systems during low flows.

Initial findings indicate that relationships between in-stream nutrient concentrations, algal biomass, and DO regimes can be quantified during low-flow periods, but a number of yet-to-be-quantified stream factors control these relationships. Daily and weekly estimates of gross primary production and community respiration calculated from the DO and temperature data are being examined as possible indicators of stream function as it relates to nutrient enrichment and other stream factors.

**Developing Linkages between Clean Sediment Indices and Biological Impairment** (paper)
Roger A. Kuhnle*, Andrew Simon, and Scott S. Knight

USDA Agricultural Research Service, National Sedimentation Laboratory, PO Box 1157, Oxford, MS 38655-1157 (*rukhnle@ars.usda.gov)

Excessive erosion, transport, and deposition of sediment in surface waters is a major problem in the United States. Clean sediment has been identified as the largest named pollutant in the 303(d) listed sites in the United States. Clean sediment is defined here as sediment uncontaminated by other substances.

The impact of sediment in many of these listed streams is from too much or too little sediment. The methods used by states to list streams as impaired by sediment are variable. Standard scientifically based assessment tools are needed to determine the likelihood that streams are impaired by clean sediments.

In this study, linkages were sought between sediment indices and biologic indices for streams with detailed records of flow discharge, suspended sediment transport, and biological data to use as analogues in the evaluation of sites lacking detailed data. Preliminary analyses show that as durations of suspended sediment concentration at or above 1,000 mg/l increase, the total number of organisms and the number of taxa tend to decrease for benthic organisms. Also, as the ratio of the bed shear stress at the one-year flow to the critical shear for the bed material increases, decreases in number of organisms and number of taxa were observed. The data for this determination were from streams in the Mississippi Valley Loess Plains in the state of Mississippi.

**An Assessment of Freshwater Biodiversity in the Central Mixed-Grass Prairie Ecoregion** (paper)
Mary Lammert1*, Jonathan Higgins1, Tom FitzHugh2, Jennifer Hall3, Brian Schreurs3, Paula Gagnon1

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2The Nature Conservancy, Freshwater Initiative, 120 East Union Avenue, #219, Olympia, WA 98501
3The Nature Conservancy, Midwestern Resource Office, 1313 5th Street SE, Suite 314, Minneapolis, MN 55414

To focus its conservation efforts, the Nature Conservancy has undertaken the identification of areas of biodiversity significance within ecoregions in North America, Latin America, and Asia. As part of this effort, we have identified priority river systems in the Central Mixed-Grass Prairie Ecoregion (CMGP), a planning area occupying roughly 59 million acres in the central portions of Nebraska, Kansas, and Oklahoma.

The CMGP overlaps parts of three ecoregional sections defined by the Forest Service: the Sand Hills, the South Central Great Plains, and the Red Bed Plains (McNab and Avers 1994). The goal of this planning effort was to represent the elements of aquatic diversity across the major environmental gradients in the CMGP, and to select a suite of places that together represent the best opportunities to protect the aquatic diversity of the region.

The first step in creating the plan was to define hydrologic units that capture environmental gradients and zoogeographic distinctions. Based on physiographic differences, we divided the major drainages that intersect the CMGP (Missouri River and Arkansas River) into ten Ecological Drainage Units (EDUs). Using the conservancy’s aquatic classification framework, we also developed a taxonomy of about 80 freshwater ecological systems describing the physical diversity of riverine ecosystems.

The second step was to select the elements of biological diversity (species and ecological systems) that would be addressed in the plan (i.e., targets). For species, we followed expert recommendations to include 13 imperiled or declining fish and five imperiled or declining aquatic macroinvertebrates. We also targeted intact natural assemblages
or groups of species. We then applied an integrity assessment to select the best occurrences of each ecosystem target (see Gagnon et al., poster presentation).

This presentation will discuss the results of this assessment and the methods used to classify aquatic ecosystems and select the set of rivers that meet the conservation goals for each target in the ecoregion.

**Wetlands Monitoring: The Big Picture** (paper)
Kathleen Mulder

Section 404/Wetlands Program, U.S. Environmental Protection Agency, Region 7, 901 N. 5th Street, Kansas City, KS 66101, 913-551-7542, mulder.kathy@epa.gov

Wetlands monitoring is a national priority of the U.S. Environmental Protection Agency. States and tribes are being encouraged to ensure that wetlands, like other waters of the United States, are part of their monitoring program. In the past, the physical, chemical, and biological monitoring of remaining wetlands in some areas within the plains region has been wanting, and region-wide there is a need to develop more robust monitoring efforts. Information from such monitoring can benefit many other programs, including water quality standards, TMDLs, and mitigation under Section 404 of the Clean Water Act and “Swampbuster” provisions of the farm bill.

**Big Muddy Bioassessment: Can Biocriteria Be Developed for the Lower Missouri River?** (paper)
Barry C. Poulton¹, Randy J. Sarver²

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Aquatic macroinvertebrate biological assessments are widely used for evaluating the status and condition of flowing waters. The methods and approaches already in place for wadeable streams need to be modified and fine-tuned for application toward great river systems such as the channelized lower Missouri. Over the past six years of research on this system, we have generated extensive species lists for multiple habitats, descriptive comparisons of the efficiency of sampling methods, and a preliminary evaluation of longitudinal site differences. We are in the process of validating large-river metrics for the invertebrate communities in the lower Missouri River by sampling a larger number of sites in autumn 2002 and including the simultaneous collection of water and sediment quality data.

To aid in future analysis and interpretation of the data, we will present some preliminary findings and the important considerations that need to be addressed to develop large-river biocriteria for the lower Missouri. Definition of reference condition and metric expectations, establishment of impairment categories, and outlining approaches used for quantifying longitudinal site differences will be discussed. An important research need for the lower Missouri system is the determination of overall water resource status and biological condition. However, other large-river-system goals can be addressed with bioassessment end points, including evaluation of the success of habitat rehabilitation projects and the identification of broad-scale indicators for monitoring ecosystem function.

**Biomonitoring Intermittent Streams Using Benthic Invertebrates** (paper)
Charles F. Rabeni

USGS, Missouri Cooperative Fish and Wildlife Research Unit, Department of Fisheries and Wildlife, University of Missouri, Columbia, MO, 573-882-3524, rabenic@missouri.edu

I investigated the feasibility of biomonitoring “very small” streams by studying benthic invertebrate communities at 15 sites of varying flow permanence within a single drainage for seven years. Streams were assigned to intermittent, intermediate, and permanent categories based on relative discharge over time.
Each category of stream had a distinctive invertebrate community structure, due more to differences in relative abundances than to presence or absence. The intermittent stream community could be considered a subset of the permanent stream community. Indices of community structure were positively related to flow permanence, and variability of indices increased as flow decreased. However, variance in reference metrics was reduced if season of sampling and habitat types sampled were taken into account.

I conclude that biomonitoring “intermediate” streams is appropriate using current standards. Biomonitoring intermittent streams is possible if appropriate reference standards are developed and if reduced metric sensitivity is acceptable.

An Overview of Harmful Algal Blooms (HABs): Diversity and Dynamics of Toxic Algae in Freshwater Lakes and Marine Habitats (paper)
Russell G. Rhodes
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Reports of the occurrence of toxic and harmful freshwater and marine algae are becoming more frequent. Not only have they been reported in the scientific community, but also in the media, and numerous Web sites have been established that include regular updates on population studies on the abundance of these forms of algae. This reporting is due, in part, to an increased awareness of the impact of algae on biota in the aquatic communities.

With the concerns of federal, state, and local agencies and interested persons sponsoring activities such as Stream Teams, mariculture managers, and knowledgeable laypersons, there is a greater assessment of the environment. Knowledge of the diversity of the kinds of algae that can have a harmful impact on the biota and on humans, while requiring some microscopic abilities and equipment, will be presented. The dynamics of the ways that such algae have an impact on the biota that are the causative agents, and potential preventative measures, will be also be presented. Thus, an overview of the problems resulting from blooms of toxic and harmful and toxic algae lends to the continuing education of those who have a need to be aware of the potential for algal impacts as stewards of our aquatic communities.

Reservoir Classification in Agriculturally Dominated Ecosystems (poster)
Aris Severn
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Understanding regional patterns of lake conditions through lake classification is critical to enhancing our ability to manage the water quality of reservoirs and to set a framework for protection and restoration goals. Reliable indicators of aquatic ecosystems function have been developed in an agriculturally dominated area by examining the relationship between organisms and their associated abiotic environment.

A protocol has been developed for grouping reservoirs into appropriate classification strata based on in-lake water quality parameters. Data-based statistical analyses of 100 reservoirs across Nebraska indicate that at least five classes exist. Cluster analyses, coupled with factor analyses, indicate that total nitrogen, chlorophyll $a$, and turbidity are most important in defining these reservoir classes. Landscape ecosystem (ecoregion) classification approaches use soil, native vegetation cover, geology, and topography data for grouping reservoirs.

Comparing these classification methodologies, we find that reservoirs belonging to the same class do not necessarily group together within an ecoregion. Land use may contribute substantially to differences in classification strategies.
Environmental Impact Assessment of Three Anti-Microbial Chemicals (poster)
Brittan A. Wilson1*, Val H. Smith1, Frank deNoyelles Jr.1, Cynthia K. Larive2

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2Department of Chemistry, University of Kansas, Lawrence, KS 66045

All finished water produced by wastewater treatment plants in the United States is released into stream ecosystems. Although these treated wastewaters meet U.S. effluent standards, they nonetheless contain detectable quantities of surfactants, antibiotics, and other types of anti-microbial chemicals contained in pharmaceutical and personal-care products (PPCPs). These chemicals minimally biodegrade, but they are currently not mandated for removal under the U.S. Clean Water Act.

The ecological effects of three representative PPCPs on natural algal communities were individually tested in this study, using a series of laboratory dilution bioassays: Ciprofloxin (an antibiotic), Triclosan (an anti-microbial agent), and Tergitol (a surfactant). Each of these compounds caused strong shifts in community structure, and genus diversity was reduced for attached and suspended algae from sites located just upstream and just downstream of the Olathe, Kansas, WWTP. Although these compounds did not significantly alter rates of exponential growth in vitro, treatment effects on the lag phase appeared to have resulted in significant differences in final biomass yields in the bioassays.

Note to Presenters about Presentation Summaries
We ask that paper and poster presenters submit a three- to six-page summary of their presentations or posters. (We did not originally ask this of poster presenters, but we would now like to extend this opportunity to all.)

These short papers will be published in a proceedings that we will distribute to conference participants next spring. This publication will serve as a reference for bioassessment and monitoring in the Central Plains states.

Deadline: November 30, 2002
Format: Electronic (MS Word or WordPerfect)
Submission: E-mail to Debbie Baker, dbaker@ku.edu
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**BioDevices Aqua 2002**

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| | Accuracy: ± 0.1°C  
| Memory | Type: Nonvolatile FLASH memory  
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| Battery Life | At 25°C, 8 mg/l, 15-minute interval:  
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| | • 200 days with a 9-volt alkaline battery  
| Enclosure | PVC cylinder, O-ring sealed  
| Depth | Maximum: 200 ft. (61 m)  
| Dimensions | Length: 14.5 in. (36.8 cm)  
| | Diameter: 1.9 in. (4.8 cm)  
| Weight | 1.5 lb. (0.69 kg)  
| Warranty | Two-year limited  
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