Long Term Resource Monitoring Program
Scope of Work–FY2005

Long Term Resource Monitoring Program
Minimum Sustainable Program
Scope of Work–FY2005

Aquatic Vegetation Component

The objective of the Long Term Resource Monitoring Program (LTRMP) Aquatic Vegetation Component is to collect quantitative data on the distribution and abundance of aquatic vegetation in the UMRS for the purpose of understanding its status, trends, ecological functions, and responses to natural disturbances and anthropogenic activities. Data are collected within three LTRMP study reaches in the UMRS (Pools 4, 8, and 13 on the Upper Mississippi). Data entry, quality assurance, data summaries, standard analyses, data serving, and report preparation occur under standardized protocols.

Methods

Aquatic vegetation sampling will be conducted following the LTRMP aquatic vegetation standard sampling protocol (Yin et al. 2000). One thousand three hundred and fifty sites will be surveyed in FY05, including 450 in Pool 4, 450 in Pool 8, and 450 in Pool 13 (Table 1). The presence/absence and abundance of aquatic plant species at each site will be measured and recorded. Pool-wide estimates of abundance and percent frequency of occurrence will be derived by pooling data over all strata.

Product Descriptions

2005A1: The 2003 Web-based Annual Component Update shall contain a summary of aquatic vegetation data collected in 2003 (See attachment A for an example of the format of a LTRMP Component Update).

2005A3: The 2004 Web-based Annual Component Update shall contain a summary of aquatic vegetation data collected in 2004.

2005A5: Navigation Pool 8: Vegetation response near HREP projects—Vegetation SRS data in the areas where the Phase I and Phase II islands were built and an area of lower Pool 8 (without HREP islands) are being analyzed. The project will evaluate the effectiveness of 2 different island-building configurations as habitat restoration techniques for aquatic vegetation, an important habitat component for many aquatic organisms.

Products and Milestones

Tracking number[1]	Products	Lead	Milestones
2005A1	WEB-based annual Aquatic Vegetation Component Update with 2003 data on Public Web Server.	Yin, Dukerschein, Sauer, Heglund	30 November 2004
2005A2	Complete data entry and QA/QC of 2004 data; 1250 observations.	Popp, Dukerschein, Kirby, Chick, Pegg, Sauer, Hansen	
	a. Data entry completed and submission of data to USGS	Popp, Dukerschein, Kirby	1 October 2004
	b. Data loaded on level 2 browsers	Hansen	1 October 2004
	c. QA/QC scripts run and data corrections sent to Field Stations	Sauer	18 October 2004
	d. Field Station QA/QC with corrections to USGS	Popp, Dukerschein, Kirby	15 November 2004
	e. Corrections made and data moved to public Web Browser	Sauer, Hansen, Caucutt	30 November 2004

Tracking number[1]	Products	Lead	Milestones
2005A3	WEB-based annual Aquatic Vegetation Component Update with 2004 data on Public Web Server.	Popp, Dukerschein, Kirby, Chick, Pegg, Sauer, Heglund	
	a. Develop first draft	Sauer, Dukerschein	15 February 2005
	b. Reviews completed	Popp, Dukerschein, Kirby, Chick, Hrabik, Pegg, Sauer, Heglund, Yin, Ardinger	28 February 2005
	c. Submit final update	Popp, Dukerschein, Kirby, Chick, Pegg, Sauer,	31 March 2005
	d. Placement on Web with PDF	Sauer, Caucutt, Ardinger	30 July 2005
2005A4	Complete aquatic vegetation sampling for Pools 4, 8, and 13 (Table 1)	Popp, Dukerschein, Kirby	31 August 2005
2005A5	Manuscript: Navigation Pool 8: Vegetation response near HREP projects in format of target journal for publication	Dukerschein, Yin, Boma, Gray, Heglund	30 September 2005
2005A6	Floodplain forest manuscript (FY02 SOW)	Chick, Yin	Awaiting journal review
2005A7	LTRMP report titled: "A multi-year synthesis of aquatic vegetation data from 1991 to 2002 for the Long Term Resource Monitoring Program on the Upper Mississippi River" to COE and USGS (FY04 SOW)	Yin, Dukerschein, Heglund	27 January 2005
2005A8	Web display of aquatic vegetation model - outstanding product	Yin, Chick, Heglund, Caucutt	30 May 2005

[1]Tracking number sequence: Year, last letter of USGS BASIS task code "BNBLA", ID number

Personnel

Dr. Yao Yin will be the principal investigator.

Literature Cited

Yin, Y., J. S. Winkelman, and H. A. Langrehr. 2000. Long Term Resource Monitoring Program procedures: Aquatic vegetation monitoring. U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, Wisconsin. April 2000. LTRMP 95-P002-7. 8 pp. + Appendixes A–C.

Fisheries Component

The objective of the LTRMP Fisheries Component is to collect quantitative data on the distribution and abundance of fish species and communities in the UMRS for the purpose of understanding resource status and trends, ecological functions, and response to natural disturbances and anthropogenic activities. Data are collected within six LTRMP study reaches in the UMRS (Pools 4, 8, 13, 26, and Open River Reach on the Upper Mississippi River and La Grange Pool on the Illinois River). Data entry, quality assurance, data summaries, standard analyses, data serving, and report preparation occur under standardized protocols (Gutreuter et al. 1995; Ickes and Burkhardt 2002).

Methods

Fish sampling will be conducted following the LTRMP study plan and standard protocols (Gutreuter et al. 1995), as modified in 2002 (Ickes and Burkhardt 2002). Species abundance, size structure, and community composition and structure will be measured over time. Between 160 and 270 samples will be collected in each study area (Table 1). Sample allocation will be based on a stratified random design, where strata include contiguous backwaters, main channel borders, main channel wingdams, impounded areas, and secondary channel borders. Tailwaters in the impounded reaches and tributary mouths in the Open River will be sampled under a fixed site design. Sampling effort will be allocated independently and equally across 2 sampling periods (August 1–September 15; September 16–October 31) to minimize risks of annual data loss during flood periods and to characterize seasonal patterns in abundance and habitat use. Pool-wide estimates of abundance will be derived by pooling data over all strata.

Product Descriptions

2005B2: The Web-based Annual Component Update shall contain a summary of fisheries data collected in 2004.

2005B3: Following on analyses conducted over the last two years, we will examine how key habitat variables affect fish diversity and production among different aquatic areas (strata). We will use bivariate or multivariate statistics to classify or cluster aquatic areas within and among research trend areas (RTAs) based on key habitat variables (e.g., vegetation, chlorophyll *a*, dissolved oxygen, current velocity, bathymetry, location within a pool, shoreline development, surface area, connectivity, etc.). We will then determine if fish production and diversity indices derived from LTRMP are related to these aquatic area classifications. If so, we will pursue more detailed analyses to determine which specific habitat features are most highly correlated with fish indices. In 2005, we will concentrate on habitat metrics related to primary productivity (chlorophyll a and aquatic vegetation), current velocity, and dissolved oxygen. These analyses will directly inform restoration efforts by identifying habitat factors directly related to abundance and diversity indices available from LTRMP sampling. As well, these analyses will inform the larger question of what supports the productivity and diversity of fishes in large rivers and suggest further studies to elucidate how large rivers function.

2005B5: Life History Database—We will complete the fish life history database begun in 2004 and make it available to the partnership. We will also develop an accompanying report describing construction, access, and use of the database. The database will contain information on life history characteristics, guild membership, growth, distribution, etc. derived from LTRMP data and other data sources. If time permits, we will integrate the database into the Graphical Fish Data Browser to allow the public to access life history information along with LTRMP information on species catch rates and community composition.

2005B11: Abundance Patterns of Centrarchids in Backwaters—Following on analyses conducted over the last two years, we will examine how key habitat variables affect fish production and

community structure among different off-channel aquatic areas. We will delineate individual off-channel aquatic areas in RTAs based on contiguous off-channel strata bordered by main or secondary channels. We will then use multivariate statistics to determine if fish production and community indices derived from LTRMP data are related to the physical and hydrological characteristics of these off-channel areas. If so, we will pursue more detailed univariate analyses to determine which specific habitat features are most highly correlated with fish indices. In 2005, we will concentrate our analysis on Pool 8 and expand to all RTA's in 2006. These analyses will directly inform restoration efforts by identifying potential physical and hydrological factors directly related to fish production and community indices available from LTRMP sampling. As well, these analyses will inform the larger question of what supports the productivity and diversity of fishes in large rivers and suggest further studies to elucidate how large rivers function.

Products and Milestones

Tracking number[1]	Products	Lead	Milestones
2005B1	Complete data entry, QA/QC of 2004 fish data; ~1,590 observations	Sauer, Popp, Dukerschein, Kirby, Chick, Pegg, Hrabik, Hansen	
	a. Data entry completed and submission of data to USGS	Popp, Dukerschein, Kirby, Chick, Pegg, Hrabik	31 January 2005
	b. Data loaded on level 2 browsers; QA/QC scripts run and data corrections sent to Field Stations	Hansen	10 February2005
	c. Field Station QA/QC with corrections to USGS	Popp, Dukerschein, Kirby, Chick, Pegg, Hrabik	18 February 2005
	d. Corrections made and data moved to public Web Browser	Sauer, Hansen, Caucutt	28 February 2005
2005B2	WEB-based annual Fisheries Component Update with 2004 data on Public Web Server.	Sauer, Popp, Dukerschein, Kirby, Chick, Pegg, Hrabik, Johnson	
	a. Develop first draft	Sauer, Popp, Dukerschein, Kirby, Chick, Pegg, Hrabik	30 April 2005
	b. Reviews completed	Sauer, Popp, Dukerschein, Kirby, Chick, Pegg, Hrabik, Johnson, Knights, Ardinger	15 May 2005
	c. Submit final update	Sauer, Popp, Dukerschein, Kirby, Chick, Pegg, Hrabik	31 May 2005
	d. Placement on Web with PDF	Sauer, Caucutt, Ardinger	31 August 2005
2005B3	Written summary of progress regarding how key habitat-matrix variables affect fish diversity and production in off channel aquatic areas.	Knights, Johnson	30 September 2005
2005B4	Complete fisheries sampling for Pools 4, 8, 13, 26, the Open River Reach, and La Grange Pool (Table 1)	Popp, Dukerschein, Kirby, Chick, Pegg, Hrabik	31 October 2005

Tracking number[1]	Products	Lead	Milestones
2005B5	Draft LTRMP report titled: Fish life history database report	Pegg, Dukerschein	22 April 2005
2005B6	LTRMP report titled: "A ten-year synthesis of fisheries data from 1993 to 2002 for the Long Term Resource Monitoring Program on the Upper Mississippi River" to COE and USGS. (FY04 SOW)	Ickes, Popp, Dukerschein, Kirby, Chick, Pegg, Hrabik, Johnson, Ardinger	June 23, 2005
2005B7	Final draft LTRMP report titled "Spatial structure and temporal variation of fish communities in the Upper Mississippi River" to COE and USGS. (FY04 SOW) Chick et al.	Chick, Ickes, Pegg, Hrabik, Johnson, Ardinger	31 January 2005
2005B8	Contract report titled: "Non-native fishes in the Upper Mississippi River System: A Synthesis of Information from the Long Term Resource Monitoring Program" to COE and USGS. (FY04 SOW) Irons et al.	Pegg, Popp, Chick, Ickes, Kolar, Hrabik, Johnson	1 June 2005
2005B9	Final draft LTRMP report titled: Spatial, temporal, and environmental trends of fish assemblages within six reaches of the Upper Mississippi River System (FY04 SOW) Barko et al.	Hrabik, Ickes, Chick, Pegg, Ardinger	31 January 2005
2005B10	Draft LTRMP report titled: Temporal and spatial trends in the frequency of occurrence, length-frequency distributions, rate of gain, and relative abundance of Upper Mississippi River Fish (FY04 SOW) Kirby and Ickes	Kirby, Ickes, Johnson	1 May 2005
2005B11	Manuscript titled: Abundance Patterns of Centrarchids in Backwaters of the Upper Mississippi River: Implications for Habitat Rehabilitation, submitted to journal.	Kirby	31 July 2005
2005B12	Complete and distribute project status reports on fish analysis. (FY02 SOW)	Ickes	1 Sept. 2005

[1]Tracking number sequence: Year, last letter of USGS BASIS task code "BNBLB", ID number

Personnel

Mr. Brent Knights will be the principal investigator.

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. 42 pp. + Appendixes A–J

Ickes, B. S. and R. W. Burkhardt. 2002. Evaluation and proposed refinement of the sampling design for the Long Term Resource Monitoring Program's fish component. U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, Wisconsin, October 2002. LTRMP 2002-T001. 17 pp. + Appendixes A–E. CD-ROM included. (NTIS #PB2003-500042)

Water Quality Component

The objective of the LTRMP water quality component is to obtain basic limnological information required to (1) increase 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.

Data are collected within six LTRMP study reaches in the UMRS (Pools 4, 8, 13, 26, and Open River Reach on the Upper Mississippi River and La Grange Pool on the Illinois River). Data entry, quality assurance, data summaries, standard analyses, data serving, and report preparation occur under standardized protocols (Soballe and Fischer 2004).

Methods

Limnological variables (physicochemical characteristics, suspended solids, chlorophyll *a*, phytoplankton [archived], and major plant nutrients) will be monitored at both stratified-random sites (SRS) and at fixed sampling sites (FSS) according to LTRMP protocols. The SRS sampling allocation will be the same as FY02.

Fixed site sampling

LTRMP water quality fixed site sampling for FY2005 will be reduced from 2004 effort as follows:

Month	Sampling frequency
October	monthly
November	monthly
December	none
January	monthly
February	none
March	monthly
April	biweekly
May	biweekly
June	biweekly
July	monthly
August	monthly
September	monthly

The number of fixed sites sampled also will be reduced according to the following criteria:

1. Discontinue sampling of small/ungaged tributaries, sites outside of study pools, and isolated backwaters.
2. Number of tributaries sampled should be reduced to ~3 per study area. Only gaged tributaries that have significant impact on the UMRS should be monitored.
3. Number of fixed sites reduced so that all sampling and field station lab work can be done in 2 days/episode (2 people). The following fixed sites are suggested as priorities for continued sampling:
    a. Main channel fixed sites at the upper and lower end of the pools.
    b. Fixed sites that are "representative" of large impounded or backwater areas.

Stratified random sampling

Stratified random sampling will be conducted at full effort levels for winter, spring, and summer episodes (Table 1).

In situ data collection

For both FSS and SRS *in situ* data will be collected on physicochemical characteristics per the standard protocols (Soballe and Fischer 2004).

Laboratory analyses

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. Sampling and laboratory analyses will be performed following LTRMP protocols (Soballe and Fischer 2004) and Standard Methods (American Public Health Association 1992). Laboratory analyses will consist of nitrogen (total N, nitrate/nitrite N, ammonia N), phosphorus (Total P, SRP), chlorophyll, silica and total and volatile suspended solids. We will not collect data on major cations and anions in water samples in FY2005.

Product Descriptions

2005D6: Preliminary analysis of light penetration data: Light regime information for the modeling of submersed vegetation in Pools 8 and 13 was collected during the 2003 field season. Measurements included light extinction (depth penetration of photosynthetically active radiation), turbidity, and Secchi disk transparency. Preliminary analysis on this data will be completed in FY2005 and final report or manuscript is planned for FY 2006 (pending funding and personnel).

2005D7: Main channel/side channel report: Our goal with long-term monitoring is to characterize long-term limnological conditions (years to decades) and to detect short-term changes or events that have lasting impacts on biota. The redesign of monitoring in the Open River reach requires information on limnological patterns in side channels and the main channel (both inshore and offshore) and any links between them. We are particularly interested in patterns of variation/homogeneity that will allow us to tailor the sampling design to maximize efficiency and the capture of ecologically important information.

LTRMP data will be analyzed to identify persistent differences between main and side channels for multiple variables using ANOVA/MANOVA techniques. We will be looking for areas or times of relative homogeneity or stability as well as times and places of maximal variability that also have strong potential for influencing the river biota. The connections between these patterns and season and stage will be specifically addressed. These analyses will help to test the general assumption of longitudinal and lateral homogeneity in the main channel.

2005D9: A Web-based Annual Report shall contain a summary of limnological data collected from 1997 to 2003 for a single study area. This format will be used as a template for other areas.

Products and Milestones

Tracking number[1]	Products	Lead	Milestones
2005D1	Complete calendar year 2004 fixed-site water quality sampling	Houser, Popp, Dukerschein, Kirby, Chick, Pegg, Hrabik	31 December 2004
2005D2	Complete laboratory analysis of 2004 fixed site and SRS data; Data loaded to Oracle data base.	Yuan	30 March 2005
2005D3	Complete data entry, QA/QC of calendar year 2004 fixed-site and SRS data.	Popp, Dukerschein, Kirby, Chick, Pegg, Hrabik	30 May 2005
2005D4	Summary (plots and brief commentary of 2004 data) completed by field stations and notes/plots send to WQ component specialist @UMESC.	Popp, Dukerschein, Kirby, Chick, Pegg, Hrabik	30 June 2005

Tracking number[1]	Products	Lead	Milestones
2005D5	Complete FY 2005 fixed site and SRS sampling for Pools 4, 8, 13, 26, Open River, and La Grange Pool (Table 1)	Popp, Dukerschein, Kirby, Chick, Pegg, Hrabik	30 September 2005
2005D6	Preliminary analysis of light penetration data collected in 2003	Dukerschein, Houser	1 May 2005
2005D7	Draft report: Main channel/side channel report for the Open River Reach.	Hrabik	1 April 2005
2005D8	LTRMP report titled: "A multi-year synthesis of limnological data from 1993 to 2001 for the Long Term Resource Monitoring Program on the Upper Mississippi River" to COE and USGS. (FY04 SOW)	Houser, Popp, Dukerschein, Kirby, Chick, Pegg, Hrabik, Ardinger, Johnson	11 April 2005
2005D9	Draft WEB-based annual Water Quality Component Update for one study area for 1997–2003 data. (FY04 SOW)	Rogala, Houser,	
	a. Develop first draft	Rogala	1 June 2005
	b. Reviews completed	Popp, Dukerschein, Kirby, Chick, Pegg, Hrabik, Johnson, Houser, Ardinger	1 July 2005
	c. Submit final update	Popp, Dukerschein, Kirby, Chick, Pegg, Hrabik, Houser	1 August 2005
2005D10	Final Draft LTRMP report titled: "Long Term Resource Monitoring Program Water Quality Component Review". (FY02 SOW)	Houser, Johnson	30 September 2005

[1]Tracking number sequence: Year; last letter of USGS BASIS task code "BNBLD"; ID number

Personnel

Dr. Jeff Houser will be the principal investigator.

Literature Cited

American Public Health Association, American Water Works Association, and Water Environment Federation. 1992. Standard methods for the examination of water and wastewater. 18th edition, American Public Health Association, Washington, D.C. 981 pp. + 6 color plates

Soballe, D. M., and J. R. Fischer. 2004. Long Term Resource Monitoring Program Procedures: Water quality monitoring. U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, Wisconsin, March 2004. LTRMP 2004-T002-1 (Ref. 95-P002-5). 73 pp. + Appendixes A-J.

Statistical Evaluation

A commitment to statistical support for the LTRMP is essential: it provides guidance for statistical analyses conducted within and among components, for contributions to management decisions, for identifying analyses needed by the Program, for developing Program-wide statistical projects, and for reviewing LTRMP documents that contain statistical content. The 'Guidance for statistical analyses' purpose is designed to save money for the LTRMP, at both UMESC and the field stations, by ensuring that LTRMP staff aren't forced to waste time searching for appropriate statistical methods or don't have to revise methods and results following a faulty analysis. The statistician is also responsible for ensuring that newly developed statistical methods are incorporated into LTRMP analyses when appropriate. This guidance would include assistance for A.P.E. projects requiring a minor amount of the statistician's time, but projects needing more assistance would build statistical support into that specific scope of work.

Guidance for management includes assistance with modifications to program design, with standardizing general operating procedures, and with estimating power to detect changes and trends. For example, LTRMP's focus on long term effects rather than on annual changes has important implications for program design. This is because the number of years of sampling is typically more important than the number of samples per year in increasing power to detect long-term trends (given some minimal number of samples per year).

The statistical component will help ensure that potentially useful analyses of data from within and across components are identified, that methods for analysis are appropriate and consistent, and that, when possible, multiple analyses work together to achieve larger program objectives, no matter which group (UMESC, field stations, Corps, etc.) is conducting the analyses. The statistician is also responsible for reviewing all LTRMP documents that contain a statistical component for accuracy and to ensure that quality of analyses are consistent among products. A primary goal of statistical analyses is to avoid drawing inappropriate conclusions that might lead to ineffective or even harmful management actions. Within the UMR, there are a variety of confounding factors and conditions that could produce spurious correlations or lead to inappropriate conclusions regarding cause and effect. Appropriate statistical analysis and interpretation is critical to understanding the limitations of LTRMP data. This, in turn, is critical in efforts to distinguish between natural variation and human effects and in evaluating the long-term effects of management actions, such as HREPs, water level manipulations, or increases in navigation.

Product Descriptions

2005E2: Report on sampling design and statistical analyses—This component proposes to provide recommended procedures for statistical analysis of LTRMP survey data. These procedures would cover generation of means and standard errors from our stratified designs, estimation of temporal trends for linear and nonlinear data, estimation of variance components, and address caveats associated with analyses of our data.

2005E3: Document describing methods for evaluating power-to-detect trends in counts—The statistics component will also describe methods for estimating power to detect temporal trends in count data. Methods for assessing power to detect trends in normal data are well established. However, corresponding methods for count data (such as are observed in the fish component) are controversial. The complexities underlying these controversies are magnified when counts derive from designs that include strata and nonproportional sampling (as our does), and when detection probabilities are assumed to vary.

Products and Milestones

Tracking number[1]	Products	Lead	Milestones
2005E1	Provide statistical consultation to individual components and LTRMP management.	Gray	Ongoing
2005E2	Draft LTRMP report on sampling design and statistical analyses—recommended procedures	Gray, Rogala, Heglund	15 July 2005
2005E3	Submit document describing methods for evaluating power-to-detect trends in counts.	Gray, Heglund	15 September 2005

[1]Tracking number sequence: Year; last letter of USGS BASIS task code "BNBLE"; ID number

Personnel

Dr. Brian Gray will be the principal investigator.

Data Management

The objective of data management of the LTRMP is to provide for data collection, archive data, and access security to a 90 million dollar database that consists of over 2 million records located in 195 linked tables. The 2 million data points currently in the system require regular maintenance and upgrading as technologies change. Also, having a publicly accessible database requires a significant level of security. This is accomplished by having the systems Certified and Accredited by a rigorous, formal process by the USGS Security team.

Methods

Data management tasks include, but are not limited to:

- Review daily logs to ensure data and system integrity and apply application updates.
- Develop and maintain field notebook applications to electronically capture data and begin the initial phase of Quality Control/Quality Assurance (QA/QC).
- Administer and maintain the Oracle LTRMP database.
- Administer and maintain LTRMP hardware, software, and supplies to support LTRMP program needs.
- Administer and maintain LTRMP public and internal web sites.

Products and Milestones

Tracking number[1]	Products	Lead	Milestones
2005M1	Update component field data entry applications.	Hansen	30 May 2005
2005M2	Load collected data into Oracle tables and make data available on Level 2 browsers for field stations to QA/QC.	Hansen	Ongoing
2005M3	Create Component Data Correction Applications and distribute on UMESC Intranet.	Hansen	Ongoing
2005M4	Move approved data to publicly accessible Level 1 tables on UMESC web site.	Hansen	Ongoing
2005M5	Provide computer and database technical assistance and expertise to the Environmental Management Program partnership	Hansen	Ongoing

[1]Tracking number sequence: Year; last letter of USGS BASIS task code "BNBLM"; ID number

Personnel

Mr. David Hansen will be the principal investigator.

Land Cover/Land Use with GIS Support

Although LTRMP will not collect data under the minimal sustainable program, the Program will maintain program expertise, manage existing data, and provide limited on-demand GIS technical assistance.

- Provide on-demand GIS technical assistance, expertise, and data production to the Environmental Management Program partnership including, but not limited to:
  - Aerial photo interpretation
  - Interpretation automation into a digital coverage
  - Flight planning and acquisition of aerial photography
  - Change detection and habitat modeling
  - Georeferenced aerial photo mosaics (pool-wide, HREPs, land acquisition areas)
  - Georeferenced archival map/plat mosaics (Brown Survey, Mississippi River Commission data, Government Land Office data)
  - Produce graphics and summary tables for partnership publications, posters, and presentations
  - Conversion of ASCII coordinate data from a GPS to a spatial dataset
  - Conversion of all georeferenced data to a common projection and datum for ease of use in a GIS

- Maintain and oversee the aerial photo library of over 50,000 print and digital images.

- Maintain and update over 20 million acres of land cover/land use and aquatic areas data spanning the late-1800s through the year 2000.

- Assist in the maintenance and updating of the USGS-Upper Midwest Environmental Sciences Center's (UMESC) web-based data repository.

Product Descriptions

2005V3: Vegetation change report—we will analyze changes in vegetation patterns that have occurred between 1989 and 2000 across the Upper Mississippi River System. This will include a description and breakdown, by pool and geomorphic reach, of areal coverage by vegetation classes in both years and a summary of changes in vegetation coverage.

Although the primary focus of this component is to provide technical assistance and maintain existing databases, as time allows the following LTRMP projects can be completed:

General Class Crosswalk of the 1989 LCU: Top priority when time is available.
All data for 1989 will be joined into a single coverage, crosswalked to the General Class vegetation classification system (31-15-7 Classes), and clipped to common boundaries with the 2000 systemic LCU wherever possible. These data will be served as NAD83 and NAD27 shapefiles. This will allow for a direct comparison to the 2000 LCU.

Re-Clip of 2000 LCU
All data for the 2000 systemic data set will be joined into a single coverage and clipped to a common boundary with the crosswalked 1989 systemic data set. These data will be served as NAD83 and NAD27 shapefiles. This will allow for a direct comparison to the similarly clipped 1989 LCU.

Web-based GIS Tutorials for Working with LTRMP Data Sets
This task will complement the vast amount of LTRMP spatial data served by UMESC. It will show users graphically, and in simple terms, how to download and manipulate spatial data. Tasks include reprojecting both raster and vector data to other coordinate

systems (Latitude/Longitude) and datums, clipping multiple data sets to a common boundary, and crosswalking UMESC and other vegetation data (GIRAS, NWI) to a common theme Other GIS tips and tricks will be described as time allows.

Year 2000 Color Infrared Mosaics of Pools 4, 8, 13, 26, and selected areas of the Open River Reach and the Illinois River's La Grange Pool

Most aerial photointerpretation is georeferenced to the earth using gray-scale DOQQs. The DOQQs are based on leaf-off small-scale (1:40,000) photography and contain very little aquatic vegetation ground control, resulting in alignment errors. A DOQ mosaic derived from the peak biomass, color infrared photos (at 1:24,000-scale) collected in the late-summer of 2000 will provide a more accurate method of georeferencing vegetation in these problem areas.

Products and Milestones

Tracking number[1]	Products	Lead	Milestones
2005V1	Provide GIS technical assistance, expertise, and data production to the Environmental Management Program partnership	Lohman, Robinson	On-going
2005V2	Provide quarterly updates to LTRMP management	Lohman, Robinson	Quarterly
2005V3	LTRMP report titled: Upper Mississippi River Vegetation Change (1989-2000) (FY03)	Lohman	31 August 2005

[1]Tracking number sequence: Year; last letter of USGS BASIS task code "BNBLV"; ID number

Personnel

Dr. Kirk Lohman will be the principal investigator.

Bathymetry Component

The overall goal of the LTRMP Bathymetry Component is to complete a system-wide GIS coverage of bathymetry used to quantitatively and qualitatively assess the suitability of essential aquatic habitats. Presently, eight pools (Pools 4, 7, 8, 9, 13, 21, 26, La Grange) are complete and nine pools (Pools 5, 5A, 10, 11, 15, 17, 18, 20, Peoria) are over 50% complete (some over 80% complete). In addition, the Middle Mississippi Reach is about 90% complete. Although LTRMP will not collect data under the minimal sustainable program, the Program will maintain some level of expertise to provide basic assistance with using the existing LTRMP data.

Provide on-demand technical assistance related to the bathymetric database to the EMP partnership including, but not limited to:

- Deliver data in non-standard formats, such as raw point data in GIS or text files.
- Adjust bathymetry data to selected water surface conditions (presently only available at "flat-pool" conditions)
- Calculate summary statistics (e.g., hypsographic curves and volume) for geographical subsets of the data
- Advise partner agencies on data collection methods that meet LTRMP needs
- Assist in spatial modeling using the bathymetric data

Products and Milestones

Tracking number[1]	Products	Lead	Milestones
2005T1	Provide technical assistance related to the bathymetric data base to the EMP partnership	Rogala, Heglund	On-going

[1]Tracking number sequence: Year; last letter of USGS BASIS task code "BNBLT"; ID number

Personnel

Mr. Jim Rogala will be the principal investigator.

Macroinvertebrate Component Wrap-up

Following guidance from the A-Team and EMP-CC, the macroinvertebrate component has been dropped from the LTRMP. Potential work to address issues of interest to the Partnership may be proposed as Additional Program Elements.

Product Descriptions

2005C1: A Web-based Annual Update shall contain a summary of macroinvertebrate data collected in 2004.

2005C2: Open River Macroinvertebrate Report: Although the target organisms selected for monitoring are ecologically important, the physicochemical nature of the Open River Reach (ORR) is unique from the five other LTRMP study areas. As a result, relative abundance of these organisms is often low and restricted by the availability of preferred habitats in the ORR. The purpose of this study was to evaluate several macroinvertebrate capture methods in an unimpounded reach of the Mississippi River to determine the most effective way to characterize macroinvertebrate community structure.

Products and Milestones

Tracking number[1]	Products	Lead	Milestones
2005C1	WEB-based annual Macroinvertebrate Component Update with 2004 data on Public Web Server.	Sauer	
	a. Develop first draft	Sauer	31 January 2005
	b. Reviews completed	Sauer, Popp, Dukerschein, Kirby, Chick, Pegg, Johnson, Ardinger	15 April 2005
	c. Submit final update	Sauer	30 April 2005
	d. Placement on Web with PDF	Sauer, Caucutt, Ardinger	16 May 2005
2005C2	Open River Macroinvertebrate Report (Outstanding product)	Hrabik, Johnson, Sauer	1 May 2004
2005C3	LTRMP report titled: "Multi-year Synthesis of the Macroinvertebrate Component from 1992–2002 for the Long Term Resource Monitoring Program" to COE and USGS (FY04 SOW)	Sauer	12 January 2005
2005C4	Final draft LTRMP report titled: "Evaluation of the Long Term Resource Monitoring Program's Macroinvertebrate Component" to COE and USGS. (FY04 SOW)	Sauer, Johnson, Ardinger	30 September 2005

[1]Tracking number sequence: Year; last letter of USGS BASIS task code "BNBLC"; ID number

Personnel

Ms. Jennifer Sauer will be the principal investigator.

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 that is easy to read and widely available.

Methods

A Web-based report will be produced that summarizes, synthesizes, and highlights the accomplishments of the LTRMP for FY04 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 and Milestones

Tracking number[1]	Products	Lead	Milestones
2005S1	Draft annual LTRMP Web-based summary report	Johnson, Heglund, Rogala, Sauer	30 September 2005

[1]Tracking number sequence: Year; last letter of USGS BASIS task code "BNBLV"; ID number

Personnel

Dr. Barry Johnson will be the principal investigator.

Table 1. LTRMP sample collection for FY05.

	Study Area					
Component	**4**	**8**	**13**	**26**	**La Grange**	**Open River**
Vegetation	450 stratified random sample sites over growing season.	450 stratified random sample sites over growing season.	450 stratified random sample sites over growing season.	—	—	—
Fisheries	~160 samples; 2 periods: Aug. 1–Oct. 30, 6 sampling gears. Mix of stratified random and fixed sample sites.	~180 samples; 2 periods: Aug. 1–Oct. 30, 6 sampling gears. Mix of stratified random and fixed sample sites.	~200 samples; 2 periods: Aug. 1–Oct. 30, 6 sampling gears. Mix of stratified random and fixed sample sites.	~180 samples; 2 periods: Aug. 1–Oct. 30, 6 sampling gears. Mix of stratified random and fixed sample sites.	~270 samples; 2 periods: Aug. 1–Oct. 30, 6 sampling gears. Mix of stratified random and fixed sample sites.	~165 samples; 2 periods: Aug. 1–Oct. 30, 6 sampling gears. Mix of stratified random and fixed sample sites.
Water Quality	135 stratified random sites done in each episode (winter, spring, summer, and fall); 14 fixed sites during 2005.	150 stratified random sites done in each episode (winter, spring, summer, and fall); 13 fixed sites during 2005.	150 stratified random sites done in each episode (winter, spring, summer, and fall); 12 fixed sites during 2005.	121 stratified random sites done in each episode (winter, spring, summer, and fall); 9 fixed sites during 2005.	135 stratified random sites done in each episode (winter, spring, summer, and fall); 11 fixed sites during 2005.	150 stratified random sites done in each episode (winter, spring, summer, and fall); 9 fixed sites during 2005.

Glide Path

Field Station Glide Path: 54.5K

Establish baseline of submersed aquatic vegetation distribution and index of abundance for the Illinois River

Submersed aquatic vegetation has been monitored in much of the lower 330 km of the Illinois River through the LTRMP (predominantly La Grange and Alton Pools). However, while there is a common understanding that stands of submersed aquatic vegetation are present in the upper half of the Illinois River, a general lack of comprehensive information describing the size and composition of such populations throughout the upper Illinois River exists. We propose to collect field and remote sensing data (where available) to identify the extent and composition of submersed aquatic vegetation in the upper Illinois River. Methods will generally follow the vegetation component sampling protocols as outlined in Yao et al. (2000). Products will include a data set that will establish existing aquatic vegetation beds in the upper Illinois River and a subsequent report detailing the findings.

Lead: Pegg (Thad Cook; 35.1K (gross))

Tracking number[1]	Products	Milestones
2005GLIDE1	Site Selection Complete	30 March 2005
2005GLIDE2	Field work complete	15 July 2005
2005GLIDE3	Draft LTRMP Technical Report	30 August 2005
2005GLIDE4	Post final report on Web	30 October 2005

Transition of field logistics to USGS

Tracking Number 2005GLIDE5: Provide USGS with technical support and training needed to effectively coordinate transition of field logistics for the LTRMP components to USGS.

Lead: Dukerschein (Jim Fischer, Heidi Langrehr, Andy Bartels; 19.4K (gross))

Upper Midwest Environmental Sciences Center Glide Path: 41.7K

Pete Boma 16.6K (gross)—See MSP Aquatic Vegetation Component
Robert Gaugush—See APE Status and Trends (32.3 K gross moved to S&T budget)
Jim Rogala 25.1K (gross): See MSP Statistical Evaluation and APE Model chlorophyll *a*

Total Glide Path dollars: 96.2K

Additional Program Elements

Status and Trends: Report Outline

Introduction

Background and History of the UMRS Environmental Management Program (EMP)
Brief discussion of the Long-Term Resource Monitoring Program (LTRMP) and Habitat Rehabilitation and Enhancement Program (HREP).

Description of the UMRS Ecosystem
Discussion of the key components of the UMRS Ecosystem. Begin to tie or relate the LTRMP monitoring components to these.

UMRS Objectives and Indicators/endpoints
UMRS objectives represent the ecologically and socially desired future condition of the UMRS ecosystem. Identified UMRS objectives from several sources (e.g., EMP HNA, Pool Plans, and Navigation Study workshops) will be discussed.

Indicators/endpoints (a subset of the UMRS objectives) are selected components of the ecosystem that are ecologically important, valued by humans, and used to evaluate changes in the ecosystem. Metrics are the quantitative values and units of measurements used to define target ranges of indicators/endpoints for ecosystem condition. An initial set of indicators/endpoints for condition of the UMRS ecosystem was recommended in the Navigation Study Science Panel Report (Barko and Lubinski 2002) (Attachment 2). A revised set of indicators/endpoints (based on the Science Panel endpoints) will be developed for use in this LTRMP Status and Trends Report.

Ecological Drivers and Stressors
Drivers are natural forces and fluxes that shape condition of the ecosystem. Stressors are physical, chemical, or biological perturbations to a system that are either foreign to the system, or natural to the system but occur at an excessive (or deficient) level (Barrett et al. 1976). Many stressors are the effects of human activity. Discussion in this chapter will highlight major UMRS drivers and stressors and which of these we can effect (through management) to address identified objectives and endpoints.

Ecosystem Management and Restoration Efforts
Ecosystem management and restoration efforts have been identified and put in place to address UMRS objectives and endpoints. This chapter will briefly discuss current and future efforts to improve the UMRS ecosystem (e.g., water level management, fish passage, and island building) and how LTRMP has influenced these efforts.

Value of Status and Trends Information
A discussion on the need for and use of status and trend information in ecosystem management and restoration efforts will be presented. It will include an introduction to LTRMP component data and the capability of the program to detect changes in these UMRS elements. This discussion will include a simple, but scientifically valid method to communicate the capabilities of the program to detect long term change. For example, express our capability to detect changes in terms of amount of change, confidence to detect that amount of change, and how long it will take us to achieve that level of confidence.

Status and Trends of UMRS Resources
Utilizing input from USGS, field station staff, and the Navigation Study Science Panel, identify and describe the status and trends of approximately five key indicators/endpoints under each primary LTRMP monitoring component. This discussion will closely follow the structure and level of detail presented in the attached Great Lakes report example (Attachment 1).

Use and Application of LTRMP Monitoring Data
In addition to identifying UMRS status and trends, this chapter will identify other important applications of the LTRMP data (e.g., improved decision making, Habitat Needs Assessment, resource management, etc.).

Additional UMRS Resource Datasets
In addition to LTRMP component data, other valuable UMRS datasets have been developed and are available (e.g., USGS NAWQA, USGS Biomonitoring of Environmental Status and Trends, State fisheries and WQ data) . A discussion of datasets that (1) augment LTRMP component data, (2) provide further insight into the Status and Trends of the UMRS Ecosystem, and (3) enhance the management of the system will be discussed.

Adaptive Resource Management
Adaptive ecosystem management involves defining target conditions (objectives and endpoints), monitoring conditions, assessing status and trends of the system, planning and implementing management actions, monitoring, assessment, evaluation and learning in a continuing cycle of activity. Discussion in this chapter will include how the LTRMP fits into an adaptive management program for the UMRS ecosystem. Details on how the program could be augmented to meet future management needs of the system will also be discussed.

Conclusions
Summary discussion of the previous chapters highlighting the status and trends of UMRS environmental resources and the application of LTRMP data in management of the UMRS Ecosystem.

Literature Cited

Thoughts behind the outline: Rational for a new approach to reporting on the status and trends of the UMRS ecosystem.

The previous LTRMP Status and Trends report assessed criteria for "ecosystem health" using graphic gauges. While the various gauge settings (unchanged/recovered, moderately impacted, heavily impacted, degraded) were easily understood, these were not directly tied to established indicators/endpoints for condition of the river ecosystem (nutrient levels, population sizes, area of habitats, etc.). Some of the ecosystem health criteria were not measurable (e.g., sustainability, ability to recover from disturbances).

For this new document, status and trends of the UMRS will be addressed with objective, technically sound, and applicable objectives and endpoints for condition of the river ecosystem. The report will be limited to indicators/endpoints that can be directly assessed by LTRMP component data.

The use of LTRMP component data in river management will also be a major theme in this document. The status and trends assessments should contribute to management decision-making. Indicators/endpoints that are relevant to river management will be identified. In the report, drivers and stressors affecting condition of the river ecosystem for each endpoint will be

discussed along with management options that are available to affect the future condition of the ecosystem. The report will describe how management actions have (or haven't) affected trends in condition of the ecosystem. Finally, a discussion of information needed to better assess status and trends of the UMRS ecosystem will be presented. The basic process for addressing each endpoint will be:

- Compile data and information relevant to the indicator/endpoint
- Assess current ecosystem status with respect to the indicator/endpoint
- Identify and describe any spatial or temporal trends
- Identify drivers and stressors affecting the indicator/endpoint
- Identify management measures that could affect the indicator/endpoint
- Identify which management measures affecting the indicator/endpoint are being applied
- Identify information needed to better monitor and assess the indicator/endpoint

USGS has the lead responsibility for the development of the Status and Trends Report. However, this will be a collaborative effort among all LTRMP partners.

The primary points of contact for development of the Report will be Bob Gaugush and Hank DeHaan, who will be working closely to coordinate the development of the Report.

Key milestones for completing this report will be developed after input from the partnership is received on the suggested outline (Nov 04). The goal is to have a draft product at the end of FY05.

Timeline for completion: 30 September 2005; Intermediate milestones to be developed

Expected Products: First draft report—Tracking Number: 2005APE1

Budget: $234,817

Project under Status and Trends: Develop control charts ("red flags") for selected water quality constituents

Principal investigator/Project leader: Brian Gray

Contact information:

Upper Midwest Environmental Sciences Center
2630 Fanta Reed Road
La Crosse, WI 54603
608-781-6234
608-783-6066 (fax)
brgray@usgs.gov

Collaborators: John Sullivan

Contact information: John.Sullivan@dnr.state.wi.us

Introduction/Background: Control charts may be used to infer whether a series of means, standard deviations or other statistics are "in statistical control." Outliers, a series of outliers, trends and other "red flags" may all be viewed as possible evidence of a change in a process. These methods may also be used with ecological monitoring data. In this case, the control charts may enable early detection of trends or other departures from stable states.

Relevance of research to UMRS/LTRMP: Control charts will help alert resource managers at an early stage to potential, adverse changes in the selected indicators. Recognition of potential changes would, in turn, allow for evaluation of potential causes and a plan for possible management action. For example, DO, nitrate or TSS levels that exceed standards may suggest small- or large-scale management action.

Methods:

1. Select indicators of ecological attributes that have external standards. [Given the shortness of our time series (≤12 years) and the apparent rarity of control charts in ecological monitoring programs, it seems prudent to begin developing control charts for the LTRMP using indicators for which outside limits have been established.] These indicators will apparently be limited to a subset of the LTRMP's water quality constituents (e.g., nitrate and dissolved oxygen).
2. Plot means and possibly standard deviations and ranges of the selected indicators against time. Investigate apparent departures from "statistical control."
3. Estimate upper and lower control limits from sampling periods during which the given process is judged to be in statistical control.
4. Plot data against both estimated and external limits.
5. Describe whether processes represented by the selected indicators appear in statistical control and, specifically, where those processes indicate departures from common sources of variation. Where possible, ascribe possible sources of variation to departures.
6. Assess whether our current ten to twelve year datasets are adequate for establishing baseline average and variance levels for future sampling events.

Staffing requirements: Gray; UMESC Biologist; Sullivan (in kind)

Special needs/considerations: none

Budget: $19,294 (All budget figures (UMESC and Field Stations include full cost accounting)
(Portion of funding under Status and Trends Budget of $240,417)

UMESC (supplies, travel, printing costs):	$ 1,537
UMESC (salaries):	$17,757

Expected products/Timeline for completion:

Tracking Number: 2005APE2: Control charts with accompanying descriptions supplied for the water quality chapter of the Status and Trends report. Completed 30 July 2005.

Bathymetry—To be coordinated by the USACOE (**Budget:** $160K)
Tracking Number: 2005APE3
Timeline for completion: 30 September 2005

Development of Two-dimensional Numerical Hydraulic Models for Mississippi River Pools 17 and 18 in Support of the LTRMP

The primary objective of this project is to develop the capability to relate hydraulic parameters for various alternative conditions to requirements for diverse biota enhancement by numerically modeling selected Mississippi River pools. Two-dimensional flow models provide good simulations of current velocity patterns and water surface elevations for selected conditions. Model information is essential for characterizing aquatic habitat conditions and for describing the hydrologic regime for floodplain habitats. The numerical models provide tools to evaluate and maximize opportunities for success in planning and designing as well as monitoring habitat improvement projects. The development of two-dimensional numerical hydraulic pool models will provide timely management tools as "on-the-shelf" models in support of the LTRMP.

Specific objectives for this project include:

- Developing calibrated, two-dimensional hydrodynamic models for UMRS Navigation Pools 17 and 18;
- Developing a common set of hydrologic conditions (based on flow duration for "representative flows" – 50% annual duration, typical over-wintering conditions, ordinary high water, etc.);
- Producing water depth, velocity, and inundation datasets for specified hydrologic conditions; and
- Developing a GIS database of model input and output datasets to be used by querying tools in combination with the HNA databases.

Staffing requirements: U.S. Army Corps of Engineers

Tracking Number: 2005APE4

Timeline for completion: 30 September 2005

Budget: $65K

LTRMP field equipment refreshment

Investment in equipment refreshment over the past several years has been sporadic due to limited annual budgets. Equipment refreshment was identified by the partnership as a priority under the recently completed 5-year planning effort, with a minimum investment of $ 57,000 annually. In FY2004, an initial effort began to develop an equipment refreshment needs plan, prioritizing items as High, Medium, or Low need. That effort will be expanded to include both short and long-term field equipment needs for refreshment. This tool will provide the program a better vision to accommodate program needs related to safety, obsolete, and unserviceable equipment. A well-planned strategy offers significant program benefits such as reliability, availability and readiness.

Tracking Number	Products	Lead	Milestones
2005APE5	Create Equipment Needs Document	Gaugush	1 March 2005

Budget: $57,000

Approved equipment refreshment list

	Estimated Cost
Lake City Field Station	
Hull, motor mount, and cage on air boat	$9,000
La Crosse (Onalaska) Field Station	
115 hp outboard motor	$6,000
Bellevue Field Station	
10 m cable for WQ sonde	$450
115 hp outboard motor	$5,500
50 hp outboard motor	$3,500
Great Rivers Field Station	
115 hp outboard motor	$5,500
[1]**Open River Field Station**	
Plate boat	$15,000
4 hp 4 stroke motor	$1,400
Havana Field Station	
20' plate boat	$9,000
UMESC/TBD	
2 Panasonic Toughbooks	$7,000

[1]Funded from state coop unexpended

Water Quality Monitoring to Evaluate Effects of Pool 5 Drawdown

Contacts:

Rob Burdis
LTRMP Water Quality Specialist
MN Department of Natural Resources
1801 S. Oak St.
Lake City, MN 55041
Rob.burdis@dnr.state.mn.us
651-345-3331

Tim Schlagenhaft
Mississippi River Coordinator
MN Department of Natural Resources
2300 Silver Creek Rd
Rochester, MN 55906
Tim.schlagenhaft@dnr.state.mn.us
507-280-5058

Justification: Water quality monitoring was completed annually by Lake City LTRMP field staff from 1993-2003 at several sites in Pool 5, including two sites in Weaver Bottoms. Analysis of the Weaver Bottoms data show distinct inflow and outflow water quality differences, indicating a degradation of water quality occurring within this area. This information is consistent with overall habitat conditions in Weaver Bottoms, especially for emergent aquatic vegetation, which has declined significantly in the past 15-20 years.

Summer drawdowns on the Mississippi River have been shown to increase aquatic vegetation, which may have a significant influence on water quality. A summer drawdown is planned for Pool 5, beginning in June, 2005, presenting an opportunity to learn more about the effects of drawdowns on water quality.

Proposal: Sample existing LTRMP fixed-site M747.3R (located in Murphy's Cut, which is one of the major inflows into Weaver Bottoms), site WW01.3M (Whitewater River), site M743.0E (located at the outlet of Weaver Bottoms), and three sites along a transect across the river below Lock and Dam 5 (M738.2F; M738.2M; M738.2T) biweekly from June through early September, 2005. Sampling would be completed during the same two days of regularly scheduled biweekly LTRMP fixed-site sampling during eight sampling episodes. The additional sampling would require approximately three hours for a two-person crew to complete both field and lab work. Parameters collected would include in-situ measurements and the full suite of laboratory analyses currently performed by the LTRMP.

The Minnesota Department of Natural Resources will provide personnel to assist the Lake City LTRMP water quality specialist on the eight proposed sampling dates. In addition, the LTRMP Lake City Field Station would perform data analysis and reporting for this effort. The MN DNR would utilize the information in the evaluation of the impacts of the drawdown through efforts of the Water Level Management Task Force.

Long-Term Need and Benefits: Funding this proposed additional sampling would provide insights on water quality impacts from drawdowns on a large degraded backwater area (Weaver Bottoms), as well as pool scale influences by monitoring at Lock and Dams 4 (which is ongoing under the current LTRMP) and 5. While this proposal is specific to 2005, monitoring in subsequent years should be considered to better understand the long-term impact of drawdowns

and the effects of increased aquatic vegetation on water quality. This information would be extremely valuable for other water quality improvement efforts in the Upper Mississippi, such as the current planning effort for establishing TMDL's in Lake Pepin.

Budget: $11,206 (All budget figures (UMESC and Field Stations include full cost accounting)

Minnesota Field Station	$ 2,806
UMESC	$ 8,400

Expected products/Timeline for completion:

Tracking Number	Products		Milestones
2005APE6	Complete water quality data sampling		30 September 2005

Laboratory analysis and chemistry data will be loaded to the Oracle database in 2006.

Pool-based Georeferenced Mosaics of the 1890s Mississippi River Commission Maps

Principal investigator/Project leader: Kirk Lohman

Contact information:

Upper Midwest Environmental Sciences Center
2630 Fanta Reed Road
La Crosse, WI 54603
608-781-6341
608-783-6066 (fax)
klohman@usgs.gov

Collaborators: Larry Robinson, (608-781-6354) lrobinson@usgs.gov; JC Nelson (608-781-6370) jcnelson@usgs.gov

Description/Background Information:
The Mississippi River Commission (MRC) maps document floodplain conditions as they existed in the 1890's. Map details include elevation, channel cross-section bathymetry, and land cover/land use. Lands cover/land use maps were generated from these maps but these data only tell part of the story. These records of the main stem floodplain are the best historical representations we have of the river's geomorphology before impoundment began in the late 1930's. As such, they are invaluable in planning the restoration of selected habitats to their pre-lock and dam states.

Objectives/Relevance:
Develop pool-based, georeferenced mosaics of the MRC maps for use in change analysis and for future habitat restoration planning.

Methodology:
Scan, edit, georeference, mosaic, compress, and serve via the internet approximately 80 MRC maps that cover the Upper Mississippi River main stem and serve as pool-based mosaics. Images will be georeferenced to 1m/pixel.

Funding Required: $23,369 (UMESC salaries—includes full cost accounting)

Expected products/Timeline for completion:

Tracking Number	Products		Milestones
2005APE7	Upper Mississippi River main stem mosaicked and served over the internet in UTM Zone 15 and/or 16 NAD27/83		16 September 2005

Analysis of fish age structure and growth in the Illinois River

Principal investigator/Project leader: Mark A. Pegg

Contact information: Illinois River Biological Station, Illinois Natural History Survey, 704 N Schrader Avenue, Havana, Illinois 62644; 309-543-6000; email: markpegg@uiuc.edu

Collaborators: Kevin Irons, Matt O'Hara, Michael Smith

Contact information: Same as above.

Introduction/Background: Fish growth is a fundamental and often a critical element of fish population analyses. Analysis of scales to determine age and growth was first used to describe basic life histories, attain average growth rates, and assist in determining age at maturation during the early part of this century. Growth assessment has since expanded to include detailed models used in fish stock assessment such as the Von Bertalanffy growth function. Other hard body parts such as otoliths, spines, fin rays, cliethra, and vertebrae have also been used for age and growth analysis. Because fish growth is a physiological response to both the biotic and abiotic environment, a ratio of the size of hard tissues to actual body length can be used as an indicator of growth and/or changes in growth rate. We propose to use existing and newly collected samples to determine age structure and growth in the La Grange reach of the Illinois River. Species used for this study include largemouth bass, white crappie, black crappie, white bass, and freshwater drum.

Relevance of research to UMRS/LTRMP: Determining age and growth structures in the UMRS is needed to gain additional insight into biotic responses to environmental conditions in the rivers being studied. These data will also be important in the future to measure responses to management practices. Growth can provide information on ecosystem function (i.e., a measure of energy allocation in fish) for which basic species composition and structure cannot account. This will ultimately lead to an additional layer of meaningful data pertaining to how biotic communities respond to their environment.

Methods: Calcified fish structures (predominantly otoliths from the species listed above) have been intermittently collected in the La Grange Reach over the duration of the LTRMP program. Age and growth determination will typically follow methods described by Pegg et al. 1998 (http://www.cerc.usgs.gov/pubs/benfish/SOP_index.htm). Age structure and growth information will be used to test hypotheses centered around spatial and temporal issues (e.g., does age structure change through time in response to extreme events; do growth rates differ among habitats and/or reaches, etc.) using common univariate and multivariate techniques.

Pegg, M.A., Pierce, C.L., and L. Sappington. 1998. Population Structure, Age, and Growth SOP #4.1 *in* L. Sappington, D Dieterman and D. Galat editors. 1998 Standard Operating Procedures to Evaluate Population Structure and Habitat Use of Benthic Fishes along the Missouri and Lower Yellowstone Rivers. Missouri River Benthic Fish Consortium USGS BRD Columbia Environmental Research Center 4200 New Haven Rd. Columbia, MO 65201.

Staffing requirements: A total time allocation of 0.5 FTE will be needed to complete the project for the La Grange Reach. This allocation includes age and growth determination, data analyses, and report writing.

Special needs/considerations: Expanding this effort to include all RTAs will considerably increase the costs and time required to complete the analyses that preclude completion in FY05. This is a very valuable exercise, but may exceed the current program limitations.

Budget: $26,980 (All budget figures (UMESC and Field Stations) include full cost accounting)

IRBS (salaries, supplies, travel):	$21,906
UMESC (salaries [review, editing, desktop publishing]; printing costs):	$ 5,074

Timeline for completion:

Tracking Number	Products	Milestones
2005APE8	Age and growth determinations complete	30 April 2005
2005APE9	Analysis Complete	30 May 2005
2005APE10	Draft LTRMP Technical Report	30 June 2005
2005APE11	Post final report on Web	30 Sept. 2005

Expected products: LTRMP technical report outlining the results of the analyses and future submission of a manuscript for publication in a peer-reviewed journal.

Asian Carp in the Mississippi River: Their impact on native fish species and predicted dispersal within the system

Principal investigator/Project leader: Valerie A. Barko

Contact information: Open River and Wetlands Field Station, 3815 E. Jackson Blvd., Jackson, MO 63755; TELE: 573-243-2659 x 26; FAX: 573-243-2897; E-MAIL: Valerie.Barko@mdc.mo.gov

Collaborators: Dr. Martin T. O'Connell and Dr. John H. Chick

Contact information: (MTO) Pontchartrain Institute for Environmental Sciences, University of New Orleans, New Orleans, LA 70148; TELE: 504-280-4032; FAX: 504-280-4022; E-MAIL: moconnel@uno.edu; (JHC) Great Rivers Field Station, Illinois Natural History, Survey, 8450 Montclair Ave., Brighton, IL 62012; TELE: (618)466-9690; Fax: (618)466-9688; E-mail: chick@inhs.uiuc.edu

Introduction/Background: Silver Carp (*Hypophthalmichthys molotrix*) and Bighead Carp (*H. nobilis*) were not documented in the Mississippi River system until the 1970's. Chick and Pegg (2001) reported exponential growth of the Bighead Carp in navigation pool 26 and increased harvest by commercial fisherman in the Mississippi River (5000+ kg in 1994 to 50,000+ kg since 1997). Both the Bighead and Silver Carp are filter feeders and may have deleterious effects on native filter feeders such as the Smallmouth Buffalo (*Ictiobus bubalus*), Paddlefish (*Polyodon spathula*), and Gizzard Shad (*Dorosoma cepedianum*) (Schrank et al. 2003). The potential magnitude of dispersion or the impact of *Hypophthalmichthys* spp. on native biota is largely unknown.

Although simple hueristic dispersal models cannot offer fine-scale explanations of population changes in an invasive species, they have been used successfully to predict broad patterns of expansion in regard to the invasive Rio Grande cichlid (*Cichlasoma cyanoguttatum*) in southeastern Louisiana (O'Connell et al. 2002). Using only the most basic of occurrence data, information on the movement behavior and reproduction of the species, and an iterative process whereby many possible expansion scenarios were compared to the actual dispersal pattern over time, these models predicted that Rio Grande cichlids use an oligohaline estuary as an expansion corridor, even though they are primarily freshwater fishes (O'Connell et al. 2002). Our goal is to generate equally useful insights by collecting and analyzing *Hypophthalmichthys* spp. occurrence data from the entire Mississippi River System and applying the information to similar dispersal models. Furthermore, this project will not only provide a better understanding the impacts of invading species on biotic assemblages which will be beneficial for all large river systems, but will also serve as a basic model for analysis of future system invaders and augment work currently being conducted by Dr. John Chick and Dr. Mark Pegg on Asian Carp in the Upper Mississippi River System (UMRS).

Relevance of research to UMRS/LTRMP: One major strength of this project is that it uses previously collected data from the LTRMP and other agencies/institutions such as Southern Illinois University, University of Illinois, Tulane University, the University of Southern Mississippi, Louisiana Department of Fisheries and Wildlife and Mississippi Department of Wildlife, Fisheries and Parks - Museum of Natural Science). This project will also create a baseline model that can be used for other aquatic invaders when they are detected within the UMRS. Early detection and predicted dispersal patterns are vital for early control, management, and eradication.

Methods:

Hueristic dispersal model

The basic tenet of reaction diffusion models is that the expansion of invading organisms will closely follow the rules of random particle dispersion (Okubo, 1980). These models have been successfully used to describe the invasion dynamics of a wide array of taxa, despite the fact that the dispersal of complex organisms is highly non-random (Holmes, 1993). To describe the dispersion of *Hypophthalmichthys* spp. throughout the Mississippi River we will use the following classical model of reaction diffusion:

$$\delta S / \delta t = D (\delta^2 S / \delta x^2) + F (S)$$

where

S = the density of invading organisms at time t and distance x
D = the coefficient of diffusion
$F(S)$ = the instantaneous rate of change of invading population
t = time
x = distance.

The coefficient of diffusion (D) was calculated as:

$$D = \gamma^2 / 2 \lambda$$

where

γ = finite velocity of the invading organism
λ = rate of changing direction of the invading organism.

Values of γ and λ specific for *Hypophthalmichthys* spp. will either be obtained through observation of carp movement in the field (as obtained through other projects) or through reviewing available literature. The instantaneous rate of change for populations *Hypophthalmichthys* spp. in the absence of dispersal ($F(S)$) will be calculated based on estimates of reproductive physiology and natural mortality of these species from the literature. With these data, we can estimate how quickly *Hypophthalmichthys* spp. could spread from a proposed point (or points) of introduction and estimate broad changes in carp densities over time and space as the invasion(s) proceed (Okubo, 1980).

With all the elements of the model in place, we will then run multiple simulations of the spread of *Hypophthalmichthys* spp. through the Mississippi River. Our goal is to find those simulations that most closely reflected the actual expansion of carp over time (as based on known distribution data). Each known locality of *Hypophthalmichthys* spp. from the last 20 years (as compiled by the UNO Research Assistant) will be tested as a potential point of introduction for each simulation with additional interstitial points also being tested if necessary. From each of these potential introduction points, simulations will be run from multiple starting years. From each simulation two components will be calculated: the extent of the overall expansion over time and the extent of high densities of carp over time. The resulting multiple simulation models will be compared to the actual distribution data over the last 20 years to determine which simulation(s) best reflects how carp have dispersed. These "best-fit" simulations will then be expanded into the next 10-20 years as a means to estimate the extent of future carp dispersal.

Data analysis:

We will investigate the impact of *Hypophthalmichthys* spp. on native fishes assumed to be adversely impacted by *Hypophthalmichthys* spp., such as Smallmouth Buffalo (*Ictiobus bubalus*), Paddlefish (*Polyodon spathula*), and Gizzard Shad (*Dorosoma cepedianum*). We will use data collected from the LTRMP to estimate annual biomass for these species. Correlations will be run on biomass and if these correlations are significant and negative, we will use a before-after-control-impact (BACI) design to further examine these relationships (Green 1979; Steel and Torrie, 1980). Because BACI will be explored in conjunction with heuristic modeling, we will have a reliable estimate of the point and time of *Hypophthalmichthys* spp. introductions into the UMRS. Pools where *Hypophthalmichthys* spp. have yet to be documented will serve as reference sites.

Staffing requirements: Barko, O'Connell, Chick, and 1 Research Assistant.

Budget: $41,859 (All budget figures (UMESC and Field Stations) include full cost accounting)

ORFS (salaries, supplies, travel):	$37,247
UMESC (salaries [review, editing, desktop publishing]; printing costs):	$ 4,612

Timeline for completion

Tracking Number	Products	Milestones
2005APE12	Enter data into GIS, create heuristic models, and conduct statistical analysis	1 September 2005
2005APE13	Write draft LTRMP project status report and submit to UMESC for review, printing, and posting	15 September 2005
2005APE14	Write and submit manuscript to peer-reviewed journal	30 October 2005

Expected products

1) Presentation of findings at two conferences, including either the UMRCC or MRRC.
2) Publication in one peer-reviewed journal.
3) Publication of LTRMP project status report.

Literature Cited

Chick, J.H. and M.A. Pegg. 2001. Invasive carp in the Mississippi River Basin. *Science* 292:2250-2251.

Green, R.H. 1979. Sampling design and statistical methods for environmental biologists. Wiley, New York.

Holmes, E.E. 1993. Are diffusion models too simple? A comparison with telegraph models of invasion. The American Naturalist, 142(5): 779-795.

O'Connell, M.T., R.C. Cashner, and G.N. Fuentes. 2002. Application of a diffusion model to describe a recent invasion; observations and insights concerning early stages of expansion for the introduced Rio Grande cichlid, *Cichlasoma cyanoguttatum*, in southeastern Louisiana. *Aquatic Invaders* 13 (4): 13-21.

Okubo, A. 1980. Diffusion and ecological problems: mathematical models. Springer-Verlag, Berlin, New York. 254 pp.

Schrank, S.J. with C.S. Guy and J.F. Fairchild. 2003. Competitive interactions between age-0 bighead carp and paddlefish. *Transaction of the American Fisheries Society*. 132: 1222-1228.

Steel, R.G.D., and J.H. Torrie. 1980. Principles and procedures of statistics: A biometric approach. MacGraw-Hill Inc., New York.

Enter pre-2002 Quality Factor fields (for Laboratory Measurements) into the Water Quality Database

Principal investigator/Project leader: Dukerschein

Contact information: 608-781-6360, tdukerschein@usgs.gov

Collaborators: Shirley Yuan, Jim Fischer, Dave Hansen, Kraig Hoff

Contact information: (Yuan) 608-781-6302; (Fischer) 608-781-6363; (Hansen) 608-781-6343; (Hoff) 608-781-6368

Introduction/Background: The LTRMP Water Quality Database contains laboratory analytical results for all of the values generated without "fatal" lab errors, regardless of analytical outcome. The general policy is to place into the database all values generated along with flags to denote data that is out-of-range, contaminated, lost, or of otherwise unknown quality. The decision to use the data is then left to the end-user based on their interpretation and needs. The QF (Quality Factor) flags for *in-situ* data are currently functional in the database; however data fields for the laboratory-derived chemical QF flags were only recently created in the Oracle database. Those newly created QF fields were populated with the recent 2002 data increment, but all years prior (1991–2001) still need to be created in the Oracle database. This is a large project and a realistic increment to complete in 2005 is the lab data from 1997-2001.

Relevance of research to UMRS/LTRMP: (Short paragraph) The water quality database will not be a complete, functional database until these QF factors have been included. Inclusion of the Quality Factors allows users of the data to evaluate whether or not the data is of suitable quality to meet their needs. Users currently have no way to evaluate the pre-2002 laboratory-generated analytical results.

Methods: Shirley Yuan has Dave Soballe's SAS code to convert electronic spreadsheets generated into the lab into an appropriate format (SQL) so that Dave Hansen can import the data into the OF fields in the LTRMP Oracle database. Any data prior to 1997 is in hard copy format and will need to be entered into appropriate spreadsheet format first. There is not time to locate all the data and do that in 2005, but the 1997-2001 increment can be completed.

Staffing requirements: Shirley Yuan- 2 staff months; Jim Fischer 1 staff month, Intern or Technician (Kraig Hoff) 1 staff month (4 weeks)

Special needs/considerations: To be able to work on this project, Shirley Yuan needs to have Becky Kreiling's contract renewed this spring so that Becky can do the lab work Shirley would normally be doing this winter. Work on this project will be on-going throughout the year.

Budget: $21,145 (All budget figures (UMESC and Field Stations) include full cost accounting)

WDNR (salaries):	$11,145
UMESC (salaries):	$10,000

Timeline for completion: 30 September 2005

Expected products:
Tracking number 2005APE15: Quality Factors in the LTRMP Water Quality SRS and Fixed site databases for the 1997-2001 increment.

Model chlorophyll *a* and suspended solids levels in backwater lakes of the UMRS

Principal investigator/Project leader: Brian Gray

Contact information:

Upper Midwest Environmental Sciences Center
2630 Fanta Reed Road
La Crosse, WI 54603
608-781-6234
608-783-6066 (fax)
brgray@usgs.gov

C**ollaborators:** Jim Rogala

Contact information: jrogala@usgs.gov

Introduction/Background: Chlorophyll and total suspended solids are important aspects of UMRS water quality. Chlorophyll concentration provides a simple measure of algal abundance which is one indicator of the amount of biological production at the base of the food web. Chlorophyll concentrations are also of interest because excessive algal abundance may lead to hypoxia in backwater areas (because of high rates of algal decomposition). High suspended solid concentrations are frequently cited as a top water quality concern in the river. Suspended solids affect macrophytes and algae by determining the depth of light penetration in water column. Thus patterns of chlorophyll and suspended solids concentrations are an integral part of our understanding of the water quality and productivity of the Upper Mississippi River System (UMRS).

Relevance of research to UMRS/LTRMP: The proposed work will develop important statistical tools and data sets for analysis of the LTRMP water quality data and will increase our understanding of the possible causes of variability in chlorophyll and suspended solids among backwater lakes within the backwater strata of the LTRMP study reaches. Specifically, this effort will investigate (i) how chlorophyll a and suspended solids levels vary across backwater lakes within LTRMP study pools, and (ii) whether this variation is associated with selected environmental predictors. Both the States and the USEPA are interested in understanding what leads to high chlorophyll and total suspended solids concentrations in rivers. In addition, Iowa, Minnesota, Wisconsin and Illinois are interested in the impacts that tributaries from their lands have on algal abundance and suspended solids in the Mississippi River.

The proposed project represents the first step of a multi-year effort to model substantial portions of the LTRMP water quality data and will focus on developing the appropriate statistical approaches to modeling variance in chlorophyll and suspended solids in the backwater strata. We hypothesize that a large fraction of this variation is associated with differences among backwater lakes that make up the strata. If there is substantial variance in chlorophyll and suspended solids associated with differences among backwater lakes, comparative study of these lakes will be a fruitful approach to understanding what causes the patterns in chlorophyll and suspended solids that we observe in the UMRS. This approach lends itself well to understanding the effects of management actions at the backwater lake scale, which to date has not been done with LTRMP data.

Methods:

1. Build a new data set in which LTRMP water quality backwater sampling locations are identified by individual backwater lakes. This data set will include attributes for each backwater lake that are possible predictors of chlorophyll and total suspended solids such as mean depth, mean macrophyte levels and water residence time.
2. Estimate the proportions of variation in chlorophyll *a* and suspended solids levels that correspond to annual, backwater lake and sampling (residual) scales. We expect this to demonstrate the importance of individual backwater lakes in the backwater strata, and to then allow association of that variance with predictors (as described in #3).
3. Model variance at backwater lake, year and sampling scales as functions of environmental predictors, and estimate proportions of variance explained by those predictors. Predictors will include reach discharge, mean depth, mean and observed macrophyte levels and water residence time. We also plan to model chlorophyll concentrations as functions of inorganic suspended solids levels at all 3 spatial scales. Spatial and temporal correlation, if substantial, will be addressed using spatial and/or temporal covariance structures.

Staffing requirements: Gray; Rogala (glide path); UMESC Biologist

Special needs/considerations: none

Budget: $26,469 (All budget figures (UMESC and Field Stations) include full cost accounting)

UMESC (supplies, printing costs):	$ 3,100
UMESC (salaries):	$23,369

Expected products/Timeline for completion:

Tracking number 2005APE16: Database for water quality stratified random sampling data with assigned backwater lake ID, and associated attributes such as depth, macrophyte levels, and retention time for individual backwaters. Completed 31 Mar 2005

Tracking number 2005APE17: Project status report titled approximately "Chlorophyll *a* and inorganic suspended solids in backwater lakes of the upper UMRS: Backwater lake effects and their associations with selected environmental predictors". Completed 30 August 2005. Manuscript for publication to be produced (pending funding) in FY2006.

HNA Query Tool Update and Maintenance

Principal investigator/Project leader: Timothy Fox

Contact information: UMESC, 2630 Fanta Reed Road, La Crosse, WI 54603, Phone: 608.781.6342, Email: tfox@usgs.gov

Collaborators: Jason Rohweder, Carol Lowenberg, Kirk Lohman

Contact information: UMESC, 2630 Fanta Reed Road, La Crosse, WI 54603 jrohweder@usgs.gov (608-781-6228), clowenberg@usgs.gov (608-781-235), klohman@usgs.gov (608-781-6341)

Introduction/Background: The HNA GIS Query Tool was developed to assist with a habitat needs assessment for the Upper Mississippi River System (UMRS) Environmental Management Program. It helps evaluate existing habitat conditions throughout the UMRS by allowing users to perform bi-directional queries of species/guilds and river habitat. That is, users may query on a species and obtain habitat information, or they may query on habitat to obtain species information.

The Query Tool is also an open system that allows users to incorporate their own information for enhanced habitat/species assessment and decision making.

Relevance of research to UMRS/LTRMP: It is important to maintain the HNA GIS Query Tool in an up-to-date format that is accessible by UMRS managers and scientists. Products generated by the Query Tool help establish a technically sound, consistent and consensus-based management framework for the restoration, protection, and enhancement of the UMRS ecosystem.

Methods:

1. Convert the HNA GIS Query Tool code from ArcObjects 8.x to ArcObjects 9.x. For the HNA Query Tool to work on the most current version of ArcGIS, the query tool's source code will have to be edited to reflect the changes made in the ArcObjects object libraries. The changes required are extensive and it will be necessary to revise the code for numerous references to object libraries.
2. Create a new installation program. A new installation program will have to be created to install the revised HNA Query Tool.
3. Update the Tool's on-line help and supporting graphics. The HNA Query Tool's online help will be revised and include examples of how the tool can be used within UMRS management context.
4. Author a hard copy manual that covers how to install and use the HNA Query Tool and a demonstration of how Arc/GIS output can be used within ArcView 3.X. The manual will also include an installation/program disk. Fifty copies of the manual with disk will be produced.
5. Install the Query Tool at Fields Stations as part of their upgrade to ArcMap 9.0
6. Provide technical support and tool maintenance (program installation and errors only)
7. Investigate the cost and feasibility of a web based HNA Query Tool.

Staffing requirements: Fox, Rohweder, Lowenberg, Lohman

Budget: $67,480 (All budget figures (UMESC and Field Stations) include full cost accounting)

UMESC (supplies, travel, printing costs):	$ 3,843
UMESC (salaries):	$63,637
UMESC will provide ESRI software for field stations.	$19,800 (in-kind)

Timeline for completion:

The Query Tool products for this project will be completed by September 1, 2005, as will the investigation of the cost and feasibility of a web-based HNA Query Tool. Technical support and tool maintenance will continue for the remainder of FY05.

Expected products:

- Tracking number 2005APE18: HNA GIS Query Tool compatible with ArcMap 9.0
- Tracking number 2005APE19: HNA GIS Query Tool Manual (50 copies including installation/program disks)
- Tracking number 2005APE20: Installation of Query Tool at the field stations where hardware is available (with their upgrade to ArcMap 9.0)
- Tracking number 2005APE21: Updated on-line Query Tool help
- Tracking number 2005APE22: Query Tool technical support (for installation or program errors only)
- Tracking number 2005APE23: Contract report assessing cost and feasibility of web-based HNA GIS Query tool.

Analysis of Factors Limiting the Abundance of Centrarchids in the UMRS

MODIFIED FOR FY05—portion of original proposal funded. (Attached below is full proposal for reference)

- USACOE will identify recommendations for analytical approaches to this question (in-kind)
- UMESC coordination—7.5K

Principal investigator/Project leader: Brent Knights

Contact information: Upper Midwest Environmental Sciences Center; 2630 Fanta Reed Road, La Crosse, Wisconsin 54603 Phone: (608) 781-6332, Fax: (608) 783-6066

Collaborators: Steve Gutreuter and Barry Johnson (UMESC)

Introduction/Background: The ecological functioning of off-channel areas is believed to be central to the biotic resources of the UMRS. Ecosystem management and restoration often focuses on backwater areas. LTRMP monitoring data, focused research (e.g., Johnson et al. 1999) and informal observations by resource managers all indicate that off-channel areas (backwaters) of the UMRS have habitat suitability problems for fish, especially in winter. The spatial distribution of these problems and the processes that contribute to them are not well quantified. The consequences of these suitability problems that might limit habitat on the productivity of lentic fishes in the UMRS have not been fully evaluated. Thus, the need for remedial action, and the most effective means to remediate these problems are also unquantified. Habitat rehabilitation efforts are often based on the untested assumption that some aspect of habitat is limiting to populations. An initial examination of the assumption about winter habitat limitation on Centrarchids in the UMRS (Gutreuter 2004) indicated a weak signal of winter habitat limitation in the lower UMR reaches where backwaters are scarce, but not elsewhere in the system. Gutreuter's suggestion that habitat restoration projects designed to increase the area of backwaters suitable for winter survival of centrarchids are unlikely to produce measurable benefits over intermediate spatial scales in the UMRS indicates the importance of correct identification of limiting factors.

Determining the factors limiting productivity of lentic fishes in the Upper Mississippi River is obviously difficult. In addition, as the spatial scale of evaluation increases, the time scale for seeing results is also likely to increase. We propose to develop a plan for investigating how to best evaluate limiting factors for centrarchid productivity in the Upper Mississippi River. This investigation should help us answer several questions regarding which management-relevant indices derived with LTRMP data can be used at what spatial and temporal scales to evaluate limiting factors. For example, pool-wide estimates of CPUE may not be useful in the short-term for determining the effects of HREPs because of variation in the data (from real and sampling sources). At what scale could we reasonably expect to see the effects of increasing some limiting factor? Are there other useful LTRMP-derived indices for evaluating these relations or should evaluations be done with directed research? What experimental designs of directed research are appropriate and what are the limitations of these designs? What are management-relevant indices of productivity can be derived from LTRMP data?

Relevance of research to UMRS/LTRMP: This project will set the groundwork for determining what factors limit the abundance of centrarchids in the UMRS by proposing specific analyses and study designs. The analyses proposed can be conducted through plans for work in FY06 and beyond. The study designs developed can be used to help plan current and future EMP work,

including the construction, sequencing, and evaluation of HREP's, to make these projects most informative for addressing this question. The potential indices suggested for investigating centrarchid abundance and productivity will help determine what data are needed from LTRMP, or other projects on the UMRS, to provide the information that can address limiting factors. The ultimate goal is developing means to evaluate the success of river management actions aimed at increasing centrarchid abundance.

Methods: We will work with the LTRMP partners to identify a set of LTRMP-relevant indices of centrarchid populations in the UMRS (e.g., PSD, ratio of age-1 to >age-1, pool-wide CPUE, strata CPUE, 10 year average CPUE, etc.) and a set of factors and processes (e.g., exploitation, reproduction, growth, over-winter survival, etc.) that may limit centrarchid abundance. We will then consider a variety of possible methods to determine which of these factors may limit abundance. We will suggest specific analyses and experiments that appear most valuable given the potential indices derived from LTRMP data and the potential for adaptive management within the EMP. If time permits, we will conduct preliminary analysis with LTRMP data to evaluate the potential of various analytical methods. Results will be written as an LTRMP contract report.

Staffing requirements: Knights; Gutreuter; Johnson

Special needs/considerations: none

Original Budget: $38,174 (UMESC salaries) (All budget figures (UMESC and Field Stations) include full cost accounting)

MODIFIED BUDGET FY05: $7,500

Timeline for completion:

Original expected products: Contract report to COE.

MODIFIED FOR FY05

- USACOE will identify recommendations for analytical approaches to this question (in-kind)
- UMESC coordination—7.5K

References

Gutreuter, S. 2004. Challenging the assumption of habitat limitation: an example from Centrarchid fishes over an intermediate spatial scale. River Research and Applications 20:413-425.

Johnson, B.L., D.M. Soballe, B.C. Knights, T.H.J. Naimo, S.J. Rogers, J.S. Sauer, R.F. Gaugush, E.M. Monroe, S. Weick, W.F. James, and A. Stevens. 1999. Evaluation of hydrologic modification for habitat improvement: The Finger Lakes Habitat Rehabilitation and Enhancement Project. U.S. Geological Survey, Upper Midwest Environmental Science Center, La Crosse, Wisconsin.

Develop retrospective, cross-component analysis report of all LTRMP data for Pool 26 for managers. Individual chapters on the water quality and fish components plus a chapter on cross component analyses

Principle investigator/Project leader: John H. Chick

Contact information: Great Rivers Field Station, Illinois Natural History Survey, 8450 Montclair Ave, Brighton, IL 62012; Phone (618) 466-9690; Fax (618) 466-9690; E-mail: chick@inhs.uiuc.edu

Collaborators (Who else is involved in completing the project): Eric Ratcliff, Eric Gittinger, Lori Gittinger, Ben Lubinski, and Rob Maher

Contact information: Great Rivers Field Station, Illinois Natural History Survey, 8450 Montclair Ave, Brighton, IL 62012; Phone (618) 466-9690; Fax (618) 466-9690

Introduction/Background: The Long Term Resource Monitoring Program has collected fish and water quality data in Pool 26 from 1989 to 2003. We will develop a report summarizing the major trends and research findings from these data. There will be separate chapters (sub-reports) for the water quality and fish components, along with an introductory chapter describing the general environmental setting of Pool 26 and a final chapter presenting some initial cross-component analysis for this study area. The chapters on water quality and fish will cover a variety of interesting trends that were not logistically possible to be covered in the systemic 10-year reports. Furthermore, we will include an executive summary specifically designed to help convey our findings to stake holders, decision makers, and the general public. The preparation of a single report on Pool 26 should be attractive to managers and attract additional political support for the EMP. The individual chapters will go into greater detail for this specific study area than was possible in the systemic 10-year reports.

Relevance of research to UMRS/LTRMP: This project will be analyzing and reporting LTRMP data. We are hoping to communicate the findings of the LTRMP and increase public awareness about this program. Although we expect to generate substantial local interest in our findings, we also expect to generate interest from managers and stakeholders throughout the UMRS because from a habitat and land cover/use perspective, Pool 26 represents an extreme end point for the pooled section of the UMRS (i.e., little to no aquatic vegetation, high percentage of agriculture in the floodplain). Finally, this report should be of interest to anyone conducting research on large rivers.

Methods:

The environmental setting of Pool 26

We will use LTRMP Water Quality data to generate mean seasonal patterns of water temperature, dissolved oxygen, conductivity, pH, total suspended solids, total phosphorus, total nitrogen, and chl-*a* for the main channel, side channels, impounded area and contiguous backwater lakes (whereas the 10-year systemic report focused on seasonal patterns for a few selected parameters in the main channel and backwaters of study areas). Seasonal discharge patterns, river stage, and depth profiles will also be calculated using LTRMP data as well as other USGS and COE data sources. Some basic socio-economic information will be presented for the area, as well as information on how river resources are.

Cross Component Analysis of Water Quality and Fish Data for Pool 26

Setting the Stage: Trends in Water Quality and Fish

Basic descriptions of trends for water quality parameters and fish populations will be needed before cross component analyses can be conducted. A review of the major water quality and fish population trends will also be useful for deriving hypotheses to be tested with cross component analyses.

Water Quality—We will generate a combination of pool-wide and strata specific trends for major water quality measures. Where appropriate, time series analysis and adjustments for discharge patterns will be made (the 10-year systemic report focused on monthly patterns for select parameters, and made had no statistical trend analysis).

Fish population trends—We will generate a combination of pool-wide and strata specific trends for the dominant fish species in pool 26. Important trends associated with the 1993 flood and the introduction of invasive species will be highlighted. Data on commercial harvest from Pool 26 is available from the Illinois Department of Natural Resources. Commercial harvest trends will be compared to trends generated from LTRMP data. We will also use LTRMP data to generate information on recruitment and size structure of commercially harvested species. These analyses are new and should help provide a direct link of LTRMP to managers, and may provide a useful template for comparing LTRMP and commercial harvest data for other study areas.

Cross-component analysis of LTRMP data for Pool 26

The primary focus on this chapter will be on testing for association of water quality and fish community trends. For example, analyses to date suggest an effect of the 1993 flood on recruitment for several species. We will attempt to determine if specific water quality, discharge, or elevation data can be statistically associated with year-class strength. Multivariate analysis will be used, including non-metric multidimensional scaling and non-parametric Mantel correlation. We may also include historic information on aquatic vegetation (LTRMP and non-LTRMP sources) to see if specific water quality parameters can be associated with years of good vegetation production in Pool 26.

Staffing requirements: Producing this report likely will consume a little over one month of time for each permanent staff member. Therefore, we propose funding one hourly employee for five months to compensate for the reduced effort by the permanent staff members

Special needs/considerations: none

Budget: $14,375 (All budget figures (UMESC and Field Stations) include full cost accounting)

GRFS (salaries, supplies, travel):	$10,375
UMESC (salaries [review, editing, desktop publishing]; printing costs):	$ 4,000

Timeline for completion:

Tracking number	Product	Milestone
2005APE24	Complete Analysis	28 February 2005
2005APE25	First draft of report (for internal review)	30 April 2005
2005APE26	Second draft – out for comment by UMESC	15 June 2005
2005APE27	Final Report	15 September 2005

Expected products:

A LTRMP technical report containing chapters noted above. The report can also be published in the Bulletin of the Illinois Natural History Survey.

Feasibility study: Investigate the possibility of automating annual compilation of USACE hydrology data and create a database of existing UMESC hydrology data

MODIFIED FOR FY05—portion of original proposal funded. (Attached below is full proposal for reference)

- Coordination with USACOE to request standardized format of data delivery across COE Districts.
- Prototype computer programming investigation (St. Paul District)

Principle investigator/Project leader: Mike Caucutt

Contact information: Mike Caucutt, mcaucutt@usgs.gov
Upper Midwest Environmental Sciences Center
2630 Fanta Reed Road, La Crosse, Wisconsin 54603
Phone: (608) 781-6345, Fax: (608) 783-6066

Collaborators: David Hansen, Ben Schlifer, Jeff Houser, Jim Rogala, Barry Johnson, One programmer from each USACE District (St. Paul, Rock Island, St. Louis)

Introduction/Background: Formerly, hydrological data were compiled and quality assured from USACE data sources and housed in large ASCII files at UMESC. This process required hiring a temporary employee to manually compile and format hydrological data from numerous USACE and USGS sources so that systemic hydrological data could be archived and used under a single, standard, quality assured format.

Compilation of these hydrologic data ceased in 2001–2002 with the retirement of Dr. Joseph Wlosinski. While Dr. Wlosinski's historical files remains available to UMESC researchers, it is no longer being maintained and the most contemporary data are unavailable in a standardized, centralized database.

Relevance of research to UMRS/LTRMP: Hydrology defines and shapes a suite of physical and biotic attributes in the Upper Mississippi River. As such, hydrologic data are central to scientific investigations that seek to model or explain the relationships among physical forces and biotic processes and responses. The existence of a standardized, systemic database on UMRS hydrology would provide UMESC researchers a valuable resource for continued modeling, synthesis, and hypothesis testing.

Methods: Take the existing historic hydrology data that Dr. Wlosinski created and store it in an Oracle database. This data goes up until 1997. Determine if the fields and format of existing UMESC hydrology data is that which LTRMP scientists require. Once existing UMESC hydrology data has been formatted and centralized into a database, and LTRMP scientists have approved of the data, then updates to the database can be requested. Begin an inquiry or study into the feasibility of each District's programmer to write a specialized script that would extract the data and send us the data in the format that would update the existing data. Each District would, in theory, have an automated query that would take the parameters that we request, extract the data and send the results to a UMESC employee. UMESC would then add the data into the new Oracle database. Users would then have a centralized location that would contain all water elevation and discharge data for selected gauging stations along the Upper Mississippi River. Write database browser scripts, similar to the LTRMP database browsers, to access data.

Staffing requirements: Hansen; UMESC computer staff; USACE programmer in each district

Special needs/considerations: This proposal will take existing UMESC hydrology data and import into an Oracle database and then determine if the USACE hydrology data can be automatically extracted sent to UMESC and update the new Oracle database.

Original Budget: $59,955 (All budget figures (UMESC and Field Stations) include full cost accounting)

UMESC (salaries):	$50,955
USACE (salaries [programmer in each district]):	$ 9,000

MODIFIED BUDGET FY05: $12,000 (UMESC salaries)

Timeline for completion: To be coordinated with a USACOE

Original expected products:

An Oracle database of UMESC historical hydrology data (up until 1997).

A detailed study plan that will outline a partnership with three USACE Districts. This partnership will work with USACE District programmers to determine the feasibility of individual scripts that would automatically extract hydrology data and send the data to UMESC.

An additional project will account for the storage and access of the data.

MODIFIED FOR FY05

- Coordination with USACOE to request standardized format of data delivery across COE Districts.
- Prototype computer programming investigation (St. Paul District)

Data Access and Delivery online tools

Principle investigator/Project leader: Mike Caucutt

Contact information: Mike Caucutt, mcaucutt@usgs.gov
Upper Midwest Environmental Sciences Center
2630 Fanta Reed Road, La Crosse, Wisconsin 54603
Phone: (608) 781-6345, Fax: (608) 783-6066

Collaborators: David Hansen, Ben Schlifer, Bob Kratt and John C. Nelson

Introduction/Background: One of the key goals of the Long Term Resource Monitoring Program (LTRMP) is to provide timely and useful information to natural resource decision makers in the Upper Mississippi River System (UMRS) basin. To date, this has been accomplished through standardized annual reporting, Web access to raw program data and the Spatial Query Tool, a stand alone program.

Relevance of research to UMRS/LTRMP: New data access and delivery products will enhance the current method of querying the LTRMP component database and introduce specific component data tools. Additional Geographic Information Systems (GIS) and web-based tools will be developed to assist LTRMP component specialists, resource managers and other users of data available from the Upper Midwest Environmental Science Centers (UMESC) Data Library.

These online tools can present LTRMP data in an intuitive, universally accessible manner that alleviates the requirement of substantial post-processing by users as well as an intricate knowledge of the statistical sampling design, thereby enhancing the usefulness of the data to resource decision makers and the general public.

Methods:

Water Quality Graphical Browser - The method used for the Pool 8 water quality fixed sites is a two part process. The first step is to create the dynamic, geographic selection interface. This is done by creating a web page with a large image map that when the cursor is moved over certain areas; an image layer is programmed to appear. Small aerial photographs of the sampling points were used for the image layer that appears. The user sees the aerial photograph and the name of the location code. This method allows the user to specifically select the geographic area to be queried.

Developing the query form is the second part of the process and a separate application. The form has multiple selection parameters (temperature, dissolved oxygen, pH, turbidity, Secchi, suspended solids) that the user will select and then submit the query to the LTRMP database. The results are processed and a graph is produced along with a link to the raw data results.

LTRMP Vegetation Graphical Browser - Use the existing LTRMP Graphical Fish Component Database Browser and modify to use the Vegetation data. PERL/DBI calls to the Oracle database to get the data, Java applets to display the data. This will use real time raw data from the Oracle database.

LTRMP UMRS Land Cover viewer - Will use current Land Cover/Land Use layers that are available from specific UMRS Pool GIS Data download pages. These layers will be incorporated into an Arc Internet Mapping Server (IMS) application allowing the user to view multiple layers from multiple years.

Staffing requirements: 0.5 FTE

Special needs/considerations: none

Budget: $40,000 (All budget figures (UMESC salaries) include full cost accounting)

Timeline for completion:

Tracking Number	Products	Milestones
2005APE28	Complete Water Quality Graphical Browser	1 September 2005
2005APE29	Complete LTRMP Vegetation Graphical Browser	1 June 2005
2005APE30	Complete LTRMP UMRS Land Cover viewer	1 April 2005

Expected products:

- Water Quality Graphical Browser for the fixed monitoring sites in Pool 8, Pool 13, and Open River Reach. The Water Quality Graphical Browser will allow online access to the fixed monitoring sites located in Pools 8, 13 and Open River. The user will be able to spatially choose the site and query on the following parameters; Temperature, Dissolved Oxygen, PH, Turbidity, Secchi, and Suspended Solids. The results are processed and a graph is produced along with a link to the raw data results.
- Vegetation Graphical Browser. The Vegetation Graphical data browser will allow an online user to graph trends in the LTRMP vegetation data.
- Land Cover Viewer. The LTRMP UMRS Land Cover viewer will be an ArcIMS application that will allow the user to select and display LAND Cover/Land Use GIS layers for the Upper Mississippi River System pools.

Budget: $40,000 (All budget figures (UMESC) include full cost accounting)

Report Definitions

Draft: A draft that has been reviewed by a UMESC Branch Chief and is ready for review by USGS, COE, A-Team, or blind review, as needed.

Final draft: The report is completely through the USGS review/revision process and is ready to go to the UMESC editorial group for production.

Reports not identified as drafts: (e.g., LTRMP report titled: Multi-year Synthesis of the Macroinvertebrate Component from 1992–2002 for the Long Term Resource Monitoring Program's) indicates a final printed version or Web-based report is on-line. For other products (i.e., manuscripts) this indicates submission to a journal.

Appendix A: FY05 Budget Summary

		FEDERAL	NON-FEDERAL	COE	TOTAL
MSP	Aquatic Vegetation Sampling	$ 253,482	$ 201,918	$ -	$ 455,400
	Fisheries Sampling	$ 223,426	$ 855,174	$ -	$ 1,078,600
	Water Quality Sampling	$ 470,431	$ 783,469	$ -	$ 1,253,900
	Statistical Evaluation	$ 114,221	$ -	$ -	$ 114,221
	Bathymetric Component	$ 18,500	$ -	$ -	$ 18,500
	Land Cover/Use	$ 131,129	$ -	$ -	$ 131,129
	Data Management	$ 425,986	$ -	$ -	$ 425,986
	Science Management Support	$ 200,925	$ -	$ -	$ 200,925
		$ 1,838,100	**$ 1,840,561**	**$ -**	**$ 3,678,661**
Glide Path		**$ 41,700**	**$ 54,500**	$ -	**$ 96,200**
COE APE Mgt & Review		$ -	$ -	**$ 60,000**	**$ 60,000**
USGS APE Science Mgt		**$ 25,000**	$ -	$ -	**$ 25,000**
APE's	Status & Trends (under development)	$ 75,000	$ 25,000	$ 83,225	$ 183,225
	Report (Gaugush)	$ 32,300	$ -	$ -	$ 32,300
	Develop Control Charts (Red Flags)	$ 19,292	$ -	$ -	$ 19,292
		$ 126,592	**$ 25,000**	**$ 83,225**	**$ 234,817**
	Bathymetry	$ -	$ -	$ 160,000	$ 160,000
	Develop 2-Dimensional Numerical Hydraulic Models	$ -	$ -	$ 65,000	$ 65,000
	WQ Monitoring to Evaluate Effects Pool 5 Drawdown	$ 8,400	$ 2,806	$ -	$ 11,206
	Pool Based Mosaics MRC Maps	$ 23,369	$ -	$ -	$ 23,369
	Analysis of Fish in Illinois River	$ 5,074	$ 21,906	$ -	$ 26,980
	Asian Carp in Mississippi River	$ 4,612	$ 37,247	$ -	$ 41,859
	Enter pre-2002 Quality Factors WQ Database	$ 10,000	$ 11,145	$ -	$ 21,145
	Model Chlorophyll *a*	$ 26,469	$ -	$ -	$ 26,469
	HNA Query Tool Update & Maintenance	$ 67,480	$ -	$ -	$ 67,480
	Analysis Factors Limiting Abundance Centrachids	$ 7,500	$ -	$ -	$ 7,500
	Cross-Component Analysis LTRMP Data Pool 26	$ 4,000	$ 10,375	$ -	$ 14,375
	Feasibility Study Automating Hydrology Data	$ 12,000	$ -	$ -	$ 12,000
	Data Access/Deliver Online Tools	$ 40,000	$ -	$ -	$ 40,000
	Equipment Refreshment	$ 16,881	$ 40,119	$ -	$ 57,000
		$ 352,377	**$ 148,598**	**$ 308,225**	**$ 809,200**
TOTAL EMP LTRMP		**$ 2,257,177**	**$ 2,043,659**	**$ 368,225**	**$ 4,669,061**

Appendix B: Minimum Sustainable Program Condensed Budget
(In thousands)

AQUATIC VEGETATION SAMPLING

Salaries	FTE	Total
UMESC	1.60	$ 238.2
States	2.97	$ 185.9
Sub-total salaries	**4.57**	**$ 424.1**
Travel/Ops		
UMESC		$ 15.3
States		$ 16.0
Sub-total travel		**$ 31.3**
COMPONENT TOTAL		**$ 455.4**

FISHERIES SAMPLING

Salaries	FTE	Total
UMESC	1.60	$ 200.4
States	13.70	$ 785.9
Sub-total salary	**15.30**	**$ 986.3**
Travel/Ops		
UMESC		$ 23.1
States		$ 69.2
Sub-total travel		**$ 92.3**
COMPONENT TOTAL		**$ 1,078.6**

WATER QUALITY SAMPLING

Salaries	FTE	Total
UMESC	3.60	$ 393.6
States	11.54	$ 708.9
Sub-total salaries	**15.14**	**$ 1,102.5**
Travel/Ops		
UMESC		$ 76.9
States		$ 74.5
Sub-total travel		**$ 151.4**
COMPONENT TOTAL		**$ 1,253.9**

STATISTICAL EVAL MONITORING DATA

Salaries	FTE	Total
UMESC	0.61	$ 98.8
Travel/Ops		$ 15.4
Component Total		$ 114.2

BATHYMETRIC COMPONENT

Salaries	FTE	Total
UMESC	0.15	$ 18.5
Travel/Ops		$ -
Component Total		$ 18.5

LAND COVER/USE

Salaries	FTE	Total
UMESC	1.00	$ 126.5
Travel/Ops		$ 4.6
Component Total		$ 131.1

DATA MANAGEMENT

Salaries	FTE	Total
UMESC	2.40	$ 280.0
Travel/Ops		$ 146.0
Component Total		$ 426.0

SCIENCE MANAGEMENT SUPPORT

Salaries	FTE	Total
UMESC	1.31	$ 190.1
Travel/Ops		$ 10.8
Component total		$ 200.9

TOTAL	40.48	$ 3,678.6

Appendix C: Additional Program Elements Condensed Budget
(In thousands)

Status and Trends (Under development)

Total S&T budget		**$**	**234.8**
S&T Project Management			
Salaries	**FTE**	**Total**	
UMESC		$	32.3
Sub-total salary	**0.00**	**$**	**32.3**
Travel/Ops			
UMESC		$	-
States		$	-
Sub-total travel		**$**	**-**
COMPONENT TOTAL		**$**	**32.3**
S&T Project: Develop control charts for selected water quality constituents			
Salaries	**FTE**	**Total**	
UMESC		$	17.6
Sub-total salary	**0.00**	**$**	**17.6**
Travel/Ops			
UMESC		$	1.7
States		$	-
Sub-total travel		**$**	**1.7**
COMPONENT TOTAL		**$**	**19.3**

Bathymetry

USACOE		**$**	**160.0**

Development of Two-dimensional Numerical Hydraulic Models for Mississippi River Pools 17 and 18 in Support of the LTRMP

Salaries	**FTE**	**Total**	
USACOE		**$**	**65.0**

Water Quality monitoring to evaluate effects of Pool 5 Drawdown

Salaries	FTE	Total
UMESC		$ 8.4
States		$ 2.8
		$ -
Sub-total salary	**0.00**	**$ 11.2**
Travel/Ops		
UMESC		$ -
States		$ -
Sub-total travel		**$ -**
COMPONENT TOTAL		**$ 11.2**

Pool-based georeferenced mosaics of the 1890's Mississippi River Commission maps

Salaries	FTE	Total
UMESC		$ 17.7
States		$ -
Sub-total salary	**0.00**	**$ 17.7**
Travel/Ops		
UMESC		$ 5.7
States		$ -
Sub-total travel		**$ 5.7**
COMPONENT TOTAL		**$ 23.4**

Analysis of fish age structure and growth in the Illinois River

Salaries	FTE	Total
UMESC		$ 3.9
States		$ 19.5
Sub-total salary	**0.00**	**$ 23.4**
Travel/Ops		
UMESC		$ 1.2
States		$ 2.4
Sub-total travel		**$ 3.6**
COMPONENT TOTAL		**$ 27.0**

Asian Carp in the Mississippi River: Their impact on native fish species and predicted dispersal within the system

Salaries	FTE	Total
UMESC		$ 3.9
States		$ 34.0
Sub-total salary	**0.00**	**$ 37.9**
Travel/Ops		
UMESC		$ 0.8
States		$ 3.3
Sub-total travel		**$ 4.1**
COMPONENT TOTAL		**$ 42.0**

Enter pre-2002 Quality Factor fields (for Laboratory Measurements) into the Water Quality Database

Salaries	FTE	Total
UMESC		$ 10.0
States		$ 11.1
Sub-total salary	**0.00**	**$ 21.1**
Travel/Ops		
UMESC		$ -
States		$ -
Sub-total travel		**$ -**
COMPONENT TOTAL		**$ 21.1**

Model chlorophyll *a* and suspended solids levels in backwater lakes of the UMRS.

Salaries	FTE	Total
UMESC		$ 23.4
Sub-total salary	**0.00**	**$ 23.4**
Travel/Ops		
UMESC		$ 3.0
States		$ -
Sub-total travel		**$ 3.0**
COMPONENT TOTAL		**$ 26.4**

HNA Query Tool Update and Maintenance

Salaries	FTE	Total
UMESC		$ 63.6
Sub-total salary	**0.00**	**$ 63.6**
Travel/Ops		
UMESC		$ 3.8
States		$ -
Sub-total travel		**$ 3.8**
COMPONENT TOTAL		**$ 67.4**

Analysis of Factors Limiting the Abundance of Centrarchids in the UMRS

Salaries	FTE	Total
UMESC		$ 7.5
Sub-total salary	**0.00**	**$ 7.5**
Travel/Ops		
UMESC		$ -
States		$ -
Sub-total travel		**$ -**
COMPONENT TOTAL		**$ 7.5**

Develop retrospective, cross-component analysis report of all LTRMP data for Pool 26 for managers

Salaries	FTE	Total
UMESC		$ 3.2
States		$ 10.4
Sub-total salary	**0.00**	**$ 13.6**
Travel/Ops		
UMESC		$ 0.8
States		$ -
Sub-total travel		**$ 0.8**
COMPONENT TOTAL		**$ 14.4**

Feasibility study: Investigate the possibility of automating annual compilation of USACE hydrology data and create a database of existing UMESC hydrology data

Salaries	FTE	Total
UMESC		$ 12.0
Sub-total salary	**0.00**	**$ 12.0**
Travel/Ops		
UMESC		$ -
States		$ -
Sub-total travel		**$ -**
COMPONENT TOTAL		**$ 12.0**

Data Access and Delivery online tools

Salaries	FTE	Total
UMESC		$ 40.0
Sub-total salary	**0.00**	**$ 40.0**
Travel/Ops		
UMESC		$ -
States		$ -
Sub-total travel		**$ -**
COMPONENT TOTAL		**$ 40.0**

EQUIPMENT REFRESHMENT

	FTE	Total
UMESC		$ 15.6
Lake City		$ 9.3
Pool 8		$ 6.2
Bellevue		$ 10.1
Pool 26		$ 6.2
La Grange		$ 9.7
Open River		$ -
Sub-total salary	**0.00**	**$ 57.0**
Travel/Ops		
UMESC		$ -
States		$ -
Sub-total travel		**$ -**
COMPONENT TOTAL		**$ 57.0**

TOTAL APE		**$ 809.2**

GLIDE PATH

Salaries	**FTE**	**Total**
UMESC		$ 41.7
States		$ 54.5
Sub-total salary	**0.00**	**$ 96.2**
Travel/Ops		
UMESC		$ -
States		$ -
Sub-total travel		**$ -**
COMPONENT TOTAL		**$ 96.2**

Appendix D: Web-based Annual Update Example

In 2003, the format of the Component annual reports was changed to a Web-based annual update where all years of data are presented in each table or figure. Following is an example of the format. (Note: the entire report is not provided here.

UMESC - LTRMP Reports - Macroinvertebrates 2000

USGS

Upper Midwest Environmental Sciences Center

Reports and Publications
Long Term Resource Monitoring Program
Macroinvertebrate Data Page

Macroinvertebrate Sampling in the Upper Mississippi River System: Annual Update

Jennifer Sauer

macro_update.pdf (1.2 MB)

- Introduction
- Study areas
- Methods
- Yearly summaries
- References

- Tables
- Figures

Annual Status Reports 1992–1999

Macroinvertebrate Data

Pool 4 | Pool 8 | Pool 13
Pool 26 | Open River Reach | La Grange Pool

Content manager: Jennie Sauer

http://www.umesc.usgs.gov/reports_publications/ltrmp/macro.html (1 of 2)11/26/2004 9:34:55 AM

USGS

Upper Midwest Environmental Sciences Center

Reports and Publications
Macroinvertebrate Update Title Page

Introduction

The objective of the Long Term Resource Monitoring Program (LTRMP) macroinvertebrate component is to annually monitor and report trends in the status and distribution of key macroinvertebrate populations. 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).

Mayflies, fingernail clams, and midges have been historically used as indicators of river water quality (Fremling 1964, 1973, 1989; Steingraber and Wiener 1995). An indicator species can be defined as a species that has particular requirements with regard to a known set of physical or chemical parameters. 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 1995*a*,*b*).

The ultimate goal of the LTRMP is to improve the understanding and management of the UMRS. That goal can best be achieved by the integration of routine monitoring with experimental research directed at identifying the causes of and solutions to specific problems. Future LTRMP studies will integrate focused analyses of data from all LTRMP monitoring components (limnology, bathymetry, sediments, aquatic plants, and fisheries) with results of experimental studies to identify causes of problems and opportunities for improved management.

The present update summarizes macroinvertebrate monitoring at each of the LTRMP field stations from 2000 to the present. Tables and figures include all years of sampling for comparison purposes. Beginning in year 2000, these annual status updates are only

USGS

Upper Midwest Environmental Sciences Center

Reports and Publications

Macroinvertebrate Update Title Page

Long Term Resource Monitoring Program study reaches for macroinvertebrate sampling.

- Pool 4
- Pool 8
- Pool 13
- Pool 26
- Open River Reach
- La Grange Pool

Navigation Pool 4 is 73 km (44 river miles) long and includes 14,700 ha (36,300 acres) of aquatic habitat. It is located between Lock and Dam 3 (above Red Wing, Minnesota) and Lock and Dam 4 (Alma, Wisconsin). Major tributaries include the Cannon and Vermillion Rivers on the Minnesota side and the much larger Chippewa River on the Wisconsin side. Lake Pepin, a riverine lake created by the Chippewa River delta, is located in the middle of Pool 4. The location of Lake Pepin divides the rest of the pool into upper Pool 4 and lower Pool 4. The smaller backwaters of upper Pool 4 have been degraded by sedimentation, whereas the larger backwaters of lower Pool 4 provides much better habitat for vegetation.

Maps of other LTRMP study areas follow this page.

USGS

Upper Midwest Environmental Sciences Center

Reports and Publications
Macroinvertebrate Update Title Page

Methods

Macroinvertebrate sampling procedures are described in detail in the LTRMP Procedures Manual (Thiel and Sauer 1999). The sampling of mayflies (Ephemeridae), fingernail clams (Sphaeriidae), and Asiatic clams (*Corbicula* sp.) began in 1992 in Pools 4, 8, 13, and 26, the Open River Reach of the Mississippi River, and La Grange Pool of the Illinois River (Figure 1). Midges (Chironomidae) were added to the sampling design in 1993 and the exotic zebra mussel (*Dreissena polymorpha*) in 1995. The presence or absence of Odonata, Plecoptera, Trichoptera, Diptera, Bivalvia, Oligochaeta, Decapoda, Amphipoda, and Gastropoda was also reported.

Sites included randomly selected locations distributed among key aquatic strata—based on enduring geomorphic features (Wilcox 1993). Aquatic strata sampled included contiguous backwaters, which have apparent surface water connection with the rest of the river; main channel borders, the area between the navigational buoys and the riverbank—not including revetments and channel-training structures; impounded areas, large, mostly open-water areas located in the downstream portion of the navigation pools; and side channels, channels that carry less flow than the navigation channel. For Pool 4, the impounded area is in the form of Lake Pepin, a tributary delta lake formed by the Chippewa River delta. In this report, only data from the randomly selected sites are discussed. The LTRMP staff developed a spatial database of aquatic areas (Owens and Ruhser 1996) on the basis of aerial photography produced in 1989. This database was used for randomized selection of sampling sites and the quantification of sampling strata.

Annual sampling was conducted at about 120 sites per study area (Table 1). Sample allocation was based on several criteria, including surface area of the aquatic area in each study reach, ability to sample within a specific strata, and the productivity of the taxa in each aquatic area. All sites were sampled in early spring, before emergence of mayflies and much growth of vegetation occurs.

Benthic samples were collected with a winch-mounted 23- × 23-cm (0.052-m^2) standard Ponar grab sampler (Ponar Grab Dredge, Wildlife Supply Company, Saginaw, Michigan). The wash frame sieve size was changed from a U.S. Standard Sieve no. 30

USGS

Upper Midwest Environmental Sciences Center

Reports and Publications

Macroinvertebrate Update Title Page

Yearly Summaries

Year 2003

- Because of budget constraints, Pools 4 and 26 of the Upper Mississippi River and La Grange Pool of the Illinois River were not sampled in 2003.
- Pools 8 and 13 were selected for continued monitoring to provide data for modeling efforts that began in 2000 using data from these two pools. Also, there was a poolwide water level drawdown in Pool 8 in 2001 and 2002. The drawdown was implemented to increase vegetation abundance, which will in turn provide habitat for waterfowl and other aquatic life forms. Because this type of hydrologic change could have an effect on macroinvertebrate densities, we decided to continue the long-term data string in Pool 8.
- The poolwide estimated mean densities of mayflies, fingernail clams, and midges were all within the range of variation previously observed in Pools 8 and 13 (Table 2; Figures 2–4). The only substantial change from 2002 was in Pool 13 where mayfly densities dropped from a 12-year high of 221 to 77 m^{-2} in 2003, which matched the 12-year low observed in 2001 (Figure 2).
- There was an extensive die-off in zebra mussels in Pools 8 and 13 (Table 2) in 2003 (Figure 5). Large numbers of dead zebra mussels were found in the samples. The few live zebra mussels found were small (<1 cm). Although the die-off was extensive, over the summer there were reports of small zebra mussels on aquatic vegetation, boats, and docks; thus, 2003 may have been a good year for recruitment. The die-off may be part of a demographic shift. Zebra mussels only live 4–5 years and our data from 1999 and 2000 indicate that large year classes of zebra mussels were produced in these pools 4–5 years ago. Thus, this may have been a natural die-off of older zebra mussels. Other potential causes include parasites, water flows, or water temperature changes in fall and winter 2002.
- The distribution of invertebrates among aquatic areas within Pools 8 and 13 was similar to previous years. The highest densities of mayflies occurred in contiguous

Previous years follow the current year's summary statements

USGS

Upper Midwest Environmental Sciences Center

Reports and Publications
Macroinvertebrate Update Title Page
Tables

Table 2. Estimated mean numbers of mayflies, fingernail clams, midges, Asiatic clams, and zebra mussels per square meter by year and study area, weighted by areas of strata. For sample sizes, refer to Table 1. Midges were added to the sampling design in 1993 and zebra mussels in 1995. The wash frame sieve size was changed from a U.S. Standard Sieve no. 30 (0.595 µm), used in 1992, to a U.S. Standard Sieve no. 16 (1.18 mm) in 1993. SE=standard error.

Study reach	Year	Mayflies (m^{-2})	± 1 SE	Fingernail clams (m^{-2})	± 1 SE	Midges (m^{-2})	± 1 SE	*Corbicula* sp. (m^{-2})	± 1 SE	Zebra mussels (m^{-2})	± 1 SE
Pool 4	1992	59	18	47	19	—	—	0	0	—	—
	1993	128	36	74	11	318	39	0	0	—	—
	1994	203	50	88	12	185	32	0	0	—	—
	1995	171	34	59	13	78	13	0	0	26	26
	1996	132	34	39	7	38	12	0	0	116	113
	1997	69	21	76	9	152	35	0	0	31	27
	1998	209	44	73	10	253	40	0	0	107	98
	1999	69	18	138	21	199	33	0	0	37	33
	2000	223	39	118	14	65	15	0	0	31	29
	2001	104	19	103	14	71	13	0	0	232	218
	2002	93	31	79	10	68	16	0	0	8	6
	2003[a]	—	—	—	—	—	—	—	—	—	—

[a] Sampling not conducted in 2003 because of budget constraints.

Tables from other LTRMP study areas follow this page.

USGS

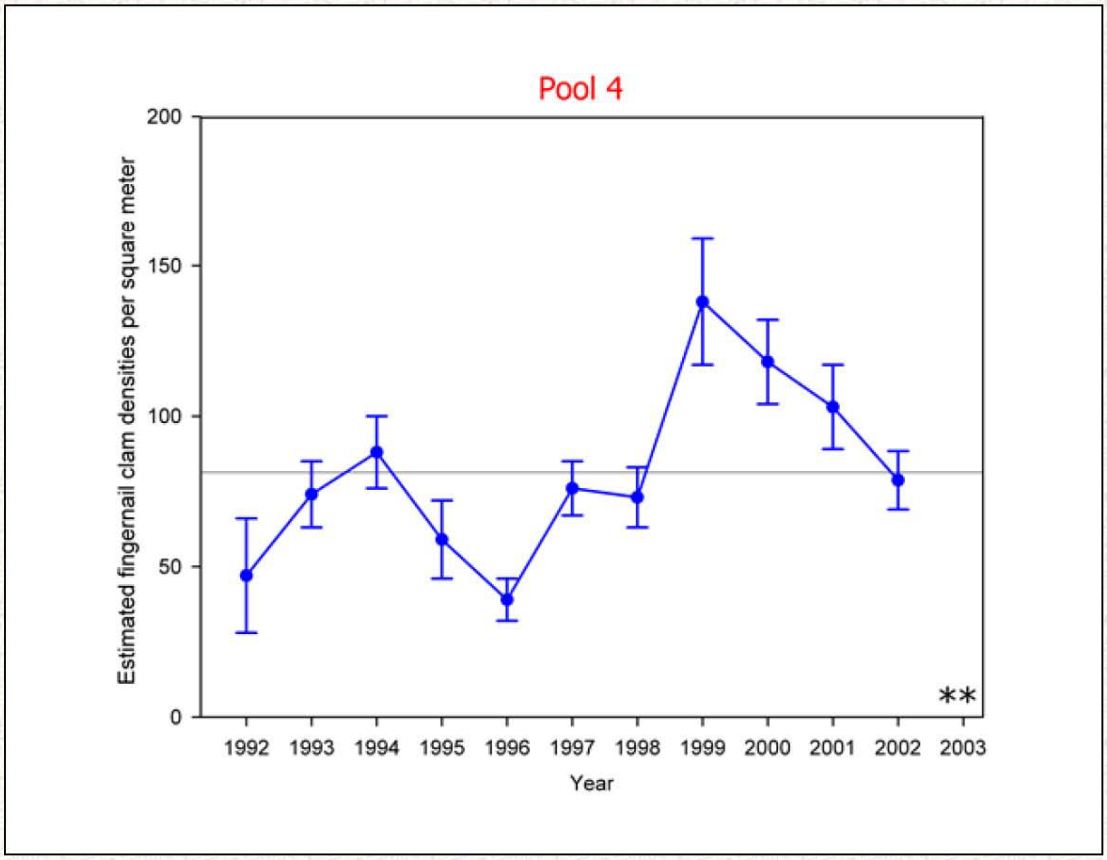
Upper Midwest Environmental Sciences Center

Reports and Publications

Macroinvertebrate Update Title Page

Figures

Figure 3. Estimated density of fingernail clams (number per square meter; ±1 standard error) by study area, weighted by area of strata. The wash frame sieve size was changed from a U.S. Standard Sieve no. 30 (0.595 µm), used in 1992, to a U.S. Standard Sieve no. 16 (1.18 mm) in 1993. Horizontal line indicates grand mean.



Trend graphs from other LTRMP study areas follow this page.