Upper Mississippi River Restoration–Environmental Management Program
Long Term Resource Monitoring Program Element
FY2013 Scope of Work

Outcome 1

Outcome 2

Output 4

Strategy

This Scope of Work (SOW) describes the tasks in support the Upper Mississippi River Restoration-Environmental Management Program (UMRR–EMP), authorized by Congress in the 1986 Water Resources Development Act and reauthorized in the 1999 Water Resources Development Act, to be performed by the USGS-Upper Midwest Environmental Sciences Center (UMESC) in La Crosse, Wisconsin, and six state-operated field stations (Illinois, Iowa, Minnesota, Missouri, and Wisconsin). This SOW supports the Long Term Resource Monitoring Program's (LTRMP) "Strategic and Operational Plan for the Long Term Resource Monitoring Program on the Upper Mississippi River System, Fiscal Years 2010-2014" (www.umesc.usgs.gov/ltrmp/ateam/Strategic_Operational_Plan_FINAL_30June2009.pdf). The top priority in the Strategic Plan and this SOW is collection, management, and serving of monitoring data.

UMESC is the designated science leader for the LTRMP. USGS LTRMP Program Manager/Science Director Dr. Barry Johnson leads and directs the work in this SOW. The tasks in this SOW align with priorities stated in the Strategic Plan. All products are dependent on funding and travel restrictions.

Aquatic Vegetation Component

The objective of the LTRMP Aquatic Vegetation Component is to collect quantitative data on the distribution and abundance of aquatic vegetation in the UMRS and to conduct research related to aquatic vegetation for the purpose of understanding its status, trends, ecological functions, and responses to natural disturbances and anthropogenic activities. Aquatic vegetation in UMRS is desirable because of its many values, most notably as food for migratory waterfowl (Korschgen et al. 1988) and habitat for fish. Monitoring data are collected within three LTRMP study reaches in the UMRS (Pools 4, 8, and 13 on the Upper Mississippi River). Data entry, quality assurance, data summaries, standard analyses, data serving, and report preparation occur under standardized protocols. (Strategic Plan Outcome 1; Output 1.1, Outcome 2, Output 2.1 and Outcome 4)

Methods

For monitoring aquatic vegetation, sampling will be conducted following the LTRMP aquatic vegetation standard sampling protocol (Yin et al. 2000). A total of 1,350 sites will be surveyed, 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

2013A5: A Summary of Data Collected in 2012 by the Wisconsin Department of Natural Resources in Navigation Pool 8 for the LTRMP.

We will initiate an annual summary that combines current year observations from LTRMP with previous years' data, for the fish, aquatic vegetation, and water quality components. This information will serve as a tool to inform and remind Wisconsin decision-makers of the value of the resource to the state and the importance of the LTRMP. The summary will be distributed throughout the WDNR as an executive summary of our sampling program for those who do not

have the time or inclination to analyze our data themselves, but have an interest in our activities and findings. Distribution can be wider, but we intend the WDNR to be the primary audience. The report will primarily utilize data from the graphical browsers and will incorporate anecdotal observations, textual narratives, and new analyses where needed. We will include a hydrologic summary, sampling methods and effort, and component-specific findings of interest. We will reference the graphical browsers for routine tabular and graphical information, displaying specific examples where useful for illustrating key points. (Strategic Plan Outcome 1; Output 1.1, Output 4.1)

2013A6: Sampling the impaired reach of the UMR (Pools 2 and 3) for submersed aquatic vegetation using LTRMP methods.

Submersed aquatic vegetation data were collected in 2012 from Pools 2 and 3 of the Upper Mississippi River by LTRMP staff located at the Lake City field station. These data will be analyzed in FY2013 and results will be distributed to interested LTRMP Partners; but specifically to river managers in Minnesota Pollution Control Agency, Minnesota Department of Natural Resources (MDNR) and Wisconsin Department of Natural Resources as summary graphics showing aquatic vegetation frequencies over-time. The data will be used to test a macrophyte index impairment threshold model (Moore et al. 2012) and to monitor whether the new TMDL-related SAV standard for the impaired reach is being met. This work is fully supported by funding from the MDNR and provides an example of leveraging LTRMP expertise to provide wider benefits to the Program such as outpool sampling. (Strategic Plan Outcome 2, Output 2.1)

2013A7: Developing a new species occupancy model using the LTRMP aquatic vegetation data

Currently LTRMP reports the frequency of occurrence (detection) as a measurement of the status of aquatic vegetation. An alternative metric is frequency of occupancy. Frequency of occurrence is different from the frequency of occupancy for two reasons; 1) the LTRMP protocol only surveys a fraction of the total area of each site, and 2) the detection is imperfect even for the area surveyed. A comparison of these two metrics will help determine their usefulness under different environmental or sampling conditions and how robust the analytical results (mean and variance) are between methods. A recent publication attempted to statistically model the frequency of occupancy using the LTRMP data. We are developing a new model that is more robust to improve the estimation of percent of occupancy and will produce a draft manuscript. The product will help compare the usefulness of these two metrics as ways to express the abundance of aquatic vegetation under different conditions using LTRMP data. This work directly addresses the LTRMP Strategic Plan, Outcome 1, Output 1.1.

2013A8: Extension of modeling capabilities for aquatic vegetation

The existing LTRMP model for submersed aquatic vegetation includes current velocity at one discharge of 90,000 CFS. The LTRMP recently acquired velocity models for Pool 8 from the University of Iowa at a series of discharges between 10,000 and 90,000 CFS. These additional velocity models make it possible to develop a dynamic model for submersed aquatic vegetation based on daily, rather than seasonal, conditions. This project will develop refinements to the Pool 8 model to enhance quantitative estimates of vegetation occurrence. Tasks will include developing SAS code to interpolate daily water levels using river mile and discharge data,

interpolate current velocity based on discharge, fitting predictive occurrence probability for submersed aquatic vegetation using LTRMP data collected in Pool 8, and identifying maximum velocities at which flow is destructive to vegetation. These results will be used to revise the Pool 8 model code. Most of this work will be performed by contract if, and only if, funding is available. If funding is available, we expect to put the contract in place in FY2013. Analyses and products will be delivered in FY2014 and covered in the FY2014 scope of work. This work addresses Question 1 in the LTRMP research framework, "Plan for research on aquatic vegetation in the Upper Mississippi River System."

Products and Milestones

Tracking number	Products	Staff	Milestones
2013A1	Complete data entry and QA/QC of 2012 data; 1250 observations.		
	a. Data entry completed and submission of data to USGS	Moore, Langrehr, Petersen	30 November 2012
	b. Data loaded on level 2 browsers	Schlifer	15 December 2012
	c. QA/QC scripts run and data corrections sent to Field Stations	Sauer	28 December 2012
	d. Field Station QA/QC with corrections to USGS	Moore, Langrehr, Petersen	15 January 2013
	e. Corrections made and data moved to public Web Browser	Sauer, Schlifer, Caucutt	30 January 2013
2013A2	WEB-based annual Aquatic Vegetation Component Update with 2012 data on Public Web Server.		
	a. Develop first draft	Sauer	30 March 2013
	b. Reviews completed	Moore, Langrehr, Petersen, Sauer, Yin	15 April 2013
	c. Submit final update	Sauer	30 June 2013
	d. Placement on Web with PDF	Sauer, Caucutt	31 July 2013
2013A3	Complete aquatic vegetation sampling for Pools 4, 8, and 13 (Table 1)	Yin, Moore, Langrehr, Petersen	31 August 2013
2013A4	Web-based: Creating surface distribution maps for aquatic plant species in Pools 4, 8, and 13; 2012 data	Yin, Rogala, Schlifer	31 July 2013
2013A5	Wisconsin DNR annual summary report 2012 that combines current year observations from LTRMP with previous years' data, for the fish, aquatic vegetation, and water quality components.	Fischer, Langrehr, Bartels, Giblin, Hoff	30 April 2013
2013A6	Summary graphs 2012: Sampling the impaired reach of the UMR (Pools 2 and 3) for submersed aquatic vegetation using LTRMP methods.	Moore	30 December 2012
2013A7	Draft manuscript: A statistical model of species occupancy using the LTRMP aquatic vegetation data.	Yin	15 July 2013
2013A8	Extension of modeling capabilities for aquatic vegetation	Yin	TBD; see text on page 4
	On-Going		
2012A6	Draft LTRMP completion report: Thirteen years (1998–2011) of aquatic vegetation in Pool 4 of the Upper Mississippi River.	Moore	30 May 2013
	Intended for distribution		

Completion report: LTRMP Aquatic Vegetation Program Review (2007A9; Heglund) (In USGS Review)
Manuscript: Importance of the Upper Mississippi River Forest Corridor to Neotropical Migratory Birds (2007APE1, Kirsch) (Accepted for publication in the Condor)
LTRMP Technical Report: Ecological Assessment of High Quality UMRS Floodplain Forests (2007APE12; Chick, Guyon, Battaglia) (In USGS Review)
LTRMP Technical Report; Experimental and Comparative Approaches to Determine Factors Supporting or Limiting Submersed Aquatic Vegetation in the Illinois River and its Backwaters (2008APE5, Sass) (In USGS Review)
LTRMP completion report: FY05-07 data--Analysis and support of aquatic vegetation sampling data in Pools 6, 9, 18, and 19 (2008APE4a; Yin) (In USGS Review)
Manuscript: Have the recent increases in aquatic vegetation in Pools 5 and 8 been the result of water level management drawdowns, HREPs, or natural fluctuations? (2009APE1a; Yin)

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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 and to conduct research related to fishes for the purpose of understanding resource status and trends, ecological functions, and response to natural disturbances and anthropogenic activities. The UMRS is probably the most biologically productive and economically important large floodplain river system in the United States (Patrick 1998; U.S. Geological Survey 1999), and fish are one of the most important goods and services the UMRS provides to humans (Carlander 1954). Fishes within the UMRS are the subject of commercial and recreational fisheries, both of which contribute substantially to local economies (Fremling et al. 1989). Scientists and fishery managers also recognize fish communities as an integrative index for a complex set of physical and biological conditions on the UMRS. Data are collected within six LTRMP study reaches in the UMRS (Pools 4, 8, 13, and 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). (Strategic Plan Outcome 1; Output 1.1, Outcome 2, Output 2.1 and Outcome 4)

Methods

For monitoring 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 250 and 400 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 3 sampling periods (June 15–July 31; 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

2013B6: Asian carp age and growth

Illinois River Biological Station (IRBS) staff began collecting Asian carp cleithral bones (the major bony component of the pectoral girdle of carp) in 2011 from LTRMP and other projects for future age and growth research. These collections will continue in FY2013. To ensure that a representative sample of the bighead and silver carp populations is obtained from the La Grange Reach, cleithrums are removed from Asian carp captured from all the major habitat strata within this reach of the Illinois River: main channel border (MCB), side channel border (SCB), and backwaters (BW). These collections will be supplemented by information and labor from other ongoing projects at the IRBS funded by the Illinois Department of Natural Resources. We will opportunistically seek funding to process the collections and analyze these data in future years, either through funding sources outside of LTRMP or through a defined project under LTRMP.

Preliminary analyses of a limited number of cleithrum samples will be conducted in FY2013 with the goal of identifying and defining the logistics of laboratory processing efforts needed to age Asian carp with these structures. A summary of progress will be prepared. Age information is critical to learning about growth, recruitment, and mortality of fishes. For invading species, growth is often an early indicator of changes in population density.

2013B7: Asian carp reduction effects

LTRMP staff at IRBS will assist with the ongoing Asian Carp Reduction project led by Dr. Jim Garvey, Southern Illinois University Carbondale. LTRMP-funded staff will provide LTRMP fisheries and water quality data to assist in investigations conducted by Dr. Garvey to assess changes in the fish community associated with reduced Asian carp populations in the Illinois River (project funded through Great Lakes Research Initiative)**.** Initiation and completion of these analyses will depend on when and if the Asian carp reduction goals are achieved. Furthermore, it will take time for the native fish community to respond to reductions in Asian carp populations, so we only anticipate assisting with preliminary analyses during FY2013. These analyses will be conducted by Casper through support from INHS. This work supports Outcome 2.1 of the LTRMP's Strategic Plan to use LTRMP data to provide insights about river process, function, and structure.

2013B8: Rehabilitation of backwater habitat in select Pool 12 backwaters

The USACE Rock Island District has proposed a Habitat Rehabilitation and Enhancement Project (HREP) in several backwater areas in Pool 12 of the UMRS. Project construction is scheduled to begin in FY13-14. Beginning in FY07, the Bellevue LTRMP station, in conjunction with Iowa DNR's Bellevue Fisheries Management station, began collecting pre-project fisheries monitoring data from Pool 12. This work is fully supported by HREP funding from the USACE Rock Island District. The Bellevue LTRMP field station's proximity to the project area allows this work to be conducted at relatively low cost, and uses existing equipment purchased by the LTRMP. We will collect another annual increment of pre-project data in FY2013.

The primary objective of the proposed HREP is to rehabilitate backwater habitat in selected Pool 12 backwaters and improve the fishery resource by increasing overwintering habitat. The "Pool 12 Overwintering" HREP provides an ideal opportunity to assess the effectiveness of overwintering habitat for improving UMR fishery resources. Despite the documented success of HREPs at improving local fish habitat conditions, resource managers on the UMR still seek scientifically quantified information that overwintering HREPs increase the abundance of desirable fish populations at the local and pool scale.

This monitoring will provide several years of "pre-project" fisheries data from Pool 12, and will be carried on for an equal number of years "post-project" (after completion). This work represents a uniquely intensive assessment of the local (individual backwater), backwater aquatic area (all backwaters within a navigation pool), and pool-scale (all aquatic area within a navigation pool) effects of off-channel fish habitat improvement in a UMR pool. We intend to test the following hypothesis: Backwater rehabilitation as implemented through HREP projects on the UMR improves centrarchid population abundance, biomass, and fish available to the recreational creel at the individual-backwater, backwater aquatic area, and pool scale.

This work will directly address the subject of availability of overwintering habitat as a limiting factor for UMR fish populations. This will provide river managers with science-based results of the application of habitat management, which is critical to the optimal use of available fiscal resources, and will subsequently benefit the UMR and UMR users. The sampling design used for the assessment incorporates use of Pool 13 fisheries data collected under standard LTRMP protocols as a "control," with hierarchically structured sampling and assessment of treatment effects in Pool 12 (i.e., assessment at the pool, backwater habitat, and individual backwater scales). This work supports Outcome 3.1 of the LTRMP's Strategic Plan to use LTRMP infrastructure, data sets, and expertise to help formulate, design, and evaluate ecological restoration projects.

2013B9: Fisheries Monitoring in Pool 13, Upper Mississippi River, 2012

This State report contains summaries and analyses of selected features of fish communities and fish populations from data collected since the LTRMP fish component was initiated on Pool 13. This report will focus on: 1) the relative abundance of commonly collected species; 2) trends in catch-per-unit-effort (CPUE) of selected game and prey species; and, 3) the detection of uncommon or rare species. This work supports Output 4.1 the LTRMP's Strategic Plan: Enhanced ecological understanding to inform decisions.

2013B10: Database addition; Special Project—Stratified random day electrofishing samples collected in Pools 16–19

The Iowa DNR's Fairport Fisheries Management Station has six years of what we to perceive to be the equivalent of LTRMP "outpool sampling" data (2006–present) This data will potentially bridge the gap of the fundamental lack of consistent and standardized fisheries information between key LTRMP pools—Pools 13 and 26, in this case. Species richness and relative abundance are among some the fisheries metrics that can be gleaned from this data, and they can be directly compared to similar metrics in the LTRMP key pools. This data may also serve as a control to assess natural variation when evaluating fisheries responses to HREP projects. This is something that the larger contingencies of river managers have asked for a long time. At this time, this project only includes data storage. No plans currently exist within LTRMP to analyze these data unless funding becomes available. This work supports Outcome 1; output 1.4 of the LTRMP's Strategic Plan: Enhanced knowledge about system status and trends.

2013B11: Database addition; Special Project—Stratified random day electrofishing samples collected in Pools 9 and 10.

The Iowa DNR's Guttenberg Fisheries Management Station began collecting SRS fisheries data in Pools 9 and 10 this summer. These data will expand the spatial extent of the current LTRMP sampling. Species richness and relative abundance are among some the fisheries metrics that can be gleaned from these data, and they can be directly compared to similar metrics in the LTRMP key pools. These data may also serve as a control to assess natural variation when evaluating fisheries responses to HREP projects. At this time, this project only includes data storage. No plans currently exist within LTRMP to analyze these data unless funding becomes available. This work supports Outcome 1; output 1.4 of the LTRMP's Strategic Plan: Enhanced knowledge about system status and trends.

2013B13: Quality assurance results for the LTRMP Fish Component: Mapping of the electrical fields on the new fleet of electrofishing boats.

In a highly standardized field sampling program like the LTRMP, it is necessary to ensure, through quality assurance audits, that field equipment is performing as originally designed and specified. River management and rehabilitation uses LTRMP data heavily to site, prioritize, and design projects. This requires unimpeachable data, comparable over time and space. This study assesses and assures such for the sampling method in the LTRMP fish component. The draft report—a posterity document empirically confirming conformity to, and continuity in, protocols and sampling specifications within the new electrofishing fleet—will be developed and include empirically measured and constructed maps of the electrical field emanating from each LTRMP electrofishing boat operating under standardized protocols. This work supports Strategic Plan outcome 1, output 1.1 and Strategy 2.

2013B14: LTRMP fish component hoop net study: results from comparative *in situ* bait trials seeking comparable substitute bait for LTRMP hoop net sampling.

In a highly standardized field sampling program like the LTRMP, it is necessary to ensure data continuity and empirical integrity in core sampling efforts, even when conditions arise that require modifications in methodology. Our previous manufacturer of bean cake does not expect to continue production of our standard bait, used for >20 years, into the future. We seek a comparable alternative with non-significant impacts on observed catches. River management and rehabilitation uses LTRMP data heavily to site, prioritize, and design projects. This requires unimpeachable data, comparable over time and space. This study seeks to assure such under by finding new substitute bait for standardized LTRMP hoop net sampling efforts. This work builds on 2012 field sampling (2012B16). This work supports Strategic Plan outcome 1, output 1.1.

2013B15: Assorted solicited blogs (N=4) for The Nature Conservancy's Great River Partnership (GRP)

The GRP has leveraged heavily in the past four years with LTRMP to advance global river conservation and science, largely through a program of technical and scientific exchange led by the LTRMP. Correspondingly, UMRR-EMP has become a notable program with global recognition and impact. There are now opportunities to advance a vision for large river conservation and science beyond the Upper Mississippi River Basin and to relate and translate lessons learned in the UMRS across the world. Great Rivers are rare entities on planet Earth. Moreover, they are all heavily impacted and used by humans everywhere they occur. Correspondingly, the future of great rivers will depend heavily on the efficacy of great river management and science, which will in turn depend on the ability to share and convey lessons, methodologies, and practices. http://www.greatriverspartnership.org/en-us/NewsAndCommunity/pages/Blog.aspx. Fulfills outreach and communication objectives conveyed in the Strategic Plan.

2013B16: Draft Fact Sheet: Tree map tool for visualizing fish data, with example of native versus non-native fish biomass.

Squarified treemaps are a way of representing large amounts of hierarchal data. Treemaps can display multiple types of information simultaneously using color and area. The LTRMP fisheries database is a perfect fit for using treemaps to query and display information. Use of Treemaps represents a substantial improvement in methods of calculating and displaying fish data for users, and a new web page was developed to provide access to this tool for the partnership (www.umesc.usgs.gov/data_library/fisheries/graphical/treemap/ltrmp_treemap.html). This fact sheet will explore the LTRMP treemap application explaining the advantages of this method and its uses. The fact sheet will present a case study of its use for calculating and displaying information on the abundance and distribution of native and non-native fishes among LTRMP reaches. This product replaces previous product 2007B4 because the improvement in analytical methods and development of a new web page is best presented in a Fact Sheet. (Strategic Plan Outcome 4.)

2013B17: Shovelnose sturgeon habitat use in the Upper Mississippi River

We will examine existing data (MDC and LTRMP) to determine the habitats used by size class of shovelnose sturgeon in the Upper Mississippi River. Several manuscripts authored by Open River and Wetlands field station staff have been published using these data in recent years and additional products are in preparation or have been submitted. This framework follows Output 2.1 of the LTRMP's Strategic Plan to provide insights about river structure, and composition, and Outcome 4, to provide enhanced ecological understanding to inform management decisions. This work is fully supported by funding from the MDC for operational and technical aspects, with consultation and oversight of analyses provided by LTRMP staff. This provides an example of leveraging LTRMP expertise to provide wider benefits to the knowledge of the river. Data sets, analysis, presentations and manuscript will be prepared.

2013B18: Evaluation of American eel abundance

American eel are thought to be in serious decline in abundance throughout the range. LTRMP fisheries data will be examined for determining trends in abundance within the system. This framework follows Output 2.1 of the LTRMP's Strategic Plan to provide insights about river structure, and composition, and Outcome 4, to provide enhanced ecological understanding to inform management decisions. This work is fully supported by funding from the MDC for operational and technical aspects, with consultation and oversight of analyses provided by LTRMP staff. This provides an example of leveraging LTRMP expertise to provide wider benefits to the knowledge of the river. Data sets, analysis, presentations and manuscript will be prepared.

2013B19: Channel catfish habitat evaluation

Channel catfish are a popular sport and commercial fish species. Habitat changes within the UMR may be affecting many fish species—but in particular channel catfish. Dynamic rate functions (growth, recruitment, mortality) will be investigated within the channel catfish population and within habitats of the UMR reach of the Big Rivers and Wetlands Field station using existing data from LTRMP and MDC. This framework follows Output 2.1 of the LTRMP's Strategic Plan to provide insights about river structure, and composition, and Outcome 4, to provide enhanced ecological understanding to inform management decisions. This work is fully supported by funding from the MDC for operational and technical aspects, with consultation and oversight of

analyses provided by LTRMP staff. This provides an example of leveraging LTRMP expertise to provide wider benefits to the knowledge of the river. Data sets, analysis, presentations and manuscript will be prepared.

2013B20: Sauger life history in the lower portion of the Upper Mississippi River

Thorough knowledge of sauger population dynamics is essential for understanding their population. However, no formalized baseline data exists for the population within Pool 22 of the Upper Mississippi River even though similar habitat modifications and exploitation exist. Because of the lack of data, we sought to evaluate the baseline dynamic rate functions (i.e., recruitment, growth and mortality) using an available commercial fishing database. In addition, because there is an interaction between reproductive ecology and the dynamic rate functions, we also assessed the reproductive characteristics of this population. This framework follows Output 2.1 of the LTRMP's Strategic Plan to provide insights about river structure, and composition, and Outcome 4, to provide enhanced ecological understanding to inform management decisions. This work is fully supported by funding from the MDC for operational and technical aspects, with consultation and oversight of analyses provided by LTRMP staff. This provides an example of leveraging LTRMP expertise to provide wider benefits to the knowledge of the river. Data sets, analysis, presentations and manuscript will be prepared.

2013B21: A comparison of methods to estimate shovelnose sturgeon mortality in the Mississippi River adjacent to Missouri.

Catch-at-age data are commonly collected for commercially exploited species, and thus, these data are often used to estimate mortality. However, bias or variance in aging data can influence mortality estimators using catch-at-age data. It has been documented that sturgeon species are difficult to age and shovelnose sturgeon ages derived from this method have not been validated. Furthermore, little catch-at-age data has been collected directly from the commercial catch. It was unclear of the many methods available to estimate mortality, which method provides the most reliable estimate. We sought to evaluate shovelnose sturgeon mortality using three common methods; Heincke's method, a linearized weighted catch curve, and an open system mark-recapture mortality approach. We will use existing data from LTRMP and MDC. This framework follows Output 2.1 of the LTRMP's Strategic Plan to provide insights about river structure, and composition, and Outcome 4, to provide enhanced ecological understanding to inform management decisions. This work is fully supported by funding from the MDC for operational and technical aspects, with consultation and oversight of analyses provided by LTRMP staff. This provides an example of leveraging LTRMP expertise to provide wider benefits to the knowledge of the river. Data sets, analysis, presentations and manuscript will be prepared.

2013B22: Determining environmental history of three sturgeon species in the Upper, Middle and Lower Mississippi Rivers

Sturgeon recovery is currently managed at a basin-specific scale, although individuals are clearly moving among them and population dynamics are interdependent. Central to management and recovery is an estimate of the abundance of the remaining fish. Population size in all reaches of the Mississippi River may fluctuate depending on seasonal movement within the river as well as from the Missouri River and time of capture. Similarly, the source of recruitment, which drives

population size, is unknown in the MMR. Phelps used microchemistry to demonstrate that larval shovelnose sturgeon in the MMR may originate as far north as Gavins Point in the Missouri River. These data need to be collected for pallid sturgeon, lake sturgeon and shovelnose sturgeon by staff from MDC. The goals of this study are 1) to refine population viability models for the MMR and the LMR by assessing the relative contribution of sturgeon adults in these reaches from the Missouri River 2) Assess the potential contribution of the river reaches to recruitment of sturgeon in the MMR and LMR. This framework follows Output 2.2 of the LTRMP's Strategic Plan to provide insights about river structure, and composition, and Outcome 4, to provide enhanced ecological understanding to inform management decisions. This work is fully supported by funding from the MDC for operational and technical aspects, with consultation and oversight of analyses provided by LTRMP staff. This provides an example of leveraging LTRMP expertise to provide wider benefits to the knowledge of the river. Data sets, analysis, presentations and manuscript will be prepared.

2013B23: Early Life History and Habitat use of Age-0 Blue Catfish in the Unimpounded Middle Mississippi River

There has been a great interest recently in the management of blue catfish (*Ictalurus furcatus*) due to increased recreational (trophy fisheries), commercial fishing, and their potential role in helping control introduced fish species. With this being said, blue catfish early-life history traits are relatively unknown. Therefore we seek to evaluate age-0 blue catfish abundance, hatch time, growth, and survival in an unimpounded reach of the Mississippi River during 2003-2010 using primarily LTRMP data supplemented by data from MDC projects. This framework follows Output 2.1 of the LTRMP's Strategic Plan to provide insights about river structure, and composition, and Outcome 4, to provide enhanced ecological understanding to inform management decisions. The operational and technical aspects of this work are fully supported by funding from the MDC, with oversight of analyses and writing provided by LTRMP staff. This provides an example of leveraging LTRMP expertise to provide wider benefits to the knowledge of the river. Data sets, analysis, presentations and manuscript will be prepared.

2013B24: A pilot evaluation of the commercial and recreational harvest of paddlefish (*Polyodon spathu*la) in Missouri.

The Paddlefish population in Missouri is valued and harvested by both a recreational and commercial fishery. Seven of the twenty-six Mississippi River basin states allow commercial harvest while 15 of 26 allow a recreational fishery. The existing recreation and commercial harvest in Missouri is managed by differing regulations—with recreational harvest being more restrictive. In addition, regulations differ among the seven states for the commercial fishery in the Mississippi River basin with Missouri harvest being the most liberal. Further information is needed on population demographics within Missouri. Information including growth rate, age at maturation, gonadosomatic index, and relative weights will be calculated by sampling the portions of the population(s) relative to each fishery. It is critical to evaluate both the recreational and commercial fishery co-incidentally because of the prevalent perception that one contributes to a greater harvest than the other. This approach encourages buy-in from both harvest mode constituents and further exhibits transparency of the agency in establishing cooperation in managing a valuable recreational and commercial fishery. This framework follows Output 2.2 of the LTRMP's Strategic Plan to provide insights about river structure, and composition, and Outcome 4, to provide enhanced ecological understanding to inform management decisions. This

work is fully supported by funding from the MDC through a contract to Southeast Missouri State University to support a graduate student. Dr. Quinton Phelps is a member of the student's committee. This provides an example of leveraging LTRMP expertise to provide wider benefits to the knowledge of the river. Data sets, analysis, presentations and manuscript will be prepared.

2013B25: Evaluation of silver carp ages derived from seven bony structures in Midwestern U.S. Rivers: Implications for management of invasive populations

Because of the lack of consensus and because there has been no formal comparative evaluation of silver carp aging structures, we seek to evaluate seven bony structures (scales, opercles, vertebrae, pectoral fin rays, postcleithra, asterisci and lapilli otoliths) that are commonly used for aging freshwater fish. Because some agencies may have concern with regards to removal and processing times and may sacrifice accuracy or precision to minimize the amount of effort, our first objective is to compare removal and processing times associated with each bony structure. Along with the importance of removal and processing times, as noted above, proper ages are essential when acquiring population demographics of silver carp. Our second objective is to determine whether age estimates from seven structures (scales, opercles, vertebrae, pectoral fin rays, postcleithra, asterisci and lapilli otoliths) would have discernible annuli and to compare precision among structures. Our last objective is to evaluate demographic information obtained with all aging structures and use these data to simulate population responses (via spawning potential ratio model) using different levels of exploitation. This would further aid in our decision in determining which structure(s) should be used for aging the invasive silver carp. This framework follows Output 2.2 of the LTRMP's Strategic Plan to provide insights about river structure, and composition, and Outcome 4, to provide enhanced ecological understanding to inform management decisions. This work is fully supported by funding from the MDC through a contract to Southeast Missouri State University to support a graduate student. Dr. Quinton Phelps is a member of the student's committee. This provides an example of leveraging LTRMP expertise to provide wider benefits to the knowledge of the river. Data sets, analysis, presentations and manuscript will be prepared.

2013B27: UMRR-EMP LTRMP Capability Related to Asian Carp

This white paper is intended to provide a framework in which the LTRMP element may increase the level of coordination between researchers and field stations, provide a systemic perspective of the role of the Program in documenting baseline conditions and changes over time, and identify possible opportunities for how the LTRMP element may assist in compatible efforts within the UMRS.

2013B28: Annotated empirical response curves for Upper Mississippi River System fishes

Environmental management actions in the Upper Mississippi River System typically require pre-project assessments of presumptive benefits under a range of project scenarios. The U.S. Army Corps of Engineers now requires certified models to conduct these assessments. Previously, benefits for fish communities were estimated using the Aquatic Habitat Appraisal Guide (AHAG) v.1.0. This spreadsheet-based habitat suitability index (HSI) approach draws upon Habitat Evaluation Procedures (HEP) developed by the USFWS (USFWS 1980). The HSI approach uses species response curves (typically using abundance as the biological response) for various

environmental variables that seek to broadly represent habitat. To date, the AHAG model used by the Corps simply uses species-specific response curves, often assembled from either the literature values, data from other ecosystems, or best professional judgment.

In a recent review of the AHAG for the Corps, Abt Associates Inc. (2011) found the model's effectiveness is reduced by its dated approach to large river ecosystems, uncertainty regarding its data inputs and rationale for habitat-species response relationships, and lack of field validation. Reviewers made two major recommendations: (1) using data from the UMR to define response curves, and (2) using post-project biological monitoring to evaluate whether pre-project benefits estimated by AHAG were achieved. This project addresses the first of these recommendations by using LTRMP data to generate updated response curves for an updated AHAG model (v.2.0).

Task 1: Canvass available data resources relative to extant AHAG biological and environmental response variables

The present AHAG model (v.1.0), including available biological response metrics and their environmental covariates, will be assessed relative to LTRMP data. Fisheries sampling with LTRMP uses a variety of standardized gears to observe the full community (relative abundance of 142 species), and records several dozen environmental characteristics at each sampling site. These data will be canvassed for biological and environmental response variables with utility to AHAG advancement.

Task 2: Identify a list of biological responses to be used in AHAG v.2.0

A list of biological responses to incorporate into AHAG v.2.0 will be coordinated with model developers and users, and will include species representing lotic and lentic habitat guilds. Considerations will include (1) assuring sufficient non-zero observations are available per species to develop empirical relationships with environmental variables; (2) representativeness of each species within each of the guild categories; and (3) general relationship(s) to management actions for which AHAG will be applied. An initial list of biological responses, including their guild membership, is presented in Figure 1. Selected biological responses will be both modeled as abundance (total catch or CPUE).

Task 3: Assemble all environmental responses observed at the LTRMP fish collection site

Environmental variables observed at each LTRMP fish sampling site will be assembled and formatted in preparation for generating empirical response curves for selected biological responses (see Step 2 above). Environmental variables from LTRMP fish sampling, with possible utility to this work, are presented in Table 1.

Task 4: Fit biological response models

Unimodal response functions will be fit to each combination of biological response (fish abundance) and environmental response variable. Inferential statements on the strength of correlation, the direction of the association (e.g., curve slope), and goodness-of-fit statistics will be made using SAS statistical software. Graphical representations of the curves, to include a mathematical representation of the best polynomial fit of the data, will be generated using CurveFitter for Windows v.4.5.8. These equations can be used by model developers to create AHAG v. 2.0. The number of response functions will depend upon the number of species and environmental variables, and the degree to which these are parsed by space (habitat type), time

(seasons), and/or size class of fishes. Initially, we will parse season into two periods. Additional limited exploratory parsing will be considered for size-based biological responses.

Task 5: Prepare and deliver final report
The final report will contain an introductory section followed by descriptions of each response curve, including: (1) a graphical representation of the best fit model; (2) strength of the association; (3) a description of the source data; (4) a mathematical equation representing the curve; (5) assumptions (a) made in the development of the curves, and (b) that may be required in their use; and (6) any additional recommendations regarding application and development for AHAG 2.0.

Staffing: Brian Ickes (UMESC) will assemble and manage a collaborative project team. Nate Richards (USACE, Rock Island) will provide over-sight and direction to ensure the work serves AHAG development.

Figure 1. Prospective species for developing environmental response curves for use in AHAG 2.0.

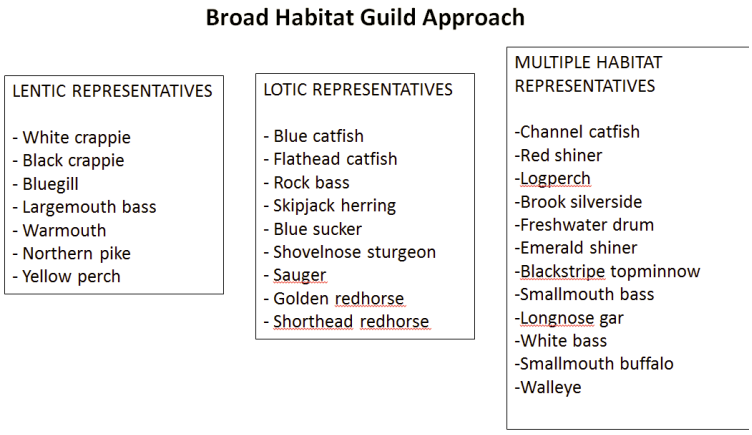

Table 1. Environmental variables observed at UMRR-EMP LTRMP fish component sampling sites in the UMRS.

Variable name	Variable type	Unit(s)
Secchi	Continuous	cm (nearest 1)
Conductivity	Continuous	µS/cm (nearest 1)
Water velocity	Continuous	m/s (nearest 0.1)
Water temp	Continuous	^{o}C (nearest 0.1)
Dissolved Oxygen	Continuous	mg/L (nearest 0.1)
Depth	Continuous	m (nearest 0.1)
Stage height (optional)	Continuous	feet (nearest 0.01)
% emergent and submersed veg	Categorical (4 categories)	%
Vegetation Density	Categorical (2 categories)	scaleless
Predominant substrate	Categorical (4 categories)	descriptive

Other structures	Binomial	Presence absence
Woody debris	Binomial	Presence absence
Tributary mouth	Binomial	Presence absence
Inlet/outlet channel	Binomial	Presence absence
Flooded terrestrial	Binomial	Presence absence
Wing dam/dyke	Binomial	Presence absence
Revetment	Binomial	Presence absence
Low-head dam, closing structure, weir	Binomial	Presence absence
Other	Binomial	Presence absence

2013B29: Refinement of Fish Component Hoop net study: Field sampling Open River

In 2012, the LTRMP fish component staff undertook paired hoop net bait trials in Pool 8 and Open River to identify and evaluate alternative and demonstrably equivalent bait, required to maintain standardized sampling efforts in the LTRMP Fish component (see 2012B16; 2012B14). The Open River study location was chosen to maximize differences in flow environments across the study. However, given the drought in 2012, this study objective was at least partially compromised. Several issues preclude a definitive conclusion on bait effects on catch for the Open River locality. First, due to drought issues, pre-defined sampling requirements to achieve a stated effect size at a given level of confidence, were compromised. Secondly, catches during the 2012 assessment were much more variable that historically observed, and upon which sample size requirements were determined a priori, perhaps also a consequence of low flow and river stages through the drought period. Correspondingly, post hoc power assessments demonstrated that the intended power of the sampling design was compromised by these issues. Given the unusual circumstance of the drought of 2012, we will repeat the Open River study again in 2013, considering the assessment complete for the Pool 8 study area. An addendum of the 2013 findings will be added to the 2012 summary letter in FY14. This work supports Outcome 1 of the LTRMP's Strategic Plan: Enhanced knowledge about system status and trends.

Products and Milestones

Tracking number	Products	Staff	Milestones
2013B1	Complete data entry, QA/QC of 2012 fish data; ~1,590 observations		
	a. Data entry completed and submission of data to USGS	DeLain, Bartels, Bowler, Ratcliff, Gittinger, West, Solomon, Michaels	31 January 2013
	b. Data loaded on level 2 browsers; QA/QC scripts run and data corrections sent to Field Stations	Schlifer	15 February 2013
	c. Field Station QA/QC with corrections to USGS	DeLain, Bartels, Bowler, Ratcliff, Gittinger, West, Solomon, Michaels	15 March 2013
	d. Corrections made and data moved to public Web Browser	Sauer and Schlifer	30 March 2013
2013B2	Update Graphical Browser with 2012 data on Public Web Server.	Sauer, DeLain, Bartels, Bowler, Ratcliff, Gittinger, West, Solomon, Michaels, Schlifer	31 May 2013
2013B3	Complete fisheries sampling for Pools 4, 8, 13, 26, the Open River, and La Grange Pool (Table 1)	Ickes, DeLain, Bartels, Bowler, Ratcliff, Gittinger, West, Solomon, Michaels	31 October 2013
2013B4	Draft LTRMP completion report: Summary of data extraction and metadata for archiving of UMRS floodplain disturbance histories. (2008APE1a; Task 1)	Ickes	1 June 2013
2013B5	Final Draft LTRMP fisheries component procedures manual	Ratcliff, Gittinger, Ickes	15 February 2013
2013B6	Asian carp age and growth: collection of	Solomon, Michaels	30 September 2013

	cleithral bones and Summary Letter on progress in methodology.		
2013B7	Asian carp reduction: delivery of LTRMP WQ and Fisheries Data	Solomon, Michaels	30 September 2013
2013B8	Database increment: Rehabilitation of backwater habitat in select Pool 12 backwaters	Bowler	30 September 2013
2013B9	IDNR Fisheries Management State Report: Fisheries Monitoring in Pool 13, Upper Mississippi River, 2012	Bowler	30 June 2013
2013B10	Database increment: Stratified random day electrofishing samples collected in Pools 16–19	Bowler	30 September 2013
2013B11	Database increment: Stratified random day electrofishing samples collected in Pools 9 and 10	Bowler	30 September 2013
2013B12	Final draft LTRMP report: Testing the Fundamental Assumption underlying the use of LTRMP fish data: Does variation in LTRMP catch-per-unit-effort data reflect variation in the abundance of fishes? (2007APE3)	Chick	30 September 2013
2013B13	Quality assurance results for the UMRR-EMP-LTRMP Fish Component: Mapping of the electrical fields on the new fleet of electrofishing boats. (Internal document)	Ickes,DeLain, Bartels, Bowler,Ratcliff and Gittinger, Solomon and Michaels, West	30 March 2013
2013B14	LTRMP fish component hoop net study: results from comparative in situ bait trials seeking comparable substitute bait for LTRMP hoop net sampling. (see 2012B16; Internal document)	Ickes,DeLain, Bartels, Bowler,Ratcliff and Gittinger, Solomon and Michaels, West	30 March 2013
2013B15	Assorted solicited blogs (N=4) for The Nature Conservancy's Great River Partnership (GRP)	Ickes	30 September 2013
2013B16	Draft fact sheet: Tree map tool for visualizing fish data, with example of native versus non-native fish biomass.	Schlifer	30 September 2013
2013B17	Shovelnose sturgeon habitat use in the UMR (Data sets, analysis, presentations and manuscript)	Phelps	30 September 2013
2013B18	Evaluation of American eel abundance (Data sets, analysis, presentations and manuscript)	Phelps	30 September 2013
2013B19	Channel catfish habitat evaluation (Data sets, analysis, presentations and manuscript)	Phelps	30 September 2013
2013B20	Sauger life history in the lower portion of the Upper Mississippi River (Data sets, analysis, presentations and manuscript)	Phelps	30 September 2013
2013B21	A comparison of methods to estimate shovelnose sturgeon mortality in the Mississippi River adjacent to Missouri (Data sets, analysis, presentations and manuscript)	Phelps	30 September 2013
2013B22	Determining environmental history of three sturgeon species in the Upper, Middle and Lower Mississippi Rivers (Data sets, analysis, presentations and manuscript)	Phelps	30 September 2013
2013B23	Early Life History and Habitat use of Age-0 Blue Catfish in the Unimpounded Middle Mississippi River (Data sets, analysis, presentations and manuscript)	Phelps	30 September 2013
2013B24	A pilot evaluation of the commercial and recreational harvest of paddlefish (*Polyodon spathula*) in Missouri (Data sets, analysis,	Phelps	30 September 2013

	presentations and manuscript)		
2013B25	Evaluation of silver carp ages derived from seven bony structures in Midwestern U.S. Rivers: Implications for management of invasive populations (Data sets, analysis, presentations and manuscript)	Phelps	30 September 2013
2013B26	White paper: UMRR-EMP LTRMP Capability Related to Asian Carp	Hubbell, Chick, Casper, Phelps, Solomon, Ickes, and Lubinski	30 June 2013
2013B27	Draft completion report for review: Empirical response curves for Upper Mississippi River fishes	Ickes, Richards	28 October 2013
2013B29	Refinement of the Fish Component Hoop net study: Field sampling Open River (see 2012B16; 2012B14)	Ickes, Phelps, and West	31 October 2013
	On-Going		
2006B6	Draft manuscript: Spatial structure and temporal variation of fish communities in the Upper Mississippi River. (Dependent on 2008B9 acceptance into journal)	Chick	TBD
2008B9	Draft manuscript: Standardized CPUE data from multiple gears for community level analysis (a previous manuscript was submitted and rejected by the journal, 2006B5; 2008B9 is a revised manuscript) (Chick)	Chick	30 Sept 2013
	Intended for distribution		
Completion report: LTRMP Fisheries Component collection of six darter species from 1989–2004. (2006B13; Ridings) (In USGS Review)			
LTRMP Report: An Evaluation of Macroinvertebrate Sampling Methods For Use In The Open River Reach of The Upper Mississippi River; Kathryn N. S. McCain, Robert A. Hrabik, Valerie A. Barko, Brian R. Gray, and Joseph R. Bidwell (2005C2) (In USGS Review)			
LTRMP technical report: Relationship of juvenile abundance of select fish species to aquatic vegetation in Navigation Pools 4, 8, and 13 of the Upper Mississippi River, 1998-2007 (2007B5; 2009B5; Popp and DeLain) (In USGS Review)			
LTRMP technical report; Setting quantitative fish management targets for LTRMP monitoring (2008APE2; Sass) (In USGS Review)			
LTRMP report: Testing the Fundamental Assumption underlying the use of LTRMP fish data: Does variation in LTRMP catch-per-unit-effort data reflect variation in the abundance of fishes? (2007APE3; Chick) (In USGS Review)			
Completion report, compilation of 3 years of sampling: Fisheries (2009R1Fish; Chick et al.) (In USGS Review)			
Manuscript: Sturgeon Life History on the UMR (2012B5; Phelps)			
Manuscript: American eel population characteristics in the Upper Mississippi River (2012B7; Phelps)			
Manuscript: Phelps, Q. E. and D. W. Willis. 2013. Development of an Asian Carp Size Structure Index and Application through Demonstration, North American Journal of Fisheries Management, 33:2, 338-343			

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U.S. Geological Survey (USGS). 1999. Ecological status and trends of the Upper Mississippi River system 1998. A report of the Long Term Resource Monitoring Program. U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, Wisconsin. LTRMP 99-T001. 236 pp.

Water Quality Component

The objective of the LTRMP's water quality component is to conduct monitoring and research 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. The water quality component focuses on a subset of limnological variables related to habitat quality and ecosystem function that includes physicochemical features, suspended sediment, and major plant nutrients known to be significant to aquatic habitat in this system.

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). (Strategic Plan Outcome 1; Output 1.1, Outcome 2, Output 2.1 and Outcome 4)

Methods

For monitoring water quality, 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.

Fixed site sampling

Fixed site sampling will be conducted as in FY2006 except for modifications made in 2010 for Pool 4 and Pool 8 (Table 1).

Stratified random sampling

Stratified random sampling will be conducted at full effort levels (same as FY2000) for fall, 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 chemical analysis (nitrogen (total N, nitrate/nitrite N, ammonia N), phosphorus (Total P, SRP), and silica) will be collected at all fixed sites and at approximately 35% of all stratified random sampling locations as specified in the sampling design. Samples for chlorophyll and suspended solids (total and volatile) will be collected at all SRS and Fixed sites Sampling and laboratory analyses will be performed following LTRMP protocols (Soballe and Fischer 2004) and Standard Methods (American Public Health Association 1992).

Product Descriptions

2013D11 & 2013D12: Measurement of low water velocities in backwaters of the UMR: evaluating the distribution of water velocities that are less than detection using standard velocity meters, and estimating low-level water exchanges and their associations with environmental variables.

Water velocity is an important habitat characteristic, and often one most substantially affected by river management projects (e.g., changing flow through a backwater, reducing flow via island construction, etc.). Rate of water transport is dependent on water velocity and is an important component of a variety of biogeochemical processes (nutrient cycling, oxygen consumption via respiration, etc.) Thus, velocity measurements collected during routine LTRMP WQ monitoring can provide a water exchange metric useful for better understanding for a variety of ecological processes (e.g., nutrient processing) and habitat conditions. Because water velocity is often quite low in backwaters (< 2 cm s-1), a large portion (> 50%) of velocity measurements from backwaters is below the detection limit (BDL) of the standard velocity meter used by LTRMP. However, small differences among these BDL measurements may be important for understanding select ecological conditions (e.g., nutrient and dissolved oxygen concentrations). Furthermore, understanding the numerical distribution of the BDL velocities will substantially improve our analysis of the entire LTRMP water velocity data set (currently, assumptions regarding this distribution are needed for some analyses). LTRMP now has the use of an Acoustic Doppler Velocimeter (ADV; purchased with USGS funding) which is capable of measuring water velocity as low as 0.1 cm s-1. Cost and logistics prevent using such a meter at all field stations, seasons and sites. However, data collected at selected sites as part of selected SRS episodes can provide important information regarding the overall distribution of low water velocities and associated water quality conditions that may be informative for other UMRS reaches and seasons.

The specific objectives of this work are as follows: 1) estimate the distributions of BDL values in LTRMP water velocity data in selected backwaters (FY2013), and 2) use the low water velocity data to determine associations between water movement and important WQ variables during critical seasons (out years). In addition to the standard LTRMP velocity data, velocity measurements using the Acoustic Doppler Velocimeter will be collected for the 2013 winter and summer SRS episodes in Pool 8 of the UMR. The 2013 products are associated with Objective 1 and include: 1) a database of low velocity measurements during the two selected SRS episodes and 2) a draft report describing the observed distribution of velocities. Future products will include a completion report on associations between water velocity and other WQ variables based on analysis of the 2013 data, and development, if warranted, of a project plan for future related studies based on the 2013 findings. This project will provide information relevant to Output 1.1 (e.g., describe distribution of BDL values in current LTRMP data), and continuation of this project will lead to information relevant to Output 2.1 (e.g., associations between low-level exchanges of water and critical WQ parameters that are important to river processes).

2013D13 and 2013D14: Long-term trends in water quality of major tributaries of the UMR

LTRMP has collected water quality data from select major tributaries of the UMR since at least 1993 (1988 for a few tributaries). This data has not been analyzed for trends over this time period.

A recent paper suggest that, despite ongoing changes (often improvements) in land use practices and water treatment plants, nutrient concentrations in the major rivers of the Midwestern USA (i.e., Mississippi, Iowa, Illinois, Missouri and Ohio rivers), little reduction in nitrate transport by these rivers has been observed, and increases have been observed at some sites (Sprague et al. 2011).

The primary source of nutrients (N and P) and sediments to the UMR is tributary input. Long term trends in tributary input provide important context for understanding (and potentially predicting) trends in the UMR itself, and for assessing the impacts of management actions on nutrient and sediment concentrations and flux in the UMR. The effects of management actions within the UMR may be mitigated, or exacerbated by long term trends in tributary inputs.

The objective of this work is to use recently developed statistical methods (Hirsch et al. 2010) to examine LTRMP tributary WQ data (specifically, total nitrogen, nitrate, total phosphorus, soluble reactive phosphorus, and total suspended solids) for evidence of trends over the last 20 years. The Chippewa River (WI), Cannon River (MN), Black River (WI), Maquoketa River (IA), and Wapsipinicon River (IA) were selected for this study based on their intact record of discharge data over the study period (1993 – 2011) as required for the analytical method. In FY2013 we will complete a trend analysis of the tributary data and write a report or draft manuscript. In FY2014, we plan to submit a manuscript for publication. This work will directly address Output 1.1 and 2.1, and may inform activities under Outcome 3.1.

2013D15 & 2013D16: Ongoing project "Nutrients, chlorophyll, and suspended sediments in channel and off-channel areas of the Upper Mississippi River (UMR)" 2012D10

The UMR exhibits considerable spatial variability in WQ. The LTRMP WQ component has been designed to facilitate quantification and description of that variability. Both longitudinal (differences among pools) and lateral (differences among aquatic areas w/in pools) are important. Longitudinal differences have been documented in a peer-reviewed scientific publication (Houser et al. 2010), but lateral differences have not (though preliminary results may be found in Houser et al. 2005). Information on lateral differences is the first step in determining how processes that control water quality can vary locally, the ecological effects of that variation, and what drivers may be involved (such as hydraulic connectivity with the channel). The ability to modify those processes to achieve local management objectives related to water quality may have implications for placement or design of habitat rehabilitation projects. In addition, lateral differences are currently an important issue as the UMRBA works with UMRR-EMP partner states to establish water quality criteria for the UMR (see this report for details: www.umrba.org/publications/wq/umr-wq-science-needs3-3-11.pdf). These multiple management questions indicate a need for a rigorous, peer-reviewed analysis of where and when there are differences in WQ that are of biological significance. The draft manuscript addresses

that need and directly addresses Outcome 1 (Output 1.1) and Outcome 2 (Output 2.1) of the 2010-2014 Strategic Plan.

For FY 2012 a draft of this manuscript was being produced. In FY2013, this draft will be revised and submitted for publication. Also a presentation will be made at a national science meeting regarding the conclusions from this work (most likely the Society for Freshwater Science Annual Meeting).

2013D17: Relationship between the temporal and spatial distribution, abundance, and composition of zooplankton taxa and hydrological and limnological variables in Lake Pepin

Zooplankton are an important link in the food web of most aquatic ecosystems. Surprisingly little information is available about zooplankton in the Upper Mississippi River System (UMRS). Analysis of a 20 year zooplankton data set from Lake Pepin (1993-2012) will provide a greater understanding of the hydrological and limnological factors controlling zooplankton distribution, abundance, and composition in this unique geomorphic feature in the UMRS. This work will provide baseline data and more detailed and up-to-date (six additional years) analysis of previous work (2006D7) by using ordination techniques to investigate the relationship between hydrological and water quality factors and the zooplankton community. Information gained from this effort will be available for future modeling and management decisions on the UMRS. The product of this effort, a manuscript in a peer-reviewed journal, will eventually contribute to outcomes 1 through 4 identified in the Strategic and Operational Plan for the Long Term Resource Monitoring Program and specifically to outputs 1.3, 1.4, 2.1, 3.1, and 4.1. This work may prove especially relevant as planktivorous Asian carps continue to spread throughout the UMRS. The impact caused by these invasive species to zooplankton communities and native fishes is largely unknown.

2013D19: Assessment of the efficacy of monitoring water quality in the UMRS using a YSI real-time Environmental Monitoring System (Pices Platform)

Lewis and Clark Community College recently purchased a YSI Pices Water Quality Monitoring Platform for the National Great Rivers Research and Education Center. The platform includes a YSI Sonde with optical sensors for Temperature, Conductivity, Dissolved Oxygen, pH, Turbidity, Chlorophyll-a, and Blue Green Algae. Additionally, the platform includes a third party (Satlantic) Ultra Violate Nitrate sensor. We will deploy this device near LTRMP fixed water quality sites in Pool 26 to test the accuracy of data from the platform with LTRMP data. Negotiations are underway with the Illinois Department of Transportation regarding the potential to moor the platform to a support pillar of the Clark Bridge, where there are three LTRMP fixed water quality sites. Until that process is complete, however, we are likely to temporarily moor the platform in Ellis Bay near another LTRMP fixed water quality site. Our WQ LTRMP field crew will be involved with deploying the platform, and would spend some time doing maintenance and calibration on the YSI and Satlantic sondes during routine fixed site data collections. Because the ultimate mooring location is still under negotiation, I am only proposing a brief (1-3 page) letter summary detailing what work was done involving LTRMP crews and any preliminary data comparisons that we are able to make. This work builds on the preliminary work done under 2012D15. Reporting will be primarily by the Field Station Leader using state funding. Dependent on funding and final

analysis, a final product for LTRMP (likely a completion report or manuscript) will be developed in subsequent years. (Strategic Plan Outputs 1.1 and 2.1)

Products and Milestones

Tracking number	Products	Staff	Milestones
2013D1 ---------	Complete calendar year 2012 fixed-site and SRS water quality sampling	Houser, Burdis, Giblin, Kueter, L. Gittinger, Cook, Sobotka	31 December 2012
2013D2	Complete laboratory sample analysis of 2012 fixed site and SRS data; Laboratory data loaded to Oracle data base.	Yuan, Schlifer	15 March 2013
2013D3	1st Quarter of laboratory sample analysis (~12,600)	Yuan, Kreiling, Manier, Burdis, Giblin, Kueter, L. Gittinger, Cook, Sobotka	30 December 2012
2013D4	2nd Quarter of laboratory sample analysis (~12,600)	Yuan, Kreiling, Manier, Burdis, Giblin, Kueter, L. Gittinger, Cook, Sobotka	30 March 2013
2013D5	3rd Quarter of laboratory sample analysis (~12,600)	Yuan, Kreiling, Manier, Burdis, Giblin, Kueter, L. Gittinger, Cook, Sobotka	29 June 2013
2013D6	4th Quarter of laboratory sample analysis (~12,600)	Yuan, Kreiling, Manier, Burdis, Giblin, Kueter, L. Gittinger, Cook, Sobotka	28 September 2013
2013D7	Complete QA/QC of calendar year 2012 fixed-site and SRS data.		
	a. Data loaded on level 2 browsers; QA/QC scripts run; SAS QA/QC programs updated and sent to Field Stations with data.	Schlifer, Rogala, Houser	30 March 2013
	b. Field Station QA/QC; USGS QA/QC.	Houser, Rogala, Burdis, Giblin, Kueter, L. Gittinger, Cook, Sobotka	15 April 2013
	c. Corrections made and data moved to public Web Browser	Rogala, Schlifer, Houser	30 April 2013
2013D8	Complete FY12 fixed site and SRS sampling for Pools 4, 8, 13, 26, Open River, and La Grange Pool (Table 1)	Houser, Burdis, Giblin, Kueter, L. Gittinger, Cook, Sobotka	30 September 2013
2013D9	WEB-based annual Water Quality Component Update with 2012 data on Public Web Server.	Rogala	30 May 2013
2013D10	Final draft LTRMP Completion Report: Changes in substrate, water quality, aquatic vegetation, zooplankton, and fish community from Geomorphic Reach 1 (above Lake Pepin) to Geomorphic Reach 3 (below Lake Pepin). 2010D6	Popp, De Lain, Burdis, Moore	30 September 2013
2013D11	Database low water velocity measurements collected by the ADV.	Rogala, Houser, Gray, Giblin	28 September 2013
2013D12	Draft completion report summarizing the distribution of water speed for typically BDL values.	Rogala, Houser, Gray, Giblin	28 September 2013
2013D13	Completed trend analysis of tributary nutrient and sediment data	Houser, Kreiling	1 June 2013
2013D14	Report or draft manuscript describing trend analysis results	Houser, Kreiling	1 September 2013
2013D15	Manuscript revised and submitted for publication (Nutrients, chlorophyll, and suspended sediments in channel and off-channel areas of the Upper Mississippi River)(2012D10)	Houser	1 August 2013

2013D16	Presentation at national science meeting (pending funds and USGS approval)		Houser		1 September 2013
2013D17	Draft manuscript: Relationship between the temporal and spatial distribution, abundance, and composition of zooplankton taxa and hydrological and limnological variables in Lake Pepin		Burdis		30 December 2013
2013D19	Letter Summary: Assessment of the efficacy of monitoring water quality in the UMRS using a YSI real-time Environmental Monitoring System (Pices Platform) (continued work on 2012D15)		Chick, L. Gittinger, Lubinski		31 October 2013

Intended for distribution
Completion report: Examining nitrogen and phosphorus ratios N:P in the unimpounded portion of the Upper Mississippi River (2006D9; Hrabik & Crites) (In USGS Review)
LTRMP report: retrospective, cross-component analysis for Pool 26. (2005APE26; Chick) (In USGS Review)
LTRMP report: Main channel/side channel report for the Open River Reach. (2005D7; Hrabik) (In USGS Review)
Manuscript: Ecosystem metabolism in the main channel and backwaters of the Upper Mississippi River: the role of submersed vegetation and hydraulic connectivity. (2008D8; Houser et al.) (In review)
Bulletin Illinois Natural History Survey (changed from LTRMP report): A Decade of Monitoring on Pool 26 of the Upper Mississippi River: Water Quality and Fish Data with Cross Component Analyses (Chick et al.; 2005APE26) (Accepted pending revisions)
Manuscript: Causes and consequences of metaphyton abundance in backwater lakes of the UMR near La Crosse, Wisconsin. (2009APE3, Houser)
Manuscript: Lateral contrasts in nutrients, chlorophyll, and suspended solids within the Upper Mississippi River System (2012D10; Houser) (In review)
Completion report, compilation of 3 years of sampling: Water Quality (2009R1WQ; Giblin, Burdis) (In USGS Review)
Manuscript: Temporal evaluation of factors influencing metaphyton biomass, distribution and composition within UMR backwaters (2010out2a; Giblin et al)
Manuscript: Kreiling, R. M., J. P. Schubauer-Berigan, W. B. Richardson, L. A. Bartsch, P. E. Hughes, J. C. Cavanaugh, and E. A. Strauss. 2013. Wetland management reduces sediment and nutrient loading to the Upper Mississippi River. Journal of Environmental Quality 42:562-572. Partial funding by UMRR-EMP LTRMP leveraged with funding by an Interagency Agreement between the USEPA and the USGS (DW14996301)

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Houser, J. N., editor. 2005. Multiyear synthesis of limnological data from 1993 to 2001 for the Long Term Resource Monitoring Program. Final report submitted to the U.S. Army Corps of Engineers from the U.S. Geological Survey, Upper Midwest Environment Sciences Center, La Crosse, Wisconsin, March 2005. LTRMP Technical Report 2005-T003. 59 pp. (NTIS PB2005-105228)

Houser, J.N., D.W. Bierman, R.M. Burdis, and L.A. Soeken-Gittinger. 2010. Longitudinal trends and discontinuities in nutrients, chlorophyll and suspended solids in the Upper Mississippi River: implications for transport, processing, and export by large rivers. Hydrobiologia 651:127–144.

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Center, La Crosse, Wisconsin, March 2004. LTRMP 2004-T002-1 (Ref. 95-P002-5). 73 pp. + Appendixes A-J.

Sprague, L.A., R. M. Hirsch, B.T. Aulenbach. 2011. Nitrate in the Mississippi river and its tributaries, 1980 to 2008: are we making progress? Environmental Science & Technology 45:7209-7216.

Upper Mississippi River Basin Water Quality-Related Science Needs (March 3, 2011). Provided to U.S. EPA Region 7 from the Upper Mississippi River Basin Association Water Quality Executive Committee. http://www.umrba.org/publications/wq/umr-wq-science-needs3-3-11.pdf

Land Cover/Land Use with GIS Support

In FY2010-11, systemic digital aerial photography was collected in cooperation with USFWS Region 3. The main task under Land Cover/Land Use will be in processing these data (See Development of 2010/11 Land Cover/Land Use GIS Database and Aerial Photo Mosaics). (Strategic Plan Outcome 1; Output 1.1)

However, we will continue to 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, Habitat Rehabilitation and Enhancement Projects (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 data set
- Conversion of all georeferenced data to a common projection and datum for ease of use in a GIS
- Conversion of all new GIS data to KMZ (Google Earth) formats for ease of viewing and sharing (as requested).
- Maintain, update, and oversee the aerial photo library of over 50,000 print and digital images.
- Maintain, update, and enhance over 20 million acres of land cover/land use and aquatic areas data spanning the late 1800s through the year 2000. This includes improving existing or developing new crosswalks for comparison of existing data sets, cropping data sets to common extents, and ensuring that all data sets are in a common coordinate system.
- Assist in the maintenance and updating of the USGS-Upper Midwest Environmental Sciences Center's (UMESC) web based geospatial data repository.
- Provide hardware and software technical support to UMESC staff and partners, as needed.
- Continue to assess advances in computer technology (hardware and software) for accurate and efficient GIS data production.

Product Descriptions

2013LC1: Although the primary focus of this component is to provide technical assistance and maintain existing databases, *as time allows* work may occur on the following LTRMP projects. As work is accomplished for each project, it will be reported in the quarterly activities. When a project is completed, that will be announced to the partners and reported in the quarterly activities. The percentage completion for each project will be updated in each subsequent scope of work.

- Continue to update the detailed spreadsheet of all LTRMP aerial photography currently housed at UMESC, including date, pool location, format (color infrared, natural color, black-and-white), scan status (yes/no, dots per inch), interpreted status, photo scale, and extent of coverage (partial or complete). This document will be served on-line and updated as necessary. (70% complete)
- Complete summaries detailing differences in land cover between 2000 and 2010/11 for the key pools (15% complete)
- Create a Google Earth help page to assist partners and public in using Google Earth to view and query LTRMP data being served in the KMZ format. (20% complete)
- Develop KMZ files for 2010/2011 aerial photo positions that include date, time, approximate water level at time of acquisition, and link to closest stream gage. This work will enhance the scope "Geospatial upgrades". (30% complete)
- Convert 1989 and 2000 LCU and other relevant GIS vector and raster data sets to Google Earth KMZ files and distribute online. (0% complete)
- Clip HREP boundaries (based on boundaries as defined in HREP web pages for individual projects, or through consultation with the Corps) across years and create a geodatabase for each HREP site. (0% complete)

Products and Milestones

Tracking number	Products	Staff	Milestones
2013LC1	Updates on progress for land cover products listed above.	Robinson	New progress reported in the quarterly activities. Percent complete updated annually.

Development of 2010–2011 Land Cover/Land Use GIS Database and Aerial Photo Mosaics

Development of the 2010/2011 Land Cover/Land Use (LCU) Geographic Information System (GIS) database will provide a third systemic dataset to compare the 1989 and the 2000 systemic coverages. Though a crosswalk was needed to compare 1989 and 2000 since different vegetation classification systems were used, the 2000 and 2010/11 LCU datasets will use the same classification and classifiers, making them directly comparable. Once completed, the 2010–2011 dataset will be invaluable in assessing and evaluating long-term vegetation trends and habitat changes over the past 20 years, and in assessing the current state of floodplain vegetation. (Strategic Plan Outcome 1; Output 1.1 and Outcome 4)

Objectives

Develop a 2010/11 LCU GIS database for Pools 1-26, the Open River Reach, the entire Illinois River, and the navigable portions of Minnesota, St. Croix, and Kaskaskia Rivers of the UMRS. Note: Extensive flooding on the Middle Mississippi River below the Quad Cities required aerial photography on Pools 14-Open River to be postponed until the late-summer of 2011. The upper pools of the Illinois River (Lockport, Brandon, and Dresden Pools) were reflown in 2011 due to heavy cloud cover in 2010.

Methods

Aerial photographs Pools 1-13, Upper Mississippi River and the Pools Alton-Marseilles, Illinois River were collected in color infrared (CIR) in August of 2010 at 8”/pixel and 16”/pixel respectively using a mapping-grade Applanix DSS 439 digital aerial camera. In August 2011, CIR aerial photographs for Pools 14-Open River South, Upper Mississippi River and Pools Dresden-Lockport, Illinois River were collected at 16”/pixel with the same camera. These CIR aerial photos were orthorectified, mosaicked, compressed, and served via the UMESC Internet site. The CIR aerial photos will be interpreted and automated using a 31-class LTRMP vegetation classification (see Attachment A). The 2010/11 LCU databases will be prepared by or under the supervision of competent and trained professional staff using documented standard operated procedures and will be subject to rigorous quality control (QC) assurances (NBS, 1995).

The LTRMP trend pools (Pools, 4, 8, 13, and the La Grange Pool of the Illinois River) were processed first in FY11. The trend pools whose imagery was collected in late summer 2011 (Pool 26 and Open River South) along with Pools 6, 9, 14, 18, and 19 were completed in FY12. Pools 3, 5, 5A, 7, 10, 12, 20, 21, 22, 24, 25 are scheduled to be completed in FY13. Pools 1, 2, 15, 16, and 17 of the UMR and Lockport, Brandon, and Dresden of the Illinois River along with the Lower Minnesota, Lower St. Croix, Open River North, and Lower Kaskaskia are scheduled to be completed in FY14 if funding is available.

- Systemic Flight of UMRS - Fly the entire UMRS in CIR at 8”/pixel for Pools 1-13 and at 16”/pixel for Pools 14-26 and the Illinois River. Completed in 2011.
- Orthorectify, Mosaic, and Serve the 2010/11 CIR Aerial Photography - UMESC has the capability to compress and mosaic high-resolution scans of the 2010/11 imagery. These

georeferenced photos would provide a base map on which existing LCU data and future LCU data could be overlaid. These photos also offer the ability to do visual-based land use or habitat analysis. These photos would be made available, by pool or reach, through UMESC's internet home page. Completed in 2012.

- Trend Pool Automation of 2010/11 Systemic Aerial Photography – Trend pools (Pools 4, 8, 13, 26, the Open River South, and the La Grange Pool of the Illinois River) will be interpreted first using the same 31-class vegetation classification system used to classify the 2000 systemic aerial photography (see Attachments A). Year 2010/11 LCU databases will be prepared by or under the supervision of competent and trained professional staff using documented standard operated procedures and will be subject to rigorous quality control (QC) assurances (NBS, 1995). The LTRMP study areas will be processed first, beginning with Pools 4, 8, 13, and the La Grange Pool of the Illinois River. Pool 26 and the Open River South reach will follow once the 2011 aerial photography is complete. Trend pools completed in 2012.

Products and Milestones

Tracking number	Products	Staff	Milestones
2013V1	Complete 2010/11 LCU databases for UMR Pools 12 and 25	Robinson, Hoy, Hanson, Langrehr, Ruhser, Nelson	31 December 2012
2013V2	Complete 2010/11 LCU databases for UMR Pools 5, 7*, 24	Robinson, Hoy, Hanson, Langrehr, Ruhser, Nelson	15 March 2013
2013V3	Complete 2010/11 LCU databases for UMR Pools 3, 5a,, 21, and 22	Robinson, Hoy, Hanson, Langrehr, Ruhser, Nelson	15 June 2013
2013V4	Complete 2010/11 LCU databases for UMR Pools 10 and 20	Robinson, Hoy, Hanson, Langrehr, Ruhser, Nelson	31 August 2013

*Funds to complete Pool 7 are being provided by the U.S. Fish and Wildlife Service.

ATTACHMENT A

LTRMP 31-Class General Vegetation Classification, Version 1.0

CODE	CODE DESCRIPTION	HYDROLOGY DESCRIPTION	DESCRIPTION
OW	Open Water	Permanently Flooded Non-Forest	Open Water; Default to Anderson Classification
RFA	Rooted Floating Aquatics	Permanently Flooded Non-Forest	Permanently flooded temperate or subpolar hydromorphic rooted vegetation
SV	Submerged Aquatic Vegetation	Permanently Flooded Non-Forest	Permanently flooded temperate or subpolar hydromorphic rooted vegetation
DMA	Deep Marsh Annual	Semipermanently Flooded Non-Forest	Semipermanently flooded temperate or subpolar grassland
DMP	Deep Marsh Perennial	Semipermanently Flooded Non-Forest	Semipermanently flooded temperate or subpolar grassland
MUD	Mud	Seasonally Flooded Non-Forest	Seasonally/Temporarily flooded mudflats
SMA	Shallow Marsh Annual	Seasonally Flooded Non-Forest	Seasonally flooded temperate or subpolar grassland
SMP	Shallow Marsh Perennial	Seasonally Flooded Non-Forest	Seasonally flooded temperate or subpolar grassland
SM	Sedge Meadow	Temporarily Flooded Non-Forest	Temporarily flooded temperate or subpolar grassland
WM	Wet Meadow	Saturated Soil Non-Forest	Saturated temperate or subpolar grassland
DMS	Deep Marsh Shrub	Semipermanently Flooded Shrubs	Semipermanently flooded cold-deciduous shrubland
SMS	Shallow Marsh Shrub	Seasonally Flooded Shrubs	Seasonally flooded cold-deciduous shrubland
WMS	Wet Meadow Shrub	Temporarily Flooded Shrubs	Temporarily flooded cold-deciduous shrubland
SS	Shrub/Scrub	Infrequently Flooded Shrubs	Temperate cold-deciduous shrubland
WS	Wooded Swamp	Semipermanently Flooded Forest	Semipermanently flooded cold-deciduous closed tree canopy
FF	Floodplain Forest	Seasonally Flooded Forest	Seasonally flooded cold-deciduous closed tree canopy
PC	Populus Community	Seasonally Flooded Forest	Seasonally flooded cold-deciduous closed tree canopy
SC	Salix Community	Seasonally Flooded Forest	Seasonally flooded cold-deciduous closed tree canopy
BHF	Bottomland Hardwood Forest	Temporarily Flooded Forest	Temporarily flooded cold-deciduous closed tree canopy
CN	Conifers	Infrequently Flooded Forest	Rounded-crowned temperate or subpolar needle-leaved evergreen forest
PN	Plantation	Infrequently Flooded Forest	Plantation
UF	Upland Forest	Infrequently Flooded Forest	Lowland or submontane cold-deciduous closed tree canopy
AG	Agriculture	Infrequently Flooded Non-Forest	Annual row-crop forbs or grasses
DV	Developed	Infrequently Flooded Non-Forest	Developed; Default to Anderson Classification
GR	Grassland	Infrequently Flooded Non-Forest	Tall sod temperate grassland
LV	Levee	Infrequently Flooded Non-Forest	Levee; Default to Anderson Classification
PS	Pasture	Infrequently Flooded Non-Forest	Perennial Grass Crops
RD	Roadside Grass/Forbs	Infrequently Flooded Non-Forest	Roadside Grass/Forb; Default to Anderson Classification
SB	Sand Bar	Temporarily Flooded Non-Forest	Temporarily flooded sand flats
SD	Sand	Infrequently Flooded Non-Forest	Dunes with sparse herbaceous vegetation
NPC	No Photo Coverage	n/a	No Photo Coverage; n/a

VEGETATION MODIFIERS

Density A = 10-33% B = 33-66% C = 66-90% D = > 90%

Height* 1 = 0-20 ft. 2 = 20-50 ft. 3 = > 50 ft. *Trees only

Bathymetry Component

The overall goal of the LTRMP's Bathymetry Component is to complete a system-wide GIS coverage of UMRS bathymetry used to quantitatively and qualitatively assess the suitability of essential aquatic habitats. Bathymetric surveys of the UMRS have been completed. Presently, the data processing for nine pools (Pools 4, 7, 8, 9, 10, 13, 21, 26, and La Grange Pool) is complete, and these data are served in standard formats on the LTRMP's website (www.umesc.usgs.gov/aquatic/bathymetry.html) The remaining unprocessed data have been delivered to UMESC, are available upon request, and will be processed into standard products under separate SOW's as funding becomes available. Under Output 1.1, the LTRMP will maintain some level of expertise to provide basic assistance with using the existing bathymetry data, as described below. (Strategic Plan Outcome 1; Output 1.1 & 1.3 and Outcome 4)

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 and locations that meet LTRMP need
- Assist in spatial modeling using the bathymetric data
- Processing of bathymetry point data available upon request as time allows www.umesc.usgs.gov/aquatic/bathymetry.html

Jim Rogala will be the principal investigator.

Statistical Evaluation

Statistical support for the LTRMP 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 helping LTRMP staff use data and analytical time more efficiently. The statistician is also responsible for ensuring that newly developed statistical methods are evaluated for use by LTRMP. Guidance for management includes assistance with modifications to program design and with standardizing general operating procedures.

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 regardless of which group (UMESC, field stations, COE, etc.) conducts analyses. The statistician is also responsible for reviewing LTRMP documents that contain substantial statistical components for accuracy, and for ensuring that quality of analyses is consistent among products. A primary goal of statistical analyses is to avoid drawing inappropriate conclusions leading 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 inferences from 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. (Strategic Plan Outcome 2, Output 2.5 and Outcome 4)

Product Description

2013E1: Long-term trend reporting, water quality component.

Estimating long-term temporal trends is a primary goal of the LTRMP. Reporting such trend estimates, whether in graphical or text form, will help partners and others better evaluate whether the appearance of temporal trends in LTRMP indicators is distinguishable from background variation. At present, the program does not have protocols for reporting such trends. A previous effort (2012E1) surveyed methods used by US federal agencies to report long-term trends in water constituents and showed that no federal agencies depicted trends in water resources. The current effort will evaluate a number of trend estimation methods for the purpose of conveying trend information to users of LTRMP water quality web pages.

Products and Milestones

Tracking number	Product	Staff	Milestone
2013E1	Draft completion report: Long-term trend reporting, water quality component	Gray, Houser, Rogala	30 Sep 2013
2013E2	Final draft completion report: An assessment of trends in water temperature in La Grange Pool (2012E3)	Gray, Robertson, Rogala, Houser	30 Sep 2013
Intended for distribution			
Completion report that describes methods of estimating variance components from LTRMP water quality data (2008E1; Gray) (In USGS Review)			
Completion Report: Duckweed and filamentous algal associations with submersed aquatic vegetation in contiguous floodplain lakes of the Upper Mississippi River. Gray and Holland. (2009APE3a) (In USGS Review)			
Manuscript: Inferring decreases in among- backwater heterogeneity in large rivers using among-backwater variation in limnological variables (2010E1, Rogala, Gray, Houser) (in USGS review)			
Completion Report (Switched to manuscript): Gray, B.R., A.M. Ray, J.R. Rogala, M.D. Holland and J.N. Houser. Accepted. Spatial and temporal variation in duckweed and filamentous algal levels in contiguous floodplain lakes of the Upper Mississippi River. Journal of Aquatic Plant Management. (2009APE3a) (Accepted to Journal of Aquatic Plant Management June 2012)			
Completion report: Summer water temperature in the Upper Mississippi River (2012E2) ; Gray, Robertson, Rogala, Houser) (In USGS Review)			

Data Management

The objective of data management for the LTRMP is to provide for data collection, correction, archive, and distribution of a 90 million dollar database that consists of over 2.2 million records located in 195 tables. The 2.2 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. (Strategic Plan Outcome 4 and Strategy 1)

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, maintain, and update the LTRMP public and intranet data browsers to insure access to all LTRMP data within USGS security policy.

Product Description

2013M3: Workshop on LTRMP data access, use, and exploration applications

The UMRR-EMP has made considerable investments in gathering baseline data on key ecosystem components across 1200 miles of river for over 20 years. In addition, we have made considerable investments to develop applications that help get these data and the information they provide into the hands of the public, program managers, natural resource managers, students, faculty, and decision/policy makers. This workshop seeks to make these data and applications more widely known and useful to program partners. We propose a workshop of 1-1.5 days, during winter 2013, conducted at UMESC, La Crosse, by UMESC staff, primarily component PI's.

Staff at UMESC will work with the Corps to determine workshop participants, with a target of no more than 12-15. We will then work with participants to determine the workshop date, and any specific data needs or questions to use as examples at the workshop. We expect the workshop will include presentations by the component PI's on the basics of database structure, access tools, processing considerations in preparing data for analyses, and any special considerations for using LTRMP data from the fish, water quality, and aquatic vegetation components. These presentations will be followed by discussion and question-answer sessions. Other data sets could be included if desired by participants and if time permits. Following the workshop, LTRMP managers will assess workshop success, strengths, and weaknesses with PI's and participants and consider the prospects for future workshops. Fulfills outreach and communication objectives conveyed in the Strategic Plan. This project is dependent on funding and any travel restrictions.

2013M5: Updating Graphical Fish Browser

With the updating of the Fisheries Procedure Manual (2013B5); the background information affiliated with the fish graphical browser will be enhanced. The graphical fish browser pages will be dynamically linked to a Web version of the procedures manual so that can directly link to various parts of the manual when referencing items from the browser like effort and gears or sampling design. This effort will be completed after the revised fish procedures manual is published. Fulfills outreach and communication objectives conveyed in the Strategic Plan.

Products and Milestones

Tracking number	Products	Staff	Milestones
2013M1	Update vegetation, fisheries, and water quality component field data entry and correction applications.	Schlifer	30 May 2013
2013M2	Load 2011 component sampling data into Oracle tables and make data available on Level 2 browsers for field stations to QA/QC.	Schlifer	30 June 2013
2013M3	1-2 day workshop on data access, use, and exploration applications.	Sauer, Johnson, Houser, Ickes, Yin, Schlifer	by May 2013
2013M5	Updating Graphical Fish Browser	Schlifer and Bartels	30 September 2013

Literature Cited

Johnson, B. L., and K. H. Hagerty, editors. 2008. Status and trends of selected resources of the Upper Mississippi River System. U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, Wisconsin, December 2008. Technical Report LTRMP 2008-T002. 102 pp + Appendixes A–B.

Landscape Pattern Research and Application

The goal of landscape pattern research on the Upper Mississippi River System is to develop concepts, maps and indicators that provide both regional-level decision makers and local-level resource managers with information needed to effectively manage the UMRS.

As described in the LTRMP's Landscape Pattern Research Framework (http://www.umesc.usgs.gov/ltrmp/ateam/landscape_patterns_research_framework_final_june2011.pdf) (De Jager 2011a), landscape pattern research on the UMRS focuses on linking decisions made at regional scales with restoration actions carried out at local scales. While regional program managers and decision makers are concerned with improving the overall ecological condition of the entire UMRS, local resource managers work to address site specific habitat and resource limitations. Landscape ecology, which focuses on the linkages between patterns visible at broad scales and ecological patterns and processes that occur at local scales, can help to integrate these two scale-dependent management activities. (Strategic Plan Outcome 2, Output 2.2 and Outcome 4)

Objectives

1) To develop broad-scale indicators of habitat amount, connectivity and diversity for the purposes of a) identifying areas for ecosystem restoration across the entire system and b) to track status and trends in habitat area, diversity and connectivity.

2) To connect broad-scale landscape pattern indicators with local-scale ecological patterns and processes critical to HREP project development.

Product Descriptions

2013L1: Draft Manuscript: Curve Fit: A pixel level raster regression tool for landscape modeling and assessment.

Curve Fits is an extension to the application ArcMap that allows users to carryout pixel-level regression analysis using a series of raster datasets. We have been using this tool to derive multi-scale landscape indicators to aid regional river management and rehabilitation decisions on the Upper Mississippi River floodplain (e.g. De Jager and Rohweder 2010 and 2011). This report will introduce other potential users to the software and its usefulness in landscape modeling and assessment. Tim Fox (UMESC) developed Curve Fit and will be a coauthor of a manuscript that focuses on its use for accomplishing objective #1 above and of the Landscape Patterns Research Framework (De Jager 2011a).

2013L2: Analysis: Effects of flood inundation duration on litter decomposition and nitrogen cycling during different states of forest succession.

Beginning in 2010, N. De Jager has been providing assistance and information to local US Army Corps of Engineers foresters (Randal Urich et al.) to guide forest restoration at a site just south of La Crosse, WI. In cooperation with personnel at the University of Wisconsin-La Crosse, studies were conducted from winter 2010 to summer 2011 on the role(s) herbivory by white-tailed deer

and flooding might play in determining the success of restoration actions (Cogger et al. In Prep A and B). In 2012, a collaborative experiment involving Whitney Swanson (student) and Eric Strauss (faculty) of the University of Wisconsin-La Crosse was initiated to examine rates of leaf litter decomposition and nitrogen cycling across the flood duration gradient in response to management actions that created different plant community types. In 2013 we begin analyzing this data for differences among the community types (e.g. reed canary grass meadow, mature forest, young forest) along the flood duration gradient. Results will help managers understand the consequences of different management approaches for nutrient processing and any feedbacks that nutrient cycling might have on forest succession. Dependent on funding and final analysis, a final product for LTRMP (likely a completion report or manuscript) will be developed in subsequent years. This research partially addresses objective 2.2 (Floodplain Soil Nutrient Dynamics) of the Landscape Patterns Research Framework (De Jager 2011a).

Products and Milestones

Tracking number	Products	Staff	Milestones
2013L1	Draft Manuscript: Curve Fit: A pixel level raster regression tool for landscape modeling and assessment.	De Jager & Fox	30 September 2013
2013L2	Analysis: Effects of flood inundation duration on litter decomposition and nitrogen cycling during different states of forest succession.	Strauss, Swanson, (UWL) & De Jager	30 September 2013
2013L3	Final draft fact sheet: Landscape Ecology on the Upper Mississippi River: lessons learned, challenges, opportunities (2012L2)	De Jager	30 June 2013
2013L4	Graphical Browser with landscape pattern indicators (2012L3)	De Jager, Rohweder, Schlifer	30 June 2013

Intended for distribution
Manuscript: De Jager, N.R. and Houser, J.N. 2012. Water mediated connectivity influences patch distributions of total nitrogen (TN), total phosphorous (TP) and TN:TP in the Upper Mississippi River. Freshwater Science (2010OUT2b2) Freshwater Science, 31(4):1254-1272. November 2012
Manuscript: Cogger, B.J. (UWL), De Jager, N.R. and Thomsen, M. (UWL). In Prep. White-tailed deer herbivory increases flood-induced tree mortality in an UMR floodplain forest (2012L5).
Manuscript: Cogger, B.J. (UWL), De Jager, N.R. and Thomsen, M. (UWL). In Review. Winter browse selection by white-tailed deer and implications for bottomland forest restoration in the Upper Mississippi River valley, USA. (2012L4) (to USGS headquarters for review)
Beta-version Graphical Browser. Rohweder, J.J and De Jager, N.R. (In review). Landscape patterns graphical web browser (2012L3).
Fact Sheet: De Jager, N.R. In Prep. Landscape Ecology on the Upper Mississippi River: lessons learned, challenges, opportunities (2012L2).
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Science Planning

The LTRMP developed a Science Management Process that was presented to the EMP-CC in May 2012. The process is designed to help LTRMP staff and managers prioritize and coordinate science effectively within the overall priorities defined in the 2010 Strategic Plan. Budget restrictions will prevent the full implementation of that process in FY2013. However, we will begin the process in FY2013 by developing and prioritizing scientific questions and uncertainties that form the basis for advancing our knowledge of ecosystem structure and function relative to management and restoration needs. In addition, we will continue to collaborate with river managers and researchers in other locations, nationally and internationally, to help develop monitoring programs that provide data for other large rivers that can be used to compare river function and responses to management across systems. (Strategic Plan Outcome 2)

2013XY: Prioritizing the critical questions needed to advance knowledge for better understanding and management of the UMRS

Since its inception, the UMRR-EMP has gained considerable knowledge about how the UMRS functions and responds to management actions. Managers have much experience with some types of management actions (e.g., back water dredging, island building, drawdowns) and can reasonably predict local and near-term effects of these actions for achieving management objectives. However, there are still many uncertainties and untested assumptions that affect managers' ability to predict the long-term effects of management or to make predictions about types of management actions with which they have little experience.

There have been previous efforts to define management or research needs and questions, both within and outside of UMRR-EMP (e.g., GREAT documents, UMRCC publications, LTRMP science questions (2003), LTRMP research frameworks). This project will begin with a review by the LTRMP Science Director and UMESC staff of previous efforts, then including categorizing and summarizing questions across documents to look for recurring questions or themes as they relate to river science and management objectives. The consolidated list, with background material, will be reviewed by UMESC staff, and discussed with the Science Director for revision. It will then be sent to the Corps program managers and A-Team for review, discussion, and initial prioritization. The goal is not to present an exhaustive list of questions, but to come to agreement on major questions and critical uncertainties that are most directly related to research and management needs. The discussion will include potential approaches for addressing high priority questions (e.g., within UMRR-EMP or outside of UMRR-EMP, through traditional focused research or by incorporating HREP evaluations, comparisons among different river reaches), including limitations on UMRR-EMP's ability to undertake some questions.

A report documenting the review process, the list of prioritized questions, and potential approaches and limitations will be prepared by the Science Director and then presented to the EMP-CC. The report and prioritized list will be used within the science planning process for help in developing LTRMP annual Scopes of Work, as a resource for UMRR-EMP strategic planning, and for sharing with researchers outside UMRR-EMP who are interested in collaborative research. The report and question list will not replace the priorities identified in the LTRMP Strategic Plan. Most research within LTRMP is still expected to be led mainly by the LTRMP research frameworks

developed under the current Strategic Plan. The prioritized questions are expected to include more topics than the research frameworks. This should provide guidance for a broader range of research interests both within UMRR-EMP HREP and with outside collaborators, and provide input to the LTRMP Science Coordination Process and to the UMRR-EMP strategic planning effort due to begin in FY13. Questions that provide a bridge between the research frameworks and broader research interests should be especially productive.

Products and Milestones

Tracking number	Products	Staff	Milestones
2013XX	Draft questions and background material to A-Team	Johnson	1-2 weeks before Spring A-Team meeting.
2013XY	Draft report: Critical questions for advancing ecosystem understanding and management capability on the UMRS	Johnson	30 September 2013
2013XZ	Final Draft report to EMP-CC	Johnson	Nov. 2013

Development of vital rates to assess the relative health of UMRS mussel resources

This project was partially funded in FY2012, using above-base funding, for work on Phase 1, Objective 3 (Estimate inter-annual variability in recruitment of mussels) from the full project plan (see FY2012 Scope of Work). Work in FY13 will continue to address this objective, supported by in-kind salary contributions from the USGS-Upper Midwest Environmental Sciences Center.

Products and Milestones

Tracking number	Products	Staff	Milestones
2012U1	Summary letter describing results to date from Phase 1, Objective 3	Ries, Newton, Zigler	30 November 2012

Continuing existing work on survival of mussels using PIT tagging

This project was partially funded in FY2012, using above-base funding (see full project plan in FY2012 Scope of Work).

Work in FY13 will include diving by Minnesota DNR staff, assisted by UMESC staff, to relocate 600 mussels tagged in 2012. These dives will also test a voice communication system purchased by Minnesota that should greatly increase the efficiency of locating tagged mussels in deep water. Work in FY13 is supported by in-kind salary contributions from the USGS-Upper Midwest Environmental Sciences Center and the Minnesota DNR.

Products and Milestones

Tracking number	Products	Staff	Milestones
2012U2	Summary Letter with field-based survival estimates	Newton	31 December 2013

Geospatial Data Upgrades

Work on this project in FY2013 is a continuation of work begun in FY2012. We are upgrading LTRMP geospatial data sets to the format needed for current versions of ArcGIS, the standard GIS software used by LTRMP partners. This involves creating projection (.prl) and metadata (.xml) files in UTM Zone 15, NAD83, and removing older files. The end result is simpler data management and easier access to files by partners. This work should be completed in FY13.

Products and Milestones

Tracking number	Products	Staff	Milestones
2012G1	Projection files (.prj) and metadata files (.xml) will be created for all publically served data (vector and raster).	Nelson	30 December 2012

Involvement of LTRMP with monitoring on other rivers, nationally and internationally

Most large rivers in the world, including the UMRS, are greatly affected by human actions and ecological variability. Balancing objectives for social, economic, and ecological benefits in large rivers is a management concern worldwide. Understanding the structure and function of large rivers is critical for developing plans and actions that can achieve management goals. However, learning about structure and function of any large river is a slow process due to a general lack of information on ecological conditions in many rivers, difficulty of data collection on large rivers, high variability in these systems, and difficulty conducting controlled field studies. Although every large river has unique features, all large rivers share many driving variables and processes that underpin their structure and function.

The UMRR-EMP has made considerable progress in understanding the structure and function of the UMRS. However, river scientists and managers would benefit greatly from being able to compare our understanding of the UMRS to that for other large rivers in the U.S. and worldwide. Such comparisons would allow all involved to learn more about differences and similarities among large rivers, and to transfer knowledge gained among rivers to all river scientists and managers. The end result should be a deeper understanding of river structure and function among multiple rivers; knowledge of similarities and differences in structure, function, and processes among rivers; a better understanding of why those similarities and differences exist; and increased ability to predict the effects of management actions under a wider variety of conditions. This should help increase the ability of river managers in the UMRS and worldwide to achieve ecological and socioeconomic objectives.

The LTRMP's long history of successful monitoring, science, and data management has made it a world leader, and river scientists and managers, both nationally and internationally, have sought our advice on developing monitoring programs. If we can help others create monitoring programs that will provide data and information for comparing across rivers, we can greatly increase the pool of knowledge regarding conditions and processes in large rivers. Our vision for UMRR-EMP is to become a clearing house for large river monitoring data and knowledge by providing access to data, reports, and lessons learned from multiple large rivers. Once available, this information can be reviewed in collaborative forums with river scientists and managers, nationally and internationally, for mutual benefit.

This work builds on LTRMP's previous interactions since 2000 to help develop large river monitoring efforts including: the Parana-Paraguay Rivers, Brazil, and the Yangtze River, China, supported by The Nature Conservancy; large rivers in Pennsylvania, through the Pennsylvania Fish & Boat Commission; the Columbia and Colorado Rivers, through the U. S. Geological Survey; and the Rio Grande through the U.S. Army Corps of Engineers.

Collaboration for monitoring and science on the Yangtze River, China: For FY2013-2014, Dr. Yao Yin, LTRMP Vegetation Component Specialist, has extended an Interagency Personnel Agreement (IPA) with The Nature Conservancy (TNC) to provide scientific expertise and assistance as the Lead on Asia Strategy for TNC's Great Rivers Partnership (GRP). This work is financially support by TNC and involves the following three tasks:

Task 1) Develop and apply science-based programs and strategies that affect integrated, sustainable management of both the Mississippi and Yangtze River systems.

Work under this task will build on previous efforts and exchanges between Chinese and U.S. scientists to share lessons learned and best practices to support sustainable management of both the Yangtze and Mississippi River basins. Between 2009 and 2011, Chinese scientists applied their learning on the Mississippi River to secure several research grants from various Chinese government agencies totaling more than $3 million (US). The research topics included fish population monitoring protocols and data base development, Asian carps spawning habitat investigation, evaluation of survival of stocked fish in the Yangtze River, and evaluation of flow on fish spawning below the Three Gorges Dam. The exchanges have given USGS and UMRR-EMP scientists access to many years of research experience on Asian carps reproduction, including Asian carp cell culture techniques, for application in invasive species control in the UMRS and the Great Lakes.

Task 2) Develop a standard protocol document for Yangtze River fish monitoring.

One of the priorities of GRP on the Yangtze River has been to help Chinese scientists enhance fish sampling methods. Past scientific exchanges have taught Chinese scientists the methods used by UMRR-EMP on the Mississippi River and allowed joint exploration of methods that could be applied in the Yangtze. The next step is to coordinate with Chinese partners to finalize and publish standard protocols for fish sampling in the "Yangtze River Fish Monitoring Handbook

Task 3) Develop and implement a three-year work plan for the Mississippi-Yangtze EcoPartnership.

On May 3rd, 2012, U.S. Secretary of State Hillary Clinton joined China's National Development and Reform Commission Vice Chairman Xie Zhenhua in Beijing in a signing ceremony celebrating five new EcoPartnerships accepted under the U.S.-China Ten-Year Framework for Cooperation on Energy and Environment. Among the five is The Nature Conservancy's Great River Partnership-The Chinese Ministry of Agriculture's Yangtze River Fishery Administration EcoPartnership, which is based on the GRP's Mississippi-Yangtze Rivers science exchange initiative. Dr. Yin has played a pivotal role establishing the Ecopartnership and will continue to play a leading role in developing a three-year work plan for the EcoPartnership, with implementation of that plan, as time and funding allow.

Results and products associated with this IPA will be communicated the LTRMP partners through LTRMP Quarterly Activity Reports and one or more white papers. All funds for salary and travel associated with this work are provided by The Nature Conservancy. The salary savings that will accrue to LTRMP will be used for contracts to conduct data analyses required for products that are Dr. Yin's responsibility within this FY13 LTRMP Scope of Work.

Evaluation of the potential for cross-program learning from individual large-river monitoring programs within the U.S.: The LTRMP is one of the largest river monitoring programs in the U.S., but fish monitoring efforts exist on other large rivers in the U.S. including the Missouri, Ohio, Illinois, Colorado, Columbia, and Tallapoosa Rivers. All of these fish monitoring efforts were developed for different purposes and use different approaches to monitoring. However, if the data available from these individual efforts can be analyzed to provide similar types of information for each river, comparisons across rivers would provide tremendous opportunities to advance

river science. Scientists from USGS, including Dr. Barry Johnson, LTRMP Science Director, UMESC, formed a team to develop a proposal to the USGS John Wesley Powell Center for Analysis and Synthesis, Fort Collins, Colorado, to explore the potential for cross-program learning from individual large-river monitoring programs within the U.S.

The proposal will seek to use data from these seven large-river fish monitoring programs to conduct similar data analyses across river systems to (1) compare structure and dynamics of fish populations and communities; (2) determine if assessment of fish status and trends are possible at regional or national scales; and (3) make recommendations regarding desirable characteristics for monitoring programs that will allow cross-program comparisons and larger scale assessments. This effort began in fall 2012 and the Powell Center proposal will be submitted in April 2013. If the Proposal is funded, a series of workshops involving river scientist from across the country would be held at the Powell Center in FY14-15.

Progress on the project will be communicated with the LTRMP partners in the LTRMP Quarterly Activity Reports. The proposal and award decision will be shared with the LTRMP partners to the extent possible given requirements for confidentiality in the proposal review process.
Funding for salary and travel for Dr. Johnson's participation on the proposal writing team was provided by USGS. Salary savings that will accrue to LTRMP from this effort will be used for contracted reviews of LTRMP products as part of program management.

Quarterly Activities

To enhance communication with the UMRR–EMP Partnership, LTRMP staff at USGS-UMESC and the six state-run field stations will track activities not explicitly listed in this current scope of work. These quarterly activity lists will document activities and accomplishments by Program partners that are not tracked in the milestone table. Activities will include such items as presentations, outreach, technical assistance, data retrieval, and consultation for LTRMP Partners including state and federal agencies, NGOs, and academia. These activities demonstrate the value of LTRMP data and expert scientific knowledge to clients and customers, and help to identify potential new collaborations that will benefit EMP and river managers. Activity lists will be placed on the web under the LTRMP ATeam Corner page (http://www.umesc.usgs.gov/ltrmp/ateam.html). This effort addresses a need for increased communication and dissemination of information relevant to Outcome 4 (Output 4.1) of the Strategic Plan.

Products and Milestones

Tracking number	Products	Staff	Milestone
2013QR1	Submittal of quarterly activities	All LTRMP staff	30 January 2013
2013QR2	Submittal of quarterly activities	All LTRMP staff	13 April 2013
2013QR3	Submittal of quarterly activities	All LTRMP staff	13 July 2013
2013QR4	Submittal of quarterly activities	All LTRMP staff	12 October 2013

A-Team and EMPCC Participation

USGS-UMESC and Field Station staff are often called upon to participate at quarterly A-Team (http://www.umesc.usgs.gov/ltrmp/ateam.html) and EMP-CC (http://www.mvr.usace.army.mil/Missions/EnvironmentalProtectionandRestoration/UpperMississippiRiverRestoration/Partnership/CoordinatingCommittee.aspx) meetings. The field station team leaders, component specialists, and UMESC LTRMP management staff are expected to participate in the A-Team meetings, if possible. Additional staff may participate as appropriate. Participation at EMP-CC meetings will be by request only. This participation could include sharing of scientific knowledge and/or presentations on current projects. Any participation by LTRMP staff at A-Team and/or EMP-CC meetings will be listed in the quarterly activity products. (Strategic Plan Outcome 4).

USACE LTRMP Technical Support

INTRODUCTION

The Upper Mississippi River Restoration - Environmental Management Program (UMRR-EMP) combines ecosystem restoration with monitoring and scientific research that is critical to defining, developing, measuring, and meeting ecosystem objectives for the Upper Mississippi River System (UMRS). The UMRR-EMP has 2 major elements; Habitat Rehabilitation and Enhancement Projects (UMRR-EMP-HREP or HREP) and Long Term Resources Monitoring Program (UMRR-EMP LTRMP or LTRMP). The management experience gained through HREP activities combined with the scientific knowledge and technical capabilities developed through LTRMP activities provide a solid foundation upon which to further develop, evaluate, and track progress towards the restoration objectives of the UMRS ecosystem.

The LTRMP element of the UMRR-EMP combines monitoring, applied research, and modeling with data management and reporting in an effort to provide a solid scientific foundation upon which to base management actions. Data collection and analysis of selected biological and physical attributes and reporting on the status and trends of these attributes for the UMRS is the primary activity of the LTRMP. The U.S. Army Corps of Engineers is charged with overall Program responsibility and funding for the LTRMP. The LTRMP is implemented by the U.S. Geological Survey's (USGS) Upper Midwest Environmental Sciences Center in cooperation with the five UMRS states; Illinois, Iowa, Minnesota, Missouri, and Wisconsin.

The broad goals of the LTRMP are to:

1. Develop a better understanding of the ecology of the UMRS and its resource problems;
2. Monitor resource change;
3. Develop alternatives to better manage the UMRS; and
4. Provide for the proper management long term resource monitoring program information.

The data, information, and understanding of the ecology of the UMRS are gained by system monitoring, research, and also by project monitoring. All of these together, within an adaptive management framework, support successful ecological restoration under UMRR-EMP.

This project describes the roles of the U.S. Army Corps of Engineers district LTRMP Technical Representatives, which are supported by regional UMRR-EMP LTRMP funds to help facilitate the two directional communications between each home district and the Regional Program (UMRR-EMP). These individuals shall serve as a point of contact with each district for LTRMP data and information, and the use of LTRMP data in the identification, formulation, and evaluation of HREPs. This work supports Outcome 3.1 of the 2010-2014 LTRMP Strategic and Operational Plan.

This paper describes the roles of the U.S. Army Corps of Engineers district LTRMP Technical Representatives, which are supported by regional UMRR-EMP LTRMP funds to help facilitate the two directional communications between each home district and the Regional Program (UMRR-EMP). These individuals shall serve as a point of contact with each district for LTRMP data and information, and the use of LTRMP data in the identification, formulation, and evaluation of HREPs.

This SOW captures an anticipated level of effort to accomplish the tasks herein, which is reflected in the funding allocated. The identified level of effort in this SOW assumes that the UMRR-EMP annual appropriation will not be sufficient to fund LTRMP Base Monitoring in full. It is anticipated that the tasks in this SOW have been adjusted to reflect a 9% reduction in funding. This reduction would represent approximately 11.8% of each Representative's time or approximately 240 hours in fiscal year 2013.

[NOTE: In years when the annual appropriation is less than the amount needed to fully fund Base Monitoring (such as FY13), the amount available for the Corps' LTRMP Technical Representatives will be reduced proportionately and the SOW will be adjusted accordingly.]

MAJOR DUTIES

1. Technical Support to Regional UMRR-EMP LTRMP Manager (high priority)

Estimated Level of Effort (~40 hours)
For all Document Review – Each document review should be coordinated throughout home district as appropriate, all comments received should be consolidated, and transmitted to the UMRR-EMP LTRMP Manager (copy furnish the other 2 district LTRMP Representatives). A minimum of 2 weeks of review and comment preparation time should be provided, if possible.

   a. Annual SOW (translation of the 2010-2014 Strategic & Operational Plan annually for base and above base efforts) – participate in conf calls as needed (1-2)
   b. Other reports - varies, as needed, and could include research frameworks, research proposals, *ad hoc* Indicator Report, Science Coordination Plan
   c. Regular bimonthly conference calls with the UMRR-EMP Regional Manager, LTRMP Regional Manager, 2 HREP coordinators, 3 LTRMP Technical Representatives (~6)

2. Represent UMRR-EMP LTRMP and home district at all regular A-Team Meetings (high priority)

Estimated Level of Effort (~40 hours)
Work under this heading includes two directional communications – regional coordination, bringing information back to the districts, and bringing local knowledge, issues, or questions to the A-Team. The level of effort hours will vary with length of meeting, meeting location, and level of prep/follow up.

   a. Conference calls – 2/year
   b. Meetings – ~2/year
   c. Support A-Team activities as appropriate

3. Serve as LTRMP data and resource contact for district PDTs (HREP-LTRMP Integration) (high priority)

Estimated Level of Effort (~80 hours)
Generally, each district's LTRMP Technical Representative serves as a proactive resource, promoting the use and/or application of LTRMP data (including research, models, etc) in their home district, primarily for project planning and monitoring. Knowledge of the available datasets (online and others), models, graphical browsers, etc, and personnel at UMESC and the field station(s) is critical for this task.

In addition to funding through LTRMP and the work described above, each home district is expected to include the LTRMP Technical Representative on at least 2 HREP Project Development Team's (funded through district UMRR-EMP HREP funds).

Also funded by district HREP funds, each district LTRMP Technical Representative should be responsible for keeping up to date on HREP monitoring accomplishments, developing the annual monitoring program for each HREP, utilizing the standardized LTRM monitoring methods when appropriate, determining who will do the monitoring work, evaluating and summarizing monitoring results, and coordinating with the LTRMP element at USGS-UMESC. All of the information could be used for each Report to Congress, as well as periodically updating the HREP Environmental Design Handbook and the HREP database.

4. Special Projects (require separate SOWs and funding)

Estimated Level of Effort (~up to 50 hours)

Some instances will arise when uses of LTRMP data or expertise are needed for more extensive investigations. For those instances, each district's LTRMP Technical Representative should lead the effort to identify and scope their district's needs from LTRMP. These needs must satisfy both of criteria below:

1. Identified need must directly support the UMRR-EMP authorization, and
2. Identified need must comply with the initiatives and priorities identified in the LTRMP 2010-2014 Strategic and Operational Plan.

Proposals shall be developed by each district's LTRMP Technical Representative and will be submitted to the Regional UMRR-EMP LTRMP Regional Manager. These proposals will be evaluated the LTRMP Management Team (Corps and USGS) and selected, as UMRR-EMP priorities and funds dictate. Scopes of Work shall then be developed by the LTRMP Technical Representative for those proposals that are selected and will be submitted to the UMRR-EMP LTRMP Regional Manager. The UMRR-EMP LTRMP Regional Manager will coordinate with the UMRR-EMP Regional Program Manager, and, if appropriate, will coordinate the SOWs with UMESC and/or the field station(s).

5. Other Meeting Attendance (if funding and time allow)

Supported Level of Effort (~30 hours)

Work under this heading includes dissemination of information, etc., from meeting/conference attendance to district personnel, PDT's, as appropriate. Discretion in choosing meetings is strongly recommended since the funding level does not support attendance at all of these listed below.

a. MRRC–Held in conjunction with April A-Team meeting
b. UMRCC –annual and/or technical session meetings
c. FWWG, FWIC or RRAT (tech) for meetings in home district

REPORTING

Each LTRMP Technical Representative will provide quarterly activity reports to the UMRR-EMP LTRMP Regional Manager; due one week after the end of each quarter of the fiscal year. These

reports will capture specific activities under any of the items above and any other significant LTRMP activity.

BUDGET

Labor Budget per Representative

a. Salary for 240 hours annually for each Technical Representative resourced annually but distributed quarterly, for regular duties described above. The individual dollar amounts allocated reflect the different pay grades of the Technical Representatives. The total labor amount budgeted for all 3 Representatives for FY13 is $68,000.

1) Could be augmented for special projects to provide regional support UMRR-EMP-LTRMP (e.g. A-Team ad hoc Indicator Team or sub group work); must have supplemental SOW or formal agreement prior to funding (funding dependent).

2) Could be augmented for special projects that address district needs, as described in Items 3 & 4 above; must have supplemental SOW prior to funding (funding dependent).

3) Could be augmented for Above Base SOW projects (aka APEs), will be included in project SOW and funding, as appropriate (funding dependent).

b. Travel funds of $1,000 each will also resourced annually, with a partial distribution in the 1st quarter, and full distribution upon receipt of final UMRR-EMP appropriation.

TOTAL estimated commitment

Approximately 11.8% of annual time (240 hours each)

$68,000 labor + $ 3,000 travel = $71,000

POC for the UMRR-EMP LTRMP Technical Representatives is the UMRR-EMP LTRMP Regional Manager, Karen Hagerty.

Product Descriptions

2013QR1 (Potter) Wind Fetch/Wave tool.

Track progress on UMESC's SOW for the updated Wind Fetch/Wave tool. Coordinate comments from the Corps on the beta version. This work is in support of the Strategic Plan Outcome 2, Output 2.3; Outcome 3, Output 3.1. David will provide oversight and coordination with UMESC on the beta version of deliverables and will solicited comments from anticipated primary users of the tool and forward these onto UMESC. David will also promote the use of the updated tool when available (ongoing task). The anticipated completion date of the finalized tool available for public use is March 28, 2013. UMESC's tasks were completed on February 26nd, 2013 (i.e., to provide the updated tool and user manual).

2013QR2 (Theiling) Fish Habitat Suitability Model for Backwaters (AHAG 2.0).

Dr. Theiling contributed to the development of the AHAG 2.0 Scope of work while investigating fish habitat benefit assessment needs on the Pool 12 Overwintering and Huron Island HREPs during FY12. HREP planning needs were integrated with AHAG 1.0 review comments and coordinated with the Fish and Wildlife Interagency Committee and UMRCC Fish Technical Committee. Theiling and Richards developed the FY13 LTRMP SOW element to

update the AHAG fish habitat benefit assessment model for HREPs using LTRMP fisheries component data. Richards will be managing implementation following the FY13 LTRMP SOW schedule with Brian Ickes. Theiling will provide review and reporting, as well as, integrating the next phase of AHAG 3.0 which will include spatial analysis. This work is supported by UMRR-EMP HREP funding. This work is in support of the Strategic Plan Output 3.1.

2013QR3 (McCain) Incorporating LTRMP data with the St. Louis District's Aquatic Habitat Classification Study.

The aquatic habitat classification effort currently ongoing within the St. Louis District is being pursued through the District's Biological Opinion for the Operation and Maintenance of the 9-ft Channel to develop habitat maps of the Middle Mississippi River (MMR).

Once the habitat classification is completed (in progress as of March 2013), the LTRMP fish data will be incorporated the into the GIS layers. The focus would be using the Open River study reach since it is fully within the habitat classification project area. Future effort would look to model these data in order to predict fish use within the UMR habitats outside of the Open River Study reach. This special project aligns with the LTRMP Strategic and Operational Plan (2010-2014) by incorporating the long-term data sets for fish with additional information (habitat classification under the Biological Opinion) in order to enhance knowledge about system status and trends. This work is in support of the Strategic Plan Outputs 1.1 and 1.3.

This effort is entirely contingent on the District's completion of the habitat classification under the Biological Opinion. If this effort is not completed, then no special project pursuing incorporation of LTRMP data with the habitat classification would be completed this fiscal year. Depending on schedule, if habitat classification is completed, then LTRMP technical representative will work with the District's geospatial department with incorporation of the LTRMP fish data into the GIS layer. Developing a predictive model would be the third step in which field station expertise of model development would be pursued.

Products and Milestones

Tracking number	Products	Staff	Milestone
2013QR1	Track progress on UMESC's SOW for the updated Wind Fetch/Wave tool. Coordinate comments from the Corps on the beta version. Promote use of this tool across all districts.	Potter	30 March 2013
2013QR2	Track progress on "Annotated empirical response curves for Upper Mississippi River System fishes" (AHAG 2.0), LTRMP Project 2013B28, under Fisheries Component	Theiling	30 September 2013
2013QR3	Incorporate LTRMP fish data with the St. Louis District's Aquatic Habitat Classification Study.	McCain	TBD

POC for the UMRR-EMP LTRMP Technical Representatives is the UMRR-EMP LTRMP Regional Manager, Karen Hagerty.

Analysis Team ad hoc Indicator Report

2013QR1 final draft A-Team ad hoc Indicator Report

This ad hoc effort will focus primarily on scientifically based indicators of ecosystem health2 or ecological integrity, as defined in the 2008 EMP Long Term Resource Monitoring Program Status and Trends Report (Johnson and Hagerty). The product will be a written report assessing all indicators in the 2008 Status and Trends Report and will contain recommendations for the next S&T Report. The indicator criteria, as defined in Dale and Beyeler (2001) will be the primary basis of this assessment. Other criteria may be added if needed, based upon the unique nature of individual indicators. Other indicators could be explored, either with current data or requiring new data collection. The report preparation is led by the A-Team appointed chair of the ad hoc group.

Products and Milestones

Tracking number	Products	Staff	Milestone
2013QR1	Revise draft report based on partner comments	Hagerty	Feb 2013
2013QR2	Draft final report to A-Team for review & endorsement	Hagerty	Feb 2013
2013QR3	Provide read ahead to EMPCC 30 days prior to meeting	Hagerty	29 April 2013
2013QR4	Present report to UMRR-EMP CC review & endorsement	Hagerty	29 May 2013

UMRR-EMP Strategic Planning

The FY2015-2019 UMRR-EMP Strategic Plan will be focused on ensuring that the UMRR-EMP Program will continue to be regionally relevant, nationally significant, internationally engaged, and technically sound.

The core team, estimated to be 17 individuals representing the makeup of the Partnership and key program functions, will consist of the following:

- 5 State members (EMP-CC, A-Team or Field Stations
- 2 USFWS member (Refuges and Ecological Services)
- 1 NGO member
- 1 member from USEPA, NRCS or Coast Guard
- 3 USGS members (LTRMP management staff, scientist)
- 1 UMRBA member
- 4 USACE members (EMP & LTRMP management, HREP/district managers)

The anticipated planning timeframe will be from April 2013 through September 2014 and will entail approximately 7-9 meetings with half being face-to-face. For FY13, active participation in 2 face-to-face and 2 conference calls is planned. No additional funding for this work has been allocated.

Science Management

Randy Hines is the Partnership Coordinator for UMESC and oversees the science communication program. He is responsible for coordinating the exchange of scientific and technical information requested by other agencies, organizations, and the general public. He also assists with outreach programs to provide educational opportunities and increase community awareness of Center and LTRMP activities. In particular, Randy oversees the coordination of LTRMP information at the USGS booth at National Meetings and acts as a Congressional liaison for the UMRR-EMP LTRMP.

Since the inception of USGS in 1879, the agency has maintained comprehensive internal and external policies and procedures for ensuring the quality and integrity of its science. This has led to the reputation of USGS being noted for science excellence and objectivity. In 2006, the scientific policies and procedures were updated, and are now known as USGS Fundamental Science Practices (FSP), a set of consistent practices, philosophical premises, and operational principles to serve as the foundation for research and monitoring activities related to USGS science. The FSP clarifies how USGS science is carried out and how the resulting information products (including maps, imagery, and publications) are developed, reviewed, approved, and released. Carol Lowenberg oversees the FSP process for LTRMP. Carol also coordinates the entry and tracking of all LTRMP abstracts, presentations, reports, manuscripts, etc, in the USGS Information Product Data System.

Tracking number	Products	Staff	Milestone
2013FS1	Final Draft Fact Sheet: Taking the Pulse of the River System #3	LTRMP staff as needed	30 September 2013
2013FS2	Final Draft Fact Sheet on LTRMP history, accomplishments, and future direction	LTRMP staff as needed	30 September 2013
2013ER1	Property inventory and tracking	LTRMP staff as needed	15 November 2013

Equipment Refreshment

LTRMP field equipment (boats, motors, sampling equipment, etc.) need to be well maintained and replaced when necessary to maintain a safe and functional work environment. (Strategy 2)

Field Station	Equipment Needs FY13
Iowa DNR Mississippi River Monitoring Station	Ohaus Scout Pro electronic scale
	Ruggedized Laptop
Big Rivers and Wetlands Field Station	Ohaus Scout Pro electronic scale
	Upgrade ES shock box
Illinois River Biological Station	150hp motor
	Turbidity meter

Addendum: Documenting the use of Long Term Resource Monitoring Program's (LTRMP) Fish Monitoring methodologies outside the UMRR-EMP throughout the Midwest Area.

Anecdotally, we know that the LTRMP has had a strong influence on the design of several regional, national, and international environmental monitoring programs. In particular the LTRMP Fish Monitoring methodologies (Gutreuter et al. in 1995) provide a standardized way to collect statistically sound fisheries data for the assessment of large river habitats. These protocols are a foundation for decision making at many levels, however, no attempts have been made to ascertain how widespread their adoption and use outside the UMRR-EMP has become. Accomplishing this could aid in future collaborations, as data collected with LTRMP standard methodologies can be compared across different systems in different regions. To rectify this, staff from the Illinois River Biological Station (IRBS) created an online survey for distribution to fisheries professionals across the Midwest that asks a variety of questions concerning use of standardized sampling methodologies and, more specifically, LTRMP methodologies. The survey was distributed online through all states in the American Fisheries Society's (AFS) North Central Division (NCD). Raw data collected (survey responses) will be kept confidential by IRBS staff, but will be summarized, presented, and reported to LTRMP personnel. The online nature of the survey will allow this to be completed with relatively low cost, as no additional equipment is required and time allocated by LTRMP staff will be minimal. No other LTRMP products will be delayed with the addition of this work.

This project supports efforts outlined in the Strategic and Operational Plan for the Long Term Resource Monitoring Program on the Upper Mississippi River System, Fiscal Years 2010-2014 (Outcome 4) with the delivery of important information that is responsive to identified needs and should aid the UMRR-EMP in future collaborations beyond the EMP partnership discussed in the 2010 UMRR-EMP Report to Congress. Information generated from this product can be used for development of any step-down document prepared for the "Involvement of LTRMP with monitoring on other rivers, nationally and internationally" (UMRR-EMP LTRMP FY13 Scope of Work).

Tracking number	Products	Staff	Milestone
2013S1	Complete online survey collection	Solomon, Casper	30 May 2013
2013S2	Assess results	Solomon, Casper	30 September 2013
2013S3	Prepare read ahead document for EMP-CC	Solomon, Casper	31 December 2013
2013S4	Present findings to EMP-CC February quarterly meeting and AFS conference (if funding for travel available)	Solomon, Casper	Spring 2014

Table 1. Sampling effort within the Long Term Resource Monitoring during fiscal years 2010–2014, and data collected by each component.

Component	Study Area						Summary of data collected[1]
	4	8	13	26	La Grange	Open River	
Aquatic 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.	—[2]	—[2]	—[2]	Species, abundance, frequency, distribution, depth, substrate, detritus
Fisheries	~160 samples; 2 periods: Aug. 1–Oct. 30, 6 sampling gears. Mix of stratified random and fixed sites. 1st period, June 15 – July 31, 82 samples	~180 samples; 2 periods: Aug. 1–Oct. 30, 6 sampling gears. Mix of stratified random and fixed sites. 1st period, June 15 – July 31, 82 samples	~200 samples; 2 periods: Aug. 1–Oct. 30, 6 sampling gears. Mix of stratified random and fixed sites. 1st period, June 15 – July 31, 100 samples	~180 samples; 2 periods: Aug. 1–Oct. 30, 6 sampling gears. Mix of stratified random and fixed sites. 1st period, June 15 – July 31, 92 samples	~270 samples; 2 periods: Aug. 1–Oct. 30, 6 sampling gears. Mix of stratified random and fixed sites. 1st period, June 15 – July 31, 120 samples	~165 samples; 2 periods: Aug. 1–Oct. 30, 6 sampling gears. Mix of stratified random and fixed sites. 1st period, June 15 – July 31, 82 samples	Species; catch-per-effort; length; subsample for weight, age, & diet; secchi; water depth, temperature, velocity, conductivity; vegetation density; substrate; dissolved oxygen
Water Quality	135 stratified random sites sampled in each episode (winter, spring, summer, and fall); 14 fixed sites[3] 14 fixed sites in Pools 4 biweekly during July and August.	150 stratified random sites sampled in each episode (winter, spring, summer, and fall); 19 fixed sites[3] 4 historic + 2 new fixed sites, biweekly from April through August.	150 stratified random sites sampled in each episode (winter, spring, summer, and fall); 12 fixed sites[3] none	121 stratified random sites sampled in each episode (winter, spring, summer, and fall); 11 fixed sites[3] none	135 stratified random sites sampled in each episode (winter, spring, summer, and fall); 11 fixed sites[3] none	150 stratified random sites sampled in each episode (winter, spring, summer, and fall); 9 fixed sites[3] none	Suspended solids, major plant nutrients, chlorophyll a, silica, pH, secchi, temperature, dissolved oxygen, turbidity, conductivity, vegetation type & density, wave height, depth, current velocity, depth of snow/ice, substrate, phaeophytin, phytoplankton (archived),
Land Cover/Land Use	Land Cover/Land Use digital aerial photography was acquired in 2010-2011 and processed in subsequent years. Systemic land cover data for the Upper Mississippi River System is collected approximately every 10 years. To date, systemic land cover has been mapped twice through the Long Term Resource Monitoring Program, in 1989 and 2000.						

[1]A full list and explanation of data collected by each component is available through the LTRMP data web site at http://www.umesc.usgs.gov/data_library/other/ltrmp_monitoring.html.
[2]Aquatic vegetation is not sampled in Pool 26 and La Grange because previous sampling revealed very low abundance, or in Open River due to a lack of suitable habitat.
[3]Frequency of fixed site sampling is bi-weekly in April, May, and June, and monthly in all other months, with no sampling in December and February (i.e., winter sampling in January only)

Product Definitions

Draft: A draft that has been submitted to the LTRMP's USGS Science Leader or his designee which is ready for review by USGS, COE, A-Team, or blind review, as needed. This step begins the process of formal USGS peer-review unless the Science Leader deems the product needs more work by the author(s).

Final draft: A document that the authors have edited based on review comments and has been submitted to the USGS LTRMP's Science Leader or his designee

Intended for Distribution: Indicates a final printed version or Web-based report is awaiting distribution and USGS final approval. For other products (i.e., manuscripts) this indicates submission to a journal. *Staff time is still expended at this stage of the report process.*

Summary Letter: A summary letter is a communication to Corps management and associated staff that provides quick information regarding progress on a project or product. They are often based on preliminary data and analyses, and represent interim information. Summary letters are reviewed internally by UMESC, but do not go through USGS peer review. Thus, they are not citable and should not be widely distributed. Summary letters are used only when a more complete and peer reviewed product is expected after more work on a specific project.