FISCAL YEAR 2002 LTRMP FUNDING

LTRMP WORK UNITS	Program
2 - MONITORING AND ANALYSIS	
2.1 - Vegetation component	$878.8
2.2 - Fisheries component	$1,642.0
2.3 - Macroinvertebrates component	$228.3
2.4 - Water quality component	$1,746.0
2.5 - Annual LTRMP summary report	$25.9
2.6 - Statistical evaluation of monitoring data	$90.2
2.7 - Bathymetric mapping of the UMRS – Tasks 2, 3 & 4	$208.8
Sub-total monitoring and analysis	**$4,820.0**
3 - APPLIED RESEARCH: LANDSCAPE & HABITAT ANALYSIS	
3.1 - Automation of 2000 Land Cover/Land Use – Task D	$161.3
Sub-total landscape & habitat analysis	**$161.3**
TOTAL PROGRAM DEVELOPMENT	**$4,981.3**

Directory SOW (Revised 12/03/01)

2.1 Vegetation Component

The Vegetation Component of the LTRMP was restructured between 1998 and 2000. The newly installed stratified random sampling protocol (Yin et al. 2000) has increased the efficiency of sampling submersed aquatic vegetation in five RTA pools (Task 1) and, subsequently, has created a window of opportunities for new initiatives beyond the core monitoring duty. In FY 2002, we will continue to sample the RTA pools. Additionally, we will utilize the freed staff time to conduct three strategically important tasks (Tasks 2-3).

Task 1. Collect one increment of submersed aquatic vegetation in five RTA pools.

Objectives

This task is one of the core elements of the LTRMP described in the LTRMP Operation Plan (U.S. FISH and Wildlife Service, 1992).

Methods

Refer to Yin et al. (2000) for a detailed description of the stratified random sampling protocol.

Products

(1) Year 2001 SAV data will be quality checked and entered into the LTRMP monitoring database.
(2) Summary statistics of year 2001 SAV sampling data will be calculated and quality checked.
(3) Statistical analysis of year 2001 SAV data to detect differences between strata, pools, and previous monitoring years.
(4) A summary of results and interpretation of year 2001 SAV monitoring, to be included in the 2001 LTRMP Monitoring Summary Report.
(5) Updated the LTRMP database of flow discharge and water elevation data of the Upper Mississippi and Illinois Rivers

Milestones

December 29, 2001 - Complete year 2001 aquatic vegetation data quality checking and entry into the LTRMP database.
March 30, 2002 - Complete statistical analyses of year 2001 aquatic vegetation data.
April 30, 2002 - Complete DRAFT year 2001 Aquatic Vegetation Monitoring Section of the LTRMP year 2001 Summary Report
May 30, 2002 - Complete FINAL year 2001 Aquatic Vegetation Monitoring Section of the LTRMP year 2001 Summary Report July 31, 2002.
September 30, 2002 - Complete adding annual increment to database of river discharge and elevation.

Task 2. Monitoring floodplain forest regeneration

Objective

The Upper Mississippi River Conservation Commission (UMRCC) Wildlife Technical Committee Chairman Mr. Gary Christoff recently sent a formal letter to the UMESC Director Dr. Leslie Holland-Bartels on behalf of a group of state and federal river managers, biologists and foresters. In the letter Mr. Christoff stated the group's "concern for the future of floodplain forests". The group "strongly encourage(s) an expanded Long term Resource Monitoring Program that involves evaluation of forest management activities through monitoring and research." We believe the concern is well justified and requires proper actions in response. Each of the six LTRMP field stations has been monitoring forest seeds and seedlings at two sites since 1997. The project has never been formalized because a). a very limited amount of resources was allocated to forest monitoring and; b). forest seed production and seedling recruitment are highly variable that short term monitoring data are rarely meaningful. We propose to use the resources freed from aquatic vegetation monitoring to summarize the data collected between 1997 and 2001 and to evaluate whether or not the project should be continued.

Methods

The protocol for monitoring forest seeds and seedlings have been reviewed and is being revised.

Products

A report to summarize findings in the forest monitoring at Pools 4, 8, 13, 26, and La Grange and at the Open River between 1997 and 2001, including recommendations for future actions.

Milestones

December 15 - complete data entry into digital files.
February 15 - complete data analysis.
June 30 - submit draft report for review.

Task 3. Collect one year of submersed aquatic vegetation data in Pools 5, 7, and 12, and Alton Pool.

Objectives

This is a one-year effort to collect data using the LTRMP protocol to provide a snapshot of species composition and distributional pattern of submersed aquatic vegetation in each of the three pools. The data, combined with the RTA pool data and the submersed aquatic vegetation model developed for Pool 8, will greatly enrich the LTRMP database. The data will be the first for the five pools that has a pool-wide coverage and is collected with the LTRMP protocol. We foresee the data be very helpful or even be critically important for the Pool 5 drawdown

planning, Alton Pool Swan Lake HREP effect assessment, and the NAV environmental impact assessment.

Methods

Refer to Yin (et al. (2000) for a detailed description of the stratified random sampling protocol.

Products

(1) One year of submersed aquatic vegetation data collected with the LTRMP protocol for Pools 5, 7, and 12, and Alton Pool.
(2) A summary report on the species composition and distribution of submersed aquatic vegetation in the five pools.

Milestones

September 30, 2002 - Complete field sampling.
December 30, 2002 - Complete summary report

Total Funding: $878,800 (Federal $477,100 & Non-Federal $401,700)

Personnel

Dr. Yao Yin will be the principal investigator in charge of LTRMP vegetation monitoring.

2.2 Fisheries Component

The Fisheries Component comprises an annual increment of data collection for fish monitoring and an analysis of previously collected fish monitoring data integrated with data from other LTRMP components.

Monitoring:

One annual increment of stratified random sampling of fish will be conducted, following the LTRMP study plan and standard protocols (USGS 1999b, Gutreuter et al. 1995). A proposal to refine the fish sampling design will be finalized in November 2001, based on analyses of previous LTRMP fisheries data. The level of effort for fish monitoring in FY 2002 and any changes to the sampling protocol will be determined by March 2002. Any changes will affect the June 15-October 15, 2002, sampling periods.

Analysis:

In FY 2001, analyses of LTRMP fisheries data focused on determining how to improve efficiency within the fisheries sampling design. In FY 2002, we will focus on cross-component analyses to model relations between fish metrics and physical and chemical predictor variables. The goals are to:

(1) identify the spatial and temporal scale at which the majority of the variance in key fish population and community metrics occurs;
(2) use this information to identify variables from auxiliary UMRS data sources that could account for additional variability in these metrics; and develop integrated generalized models of fish metric responses that identify relationships and;
(3) predict the fisheries metric of interest.

The results of these analyses will have several important applications. First, models developed for the Resource Trend Areas (Pools 4, 8, 13, 26, La Grange Reach, and the Open River Reach) can be applied to areas presently unsampled (out-pool areas) to predict fisheries population or community metrics of interest (e.g., relative abundance, frequency of occurrence, probability of occurrence, species richness, etc.). Out-pool sampling in future years could help validate these models and help to assess whether the Resource Trend Areas are representative of larger reaches within the UMRS. Second, models could be used in HREP planning and in post-construction evaluations of biotic responses. Third, the integrated models provide hypotheses about the relations among components and can help guide experimental studies to test those hypotheses. Lastly, model results can help gauge the adequacy of the LTRMP sampling design to elucidate cross-component relations.

These analyses support the following objectives from the LTRMP Strategic Plan: (L11) "Analyze existing monitoring data to address long-term and longitudinal trends … and linkages to riverine biota …", (L16) Provide data, analyses, and models necessary to plan and design selected Habitat Rehabilitation and Enhancement Projects." They also support activities IIIc,

"Integrated analysis of fish monitoring data," and IIIg, "Model development and testing," listed in the LTRMP Out-Year Plan. In addition, these analyses support information need number 10, "Development of refined species-habitat models," from the Habitat Needs Assessment.

Objectives

Monitoring:

(1) Measure the relative abundance, community composition, and population structure of fishes within six LTRMP study areas in the UMRS (Pools 4, 8, 13, 26, and the Open River reach of the Upper Mississippi River and the La Grange Pool on the Illinois River).
(2) Determine if relative abundance, community composition, and population structure of fishes differ between strata, within study areas, and between study areas.
(3) Determine if the relative abundance, community composition, and population structure of fishes have changed from previous years of monitoring.

Analysis:

(1) Variance decomposition: Quantify sources of spatial and temporal variation in a suite of population and community metrics (e.g., relative abundance; presence/absence; probability of occurrence; species richness) for select combinations of species, strata, gears, and Resource Trend Areas.
(2) Use variance decomposition results to identify variables from other UMRS data sources that can be used to model the fishery responses of interest and to explain additional variance.
(3) Develop generalized regression models (linear, log-linear, logistic) and / or multivariate models using integrated data. Assess and test the predictive capabilities of each model.

Methods

Monitoring:

Fish will be sampled from randomly chosen locations from within aquatic areas strata present within each LTRMP study area as listed in the fisheries standard protocol (Gutreuter et al. 1995). Fish will be sampled with multiple sampling gears during three time periods between June 15 and October 15 in each LTRMP study area. In prior years, sampling has been done with electrofishing, fyke nets, seines, small fyke nets, hoop nets, and small trawls, following standard LTRMP protocols (Gutreuter et al. 1995). Details on analytical methodology and statistical protocols are documented in Gutreuter et al. (1995).

Sampling efforts will be refined in FY 2002 based on recommendations derived from analyses of the effectiveness of different gears for characterizing community composition and the relative abundance of key fish species. We recommend that four gears be eliminated from the program systemically: tandem mini fyke nets, tandem fyke nets, seines, and night electrofishing. Estimated effort savings from these reductions vary from about 5% to 40% by RTA area. Total effort savings for the component overall, across all field stations, are estimated at 25%-35%

when fully implemented. In FY2002, sample processing, data analysis, and report writing will still be conducted for all gears used in the 2001 sampling, thus effort savings will be realized only during the field season beginning in June 2002.

Analysis:

What is variance decomposition and why is it the proposed methodology for integrated analysis? Variance decomposition is a general analytical approach comprised of several methodologies that seeks to partition observed variation into specific components. For this work, we are interested in several spatial and temporal components. The goal of variance decomposition is to identify the relevant spatial and temporal scales of variation in key population and community metrics. We will then look for potential explanatory factors operating at similar scales that may be driving the response of interest, thus allowing integrated model development. In addition to providing a robust baseline for integrated analysis, one of the methods (multi-factoral analysis of variance) provides estimates of measurement error; a poorly understood property of the LTRMP fish component data. The proposed methods are derived from a desire to produce useful models for the river management and HREP communities and to identify testable hypotheses that address process-oriented questions, leading to understanding of system function. Both methods strive to prevent homogenization of the data that would mask the ability to discriminate scale issues.

Objective 1: Two methods of variance decomposition will be performed on several population and community metrics, including relative abundance (mean catch-per-unit-effort), species presence/absence, probability of occurrence, and species richness. Both methods avoid homogenization of the data over larger scales and provide objective results. The first method is termed multi-factorial analysis of variance. In essence, the fishery response variable of interest is modeled as a function of several spatial (e.g., reach, pool, and strata) and temporal (e.g., year, sampling period, month) variables that are intrinsic to the LTRMP dataset. The variance is partitioned among main effects (e.g., pool, year, or sampling period for example), interaction effects (e.g., pool * year, or reach*strata*month interactions for example), and residual error. The significance of the main and interaction effects identifies the temporal and spatial nature of the variance in the response variable and provides inference regarding other LTRMP component variables that may be driving the observed variance patterns because they operate at similar spatial and temporal scales. The residual error is hypothetically due to sampling error. Compared within gears among strata, insight into spatial sampling bias is gained. Compared across gears, differences in gear efficiency can be elucidated.

The second method is a multivariate method termed principal coordinates analysis (PCoA). PCoA is a method of multidimensional scaling that performs sample ordination based on similarity measures between samples. This technique results in quantitative partitioning of the total variation within a dataset into its spatial and temporal components. The graphical nature of PCoA, in conjunction with the quantitative results, assists in the examination of specific hypotheses concerning the structure and nature of the variation. The hypotheses to be examined are tested for significance against null hypothesis matrices using Mantel tests. Specific results

from each form of variance decomposition will be used to cross-validate results from each analysis**.**

Objective 2: Based on the variance decomposition results, data sources external to the fish component will be canvassed for likely explanatory variables, then appropriate species-specific datasets will be derived. Potential sources of auxiliary data include complimentary LTRMP component data (vegetation, water quality, invertebrates), UMRS spatial data (raw bathymetry, land-use/land-cover, aquatic area data, spatially derived metrics such as shoreline development indices), and data from other agencies (e.g., USACE hydrologic data, NOAA climatologic data).

Objective 3: Depending on the form of the response variable (e.g., continuous, binary, count, ratio-scale) appropriate generalized regression models will be fit using fish component data and auxiliary explanatory data, with considerations for spatial and temporal autocorrelation. Best-fit models will then be used to predict the fishery response of interest using spatially explicit applications of the models in conjunction with existing spatial GIS coverages of the Resource Trend Areas. Standard statistical diagnostic methods will be used to assess the predictive capabilities of the generated models. This objective will be addressed in part by Michelle Cripps, a Master of Science student at University of Wisconsin – La Crosse.

This is a considerable volume of work to be accomplished and this SOW should be viewed as a multi-year effort. Objectives 1, 2 (in part) and 3 (in part) will be addressed in fiscal year 2002. Objectives 2 and 3 will also be addressed in out-years and will be refined based on work completed in 2002.

Products

Monitoring:

(1) Fish data will be quality checked and entered into the LTRMP monitoring database.
(2) Summary statistics of fish sampling will be calculated and quality checked.
(3) A summary and interpretation of results of year 2000 fish monitoring, to be included in the 2000 LTRMP Monitoring Summary Report.
(4) Electronic capture of LTRMP fish data will be tested.

Analysis:

(1) Two Project Status Reports titled; "Scales of temporal and spatial variation in selected UMRS fish species: where to begin integrated analysis," and "Development of integrated models of fish distribution in the UMRS."
(2) A technical report summarizing annual progress and preliminary results from the above objectives will be prepared.

Milestones

November 1, 2001 - Complete the third FY 2001 fish sampling effort (September 16-October 31, 2001)
November 2001 - Finalize proposed changes to fish sampling design.
February 1, 2002 - Complete 2001 fish data quality checking and entry into the LTRMP database.
March 1, 2002 - Complete variance decompositions for selected species (Analysis Obj 1)
March 15, 2002 - Identify potential explanatory data and begin to develop necessary databases for generalized modeling efforts 3 (Analysis Obj 2)
March 31, 2002 - Complete summary statistics and statistical analyses of 2001 fish data.
March 2002 - Decision date to determine fisheries sampling protocol for FY02.
May 1, 2002 - Begin fitting and testing generalized models (Analysis Obj 3)
May 30, 2002 - Complete draft of 2001 fish monitoring section of the LTRMP year 2001 Monitoring Summary Report for serving on the web.
July 31, 2002 - Complete the first fish-sampling effort for the year 2002.
August 31, 2002 - Complete and distribute project status reports on fish analysis.
September 15, 2002 - Complete the second year fish sampling effort for the year 2002.
September 30, 2002 - Complete and distribute to COE draft technical report on fish analysis.

Total Funding: $1,642,000 (Federal $704,800 & Non-Federal $937,200)

Personnel

Mr. Brian Ickes and Mr. Randy Burkhardt will be the principal investigators in charge of LTRMP fisheries monitoring.

Literature Cited

Gutreuter, S., R. Burkhardt, and K. Lubinski. 1995. Long Term Resource Monitoring Program Procedures: Fish Monitoring. National Biological Service, Environmental Management Technical Center, Onalaska, Wisconsin, July 1995. LTRMP 95-P002-1. 42pp. + Appendices A-J

2.3 Macroinvertebrate Component

In 1992, macroinvertebrate sampling was initiated in Pools 4, 8, 13, 26, and the Open River reach of the Mississippi River and La Grange Pool of the Illinois River as part of the Long Term Resource Monitoring Program (LTRMP). Mayflies (Ephemeridae), fingernail clams (Sphaeriidae), and the exotic Asiatic clam (*Corbicula* sp.) were selected for monitoring. Midges (Chironomidae) were added to the sampling design in 1993 and the exotic zebra mussel (*Dreissena polymorpha*) in 1995.

Mayflies, fingernail clams, and midges, part of the soft-sediment substrate fauna, were chosen as target organisms for the LTRMP because of their important ecological role in the UMRS. For example, Thompson (1973) found that in fall, lesser scaup (*Aythya affinis*) gizzard contents contained 76% sphaeriids and about 13% mayflies. Thompson also found the target organisms to be important to canvasbacks (*A. valisneria*), ring-necked ducks (*A. collaris*), and American coots (*Fulica americana*) feeding in open water. A number of fish, including commercial and recreational species, eat the target organisms (Hoopes 1960; Jude 1968; Ranthum 1969).

Researchers have also traditionally used macroinvertebrates as biological indicators of river water quality (Myslinski and Ginsburg 1977; Rosenberg and Resh 1992). An indicator species can be defined as a species that has particular requirements with regard to a known set of physical or chemical parameters. Mayflies, fingernail clams, and midges have been historically used as indicators of river water quality (Fremling 1964, 1973, 1989; Steingraber and Wiener 1995). Macroinvertebrates also perform an important ecological function by digesting organic material and recycling nutrients (Reice and Wohlenberg 1992). Asiatic clams and zebra mussels were chosen for sampling because of their potential adverse effects on the economy and biology of the UMRS (Tucker 1995a, 1995b).

The Open River Study Area was dropped from the invertebrate monitoring design in 2001 because densities of mayflies and fingernail clams were consistently low, presumably due to unfavorable habitat for these taxa. The Open River Field Station is currently investigating alternative methods of sampling invertebrates in the Open River.

Objectives

(1) Measure the density of macroinvertebrates in soft-substrate within five LTRMP study areas in the UMRS (Pools 4, 8, 13, and 26 on the Upper Mississippi River and the La Grange Pool on the Illinois River) and note the presence or absence of Odonata, Plecoptera, Trichoptera, Diptera other than chironomids, Bivalvia, Oligochaeta, Decapoda, Amphipoda, and Gastropoda.
(2) Determine if macroinvertebrate densities differ between strata within study areas and differ between study areas.
(3) Determine if macroinvertebrate densities have changed from previous years of monitoring.
(4) Assess partner satisfaction with objectives of the macroinvertebrate component and determine the potential of the current design to provide needed information.

Methods

One annual increment of macroinvertebrate sampling will be conducted, following the LTRMP study plan and standard protocols (USGS 1999c, Thiel and Sauer 1999). The sampling effort will be the same as that applied during 2001. Benthic macroinvertebrates will be sampled by Ponar dredge and screened (1.18 mm) in the field (Thiel and Sauer 1999). Mayflies , fingernail clams, Asiatic clams, midges and zebra mussels will be collected, identified, and enumerated. The presence or absence of macroinvertebrates in the classes Odonata, Plecoptera, Trichoptera, Diptera, Bivalvia, Oligochaeta, Decapoda, Amphipoda, and Gastropoda will be observed and reported. Approximately 125 macroinvertebrate samples will be collected in each study area. Sample allocation will be based on a stratified random design, where strata include contiguous backwaters (BWC), main channel borders (MCB), impounded areas (IMP), secondary channels (SC), and tributary delta lake (TDL). All sites will be sampled in spring to characterize the benthic community before the emergence of adult mayflies. Pool-wide macroinvertebrate densities will be estimated by pooling data over all strata.

To evaluate the LTRMP macroinvertebrate component and the current monitoring design, we will use a preliminary web-based survey of resource managers to assess general support and identify issues or concerns about the component. Partner satisfaction and the information potential of current data will be evaluated at a workshop involving LTRMP staff and partners. Before the workshop, we will provide participants with information on the history of the sampling design and with results from previous work analyses including initial design analyses (Bartsch et al. 1998), modeling results (including this years SOW 2.7), and statistical power analyses. At the workshop, participants will review the history of the component and the questions and objectives it was designed to address; review the evolution of the sampling design; review macroinvertebrate work conducted by other agencies; assess the potential of the current sampling scheme to provide various types of information; identify data gaps (e.g., invertebrate drift); discuss strengths, weaknesses, and potential changes or new directions for the component; and develop recommendations.

Products

(1) Macroinvertebrate density data for the year 2002, quality checked and entered into the LTRMP monitoring database.
(2) Summary statistics of data on macroinvertebrate density served via the UMESC web site.
(3) A summary and interpretation of results of year 2002 macroinvertebrate monitoring, to be included in the LTRMP Monitoring Summary Report for the year 2002.
(4) A draft summary report on survey results.
(5) A draft workshop report discussing objectives for the component, with recommendations on potential changes or new directions for the component.

Milestones

January 31, 2002 - Complete quality checking of macroinvertebrate data for the year 2001, calculate summary statistics, and enter data into LTRMP database.
March 31, 2002 - Complete statistical analyses of macroinvertebrate data from the year 2001.
April, 30, 2002 - Complete draft of invertebrate monitoring section of the LTRMP YR2001 Summary Report
July 31, 2002 - Complete macroinvertebrate sampling efforts in each LTRMP study area.
August 1, 2002 - Complete draft summary report on survey results.
September 4, 2002 - Tentative workshop date.
September 30, 2002 - Submit draft workshop report with recommendations on potential changes or new directions for the component to COE.

Total Funding: $228,300 (Federal $161,900 & Non-Federal $66,400)

Personnel

Ms. Jennifer Sauer will be the principal investigator in charge of LTRMP macroinvertebrate monitoring.

References

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2.4 Water Quality Component

This section describes activities proposed as part of the core funding for LTRMP water quality in FY02. Any work beyond the core activities are submitted as separate work units. As core activity in FY02, one annual increment of LTRMP water quality monitoring will be conducted in conformance with LTRMP protocols and sampling design as revised in 1999. Annual reports (web based) and a general summary will be produced. In addition, we will conduct a review of the component, focusing on objectives, potential increases in efficiencies, and quality assurance.

The LTRMP water quality component collects field data and performs investigations and analyses as needed to obtain basic limnological information required to (1) contribute to increased understanding of the ecological structure and functioning of the UMRS , (2) document the status and trends of ecological conditions in the UMRS, and (3) contribute to the evaluation of management alternatives and actions in the UMRS. Funding and partnership decisions over the last 10 years have strongly emphasized goal 2 (monitoring for status and trends). Broad-scale, long-term water quality monitoring is best suited to goal 2 (which should drive goals 1 and 3), and the monitoring design necessarily emphasizes this role.

The priority limnological issues within the UMRS include sediment and sedimentation, decline in aquatic species, and loss of habitat due to (1) sedimentation and eutrophication (nutrient enrichment), and (2) physical changes associated with natural processes, navigational activities, and management actions. LTRMP water quality monitoring design addresses these priority issues by gaging the sources, anticipated fates, and effects of sediment, plant nutrients, and other characteristics known to strongly influence aquatic biota in the LTRMP study areas. In combination with data from bathymetric surveys, flow and stage gaging, and meterology, water quality monitoring also measures the net effect of system changes and fluctuations on physical-chemical aspects of aquatic habitat. Where funding has allowed, LTRMP water quality (under goals 1 and 3) has begun to explore the relationships among physical-chemical habitat features (e.g. temperature, dissolved oxygen, turbidity, water depth, wind fetch, geomorphometry) and the links between these features and biotic responses (e.g. algal blooms, overwintering success, vegetation abundance). The value and relevance of the LTRMP monitoring data for management was well demonstrated when LTRMP sediment and turbidity information contributed significantly to model development and risk assessment in the USACOE navigation studies.

Objectives

(1) Measure limnological variables and collect water samples in the six LTRMP study areas in the UMRS (including Pools 4, 8,13, 26, the Open River reach of the Upper Mississippi River, the La Grange Pool on the Illinois River, tributaries to these reaches, and reaches adjacent to these areas as indicated in the study design).
(2) Perform summary analyses on the collected data to be presented in six field station reports published on the web and included in the annual LTRMP summary.
(3) Review the component objectives, design, and procedures (including quality assurance and quality control) for field data collection and laboratory analyses.

Methods

Objective 1: Limnological variables (physicochemical characteristics, suspended sediment, major plant nutrients, and major cations and anions) will be monitored at stratified-random sites (SRS) and at fixed sampling sites (FSS) as defined in the sampling design. Upper Iowa University will conduct fixed site sampling on a volunteer basis in Pool 9 (adjacent to the LTRMP study area in Pool 8) and its tributaries in conformance with LTRMP sampling design and protocols, providing samples and data to UMESC at no charge. Bellevue field station will take advantage of existing, routine tributary sampling trips (as conducted from bridges and on-shore structures by all field stations) to collect fixed-site samples at three HREP-related sites and two navigation dams in pools adjacent to Pool 13 as outlined in the water quality interim report.

Allocation of sampling will be approximately equal between SRS and FSS. SRS will consist of four seasonal episodes and FSS will be conducted at 2 or 4-week intervals (as specified in the sampling design) at each fixed site. The sampling allocation will be the same as FY 2001. Samples for laboratory analysis will be collected at all fixed sites and at approximately 35% of all stratified random sampling locations as specified in the sampling design. Water quality sampling and laboratory analyses will be performed following LTRMP protocols and Standard Methods (American Public Health Association, 1992). A revised procedures manual for the water quality component, presently in peer review, will be published.

Objective 2: The annual water quality reports for the individual field stations were automated in FY99 and FY00 for publication in traditional (paper) form. A new initiative in FY02 is to provide paper copies in limited numbers and only as needed, with primary access to the reports through web-based publishing. This requires significant retooling of the report production process, but will result in increased speed and efficiency in the longer term

Objective 3: A review of the water quality component will be conducted and include the objectives of the component, the ability of the current sampling design to meet those objectives, and the procedures for quality assurance in data collection and laboratory analyses. The review will involve a panel of external experts and will document the recent changes in electronic capture of field data and in the operation of the analytical laboratory. The review panel will assess the objectives of the component relative to LTRMP goals, including the ability to use routine water quality monitoring data in cross-component analyses, the efficiency of the design, and the adequacy of quality assurance/quality control procedures. Findings and recommendations of the review will be detailed in a technical report.

Products

Objective 1:
Water-quality data, quality checked and entered into the LTRMP monitoring database from fixed site sampling and four stratified random sampling episodes during FY02.
Analytical results for water quality samples collected.
Summary statistics for calendar year 2001 water quality data.

Objective 2:
Web-based reports summarizing water-quality data for each of the six study areas during the 2000 & 2001 calendar years.
A summary of analysis and interpretation of water quality data emphasizing calendar year 2001, to be included in the LTRMP Monitoring Summary Report for the year 2001.

Objective 3:
Publication and distribution of revised Procedures Manual for LTRMP water quality monitoring.
A technical report on review of component objectives, design, and quality assurance.

Milestones

October 22, 2001 Complete fall stratified random sampling episode at each of the six LTRMP field stations (Objective 1).
December 31, 2001 Complete year 2001 water quality sampling at 2-4 week intervals (Objective 1)
January 31, 2002 Publish procedures manual for water quality component (Objective 3)
February 15, 2002 Complete winter stratified random sampling episode at each of the six LTRMP study areas (Objective 1).
March 31, 2002 Complete error checking of 2001 water quality laboratory analyses (Objective 1).
April 30, 2002 Complete calendar year 2001 water quality field data checking and entry to LTRMP database for fixed-site sampling and stratified random sampling (Objective 1)
May 15, 2002 Complete spring stratified random sampling episode at each of the six LTRMP field stations (Objective 1).
May 30, 2002 Complete transfer of calendar year 2001 analytical data from laboratory database to LTRMP database (Objective 1).
June 30, 2002 Complete web-based reports summarizing water-quality data for each of the six study areas during the 2000 & 2001 calendar years. (Objective 2)
June 30, 2002 Complete water quality section of the 2001 LTRMP monitoring summary report (Objective 2)
August 15, 2002 Complete summer stratified random sampling episode at each of the LTRMP field stations (Objective 1)
September 15, 2002 Draft report on review of component objectives and quality assurance to COE (Objective 3).

Funding: $1,746,000 (Federal $966,300 & Non-Federal $779,700)

Personnel

Dr. David Soballe will be the principal investigator in charge of LTRMP water quality monitoring.

References

APHA (American Public Health Association). 1992. Standard methods for the examination of water and wastewater. 18th edition. American Public Health Association, 1015 15th Street, NW, Washington, D.C. Variously paged.

2.5 Annual LTRMP Summary Report

Communication is a cornerstone of the LTRMP. We must communicate the accomplishments of the program to partners, customers, decision makers, politicians, and the general public in a way that is simple and effective, and that makes the program relevant to their needs. Each LTRMP project communicates its results in some form, which yields a variety of products available through various outlets. The program needs a single product that summarizes and highlights its accomplishments annually in a format is easy to read and widely available.

Objective

Complete and distribute an annual report summarizing LTRMP accomplishments and interpreting ecological conditions in the UMRS during the year 2001.

Methods

A web-based report will be produced that summarizes, synthesizes, and highlights the accomplishments of the LTRMP for FY2001 and shows how these accomplishments are important to river management. Types of information that may be included are monitoring efforts, applied research results, analyses, GIS tools and products, data syntheses and interpretations, unusual or newsworthy events, lessons learned, efficiencies gained, substantive changes in operation/organization, updates to long-term ecological trends, and examples of how LTRMP information is making a difference. The aim will be to report accomplishments in an informative manner that relates science to management. The report will concentrate primarily on system-level information, although noteworthy accomplishments at smaller scales will be included. The report will build on previous annual summary reports, the LTRMP Report to Congress, and the USGS Status and Trends report (Wiener et al. 1998) and will become the basis for contributions to the next Report to Congress.

Products

Annual summary report for the UMRS for the year 2001.

Milestones

June 30, 2002 - Draft report submitted for USGS review.
September 30, 2002 - Final draft report completed and submitted to COE.

Total Funding: $25,900 (Federal $25,900)

Personnel

Dr. Barry Johnson will be the lead UMESC principal investigator responsible for the LTRMP annual summary report.

Reference

Wiener, J. G., C. R. Fremling, C. E. Korschgen, K. P. Kenow, E. M. Kirsch, S. J. Rogers, Y. Yin, and J. S. Sauer. 1998. Mississippi River. Pages 351-384 in M. J. Mac, P. A. Opler, C. E. Puckett Haecker, and P. D. Doran (editors), Status and Trends of the Nation's Biological Resources, Volume 1. U.S. Geological Survey, Reston, Virginia.

2.6 Statistical Evaluation of Monitoring Data

The current LTRMP includes ongoing studies and new investigations that involve synthesis, analysis, or modeling of LTRMP and other UMRS data. Other LTRMP studies are examining the program's sampling framework or planning systemic analyses to characterize resources or habitats of the UMRS. Program partners have also recommended including investigations of other biotic groups, such as mussels, wildlife and imperiled species, into the LTRMP resource-analysis framework.

The above efforts involve application of statistical theory and methodology for sampling design, estimation, hypothesis testing and predictive modeling. Yet, the program has historically lacked the requisite level of statistical support needed for consultation with LTRMP scientists, managers and partners. The infusion of statistical expertise provided by this project will enhance the scientific defensibility and efficiency of LTRMP monitoring components and investigative studies. Such information will provide needed statistical input during programmatic planning efforts and will facilitate the timely completion of planned products.

Objectives

(1) Provide statistical support on both planned and as-requested bases for ongoing and developing studies. This support will include guidance on monitoring and study design, data synthesis, quantitative analysis and modeling.
(2) Model mayfly abundance within and across LTRMP pools as functions of habitat predictors. As part of this process, develop a general approach suitable for addressing within- and across-pool functional relationships for other taxa and for communities.

Methods

Objective 1: Statistical guidance will be provided to LTRMP investigators at appropriate stages of study planning and execution. Statistical contributions will include active participation in project planning, review of written study plans, evaluation of proposed and existing sampling designs, and provision of guidance on proposed methodologies for statistical estimation, hypothesis testing, and modeling. In FY02, a portion of the effort for this objective will be directed toward meeting objective 4 (AAssess partner satisfaction ... and determine the potential of the current design to provide needed information@) of Project 2.3, AMacroinvertebrate Component;" and objective 3 [AReview the component objectives, design, and procedures (including quality assurance and quality control) for field data collection and laboratory analyses"] of Project 2.4, AWater Quality Component."

Objective 2: LTRMP data from stratified random sampling of macroinvertebrates have been collected since 1992 in Pools 4, 8, 13, 26, Open River and La Grange. However, these data have not been modeled as functions of habitat measures. We will begin the modeling process using mayfly abundances or counts: Mayflies, principally *Hexagenia* mayflies, are one of the most abundant and important components of the macroinvertebrate communities in the UMRS. To assess our ability to predict abundances in unsampled pools and in future years, we will begin

modeling using a subset of sample pools (i.e., pools 4 and 13) and years. We will regress these data on physicochemical and biological predictors. The predictor set will include those variables determined from the literature to be important in driving mayfly abundances in rivers and streams, such as discharge, sediment characteristics, water depth, conductivity, temperature and dissolved oxygen, and may involve time lags based on life history considerations. We will also estimate the value of measuring detailed sediment characteristics (using sediment data collected by the component in 1992) for modeling mayfly abundances and will compare this value (scientifically and financially) to that derived from an inexpensive, gross sediment characterization method that can be easily performed in the field. Potential biological predictors will include mayfly counts from neighboring sampling locations, counts from the previous year and possibly a qualitative indication of the size of the previous season's hatch. We will examine the accuracy and precision of across-pool predictions by predicting counts in pools 8 and 13, and then comparing those predictions with observed counts. The accuracy and precision of across-year predictions will be examined by comparing predicted and observed counts in unmodeled years. Finally, by combining all data from all pools and years, we will attempt to qualitatively estimate pool-specific deviations from an approximately system-wide model. If the model appears to be a useful tool, we will develop a plan for future testing of the model in unsampled pools. Results from the regression models, combined with spatially-explicit habitat information, will be used to generate pool-specific maps of mayfly abundance. This modeling process is expected to serve as a template for the development of midge and fingernail clam models in FY 2003, and to inform future LTRMP modeling efforts in general.

This study plan represents a continuation of the effort to provide the full level of statistical support needed for programmatic planning, critical evaluation of proposed and existing sampling designs, and statistical support of LTRMP projects.

Products

(1) Quarterly reports of activity highlights, including modeling efforts and substantial consultations or collaborations with LTRMP components. (objective 1)
(2) Contribute to the technical report on Macroinvertebrate Component objectives and design (see objective 4, Project 2.3, “Macroinvertebrate Component”). (objective 1)
(3) Contribute to the technical report on Water Quality component objectives, design and quality assurance (see objective 6, Project 2.4, “Water Quality Component”). (objective 1)
(4) Final report summarizing mayfly modeling results. (objective 2)

Milestones

Dec 30, 2001 - Complete fourth quarter activity highlight report (objectives 1 and 2)
Mar 31, 2002 - Complete first quarter activity highlight report (objectives 1 and 2)
Jun 30, 2002 - Complete second quarter activity highlight report (objectives 1 and 2)
Jul 30, 2002 - Complete draft mayfly abundance model report (objective 2)
Sep 30, 2002 - Complete final mayfly abundance model report (objective 2)
Sep 30, 2002 - Complete annual (FY 2002) activity highlight report (objectives 1 and 2)

Total Funding: $90,200 (Federal $90,200)

Personnel

Dr. Brian Gray will be the principle investigator for this project.

2.7 Bathymetric mapping of the UMRS

This is a continuation of previous bathymetric mapping projects in the UMRS as funded by LTRMP. Resource managers have in the past, and again recently, identified bathymetric data as one of the primary data needs for the UMRS. Although the U.S. Army Corps of Engineers completes surveys of the main channel, the highly ecologically productive off channel areas of the River have gone largely unsurveyed. Bathymetric data is needed to quantitatively and qualitatively assess the suitability of essential aquatic habitats (e.g. backwaters and side channels). Such information is also critical for the spatial and temporal trend analysis of aquatic habitat modification. The bathymetric GIS dataset generated in this project will provide the opportunity to assess pool-wide habitat conditions (e.g. Habitat Needs Assessment), and also be used to detect changes from both historical maps and maps generated in the future.

In addition to bathymetric mapping of pool-wide conditions, a monitoring program to determine annual sedimentation rates in backwaters was established in 1997, to meet informational needs of resource managers (e.g. forecasting future conditions). Managers predict future changes in available water depth will have dramatic affects on the ecologically important backwaters of the UMRS. However, these predictions have not been quantified in an unbiased manner, therefore the severity of the problem in the UMRS is unknown. Additionally, an understanding of the sedimentation process can be used to better guide habitat enhancement projects (e.g. HREP projects).

There are five tasks for FY2002:

(1) Collect and process bathymetric data in FY2002 to fill gaps in pools that are nearly completed (e.g. pools surveyed by contractor).

(2) Develop GIS based models using pool-wide data sets (e.g. bathymetry) and sedimentation patterns from LTRMP monitoring data to predict future conditions of backwaters.

(3) Conduct surveys along backwater transects to determine sedimentation rates.

(4) Analyze and report on sedimentation along backwater transects that were established in 1997 in Pools 4, 8, and 13.

(5) Contract for additional bathymetric surveys in FY2002.

Upon completion of processing the contractual data collected in FY2001, gaps in that data will be identified and surveyed by UMESC personnel. A total of 100 field days will be allocated to bathymetry surveys to fill these gaps, which are quite substantial. The data collected will be processed in a GIS at UMESC. The mapping will provide for pool-wide data for as many as 6 pools (Pools 5, 10, 11, 15, 17, and 18). The completion of these pools will be dependant on the extent of completion by the contractors in early FY2002. Completion of all of these pools will bring the total of completed pools to 14, with 16 pools remaining to be surveyed. The status of the pool-wide GIS coverages will be depicted by a map on the LTRMP web site (www.umesc.usgs.gov/aquatic/bathymetry/status.html). In addition, data collected by MVS in the Open River reach of the UMR during FY2001 will be incorporated into the bathymetry

database and additional survey needs identified. Additional surveys will be conducted by contract in two or more newly selected pools in FY2002, dependent on available funding (Pools 16 and 25 are currently proposed).

The backwater sedimentation surveys are to be completed in the winter of FY2002 and change data will be analyzed and reported on. The data will include effects of the flood in 2001, thereby allowing for determination of differences in sedimentation during "normal" and high water years. In addition, the inclusion of the effects of the flood of 2001 will provide a better capability for forecasting future conditions because major flood effects can be accounted for in any predictions. If data are not collected in the winter of FY2002, no effects of a major flood can be determined. The analysis will include an evaluation of the current monitoring design (including survey frequency), and suggest changes to that design.

The modeling of future backwater conditions integrates the pool-wide bathymetric mapping, monitoring of sedimentation along backwater transects, and prior LTRMP work on modeling backwater limnological conditions. The product will be an enhancement of the pool-wide estimate of changes in backwater morphometry obtained from the stratified random sampling. The model will not identify locations of sedimentation, but only estimate changes at a pool scale on the basis of backwater characteristics measured in a GIS. The work in FY2002 will evaluate the success of the model, and determine if out-year modeling efforts should be proposed. This work will enhance past backwater modeling efforts by providing an opportunity to investigate the worthiness of the GIS variables in the model, and suggest additional variables that may be needed.

Objectives

(1) Complete additional pool-wide surveys in order to expedite the completion of a systemic GIS bathymetric data set for the UMRS (Task 1 and 5).
(2) Analyze and report on sedimentation along backwater transects and recommend a future monitoring design.
(3) Integrate LTRMP data using a GIS-based model to predict future morphometric conditions.

Methods

No major changes to the existing methodology used in the past by LTRMP are anticipated. The methods for bathymetric surveys by boat are designed to produce data suitable for generating a pool-wide GIS coverage using interpolation between sample points. The methods for monitoring sedimentation along backwater transects use precise surveys using traditional survey techniques. The modeling techniques will be similar to previous LTRMP backwater modeling work used to predict limnological characteristics.

Products

(1) Standard set of products (i.e. data, images) available through the UMESC bathymetry web pages for completed pools.
(2) A Project Status Report on information obtained by the backwater transect surveys and recommended changes to the monitoring design.
(3) Draft report on sedimentation along 72 backwater transects in Pools 4, 8, and 13 and web pages illustrating monitored results.
(4) Draft PSR report on model to predict future morphometric conditions.

Milestones

December 31, 2001 - Complete processing of FY2001 contractual data.
April 30, 2002 - Complete update of the UMESC bathymetry web pages.
May 31, 2002 - Complete PSR on information obtained by the backwater transect surveys and recommended changes to the monitoring design.
September 30, 2002 - Complete collecting and processing data collected in FY2002 by UMESC and contractors (Task 1 and 5).
September 30, 2002 - Complete draft report on sedimentation along backwater transects and have results served on the UMESC web site.
September 30, 2002 - Complete a draft PSR on a model to predict future morphometric conditions.

Funding

Total Funding: $208,800 (includes Tasks 2, 3, and 4; and funds some staff time available for Task 1) (Federal $208,800)

Unfunded Task 1: $83,400
Unfunded Task 5: $100,000 ($90,000 to contractor, $10,000 to UMESC)

Personnel

Jim Rogala will be the UMESC principal investigator in charge of bathymetric surveys, GIS database generation, reporting on sedimentation in backwaters, and modeling future morphometric conditions.

3.1 Automation of 2000 Land Cover/Land Use

This scope continues the development of a systemic year 2000 Land Cover/Land Use (LCU) GIS database for the Upper Mississippi River System. This database would provide an 11-year time step since the 1989 systemic coverage, allowing examination of changes resulting from the 1993 flood and HREP projects. This scope of work references a portion of "Task D" from the LTRMP umbrella scope of work titled "Year 2000 Land Cover/Land Use and Aquatic Areas GIS Database". This umbrella scope was written for FY2001 and includes base and Over-Target funding of multiple tasks spanning three fiscal years. Year 2000 LCU for the trend pools was completed in FY2001 with approximately half of non-trend pools scheduled for completion in FY2002 and the remaining pools in FY2003 (See Figure 1).

Objectives

Complete year 2000 LCU for approximately half of the non-trend pools.

Methods

Aerial photographs of the entire UMRS were taken in color infrared (CIR) at 1:24,000 scale in the late summer of 2000. Aerial photos will be scanned, rectified, and served via the UMESC Internet site. These aerial photos will be interpreted, using a 31-class LTRMP vegetation classification (see Attachment A). Year 2000 LCU GIS databases will be prepared by or under the supervision of competent and trained professional staff using documented standard operated procedures and will be subject to rigorous quality control (QC) assurances (NBS, 1995). All LCU datasets will be provided in NAD27 and NAD83 and in both Zone 15 and 16 where necessary. In addition, since many analysts are converting their spatial databases to the more current North American Datum of 1983, UMESC will serve legacy LCU and 2000 aerial photo mosaics for trend pools in both datums over the internet by the end of the fiscal year. These legacy LCU datasets are from 1890, 1975, and 1989. Aquatic areas datasets based on 2000 LCU, identified below as Task E, will require separate funding.

Completed in FY01:

Task A: A complete set of late summer aerial photography (prints and transparencies) for the entire UMRS floodplain in TC and CIR.

Task B: Georeferenced digital TC photo mosaics for each LTRMP study area on the UMRS (trend pools and half the non-trend pools), served via the UMESC internet site.

Task C: Automation of 2000 LCU datasets for trend pools (Pools 4, 8, 13, 26; Open River South; Illinois River - La Grange Pool), served via the UMESC Internet site.

FY2002 Schedule of Products:

Task D: Automation of 2000 LCU datasets for non-trend pools served via the UMESC Internet site.

Task D1: Alton (previously funded in FY01)
Task D2: Pools 9-12
Task D3: Pools 24-25
Task D4: Pools 5-7
Task D5: Open River North/Lower Kaskaskia
Task D6: Reproject legacy trend-pool data to NAD83
Total Funding required: $161,300

Potential FY2003 Schedule of Products:

Task D7: Peoria-Lockport Pools, Illinois River
Task D8: Pools 14-23
Task D9: Pools 1-3, Lower St. Croix, and Minnesota Rivers

Potential FY2004 Schedule of Products:

Task E: Automation of 2000 Aquatic Areas datasets for the entire UMRS, served via the UMESC Internet site.

Milestones

December 31, 2001 - Complete UMR Pools 9-12 and Alton Pool of the Illinois River
March 31, 2002 - Complete UMR Pools 24, and 25
June 30, 2002 - Complete UMR Pools 5-7
August 31, 2002 - Complete Open River North/Lower Kaskaskia River

Funding: $161,300 (Federal $161,300)

Personnel

Mr. Larry Robinson will be the UMESC principal investigator in charge of developing the Year 2000 LCU GIS databases for the UMRS.

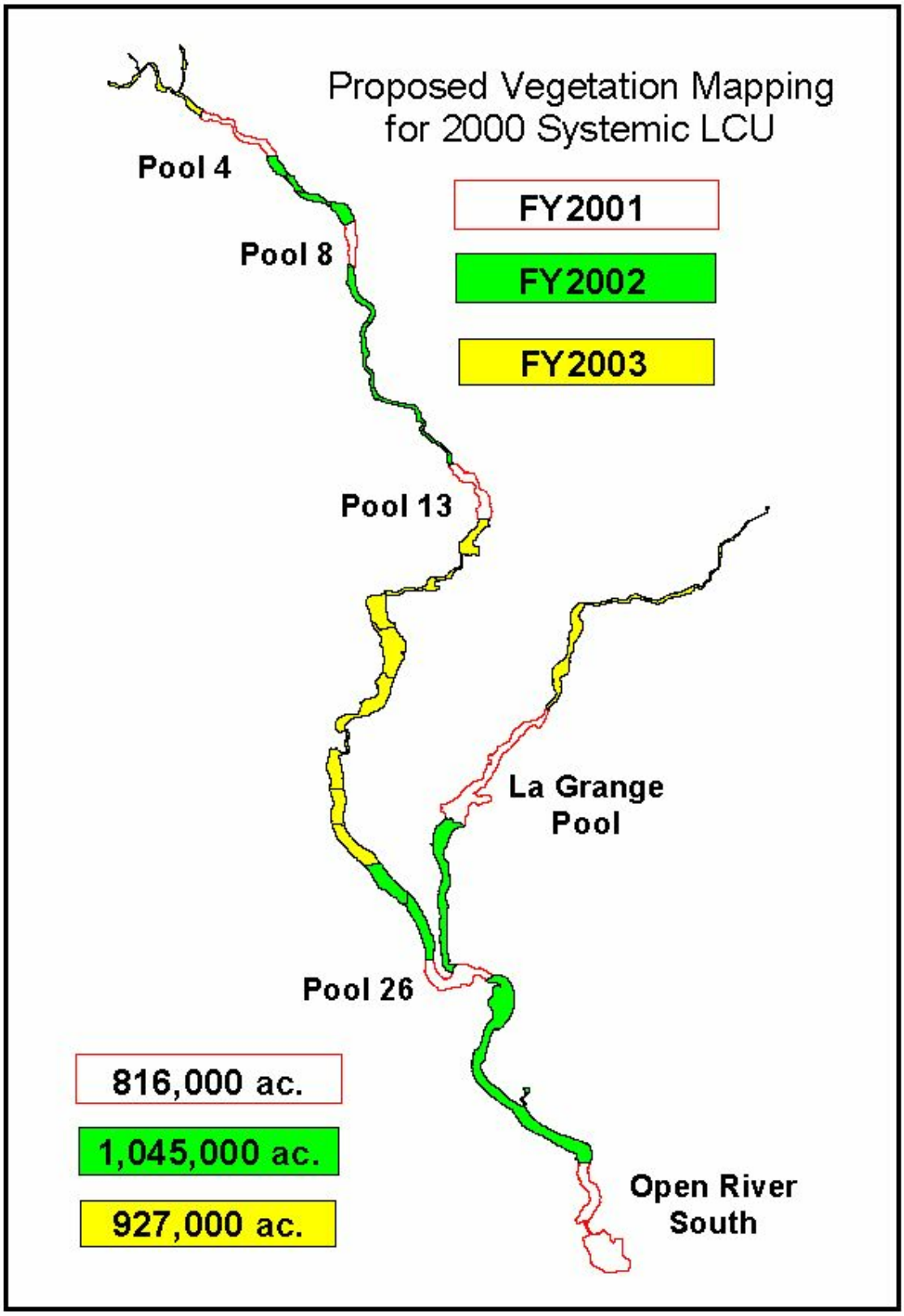
Proposed Vegetation Mapping
for 2000 Systemic LCU
Pool 4
Pool 8
Pool 13
La Grange
Pool
Pool 26
Open River
South
FY2001
FY2002
FY2003
816,000 ac.
1,045,000 ac.
927,000 ac.

Figure 1. Proposed UMRS Land Cover/Land Use Mapping for FY02 and FY03.
Attachment A. 31-Class Vegetation Classification System

UMR_CODE	UMR_CLASS	UMR_CLASS_DESCRIPTION	HYDRO_DESCRIPTION
AG	Agriculture	All obviously cultivated fields. This category may include transitional fallow fields that show evidence of tilling.	Infrequently Flooded Non-Forest
CN	Conifers	All natural or semi-natural evergreen communities. Typically Pine, but occasionally Cedar.	Infrequently Flooded Forest
DMA	Deep Marsh Annual	Dominated by Wild Rice, but may include floating-leaf species, submergents, or deep marsh perennials.	Semipermanently Flooded Non-Forest
DMP	Deep Marsh Perennial	Persistent emergents that prefer lots of water. Dominated by Arrowhead, Bur-reed, and Cattail and may include Pickerelweed, Giant Reed Grass, and Bulrush.	Semipermanently Flooded Non-Forest
DMS	Deep Marsh Shrub	Shrubby vegetation >25%, dominated by Buttonbush and Water Willow, frequently growing in standing water. May include RFA, SV, and deep marsh perennials.	Semipermanently Flooded Shrubs
DV	Developed	Areas that are predominantly artificial in nature such as cities/towns, large farmsteads, and industrial complexes.	Infrequently Flooded Non-Forest
FF	Floodplain Forest	Softwood forests growing on saturated soils near the main channel and in floodplain backwaters. These forest are predominantly Silver Maple, but also include Elm, Cottonwood, Black Willow, and River Birch.	Seasonally Flooded Forest
GR	Grassland	Drier upland grass or grass/forb fields. May include fallow fields, sand prairies, and shrubby vegetation < 25%.	Infrequently Flooded Non-Forest
LF	Lowland Forest	Lowland Forest - More common on southern reaches of the UMRS. These forests grow along the river banks on sites that are drier than FF sites. Typical species include many Hickories, Pecan, River Birch.	Temporarily Flooded Forest
LV	Levee	All continuous dikes or embankments designed for flood protection. More common on southern reaches of the UMRS and typically covered with mixed grass and forbs.	Infrequently Flooded Non-Forest
MUD	Mud	Exposed, non-vegetated mudflats. May occur near the main channel or in backwaters.	Seasonally Flooded Non-Forest
NPC	No Photo Coverage	Gaps in photo coverage. May include areas obscured by clouds or shadows.	No Photo Coverage
OW	Open Water	All non-vegetated open bodies of water.	Permanently Flooded Non-Forest
PC	Populus Community	Predominantly Cottonwood (>50%) but may include willow and other floodplain forest species.	Seasonally Flooded Forest
PN	Plantation	All commercially-grown evergreen plantations, large nurseries, and orchards. Typically will be Red or White Pine.	Infrequently Flooded Forest
PS	Pasture	All grass fields used for the production of livestock.	Infrequently Flooded Non-Forest
RD	Roadside Grass/Forbs	Grass/forb-covered right-of-ways along side of roads, highways, and railroads.	Infrequently Flooded Non-Forest
RFA	Rooted Floating Aquatics	Typically Lotus and Lily, but may include Water Shield and Water Primrose. Frequently grows with submergent vegetation when RFA density is < 90%.	Permanently Flooded Non-Forest

SB	Sand Bar	Exposed sand bars typically found in and near the main channel, and often associated with wing dams and islands.	Temporarily Flooded Non-Forest
SC	Salix Community	Predominantly Willow (>50%) but may include Cottonwood and other floodplain forest species.	Seasonally Flooded Forest
SD	Sand Dunes/Spoil	Sand spoil banks, beaches, and other sparsely-vegetated sandy areas.	Infrequently Flooded Non-Forest
SM	Sedge Meadow	Dominated by mixed Sedges but may include perennial emergents and moist soil grass/forbs.	Temporarily Flooded Non-Forest
SMA	Shallow Marsh Annual	Typically Wild Millet and Beggarsticks and other annual species that favor mudflats and shallow basins.	Seasonally Flooded Non-Forest
SMP	Shallow Marsh Perennial	The transition zone between deep marsh and wet meadow that is dominated by Bulrush, and to a lesser extent Cattail, Arrowhead, Bur-reed, Giant Reed Grass, Smartweed, and other moist soil species.	Seasonally Flooded Non-Forest
SMS	Shallow Marsh Shrub	Mixed shrubs >25%, but typically Sandbar Willow growing near the main channel and in backwaters along with mixed emergents, grasses, and forbs.	Seasonally Flooded Shrubs
SS	Shrub/Scrub	Shrubby vegetation > 25% on drier soils with a mixed grass/forb understory.	Infrequently Flooded Shrubs
SV	Submerged Aquatic Vegetation	All submersed aquatic vegetation.	Permanently Flooded Non-Forest
UF	Upland Forest	Forests growing at the edge or out of the UMRS floodplain. Species include Red/White Oak, Hickories, Elm, and other deciduous trees.	Infrequently Flooded Forest
WM	Wet Meadow	Dominated by moist soil grasses such as Reed Canary Grass and Rice Cutgrass. Also includes Loosestrife, Smartweed, and small inclusions of other mixed emergents, grasses, and forbs.	Saturated Soil Non-Forest
WMS	Wet Meadow Shrub	Mixed shrubby vegetation > 25%, typically Alder, Elder, False Indigo, Dogwood and/or Willow with a sedge/grass/forb understory.	Temporarily Flooded Shrubs
WS	Wooded Swamp	Most common in southern reaches of UMRS. Includes Bald Cypress, Water Tupelo, Sourgum, and Black Ash.	Semipermanently Flooded Forest