UPPER MISSISSIPPI RIVER RESTORATION

SCIENCE In SUPPORT of

RESTORATION AND MANAGEMENT

SCOPES OF WORK

FISCAL YEAR 2014

Scope of Work	UMESC funding	STATE funding	USACE funding	TOTAL COST
Seamless Elevation Data	$113,276			$113,276
Land cover/land use + AA, Val	$209,319			$209,319
Standardized HREP Non-forested wetland plant sampling protocol			$5,000	$5,000
Standardized HREP Forested wetland plant sampling protocol			$5,000	$5,000
Aquatic vegetation model	$ 72,247		$23,300	$ 95,547
UMRS Vegetation Handbook	$45,166	$3,482		$48,648
Phase 2 Geospatial Data Upgrades	$17,749			$17,749
Spatial Data Query Tool	$62,246			$62,246
UMRS Data Map	$61,689			$61,689
Assessing system-wide hydrodynamic model availability to support ecosystem restoration			$37,064	$37,064
Development of vital rates to assess the relative health of UMRS mussel resources	$127,604			$127,604
Validation of a Mussel Community Assessment Tool for the Upper Mississippi River System	$33,905		$35,488	$69,393
Effects of nutrient concentrations and zooplankton on phytoplankton abundance and community composition	$ 685	$22,831		$23,516
Ecological Shifts in a Large Floodplain River during a Transition from a Turbid to Clear Stable State	$ 589	$19,632		$20,221
1. Asian Carps Activities (#4) Invasive carp population demographics in the UMRS: an evaluation of the dynamic rate functions	$2,818	$93,926	$2,000	$98,747
2. Asian Carps Activities (#5) Identifying recruitment sources of Asian carp				
3. Asian Carps Activities (#6) Effects of Asian Carp on the diets of native piscivores in the UMRS				
4. Asian Carps Activities (#7) Early life history of invasive carp in the UMR Basin				
LTRM FY14 equipment (WI airboat only)		$76,112		$76,112
TOTAL SOWs				**$1,162,286**

These Scopes of Work (SOWs) describe the Science in Support of Restoration and Management tasks for fiscal year 2014 for the US Army Corps of Engineers' Upper Mississippi River Restoration (Environmental Management Program) (UMRR), authorized by Congress in the 1986 Water Resources Development Act, and as amended, to be performed by the Corps of Engineers, St. Paul, Rock Island, and St. Louis Districts, USGS-Upper Midwest Environmental Sciences Center (UMESC) in La Crosse, Wisconsin, and the five UMRS basin states of Wisconsin, Minnesota, Illinois, Iowa, and Missouri.

Seamless elevation data for UMRS

1) Description of the work.
Bathymetry and LiDAR are two of five high priority components identified in the UMRR-EMP LTRM 2010-2014 Strategic Plan needed to broaden the understanding of the relationships among ecosystem components and processes. Bathymetry and floodplain topographic (LiDAR) data will be used to create a systemic seamless elevation data layer for the UMRS. Such information is essential in understanding the river ecosystem, as well as for habitat restoration planning, landscape modeling, and researching the ecology of floodplain communities. UMRR-EMP has invested heavily in the data acquisition. Continuing the work towards completion is a high priority of the UMRR-EMP partnership.

2) Principle investigator: Jennifer Dieck
Additional UMESC staff required (see attached budget spreadsheet)

3) How does the work relate to the needs of UMRR-EMP and river managers?
- UMRR-EMP Long Term Resource Monitoring Program 2010-2014 Strategic and Operational Plan, dated 30 June 2009
- UMRR-EMP LTRM LiDAR Data Acquisition Plan, dated 29 January 2009
- UMRR-EMP LTRM Bathymetry Data Acquisition Plan, dated 22 May 2009

4) Priority products for FY14 include:
- Annual license
- Remaining LiDAR Tier 1
- LiDAR Tier 3 for select pools

5) Time frame and logistic considerations for the work.
- Can the work be completed within the current (or upcoming) Federal fiscal year? **No, the project would need a full year and would need to extend into FY15**
  - **Work within the first 9 months will include processing the remaining Tier 1 LiDAR and the seamless LiDAR for Pools 4, 5, 7, 8, 9, 10, 13, and 21**
  - **Work within the first year will include metadata written for all processed Tier 1 and Tier 3 LiDAR data, as well as the data being served on-line**
- Is there a deadline date for beginning the project? **No**
- Is the work dependent upon construction or other contracts to be implemented by the Corps (for HREP, dredging, dewatering, other management actions, etc.)? **No**
- This is a multi-year project:
  - **The remaining work is identified in the attached spreadsheet. Funding required to complete all of the remaining work is $458,012 plus $16,387 annually for software maintenance. This work would take 2-3 years to complete in its entirety.**
  - **New funding will be needed in future years.**
- Are there any other special considerations regarding logistics, timing, hiring, equipment purchases, etc. that will affect beginning or completing this project?
  - **Annual software maintenance (see attached spreadsheet)**

6) Estimated budget by year (gross costs) (attached spreadsheet)

- For priority items, **total cost $113,276**:
  - Annual license **$16,387**
  - LiDAR Tier 1 **$72,793**
  - Seamless (Tier 3) for Pools 4, 5, 7, 8, 9, 10, 13, and 21 **$24,096**
- All of the remaining work can be done in increments as outlined in the attached spreadsheet.
  - LiDAR Tier 2 $247,655
  - Bathymetry point data for remaining areas $20,095
  - Remaining Seamless (Tier 3) $93,374

Products and Milestones

Tracking number	Products	Staff	Milestones
2014LB1	LiDAR Tier 1, processing and meta data, data on line: Pools 15-19, Pool 25 – Open River, Kaskaskia, IL River all pools	Dieck, Rohweder, Nelson, Fox	30 March 2015
2014LB2	LiDAR Tier 3, processing and meta data, data on line: Pools 4, 5, 7, 8, 9, 10, 13, and 21	Dieck, Rohweder, Nelson, Fox	30 March 2015

Note: per request for Pool 3 HREP, on 1 May 14, Pool 3 was added to Tier 3, the bathy data needed would be processed under the Base LTRM SOW. Pool 10 was dropped.

Land Cover / Land Use data and Accuracy Assessment/Validation for UMRS

1) Description of the work.
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. This work is considered to be included in the LTRM Base Monitoring Program since it is considered to be one component of the LTRM standardized monitoring. However, due to its importance to the UMRR-EMP Partners, some of the remaining work is being funded with other funds.

In addition, the effort to compare the thematic accuracy assessment and validation methodology to determine the accuracy of the 2010/2011 land cover/land use data for the Upper Mississippi River System floodplain is near completion. All field data collection and accuracy assessment analyses have been completed. Only the assessment of the validation method and final report comparing the two methods still remain.

2) Principle investigator: Jennifer Dieck
Additional UMESC staff required (see attached spreadsheet)

3) How does the work relate to the needs of UMRR-EMP and river managers?
- UMRR-EMP Long Term Resource Monitoring Program 2010-2014 Strategic and Operational Plan, dated 30 June 2009
- Continuation of the 2010/2011 Land Cover/Land Use Development and Accuracy Assessment/Validation

4) Priority products for FY14 include:
- 70% of the 2010/11 LCU database for UMR Open River North
- Final LTRM Completion Report on Accuracy Assessment/Validation

5) Time frame and logistic considerations for the work.
- Can the work be completed within the current (or upcoming) Federal fiscal year? **Yes**
  - **Work will be completed by Sept 30, 2014**
- Is there a deadline date for beginning the project? **Already in progress with base funds**
- Is the work dependent upon construction or other contracts to be implemented by the Corps (for HREP, dredging, dewatering, other management actions, etc.)? **No**
- This is a multi-year project:
  - **Some of this work is being accomplished under Base Monitoring (see '2010–2011 Land Cover/Land Use Data Development and Accuracy Assessment/Validation for the UMRS" in the FY14 LTRM Base Scope of Work). New funding will be needed in future years.**
- Are there any other special considerations regarding logistics, timing, hiring, equipment purchases, etc. that will affect beginning or completing this project?

- **Annual software maintenance (see 2010–2011 Land Cover/Land Use Data Development and Accuracy Assessment/Validation for the UMRS" in the FY14 LTRM Base Scope of Work)**

6) Estimated budget by year (gross costs) (attached spreadsheet)

- For FY2014 priority items, total cost **$209,319**:
  - 70% of the 2010/11 LCU database for UMR Open River North $189,449
  - Accuracy assessment/Validation Completion Report $ 19,870

Products and Milestones

Tracking number	Products	Staff	Milestones
2014V2	Complete remaining 70% of the 2010/11 LCU database for UMR Open River North	Robinson, Hoy, Hanson, Langrehr, Ruhser, Nelson	30 Sept 2014
2014V4	Final LTRM Completion Report on Accuracy Assessment	Ruhser, Jakusz	30 Sept 2014

Development of Standardized HREP Non-Forested Wetland Plant Sampling Protocol

1) Description of the work.

Manipulation of water levels through increased capacity of water control structures or increased pumping capacity is a common project feature implemented in Habitat Rehabilitation Enhancement Projects (HREPs). This improved water manipulation is to increase desired wetland plants that resident and migratory wildlife depend on. Species diversity or percent cover are common biological indicators of project features success used for HREP monitoring; however to date there is no standard monitoring protocol used program-wide that can be used for both project evaluation and for comparison among HREPs with improved water level management features.

Since existing HREPs implement varying non-forested wetland plant monitoring protocols, this proposal is seeking to develop a standardized monitoring protocol to be implemented for future HREPs which have a project feature aimed at improving non-forested wetland plant communities through some form of water level manipulation. HREP project sponsors often have their own agency protocol used for monitoring non-forested wetland plants. These protocols will be evaluated for similarity and implementability at HREPs. Further discussion with managers and partners is needed to determine if there is an existing protocol that can be used or if a hybrid of protocols needs to be developed which will then be implemented for future HREPs that currently do not have a monitoring plan approved by MVD.

This work is important because having a standardized monitoring protocol for non-forested wetland plants would allow not only for site-specific project evaluation, but also provide the data required to compare among other HREPs as well as contribute to our knowledge on how HREP project features alter plant communities across the system. Additionally, standardizing a method of data collection will contribute to management decisions within an adaptive management framework.

2) Who's involved?

- Principal Investigator: Kat McCain (USACE-MVS)
- Additional Team Members: Megan McGuire (USACE-MVP), Josh Petersen (IADNR)
- Ancillary Team Member (supporting role only): Megan More (LTRM – MN)

3) How does the work relate to the needs of UMRR-EMP and river managers?

- LTRM Strategic Plan Outcome 2 – Enhanced knowledge about system process, function, structure, and composition.
    - Developing a standard monitoring protocol to measure indicators of success at the project-scale as well as being able to compare among HREPs would enhance our learning from management actions targeted at improving water level management and the subsequent biological response of moist soil plants. Having the ability to compare among HREPs would provide future opportunities of accelerated learning within an adaptive management framework.

- LTRM Strategic Plan Outcome 3: Enhanced use of scientific knowledge for implementation of ecosystem restoration programs and projects
    - Output 3.1: Use of LTRM infrastructure, data sets, and expertise to help formulate, design, and evaluate ecological restoration projects
        - Development of this protocol will seek to engage LTRM staff and other wetland specialists in development of a protocol that can be used to evaluate ecological restoration projects and add to our system understanding

4) What product(s) will result this fiscal year or in the first year of the project?
   - The product would be a partner-reviewed and accepted non-forested wetland plant monitoring protocol that will be shared program-wide for implementation. In the future, data collected using this protocol will be deposited in the regional HREP database.

5) Time frame and logistic considerations for the work.
   - Can the work be completed within the current (or upcoming) Federal fiscal year? YES
   - Is there a deadline date for beginning the project? NO
   - Is the work dependent upon construction or other contracts to be implemented by the Corps (for HREP, dredging, dewatering, other management actions, etc.)? NO
   - If this is a multiyear project: N/A
     - what products are expected in future years?
     - how will the work be funded in future years (new funding covered by LTRM base, in-kind contributions, etc.)? What are the ramifications if additional funding is not available?
   - Are there any other special considerations regarding logistics, timing, hiring, equipment purchases, etc. that will affect beginning or completing this project? NO

6) Estimated budget by year.
   - Budget is minimal. Most of the work would involve communication via email with LTRM staff, HREP managers, project sponsors, and other wetland specialists on deciding which protocol to use. The main budget is requested by the project lead that will be responsible for identifying people to be involved, sharing existing protocols, facilitating discussions on how to modify existing protocols, and ultimately writing up the protocol.

Products and Milestones

Tracking number	Products	Staff	Milestones
2014NFW1	draft NFW monitoring protocol	McCain	28-Feb-14
2014NFW2	Final draft NFW monitoring protocol	McCain	30-Mar-14
2014NFW3	A-Team review	McCain	1-Apr-14
2014NFW4	completed NFW monitoring protocol available	McCain	30-Sep-14

Development of Standardized HREP Floodplain Forest Sampling Protocol

1) Description of the work.

Reforestation is a common project feature implemented in Habitat Rehabilitation Enhancement Projects (HREPs); however to date there is no standard monitoring protocol used program-wide that can be used for determining project success of reforestation efforts and be used to compare among different HREPs.

The USACE forest inventory protocol, which is used by all three Corps districts, provides a useful tool and provides some information on forest inventory. This protocol uses one site every 2.5 acres but due to the quantity of forested land that USACE manages, the stand information collected is reduced to make it manageable. This protocol does not provide a complete picture of seedling density or a complete inventory of species composition, and has been deemed not appropriate for use for HREPs involving reforestation by a USACE forester.

A second sampling protocol developed by USACE provides a more detailed level of forest inventory using approximately one site every 450 acres and would provide the needed information to determine project success. Whereas, the previous sampling technique is plotless, this is a nested plot design. It captures more information and has been utilized by the St. Louis District for about 12 years and considerably longer at Rock Island and St. Paul. USACE and USFWS are currently working together to add to both sampling techniques to capture more information pertinent to wildlife management. This includes quantity and size of cavities and % cover and size of downed dead woody debris.

Another sampling protocol used in the Duck Creek Mingo Swamp (DCMS) project developed by MDC and USFWS is similar to the sampling protocol for the site every 450 acres used by USACE. The differences include the size of the nested plots and the size of the trees measured within each nested plot. USACE plot size is 1/10, 1/100, and 1/300 acre while DCMS uses 1/5, 1/100, and 1/1000 acres. The 1/100 acre nested plot is where USACE captures seedling/sapling cohort; whereas the DCMS measures them in both the 1/5 and 1/100 acre nested plots. The DCMS project was interested in measuring the success of seedling/sapling recruitment following treatment, which may be more applicable for HREPs. The DCMS method is currently being implemented at Ted Shanks Conservation Area HREP (Pool 24) and proposed at the Clarence Cannon National Wildlife Refuge HREP (Pool 25).

Since existing HREPs implement different reforestation monitoring protocols, this proposal is seeking to develop a standardized monitoring protocol to be implemented for future HREPs which have a project feature of reforestation. Further discussion with managers and partners is needed to determine which protocol is adequate or if a hybrid existing protocols needs to be developed or if there are other protocols that are more suitable.

This work is important because having a standardized monitoring protocol for reforestation would allow not only for site-specific project evaluation, but also provide the data required to compare among other HREPs as well as contribute to the Forest Inventory of the UMRS.

2) Who's involved?

- Principal Investigator: Kat McCain (USACE)
- Additional Team Members: Robert Cosgriff (USACE – MVS RPO forester); Jon Sobiech (USACE-MVP); Randy Urich (USACE-MVP); Jon Schultz (USACE-MVR); potential for others

3) How does the work relate to the needs of UMRR-EMP and river managers?

- LTRM Strategic Plan Outcome 3: Enhanced use of scientific knowledge for implementation of ecosystem restoration programs and projects

- Output 3.1: Use of LTRM infrastructure, data sets, and expertise to help formulate, design, and evaluate ecological restoration projects
    - Development of this protocol will seek to engage LTRM staff and other forest managers in development of a protocol that can be used to evaluate ecological restoration projects and add to our system understanding

4) What product(s) will result this fiscal year or in the first year of the project?
   - The product would be a partner-reviewed and accepted forest monitoring protocol that will be shared program-wide for implementation. In the future, data collected using this protocol will be deposited in the regional HREP database.
5) Time frame and logistic considerations for the work.
   - Can the work be completed within the current (or upcoming) Federal fiscal year? YES
   - Is there a deadline date for beginning the project? NO
   - Is the work dependent upon construction or other contracts to be implemented by the Corps (for HREP, dredging, dewatering, other management actions, etc.)? NO
   - If this is a multiyear project: N/A
     - what products are expected in future years?
     - how will the work be funded in future years (new funding covered by LTRM base, in-kind contributions, etc.)? What are the ramifications if additional funding is not available?
   - Are there any other special considerations regarding logistics, timing, hiring, equipment purchases, etc. that will affect beginning or completing this project? NO
6) Estimated budget by year.
   - Budget is minimal. Most of the work would involve communication via email with HREP managers, project sponsors, and other foresters on deciding which protocol to use. The main budget is requested by the project lead that will be responsible for identifying people to be involved, sharing existing protocols, facilitating discussions on how to modify existing protocols, and ultimately writing up the protocol.

Products and Milestones

Tracking number	Products	Staff	Milestones
2014FW1	draft FW monitoring protocol	McCain	30-Nov-13
2014FW2	Final draft FW monitoring protocol	McCain	30-Mar-14
2014FW3	A-Team review	McCain	1-Apr-14
2014FW4	completed FW monitoring protocol available	McCain	30-Sep-14

Predictive Aquatic Cover Type Model

1) Description of the work.

Many Habitat Rehabilitation and Enhancement Projects (HREP) quantify benefits using habitat units to compare alternatives and assist in the project selection process. The Habitat Evaluation Procedure (HEP) is one method used to evaluate species in a study area in terms of habitat units. The HEP approach recommends a data organization scheme using cover types to capture similar physical, chemical, and biological characteristics (cover typing). Under this approach, acres for each cover type are quantified under existing conditions and are projected for future years, with and without a proposed HREP.

Open water, submersed aquatic, rooted floating-leaf, and emergent vegetation are cover types that can be used to quantify habitat units in aquatic environments and are identified under UMESC's periodic land class/land use mapping assessment (15 classes). Without the use of tools, projecting the response of these cover types to a number of project alternatives can be a slow and tedious process involving a high level of subjectivity and uncertainty.

USGS scientists have previously developed an empirical equation to estimate the likelihood of occurrence of submersed aquatic vegetation in Pool 8 based on statistical analysis of water velocities, bathymetry, wind fetch, light extinction, and LTRM vegetation data. The same modeling approach can be used to develop empirical equations for rooted floating and emergent aquatic vegetation types. Separately, the Army Corps of Engineers has developed hydraulic models that predict flow velocity under a variety of island configuration and discharge scenarios. It is a logical next step to incorporate these models into a single, easy-to-use tool that can be used in the HREP plan formulation process.

Our proposal calls for the development of such a model. The model would initially be used in Pool 3 to help quantify ecosystem benefits for the North and Sturgeon Lake HREP project. One-time use approval by the Corps Eco-PCX would be pursued in accordance with Corps requirements (Engineering Circular 1105-2-412). In future years there would be potential to develop a regional model that could be applied throughout the Upper Mississippi River Basin. Additional research and statistical analysis after FY14 would be required to increase the capabilities of the model to a regional scale (not included in this scope). The regional model would also be subject to model certification requirements.

2) Who's involved?

- Principal Investigators: Yao Yin (UMESC) and Derek Ingvalson (USACE – MVP)
- Additional Contributors: Jim Rogala (UMESC) and David Potter (USACE – MVP)

3) How does the work relate to the needs of UMRR-EMP and river managers?

- LTRM Strategic Plan Outcome 1 – Enhance knowledge about system status and trends
    - Output 1.1: Status and trends information based on long-term data sets for aquatic vegetation, water quality, fish, and land use/land cover.
        - The model would be based on the statistical analysis of LTRM datasets and research. The model would predict vegetation trends using statistical analysis.

- LTRM Strategic Plan Outcome 3 – Enhanced use of scientific knowledge for implementation of ecosystem restoration programs and projects
    - Output 3.1: Use of LTRM infrastructure, data sets, and expertise to help formulate, design, and evaluate ecological restoration projects
        - Development of this model would use LTRM data, staff, and utilize tools previously developed under LTRM (i.e., Wind Fetch/Wave Tool).
        - The development of the model would utilize the scientific knowledge of LTRM personnel and promote the use of their research.
        - The model would be used to formulate, design, and evaluate HREP projects.
- LTRM Strategic Plan Outcome 4 – Enhanced ecological understanding to inform decisions
    - Output 4.1: Key decisions are informed by LTRM data, research, and decision support tools
        - The model would be based on LTRM data and research. The model outputs would be used support HREP plan selection.

4) What product(s) will result this fiscal year or in the first year of the project?
- The product would be a series of cover type maps for the North/Sturgeon Lake HREP under future with- and without-project conditions.

5) Time frame and logistic considerations for the work.
- Can the work be completed within the current (or upcoming) Federal fiscal year? YES
- Is there a deadline date for beginning the project? Yes, the work has to be approved before April 2014 to ensure completion within specified timeframe listed below.
- Is the work dependent upon construction or other contracts to be implemented by the Corps (for HREP, dredging, dewatering, other management actions, etc.)? YES, USGS scientists need the 2-D modeled flow velocity outputs from USACE.
- If this is a multiyear project: YES, but request is for a single year only.
    - what products are expected in future years?
        - The eventual product would be a user-friendly tool that could be used systemically throughout the Upper Mississippi River.
    - how will the work be funded in future years (new funding, covered by LTRM base, in-kind contributions, etc.)? What are the ramifications if additional funding is not available?
        - HREP science funds and in-kind LTRM funds.
        - If funding is not available a user-friendly model will not be produced. However, the model will still have been useful in the initial evaluation of the North/Sturgeon Lake HREP.
- Product milestones for FY14 and beyond

  Are there any other special considerations regarding logistics, timing, hiring, equipment purchases, etc. that will affect beginning or completing this project?

  -A high capacity work station may be needed at MVP to assist with model processing.

6) Estimated budget and project milestones by year.
- FY14 - $67,000 (UMESC) / $25,000 USACE

The FY14 dates and milestones are based on the current schedule for finalizing the North and Sturgeon Lake Detailed Project Report (DPR). Any adjustments to the DPR schedule will translate into corresponding changes to this effort.

- Corps completion of hydraulic modeling of existing conditions necessary for vegetation model – Spring 2014
- Compile data for vegetation model – Spring 2014
- Develop empirical equations for all three aquatic vegetation cover types using the Stoddard HREP of Pool 8 as the pilot site - Summer/Fall 2014
- Apply models to North/Sturgeon Lake HREP to produce preliminary outputs – Fall 2014
- Eco-PCX approval for one-time use of model for North/Sturgeon Lake HREP – Fall 2014
- Final model outputs for North/Sturgeon Lake HREP – Fall/Winter 2014

- FY15 & FY16 – budget to be estimated during the next budgeting cycle.

  - Calibrate and validate the model in multiple pools of the UMRB which may require some data collection (i.e. Pool 26 aquatic vegetation survey) – FY15
  - Final version of regional model for UMRB – FY15/FY16
  - Eco-PCX certification of regional model for UMRB – FY16
  - After certification, create a user-friendly beta version of the regional model for UMRB – FY16

Products and Milestones

Tracking number	Products	Staff	Milestones
2014AQ1	Complete hydraulic model of existing conditions	Hendrickson	30 April 2014
2014AQ2	Compile vegetation data and develop empirical equations, Stoddard as pilot	Yin, Rogala, Ingvalson, Potter	31 Aug 2014
2014AQ3	Compile vegetation data and develop empirical equations, North & Sturgeon	Yin, Rogala, Ingvalson, Potter	30 Sept 2014
2014AQ4	Final model and outputs	Yin, Rogala, Ingvalson, Potter	31 Dec 2014

UMRS Vegetation Handbook

1) Description of the work.

The General Classification Handbook for Floodplain Vegetation in Large River Systems Techniques and Methods 2 A-1 is a valuable resource to people engaged in assessing and mapping floodplain vegetation, as well as the resource managers and scientists who will ultimately use those map products. Since the handbook was published, there have been significant advancements in technology. Moving from frame photography to digital imagery, among other advances, has resulted in major changes to nearly all the methods described by Appendix 1. In order to accurately document the methods used for the 2010-2011 systemic UMRS mapping effort, this entire section must be updated. Updating the handbook will allow us to incorporate what we have learned during this time of rapid change and to continue to improve our products. As we strive to maintain the continuity necessary for the best quality long term data set even as methods and technologies change, the handbook has been and will continue to be an important reference. Apart from the methods, as we have worked with the handbook both in the office while interpreting imagery and in the field assessing vegetation, we have discovered points of the classification and key where improvements could be made. Results from accuracy assessment and validation procedures have shown that some of the most common errors and inconsistencies could be mitigated by modifications to the classification. Updating the handbook will allow us to revise parts of the classification system in Appendix 2, and the classification key in Appendix 3, that have been determined to be unclear or ambiguous. Enhancing the clarity and usefulness of the classification system and key will in turn improve our map products.

2) Who is involved?

- Heidi Langrehr
- Erin Hoy
- Jennifer Dieck (PI)
- Larry Robinson
- Janis Ruhser

3) How does the work relate to the needs of UMRR-EMP and river managers?

This project supports Output 1.1 in the LTRM Strategic Plan (""Integrity of LTRM data sets" refers to the ability to maintain a consistent line of specific knowledge, evidence, or indicators from a data string. Such knowledge is generated by a specific analysis with specific data requirements. Those requirements should be maintained within the data set, both temporally and spatially, such that results of the analysis are directly comparable with the same analysis performed for different times or locations.").

4) What product(s) will result this fiscal year or in the first year of the project?

- A USGS Open File Report

5) Time frame and logistic considerations for the work.

- Can the work be completed within the current (or upcoming) Federal fiscal year? **No, the project would need a full year and would need to extend into FY15**
  - **By August 2014, technical revisions will be drafted**
  - **By September 2014, new images will be acquired**
  - **By December 2014, updated vegetation descriptions will be drafted**
  - **By March 2015, handbook will be in USGS review.**
- Is there a deadline date for beginning the project? **March 2014**

- Is the work dependent upon construction or other contracts to be implemented by the Corps (for HREP, dredging, dewatering, other management actions, etc.)? **No**
- If this is a multiyear project? **No**
- Are there any other special considerations regarding logistics, timing, hiring, equipment purchases, etc. that will affect beginning or completing this project? **Yes, funding must arrive in time to collect peak vegetation field images during the Summer 2014 field season for the updated classification**

6) Estimated budget by year.

- $48,648
- See Budget Template for details

Products and Milestones

Tracking number	Products	Staff	Milestones
2014VH1	Acquire new field images for handbook	Dieck, Langrehr, Hoy, Robinson, Ruhser	30-Sep-14
2014VH2	Draft updates to technical sections and vegetation descriptions	Dieck, Langrehr, Hoy, Robinson, Ruhser	31-Dec-14
2014VH3	Finalize handbook and submit for USGS review	Dieck, Langrehr, Hoy, Robinson, Ruhser	31-Mar-15

Phase 2 Geospatial Data Upgrades

1) Description of the work.

In FY11, a data upgrades project was funded. This previous project funded the creation of updated land cover/ land use data to have the same extents and be cross-walked to the same auxiliary table information. This new project would further enhance these datasets by creating pool-level vector based spatial data geodatabases. The geodatabase is the newest and most efficient spatial data format. The creation and deployment of these geodatabases will give users the ability to get all of a pool's vector-based spatial data in one file.

Additionally, UMESC has begun the creation KMZ files (Google map-ready) for remaining land cover/ land use (LCU) product. The addition of the KMZ files would expand the software types able to read the LCU products. The KMZ files will be placed on the UMESC website and be available for download. Upon downloading, the file can be opened with Google Earth and viewed as a layer with the existing Google data. Upon completion, there will be KMZ files for all of the Landcover data UMESC has created.

The data included in the geodatabases will be:
1989 Aquatic Areas (Where Available)
2010/11 Land Cover/Use (Where Available)
2002 Land Cover/Use (Where Available)
2000 Land Cover/Use
1998 Land Cover/Use (Where Available)
1994 Land Cover/Use (Where Available)
1991 Land Cover/Use (Where Available)
1989 Land Cover/Use
1989 Land Cover/Use - Satellite Data
1975 Land Cover/Use (Where Available)
1890's Land Cover/Use (Where Available)
UMESC River Miles
1993 Levees
Boat Access Points (Where Available)
Wing Dams (Where Available)

Also at the conclusion of this work KMZ files will be available for the following datasets:
2010/11 Land Cover/Use (Where Available)
2002 Land Cover/Use (Where Available)
2000 Land Cover/Use
1998 Land Cover/Use (Where Available)
1994 Land Cover/Use (Where Available)
1991 Land Cover/Use (Where Available)
1989 Land Cover/Use
1989 Land Cover/Use - Satellite Data
1975 Land Cover/Use (Where Available)
1890's Land Cover/Use (Where Available)

2) Who is involved?

- Larry Robinson
- JC Nelson (PI)

- GIS Interns

3) How does the work relate to the needs of UMRR-EMP and river managers?

This project supports Strategy-1d in the LTRM Strategic Plan ("Expand data clearinghouse functions").

4) What product(s) will result this fiscal year or in the first year of the project?

- Geodatabases of all UMRS pool data, by pool
- KMZ files for LCU Products

5) Time frame and logistic considerations for the work.

- Can the work be completed within the current (or upcoming) Federal fiscal year? **Yes**
  - **Work will be completed and available online by Sept 30, 2014.**
- Is there a deadline date for beginning the project? **March, 2014**
- Is the work dependent upon construction or other contracts to be implemented by the Corps (for HREP, dredging, dewatering, other management actions, etc.)? **No**
- If this is a multiyear project? **No**
- Are there any other special considerations regarding logistics, timing, hiring, equipment purchases, etc. that will affect beginning or completing this project? **No**

6) Estimated budget by year.

- $17,749
- See Budget Template for more details

Products and Milestones

Tracking number	Products	Staff	Milestones
2014GD1	Complete geodatabases by pool for the entire UMRS	Nelson, Robinson	30-Sep-14
2014GD2	Complete KMZ files for river miles, levees, boat access points, wing dams, aquatic areas, and remaining land cover data	Nelson, Robinson	30-Sep-14

Spatial Data Query Tool

1) Description of the work.

The Long Term Resource Monitoring Program has collected millions of records over 20 years. Fisheries, water quality, vegetation, and invertebrates have all been sampled. Geographic locations were collected for all sampling points. This information is available in data tables, but is not available to scientists, resource managers, and the public via an internet-based mapping application.

Vegetation, land use, hydrology, and geomorphic characteristics vary significantly over the Upper Mississippi River System and are captured in spatial databases available at UMESC. When integrated with monitoring data, spatial databases can assist scientists and managers in determining ecological status and trends and help explain causal relationships. This project will integrate LTRM monitoring databases with the wealth of spatial data now available for the Upper Mississippi River and Illinois River floodplains.

This project will upgrade the existing application "Upper Mississippi River LTRM Data Viewer and Query Tool" to the current ArcGIS Server application "Upper Mississippi River Landcover Viewer" (see: http://umesc-gisdb03.er.usgs.gov/landcover/viewer.aspx). This will allow visualization and querying of the LTRM component data in conjunction with the LTRM and other UMRS spatial data from the UMESC spatial database. This easy-to-use Web-based application would allow logical and spatial querying. Query results would be shown as locations on maps and could also be downloaded as data files.

2) Who is involved?

- Jason Rohweder (PI)
- Tim Fox
- UMESC GIS Interns

3) How does the work relate to the needs of UMRR-EMP and river managers?

- This project supports Output 2.3b ("Provide assistance to decision makers who ask for decision support tools") and;
- S-1c ("Implement the ESRI Enterprise GIS tools, such as Arc Spatial Database and ArcGIS Server. These tools will allow data to be viewed with an internet browser or through ArcGIS on desktop computers, where they can be combined with other data sets") in the LTRM Strategic Plan.

4) What product(s) will result this fiscal year or in the first year of the project?

- Web-based application that would allow logical and spatial querying

5) Time frame and logistic considerations for the work.

- Can the work be completed within the current (or upcoming) Federal fiscal year? **No, this project could begin in FY14, however the bulk of the tool development would occur in FY15.**
  - **Work within the first 4 months will include compiling all data available and converting it to a useable format**
  - **Work within the first 8 months will include a web-based platform that contains all spatial data, have all queries converted to ArcGIS, and have a tool for custom queries.**

- **Work within the first year will include a beta tested tool ready for USGS review.**

- Is there a deadline date for beginning the project? **No**
- Is the work dependent upon construction or other contracts to be implemented by the Corps (for HREP, dredging, dewatering, other management actions, etc.)? **No**
- If this is a multiyear project? **Not as proposed, but as additional data are captured or created updates would enhance the tool**
- Are there any other special considerations regarding logistics, timing, hiring, equipment purchases, etc. that will affect beginning or completing this project? **No**

6) Estimated budget by year.

- $62,246
- See Budget Template for more details

Additional tasks:

1. Address comments from B. Gray, dated 16 Feb 2014
2. Provide cost estimate for updates with new data, include estimated frequency (annually?)

Products and Milestones

Tracking number	Products	Staff	Milestones
2014SQ1	Compile all LTRM sampling data collected through 2013 and convert to a useable format	Rohweder, Fox	1-Aug-14
2014SQ2	Create a web-based platform that contains all spatial data; convert all queries to ArcGIS	Rohweder, Fox	31-Dec-14
2014SQ3	SDQT beta tested and ready for USGS review	Rohweder, Fox	31-Mar-15

UMRS Data Map

1) Description of the work.

The Upper Mississippi River System Data Map would support the research, science and monitoring missions on the Upper Mississippi River System by allowing the users to discover, visualize, share, and retrieve information and data sets related to the Upper Mississippi River System. It would identify:
1) available information such as publications and research within the Upper Mississippi River System; publications would only include those from the USGS Publications Warehouse (this can be expanded at a later time).
2) quantity and quality of digital tabular and spatial data within the Upper Mississippi River System; this includes data both internal (UMESC/USGS) and external (state and Federal) that can be found on the web.

The identified data links would be included in a discovery tool for the Upper Mississippi River System. The technology backbone for this project is the USGS's ScienceBase application. ScienceBase has become a data catalog standard for several federal partnerships including the U.S. Fish and Wildlife Service's Landscape Conservation Cooperatives. Using this established tool helps keep the cost of the project down while offering the technical support of an entire development team.

2) Who is involved?

- Janis Ruhser
- JC Nelson (PI)
- UMESC GIS Interns

3) How does the work relate to the needs of UMRR-EMP and river managers?

This project supports Output 2.3b and S-1e in the LTRM Strategic Plan ("Develop a computerized "data map" that uses a GIS-based approach to catalog and display data").

4) What product(s) will result this fiscal year or in the first year of the project?

- A web-based tool showing data for the UMRS

5) Time frame and logistic considerations for the work.

- Can the work be completed within the current (or upcoming) Federal fiscal year? **No, the project would need a full year and would need to extend into FY15**
  - **By Sept 30, 2014 the web-based library will contain references to all UMRR-EMP data currently being held at UMESC that is publically available.**
  - **By Dec 31, 2014 references to publications will be made**
  - **By March 31, 2015 additionally data references for state and Federal data will be added.**
- Is there a deadline date for beginning the project? **March 2014**
- Is the work dependent upon construction or other contracts to be implemented by the Corps (for HREP, dredging, dewatering, other management actions, etc.)? **No**
- If this is a multiyear project? **Yes, yearly maintenance (at least) to ensure the most up-to-date data is included. Also, additional data expanding into the entire Upper Mississippi River Basin could be added**
- Are there any other special considerations regarding logistics, timing, hiring, equipment purchases, etc. that will affect beginning or completing this project? **No**

6) Estimated budget by year.

- $61,689
- See Budget Template for details

Additional tasks:

1. Provide cost estimate for yearly maintenance

Products and Milestones

Tracking number	Products	Staff	Milestones
2014DM1	Include all UMRR-EMP data created at UMESC in the data map	Nelson, Ruhser	30-Sep-14
2014DM2	Include all UMRR-EMP publications from http://umesc.usgs.gov/reports_publications/ltrmp_rep_list.html in the data map	Nelson, Ruhser	31-Dec-14
2014DM3	Include additional state and federal data references in the data map	Nelson, Ruhser	31-Mar-15

Assessing System-wide Hydrodynamic Model Availability
to Support Ecosystem Restoration

1) Description of the work.

Hydrology is an important driver in river ecosystems so it is appropriate for the UMRR-EMP to support a standard approach to analyze it for ecosystem restoration planning and management. Hydrological information and models are used by all LTRM components and most of the customers of the UMRR-EMP. Water specialists use hydrology to consider mass transport, botanists use it to understand plant distribution, fisheries biologists and scientists are concerned with the availability of habitat, and natural resource manager use these relationships to support their mission.

Work proposed for FY14 is to integrate information from Corps, USGS, and academic partners to:

1. Understand current hydrologic and hydraulic analysis capability with an inventory of existing tools used in the UMRS in order to consider incorporation of the seamless elevation topographic data set into (standardized) models.
2. Consider automating and providing hydrologic data in a format useful to other researchers.
3. Identify linkages from hydrology to other ecosystem components through inundation, material transport, and water chemistry relationships that are frequently integrated into hydrodynamic models.
4. Develop a plan for the efficient and standardized sharing of topographic and hydrologic data to meet ecosystem restoration needs.

Work in FY14 will include a workshop between Corps, USGS, and academic staff to compile data, tools, models, recent analyses, and ideas on how to efficiently utilize the massive amounts of topographic and hydrologic data to support ecosystem restoration needs. Based on the results of the workshop a conceptual plan including estimates of work effort will be developed for consideration of follow on activities.

2) Who's involved?

Who is the principle investigator?

Chuck Theiling (USACE-MVP) will lead the team with assistance from, but not limited to:
Mike Dougherty (USACE-MVR), Jon Hendrickson (USACE-MVP H&H), Toby Hunemuller (USACE-MVR H&H), Eddie Brauer (USACE-MVS H&H), Jim Rogala (USGS), Jeff Houser (USGS), Pool 8 Fluent model developers (U-Iowa IIHR - Schnoebelen)

3) How does the work relate to the needs of UMRR-EMP and river managers?

H&H is a primary environmental driver affecting all other parts of UMRS management. The Corps uses H&H principles to design and operate navigation, flood protection systems, and design ecosystem restoration projects. Pool scale rating curves were established long ago and the most recent system wide flood stage hydrologic model was completed during the Comprehensive Plan in 2004. Analytical models improve and environmental conditions change over time so system-wide model updates are necessary. Work has begun to update the system-wide flood model using the HEC-RAS modeling suite in support of the Corps Flood Risk Management mission. The Corps also has many specialized, 2-dimensional models for site-specific navigation system operations and ecosystem restoration applications. USGS (Wlosinski) previously produced ecologically relevant hydrologic summaries by river mile for forest managers. Wlosinski also evaluated navigation pool dam operations and the environmental benefits of alternative water level management strategies. USGS-UMESC

continues to use a combination of stage records and spatial analysis tools for forestry and drawdown analysis, and develops GIS tools to increase the utility of available data (e.g., Tim Fox's curve fit tool). University of Iowa IIHR-Hydro science and Engineering has completed high fidelity nutrient models for backwater lakes and pool scale high resolution Fluent hydraulic models for Pool 8 pre-dam and post dam conditions. They demonstrated the utility of ecosystem restoration simulations and habitat suitability models. This workshop will examine the applicability and efficiency of these and other modeling efforts at differing scales to support ecosystem restoration. The workshop will also explore model and data sharing.

Above was a very short list of H&H applications relevant to UMRR-EMP, it is necessary to compile as much existing information as possible before institutional memory fades. The proposed summary of available and ongoing H&H activity will achieve that documentation, but it also addresses administrative efficiency by connecting program elements, minimizing duplication of effort, or and maximizing the utility data and availability of H&H model outputs.

4) What product(s) will result this fiscal year or in the first year of the project?

- A white paper summarizing hydrologic and hydraulic model availability and recommendations for their efficient use to support ecosystem restoration.
- A conceptual plan for additional (follow on) modeling and data management efforts.

5) Time frame and logistic considerations for the work.
This work will require one face-to-face meeting and follow-up phone calls. It can be completed in a single year.

6) Estimated budget by year. $37,064 (see attached)

Additional tasks: Coordinate with Data Map PI (Nelson)

Products and Milestones

Tracking number	Products	Staff	Milestones
2014SHM1	Kick off Email to workshop participants	Theiling	30-Apr-14
2014SHM2	Compile list of UMR-IWW hydrologic models	Theiling	31-May-14
2014SHM3	Complete read-aheads	Theiling	15-Jun-14
2014SHM4	Conduct workshop/webinar	Theiling	Jul-14
2014SHM5	Summarize webinar	Theiling	31-Jul-14
2014SHM6	Draft white paper	Theiling	31-Aug-14
2014SHM7	Final white paper	Theiling	30-Sep-14

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

Principal Investigators: Teresa Newton, USGS, Upper Midwest Environmental Sciences Center, La Crosse, WI, Steve Zigler, USGS, Upper Midwest Environmental Sciences Center, La Crosse, WI, and Mike Davis, Minnesota Department of Natural Resources, Lake City, MN.

Introduction: Over the past 50 years, about 20 mussel species have been lost or greatly diminished from the Upper Mississippi River System (UMRS) basin and overall abundance of mussels has substantially declined in many portions of the river. Because of the long life spans of native mussels (30-100 years) and the slow response times for aquatic ecosystems to respond to human-induced alterations, sensitive indicators of mussel population responses to river conditions and management need to be developed. Traditional measures such as species richness and abundance of adults may not be sensitive enough to detect subtle environmental changes. Rather, indicators such as population vital rates (e.g., mortality, recruitment, growth) may be more appropriate. The lack of information on these functional metrics makes it difficult for resource managers to evaluate the effects of management actions such as habitat restoration projects on this imperiled faunal group. The proposed research supports question 3a of the LTRM research framework on native mussels ("what is the difference and annual variation in population-level characteristics [e.g., mortality, recruitment, growth] across species with varying life histories") and output 2.2c ("information generated from focused research agenda on setting management objectives and defining indicators, aquatic vegetation, mussels, floodplain connectivity, and landscape patterns") in the LTRM strategic plan.

Proposed research: We propose to measure mortality of adult mussels in a well-sampled mussel assemblage in the UMRS. In the recent pool wide surveys (Pools 5, 6, and 18), mortality of several species was estimated from age-frequency curves. This indirect method is restricted to species with high abundance, and is subject to assumptions that limit interpretation; a more direct method of assessing mortality would be useful. Passively integrated transponder tags (PIT tags) can be used to follow the fate of individual mussels thereby providing mortality estimates on both common and less common species. PIT tag life is infinite, so this method might allow long-term monitoring of mussels. In 2012, we tagged 577 mussels, including both common (*Amblema plicata*, *Obliquaria reflexa*) and less common (*Quadrula pustulosa*, *Pleurobema sintoxia*) species in West Newton Chute, Pool 5. Tagged mussels were placed into 1 of 20 study plots that encompassed both low and high density areas of the mussel bed. In 2013, we returned to the mussel bed and relocated tagged mussels. However, given that mussels are long-lived, we need to monitor this bed for multiple years to get accurate mortality estimates. Thus, we are requesting funds to cover the costs of divers needed to relocate tagged mussels in 2014-2016. This would give us four years of mortality data and provide data for assessment of annual variation. Pending sufficient funds, we hope to continue this research for at least 10 years.

Cost: $128K (gross). This includes 36K for divers (10K in FY14, 12K in FY15, 14K in FY16) from the MN Department of Natural Resources to relocate tagged mussels in 2014-2016. Because the MN DNR is already on-site doing their own annual sampling, this cost is a small fraction of what it would cost to otherwise get divers on-site. USGS will leverage three-quarters of the salaries (~50K) and all supplies during 2014-2016, however, we request 30K in FY17 for statistical analysis and report writing. Although this is a long-term project, we would provide a brief summary report in FY15 and FY16 and a completion report in FY17 that estimates the temporal and spatial variation in mortality rates and addresses the utility of using mortality rate as a sensitive metric to monitor the response of native mussels to habitat rehabilitation and enhancement projects.

Products and Milestones

Tracking number	Products	Staff	Milestones
2014MVR1	Brief summary report	Newton, Zigler, Davis	30-Sep-15
2014MVR2	Brief summary report	Newton, Zigler, Davis	30-Sep-16
2014MVR3	Completion report on a vital rates of native mussels at West Newton Chute, UMRS	Newton, Zigler, Davis	30-Sep-17

Validation of a Mussel Community Assessment Tool for the Upper Mississippi River System

Principal Investigators: Teresa Newton, USGS, Upper Midwest Environmental Sciences Center, La Crosse, WI, Steve Zigler, USGS, Upper Midwest Environmental Sciences Center, La Crosse, WI, Jon Duyvejonck, U.S. Fish and Wildlife Service, Moline, IL, and, Heidi Dunn, Ecological Specialists, Inc., O'Fallon, MO

Introduction: In 2010-2011, the COE funded a proposal to develop a mussel community assessment tool for the Upper Mississippi River system. This proposal contained 4 phases, and only the 1st phase ("gather existing data and explore metrics to assess mussel community health") was funded. We now request additional funding to complete phase 2 ("conduct full analyses of selected metrics"). Many data gaps became apparent during phase 1. The most noticeable was the lack of data sets with low mussel densities, thus our phase 1 results are skewed towards higher density areas (i.e., mussel beds). How assessment metrics would change in lower mussel density areas needs to be assessed. Examination of temporal variation of assessment metrics in representative beds would also be informative because mussel populations are variable to an unknown extent, but management decisions are often based on a single survey at one point in time. The proposed research supports question 4b of the LTRM research framework on native mussels ("how can we assess the health of the mussel assemblage") and output 1.3a ("additional information for status and trends knowledge regarding mussels") in the LTRM strategic plan.

Proposed research: The next step is to validate the mussel community assessment tool. The most scientifically rigorous approach would be to obtain numerous quantitative samples over a wide range of mussel community types (from good to poor) to derive accurate distributions for the community metrics. This approach would be costly because a substantial number of reaches would have to be sampled to derive a reasonably complete distribution for the metrics. A more realistic approach might be to test whether the current metrics (or an aggregated index) could discriminate between areas perceived to have high (i.e., not impacted) and low (i.e., impacted) quality mussel communities. This validation would require *a priori* selection of test areas expected to contain mussel communities of each quality. Test areas could be selected using expert opinion. The validation would then be a test of whether the metrics (or aggregated metric) capture expert judgment. We will provide managers with criteria for selecting reference and impact sites and then document their responses and justifications for meeting those criteria for sites that are nominated. The utility of this approach would be as an objective management tool for decision-making, but would not necessarily be useful for monitoring purposes. The mussel community tool would likely require changes in the scoring cut-points, and perhaps metrics, as experience and data accumulate. This approach is likely to be less costly than a broadly-based sampling approach. The result of this research would be a validated mussel community assessment tool for use by river managers. Thus, we propose to host a workshop in spring 2015 (most likely in conjunction with a meeting such as the UMRCC to facilitate travel) with the following goals:

1. Qualitatively validate the mussel assessment tool. This would be accomplished by asking resource managers if they agree with the rankings of metrics used to score specific mussel beds as poor, fair, or good; reference or impacted.
2. Determine if there are other existing datasets from locations that resource managers can *a priori* classify into reference and impacted sites.
3. Determine if there are other areas, without existing data, that resource managers can *a priori* classify into reference and impacted sites that we could sample in the future.

Following the workshop, we propose to:

1. Format up to 10 additional data sets identified by resource managers into a common format.
2. Evaluate these data sets to determine if the selected metrics correctly classify these sites as poor or good.
3. Evaluate the temporal variation in metrics using data from our original and newly identified datasets that contained multiple samples over time.
4. Refine the assessment tool metrics.

Cost: $96K (gross) to hold the workshop, add up to 10 additional datasets, refine assessment tool metrics and evaluate temporal variation in metrics. Most of the requested funds go towards hosting the workshop and revising the assessment tool. While USGS will leverage most of the salaries and all required software (~44K), we are requesting $22K in salaries for statistical analysis and report writing. The product would be a completion report, submitted 18 months from notification of funding, and would contain the validated mussel community assessment tool for use by river managers.

Additional task:

1. Address comments from B. Gray, dated 16 Feb 2014.

Products and Milestones

Tracking number	Products	Staff	Milestones
2014MCA1	Workshop of mussel experts in UMRS	Newton, Zigler, Dunn, Duyvejonck	1-May-15
2014MCA2	Draft completion report on a validated mussel community assessment tool for use by river managers	Newton, Zigler, Dunn, Duyvejonck	1-Dec-15
2014MCA2	Completion report on a validated mussel community assessment tool for use by river managers	Newton, Zigler, Dunn, Duyvejonck	1-Mar-16

Effects of nutrient concentrations and zooplankton on phytoplankton abundance and community composition

1) Description of Work

Questions being addressed

Is there evidence that zooplankton abundance and community composition affects the response of phytoplankton to the high nutrient concentrations frequently observed in the UMRS? Do these effects differ among aquatic area types?

Why is this important / What are the implications for river management or rehabilitation?

There is growing evidence that high nutrient concentration in the UMR affects the local riverine ecosystem in addition to the more widely recognized effects on the Gulf of Mexico. Potential effects of increased input of nutrients to the UMR include: increased phytoplankton biomass, shifts to bloom forming, toxic and inedible algal species, increased incidence of fish kills, reductions in species diversity, decreased water transparency, oxygen depletion, and perceived decrease in the recreation value of the river.

The objective of this study is to better understand how nutrient concentration affects phytoplankton abundance and community composition by examining how those effects may be mitigated or exacerbated by zooplankton, and what the implications are for blooms of undesirable and potentially toxic algae.

Phytoplankton can be an important source of energy for the upper levels of the food web. The quality of the food resource provided by phytoplankton depends on its abundance and the dominant species present. Diatoms generally provide higher energy food, whereas cyanobacteria (blue-green algae) are a lower energy food and when filamentous taxa dominate, zooplankton feeding may be impaired and energy flow to the upper levels of the food web diminished.

Nutrient availability is an important determinant of phytoplankton abundance and community composition. For example, high phosphorus concentrations, common in the UMRS, have been associated with abundant cyanobacteria (especially when high phosphorus concentrations co-occur with low nitrogen concentrations). In lakes, the abundance and composition of the zooplankton can significantly alter the response of algae to high nutrient concentrations, but whether similar interactions occur in large rivers is unknown. Additionally, this dataset will serve as an invaluable pre-Asian Carp zooplankton and phytoplankton community baseline for Navigation Pool 8.

Relation to previous work

This study builds on previous and ongoing studies of UMRR-EMP-LTRM phytoplankton samples. Decker (2013) conducted initial counts of UMRR-EMP-LTRM phytoplankton samples from Navigation Pool 8. Her results provided an initial species list for this reach of the river, described basic contrasts in phytoplankton community composition between channel and off-channel areas, and documented the occurrence of substantial blooms of blue-green algae in both main channel and backwater areas.

John Manier's ongoing work is expanding on Decker's findings by including samples from all of the UMRR-EMP-LTRM UMR sampling reaches and a suite of years that span a range of discharge conditions, measuring both abundance and biovolume (analogue of biomass; not measured by Decker 2013) of

phytoplankton, and, investigating relationships between water quality conditions and phytoplankton community composition.

The work proposed here will build on the results of Decker and Manier in several ways. Most importantly, it will include two years of zooplankton data (2009 and 2011) collected as part of another project. By including the role of nutrients ("bottom up control") and zooplankton ("top down control"), a more complete picture of the factors influencing phytoplankton abundance and community composition (indicates food quality and presence/absence of blue green algal blooms) will result.

Methods

There will be no new field work as all samples have already been collected either as part of standard LTRM water quality sampling or other efforts. The requisite limnological data is contained in the LTRM water quality data base. The zooplankton abundance and community composition data has already be collected and organized by the Wisconsin DNR. Phytoplankton samples have been collected but not counted. These sites were sampled in 2009 and 2011 at LTMRP fixed sampling sites, and represent a large range of hydraulic connectivity by including sites from main channels and contiguous backwaters. Funding for phytoplankton counting is being requested as part of this proposal.

2. Who's involved

PI: Shawn Giblin
Collaborators: Ben Campbell, Jeff Houser, John Manier, and BSA Environmental Services.

3) How does the work relate to the needs of the UMRR-EMP and river managers?

The UMRR-EMP LTRM Indicator Report included in its recommendations regarding chlorophyll a that "future investigation on blue-green algae is also recommended". The phytoplankton data produced in this study will facilitate such future studies.

Section 2.4 of the Landscape Pattern research framework emphasizes the need to understand the distribution and effects of "hot" and "cold" spots of nutrient concentrations in the UMR. The proposed work will investigate how zooplankton may interact with that distribution of nutrient concentrations to determine phytoplankton abundance and community composition

By investigating factors affecting an important component of the base of the food web, the proposed project addresses Outcome 2, Output 2.1 "Insights about river process, function, structure, and composition based on long-term data sets" in the 2010 - 2014 Strategic Plan.

4) What products will result this fiscal year or in the first year of the project?

The first year of work will provide the phytoplankton counts and biovolume estimation that will be used in the following year to write a research paper. Subsequent work will evaluate water quality and hydraulic variables to further enhance our understanding of algal and zooplankton community composition and dynamics in response to variable river conditions.

5) Time frame and logistic considerations for the work.

The phytoplankton counts and initial summary of that data can be completed during a single fiscal year. The more detailed analysis and questions described above will be addressed in a report produced in the second year. Specifically:

Year 1
-Counting of phytoplankton samples by BSA Environmental Services completed.

-Funding required beyond LTRM base	$13,000
-Estimated time required under LTRM base	2 weeks

Year 2
-Database containing phytoplankton, zooplankton, and associated WQ data completed
-Data analysis and results summary completed

-Funding required beyond LTRM base	NONE
-Estimated time required under LTRM base	3 weeks

Year 3
-Full manuscript describing results completed

-Funding required beyond LTRM base	NONE
-Estimated time required under LTRM base	8 weeks

6) Estimate budget by year.

Funding above base is only needed for the counting of the phytoplankton samples in the first year. The second and third years of work can be completed as "analysis under base".

Reference

Decker, J.K. 2012. Nutrient controls on phytoplankton composition and ecological function among hydrologically distinct habitats in the Upper Mississippi River. PhD Dissertation. Fordham University, NY.

Additional task: Address comments from B. Gray, dated 16 Feb 2014.

Products and Milestones

Tracking number	Products	Staff	Milestones
2014NC1	Counting of phytoplankton samples	Giblin, Campbell, Houser, Manier	13-Mar-15
2014NC2	Database completed and analysis completed	Giblin, Campbell, Houser, Manier	13-Mar-16
2014NC3	Full manuscript completed	Giblin, Campbell, Houser, Manier	13-Mar-17

Ecological Shifts in a Large Floodplain River during a Transition from a Turbid to Clear Stable State

1) Description of Work

Questions being addressed

In this study we will analyze LTRM water quality, aquatic vegetation and fisheries data in order to further understand ecological shifts experienced during the transition from a turbid to clear stable state. We hypothesize that increased SAV abundance over a nearly two decade period has resulted in changes in water clarity, water chemistry and fish community composition.

Why is this important / What are the implications for river management or rehabilitation?

Ecological shifts between a clear, macrophyte-dominated stable state and a turbid stable state dominated by phytoplankton and high inorganic suspended solids have been well described in shallow lake ecosystems (Scheffer, 2004). Recent studies have documented the presence of alternate stable states among regulated rivers (Hilt et al., 2011). The majority of rivers worldwide are impounded and characterized by increased hydraulic retention time relative to free-flowing rivers (Hillbricht-Ilkowska, 1999). Long retention-time rivers can alternate between phytoplankton and macrophyte dominance (Hilton et al., 2006). Multi-decadal datasets such as the Long Term Resource Monitoring Program (LTRM) dataset collected on the Upper Mississippi River (UMR) can provide unparalleled insight into these dynamics among regulated floodplain river ecosystems.

The positive relationship between submersed aquatic vegetation (SAV) and water clarity is well understood (Scheffer, 1998). The prevalence of SAV is known to drive a variety of ecological processes in aquatic ecosystems (Meerhoff et al., 2003). Proliferation of SAV can result in a variety of feedback mechanisms including: reduced sediment resuspension (James, 2004), reduced phytoplankton biomass via competition for nutrients and sinking (James and Barko, 1994), increases in invertebrate biomass (Engel, 1988), increased refuge for zooplankton (Schriver et al., 1995), increased denitrification (Weisner et al., 1994), production of allelopathic substances (Jasser, 1995), and increases in waterfowl abundance (Rybicki and Landwehr, 2007).

The presence or absence of SAV is one of the major factors driving fish community characteristics (Grift, 2001). Vegetated systems tend to be dominated by visual predators such as yellow perch and northern pike (Kipling, 1983). Piscivorous fish such as northern pike are often able to substantially reduce recruitment among planktivorous fishes (Sondergaard et al., 1997). This reduction in planktivorous fish can alter food webs and result in further increases in SAV and water clarity (Persson et al., 1988). Alternatively, benthivorous fish such as common carp tend to be abundant in turbid systems and can keep these systems in a turbid state due to resuspension during their feeding activities (Miller and Crowl, 2006). Once substantial populations of common carp and other benthivores are high, establishing SAV can become difficult due to poor water transparency (Havens, 1991).

Relation to other work

This work will build on that of Popp et al. (2013; Completion Report 2010 D6). Popp's work documented ecological shifts in lower Pool 4 during a period of increasing water clarity and vegetation density. This work will provide additional insight into factors driving ecological change in the Upper Mississippi River.

Methods

There will be no new field work as all samples have already been collected either as part of standard LTRM sampling efforts. We will analyze Pool 8 water quality, aquatic vegetation, and day electrofishing SRS data from 1993-2012, with the intent to examine trends, associations, and ecological breakpoints among these datasets.

2. Who's involved

PI: Shawn Giblin
Collaborators: Brian Ickes, Heidi Langrehr, and Andy Bartels

3) How does the work relate to the needs of the UMRR_EMP and river managers?

It is critical for the UMRR_EMP and river managers to understand factors driving long-term shifts in river biota such as fish. Increased understanding of ecological "tipping points" where the system shifts to an alternate stable state will allow the UMRR_EMP and river managers to develop "goal oriented" management actions to prevent or moderate catastrophic ecological changes (i.e. submersed aquatic vegetation loss). This work relates to LTRM Strategic Plan Outputs 1.1, 1.2, 2.1, 3.1 and 4.1.

4) What products will result this fiscal year or in the first year of the project?

Literature review, initial analyses and draft results. Additional analytical and statistical work will be identified for the next year and a draft manuscript outline will be prepared.

5) Time frame and logistic considerations for the work

FY 2014 Literature review and initial data analyses completed.
FY 2015 Refined analyses/statistical work, graphics and draft manuscript preparation
FY 2016 Manuscript submitted for publication in peer reviewed journal

6) Estimate budget by year.

FY 14: $12K for temporary labor to backfill maintenance, lab work, minnow identification, and sampling duties.
FY 15: $12 K for temporary labor to backfill maintenance, lab work, minnow identification, and sampling duties.
FY 16: $0 complete under Base

Additional task: Address comments from B. Gray, dated 16 Feb 2014.

Products and Milestones

Tracking number	Products	Staff	Milestones
2014ES1	Literature review and initial analyses competed	Giblin, Ickes, Langrehr, Bartels	13-Mar-15
2014ES2	Refined analyses and draft manuscript prepared	Giblin, Ickes, Langrehr, Bartels	13-Mar-16

2014ES3	Manuscript submitted for publication		Giblin, Ickes, Langrehr, Bartels	13-Mar-17

Asian Carp Activities

1) Description of Work

This document contains a proposal for above-base funding for UMRR-EMP activities related to Asian Carp in the UMRS. It is common knowledge that Asian Carp alter ecosystem structure and function; and a goal of UMRR-EMP is to restore ecosystem structure and function; therefore we need to better understand how these species are altering ecosystem process, function, structure and composition (related to LTRM Outcome 2). The following proposal as a whole provide a continuum of how Asian Carp alter ecosystem process through their various life stages (adult, juvenile, larval) and the associated factors that influence (associations with native fishes) the overall population. This proposal has been discussed and shared among the field stations and UMESC and provide system-wide ideas on how to address the issues related to Asian Carp that are appropriate and feasible to address within UMRR-EMP. In addition, the research will add to past and ongoing efforts conducted by Garvey, Chapman, Knight, and Casper (please see each project below for specific contributions). Not only are ideas related to utilizing LTRM status and trends data to detect these species, but also seek to increase our understanding of how Asian Carp alter ecosystem processes which directly relate to the success of many of our HREPs and restoring the UMRS. This proposal has 4 projects and includes "analysis under base" and a request for "above base" funding which leverages data collection, analysis, and labor.

Contents

2) Who's Involved – Listed on each project, but overall included:
   - Principal Investigators: Kat McCain (USACE) and Quinton Phelps (LTRM-ORWFS)
   - Additional Contributors: Levi Solomon (LTRM-IRBS); Andy Casper (LTRM IRBS); Nerissa Michaels (LTRM-IRBS)
   - Additional Team Members (supporting role): John Chick (LTRM-NGRREC)
3) How does this work relate to the needs of the UMRR-EMP and river managers? – Discussed within each project, but overall included:
   - LTRM Strategic Plan Outcome 2: Enhanced knowledge about system process, function, structure, and composition
     - Output 2.1: Insights about river process, function, structure, and composition based on long-term data sets
       - Understanding how Asian carp alter ecosystem processes and impact native species is important in order to restore the UMRS and design HREPs to promote native species versus Asian Carp
   - LTRM Strategic Plan Outcome 3: Enhanced use of scientific knowledge for implementation of ecosystem restoration programs and projects
     - Output 3.1: Use LTRM infrastructure, data sets, and expertise to help formulate, design, and evaluate ecological restoration projects

        - Several ideas are proposed to monitor Asian Carp using HREPs. LTRM staff and expertise will be used and lessons learned on how Asian carp using HREPs will be shared to help formulate, design, and evaluate future HREPs

4) <u>What product(s) will result this fiscal year or in the first year of the project?</u>
    - At the end of this project (December 2016), data will be analyzed and will be shared with the partnership through an annual progress summary, presented at MRRC 2017 (Power Point Presentation) or at an A-team meeting. All data will be provided electronically to the partners in an excel spreadsheet (USACE, USGS, States). If data permits, a publication may potentially be developed.
5) <u>Time frame and logistic considerations for the work.</u>
    - 2 year project
        - 1st year data collection
        - 2nd year data analysis
6) <u>Estimated Budget/Level of Effort:</u>
    - "Analysis Under Base" – Asian Carp collected through LTRM base monitoring; labor for ORWFS staff
    - "Above Base" – requested for year 1 sampling efforts -
        - See budget sheet for labor and operational costs for ORWFS and USACE staff
        - Graduate Student funding - $20K
        - Out-of-state travel request for ORWFS – HREP collections = $7,000
        - In-state travel request for ORWFS – HREP collections = $3,000
        - Sample processing - $13,000 (approximately $15/sample; max sample size including LTRM collected fish and HREP fish = ~ 850 samples)
        - Field Supplies - $2,000
        - No additional operational costs requested

<u>Project Lead:</u> Quinton Phelps

<u>Project Team</u>: Field station staff, Kat McCain

Part 1. Invasive Carp Population Demographics in the Upper Mississippi River System: An Evaluation of the Dynamic Rate Functions

Project Description: The purpose of this project is to evaluate invasive carp (species which may collected through LTRM monitoring may include silver carp, bighead carp, grass carp, common carp, and black carp) populations throughout the Upper Mississippi River, which will enhance the programs understanding of how invasive species alter system process, function, structure, and composition (LTRM Strategic Plan, Outcome 2).

Invasive carps are exotic fishes that were first introduced to the United States in the mid-to-late 1800's from Asia. Since this time, invasive carps have expanded their range and now inhabit the majority of United States freshwater lakes, rivers, reservoirs, and streams. Previous research has indicated that invasive carp may have negative impacts on native fishes and their associated habitat. Preliminary evidence suggests that invasive carps likely constitute an overwhelming majority of the fish biomass throughout the Upper Mississippi River (UMESC, Fish Graphical Browser). Given these exceedingly high carp biomass estimates (relative to all other fishes captured) in the Upper Mississippi River, carp are undoubtedly exerting deleterious force on this system. Thus, gaining insight into these invasive carp populations is imperative. More specifically, determining the demographics throughout the Upper Mississippi River would help our understanding of invasive carp population ecology, and may indicate potential management strategies that could effectively minimize their effects on the Mississippi River ecosystem. This would also benefit habitat projects seeking to restore ecosystem processes that have been detrimentally impacted by these invasive fish. This study will also provide a more broad-based systemic approach and understanding to Asian carp populations relative to the research conducted by other scientists throughout the Mississippi River basin.

Goal and Objectives: To determine invasive carp dynamic rate functions (recruitment, growth, and mortality) in all six study reaches of the Upper Mississippi River basin to better our understanding of how these species alter ecosystem structure and function. . Specifically, Part 1 would further UMRR-EMP's understanding of the river system by providing new information on how native fishes and the Upper Mississippi River System (i.e., structure and function) as a whole are impacted by invasive carp.

Methods: Through LTRM base monitoring efforts, invasive carp populations will be collected during June through October (corresponding to already in place efforts; LTRM protocols) using standard LTRM electrofishing in all six study reaches (collaborative efforts for collection among LTRM field stations and will be completed opportunistically during already scheduled LTRM sampling). We will attempt to collect invasive carp samples from pool 4 (Lake City, Minnesota, RKM 1210-1283), pool 8 (LaCrosse, Wisconsin, RKM 1092-1131), pool 13 (Bellevue, Iowa, RKM 841-896), pool 26 (Alton, Illinois, RKM 325-389), La Grange Pool (Illinois River, RKM 80-158) and the open river (Cape Girardeau, Missouri, RKM 47-129), and three HREP locations (e.g., Batchtown, Swan Lake, and Chautauqua) will be targeted for additional sampling based on river conditions. Total length, weight, and gender recorded from each fish. Otoliths will be removed from the fish, sectioned and aged to determine population age structure. For each carp population sample, we will evaluate the dynamic rate functions (recruitment, growth, and mortality; see below).

To determine the relative number of carp that are entering (i.e., recruiting) the systems each year, the number of fish in each year class will be quantified. Ages derived from otoliths will be used to determine recruitment patterns. For each age class present in all six river reaches, we will quantify the relative strength or weakness of each cohort within each reach using the residual method. Specifically, positive residual values from the regression would indicate a relatively strong year class while negative residuals would indicate weak year classes. Recruitment variability will be quantitatively categorized (consistent recruitment-no missing year classes= 1; few missing year classes or variability in year class strength= 2; moderate number of missing year classes or moderate variability in year class strength = 3; abundant missing year classes or high variability in year class strength= 4) among carp capture locations.

Mortality rates of the individual carp populations in the Mississippi River basin will be determined using a catch-curve approach. Catch curves will be generated by summing the number of fish caught per age class in each individual river reach. These data will allow for the development of individual regression models to estimate instantaneous mortality. Instantaneous mortality rate (Z), which will be used to determine the total annual mortality (A = 1 ? e-Z) for carp populations from each river reach.

Invasive carp growth will be estimated for each reach by determining the mean length at age. Mean-length at age data will be incorporated into Fisheries Analysis and Modeling Simulator and will be used to model growth using a von Bertalanffy approach. The equation generated using the von Bertalanffy growth model is $L_t = L_\infty(1-e^{(-K(t-t0))})$; where, Length infinity (L_∞) is the theoretical maximum length that a fish can achieve, K is the growth constant or growth rate of the population, and t0 is the theoretical length at time zero (i.e., age 0).

Using these population parameters we will simulate commercial harvest levels using a yield-per-recruit/spawning potential ratio approach to determine target size and the relative amount of commercial harvest needed to recruitment overfish the invasive carp population within each particular river reach. For among reach comparisons, the relative strength or weakness of year classes (residual values) from the catch-curve regression from each individual area of invasive carp collection will be cross correlated with all other areas of carp capture locations. Using these analyses will allow us to determine if recruitment patterns were similar among river reaches. To determine if differences in mortality occurred, we will compare the carp mortality rates among river reaches using the homogeneity of slopes test (i.e., test of interaction using ANCOVA). The overall growth curves generated for all river reaches will be compared using the residual sums of squares from the coinciding von Bertalanffy models. The individual parameters of the von Bertalanffy model will be used to descriptively compare among carp capture locations. Specifically, theoretical maximum length, and the Brody growth coefficient will be compared descriptively among sites.

Additional task: Address comments from B. Gray, dated 16 Feb 2014, letter summary.

Products and Milestones

Tracking number	Products	Staff	Milestones
2014CPD1	Summary letter	Phelps, Mccain	31-Jan-15
2014CPD2	Manuscript	Phelps, Mccain	31-Mar-16

Part 2. Identifying Recruitment Sources of Asian carp Inhabiting the Upper Mississippi River

Project Description: Bighead and silver carps have become extremely abundant in the large rivers of the central United States and appear to be affecting ecosystem structure (i.e. native riverine fishes) and ecosystem function (i.e. food webs) as well as representing a hazard to boaters. While Asian carp spawning and recruitment have been observed in the Illinois, Middle Mississippi, and Missouri Rivers, circumstantial evidence suggests that Asian carp reproduction and subsequent recruitment to the juvenile stage within the pooled portion of the Upper Mississippi River upstream of the Illinois River confluence is limited, particularly during years with a weak flood pulse and less frequent run-of-river conditions. The flood pulse has been shown to be hugely important to production and subsequent recruitment (i.e., weak flood pulse in 2012 showed only one YOY Silver/Bighead Carp collected within the Open River study reach). Thus, the Asian carp stock in the impounded Upper Mississippi River may be heavily supplemented or possibly even primarily composed of fish that recruited in other river segments (e.g., the unimpounded Middle Mississippi River, Missouri River, or the Illinois River) and immigrated into the Upper Mississippi River. Understanding bighead and silver carp recruitment and immigration/emigration patterns is critical for planning and management efforts which will benefit habitat projects seeking to restore ecosystem processes that have been detrimentally impacted by these invasive fish.

Recent research has demonstrated that fishes that reside in the Upper Mississippi, Middle Mississippi, Missouri, or Illinois Rivers can be distinguished from one another using naturally occurring, river-specific chemical "signatures" present in fish otoliths and fin rays. Otoliths contain a permanent chronological record of the "signatures" representing environments an individual fish has occupied during its lifetime, enabling reconstruction of that fish's environmental history through sub-sampling for isotopic and elemental analysis across the otolith. This approach is currently being applied to identify natal environments and immigration patterns of adult Asian carps inhabiting the Illinois River (SIUC, Jim Garvey and Greg Whitledge). This study will build on the Southern Illinois University study and provide a more systemic understanding of origin of invasive carps throughout the Mississippi River basin.

Goal and Objectives: Determine environmental life history of Invasive carps in the Upper Mississippi River. This information is vital to further the UMRR-EMP's understanding of where these species originate and how they use the river system throughout their life history. This is critical for the Program in order to increase our knowledge and provide better science-informed management decisions on a species known to have detrimental impacts to our native fishes and other ecosystem processes.

Methods: We propose to identify natal environment (Upper Mississippi River, Middle Mississippi River, Missouri River, or Illinois River) and characterize immigration patterns for juvenile and adult Asian carps collected from the pooled portion of the Upper Mississippi River, and will include targeted sampling at three HREPs (e.g., Batchtown, Swan Lake, and Chautauqua) , through analysis of strontium:calium (Sr:Ca) ratios within fish otoliths collected under LTRM base monitoring using standard LTRM sampling gear. A representative maximum sample size of 300 fish would be used for this study (same fish as Part 1). Otoliths will be extracted from each fish; one otolith from each fish will be embedded in epoxy, sectioned, cleaned, and analyzed for Sr:Ca along a transect from otolith core to edge using laser ablation inductively coupled plasma mass spectrometry (LA-ICPMS). Sr:Ca at the otolith core will be used to identify natal environment for each fish via comparison with established Sr:Ca signatures indicative of residency in each of the river segments listed above. Changes in Sr:Ca across sectioned otoliths will be used to infer frequency and timing of immigration into the Upper Mississippi River from other river segments.

Additional task: Address comments from B. Gray, dated 16 Feb 2014, letter summary.

Products and Milestones

Tracking number	Products	Staff	Milestones
2014CRS1	Summary letter	Phelps, Mccain	31-Jan-15
2014CRS2	Manuscript	Phelps, Mccain	31-Mar-16

Part 3. Effects of Asian Carp on the Diets of Native Piscivores in the Upper Mississippi River System

Project Description: The purpose of this project is to evaluate the predatory effects that native piscivores have on Asian carp (silver carp, bighead carp) throughout the Upper Mississippi River (LTRM Strategic Plan, research framework Output 2.1). Asian carp are invasive fishes that were first introduced to the United States to maintain water quality in aquaculture facilities. From this point of origin (via escapement during flooding), Asian carps have expanded throughout the major drainages of the Midwestern United States (Upper Mississippi River particularly emphasized). Several research studies have indicated that Asian carp may have deleterious effects on trophic structure and dynamics (e.g., competition with native fishes and altering lower trophic levels) of the Mississippi River basin. Understanding if and how native piscivores consume Asian carp or how Asian carp have altered food habits of piscivores will provide useful information in terms of understanding how Asian carp have altered ecosystem processes (i.e. trophic structure), and provide insight to habitat projects seeking to restore ecosystem structure and function to benefit native fish communities. Jim Lamer and Andy Casper are conducting a similar study in the Illinois River and a small portion of the UMRS; however, this study will provide additional information on a more systemic scale

Goal and Objectives:
Goal: Determine if Asian carp have changed food habits of native piscivores which would further UMRR-EMP's understanding if the abundant presence of Asian Carp have altered the food preference and/or availability of prey species (e.g., altering the trophic structure of the river system).

In addition, the diet analysis would also provide insight on if the native piscivores are consuming Asian Carp. This ancillary information would further UMRR-EMP's understanding of not only how Asian Carp have altered the diets of native fishes (and ultimately trophic structure), but if and how native fishes are utilizing Asian Carp in their diets. Information gained from this study would be used by the UMRR-EMP to make better science-informed management decisions involved with Asian Carp.

Methods: Native piscivorous fishes will be sampled during June through October (corresponding to already in place efforts; LTRM protocols) using standard LTRM electrofishing in the three lower reaches (collaborative efforts for collection among LTRM field stations) where Asian carp persist. Specifically, we will attempt to collect native piscivores from pool 26 (Alton, Illinois, RKM 325-389), La Grange Pool (Illinois River, RKM 80-158) and the open river (Cape Girardeau, Missouri, RKM 47-129), and three HREPs will be targeted (Batchtown, Swan Lake, and Chautauqua) . Total length, weight, and gender recorded from each native piscivorous fish collected. Approximately 150 piscivorous fish will be gastrically evacuated using methods described in numerous previous studies. Gut contents will be removed and preserved for further analyses. We will use these data in accordance with standardized sampling to determine if native piscivore prey consumption is proportional to the environment (e.g., selectivity). Furthermore, we will also be able to determine the species of native piscivore that has the greatest capacity for consuming Asian carp; and to better understand how piscivorous fish diet could be influenced by the presence of Asian carp.

Additional task: Address comments from B. Gray, dated 16 Feb 2014, letter summary.

Products and Milestones

Tracking number	Products	Staff	Milestones
2014NPD1	Summary letter	Phelps, Mccain	31-Jan-15
2014NPD2	Manuscript	Phelps, Mccain	31-Mar-16

Part 4. Early Life History of Invasive Carp in the Upper Mississippi River Basin

Project Description: Invasive carps (common carp, grass carp, silver carp, bighead carp, and black carp) are a nonnative species rapidly expanding their range. This rapid expansion may be attributed to their tolerance of a wide range of environmental conditions, efficiency of feeding, high fecundity, rapid growth rates, lack of natural predators, and other r-selected characteristics. To date very limited information exists on invasive carp early life history (i.e., from time of hatch through the following spring), despite the apparent relevance. For many fishes, excessive mortality occurs during this time period and may play a key role in regulating recruitment. Specifically, previous research suggests that year class strength is determined during the early life history. Thus, understanding factors that affect survival during this critical time period is crucial to management of invasive carps. Understanding early life history attributes (hatch timing, daily growth, habitat use, and diet) of invasive carps could provide insight into the complex mechanisms that structure these populations and could provide insight into potential approaches for management and restoration project design.

Goals and Objectives: This study has multiple goals and objectives and are as follows:

1. Quantify sizes, abundance, growth rates, and hatch timing of age-0/age-1 invasive carps
2. Describe habitat use by age-0/age-1 invasive carps
3. Evaluate diet of age-0/age-1 invasive carps
4. Estimate natural mortality of cohorts of age-0 invasive carps as they transition into spring age-1 by quantifying the decline of individuals in the catch through time.

This early life history history, which is currently unknown at this time, will further UMRR-EMP's understanding of the complex population structure of invasive carp, specifically what within the river system is regulating recruitment into adulthood. This information would be used by the Program to make better science-informed management decisions and provide insight on if invasive carp are utilizing HREPs during this critical life stage. This latter information could then be used and considered during future HREP designs.

Methods: Through LTRM base monitoring efforts at all 6 field stations, asian carp will be collected. In addition to base monitoring efforts, LTRM gears will be deployed at three HREPs (e.g., Batchtown, Swan Lake, and Chautauqua) to supplement base monitoring. These species will be opportunistically sampled with a max target sample size 150 per Asian carp species for otolith and stomach contents analysis.

Additional task: Address comments from B. Gray, dated 16 Feb 2014, letter summary.

Products and Milestones

Tracking number	Products	Staff	Milestones
2014CLH1	Summary letter	Phelps, Mccain	31-Jan-15
2014CLH2	Manuscript	Phelps, Mccain	31-Mar-16

WI Airboat Replacement

UMRR LTRM facilities and equipment (boats, motors, sampling equipment, etc) need to be well maintained and replaced when necessary to maintain a safe and functional work environment. The need to ensure the safety of field staff is the primary driver. When equipment presents an unacceptable safety risk to personnel, it needs to be replaced.

After a professional inspection, the WI UMRR LTRM Field Station airboat was deemed no longer safe for operation in the UMR marine environment and its replacement was recommended. This purchase was completed after accepting the lowest bid from a vetted company.

For the WI UMRR LTRM Field Station:

American Airboat Corporation
18' Hull-welded airboat and trailer
TOTAL COST $76,112