U.S. Army Corps of Engineers'
Upper Mississippi River Restoration Program
Long Term Resource Monitoring Element

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Technical Report
2016–T001

Documenting the Use of the Long Term Resource Monitoring Element's Fish Monitoring Methodologies Throughout the Midwest

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Documenting the Use of the Long Term Resource Monitoring Element's Fish Monitoring Methodologies Throughout the Midwest

By Levi E. Solomon and Andrew F. Casper

U.S. Army Corps of Engineers Upper Mississippi River Restoration Program
Long Term Resource Monitoring Element

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Preface

The U.S. Army Corps of Engineers' (USACE) Upper Mississippi River Restoration (UMRR), including its Long Term Resource Monitoring element (LTRM), was authorized under the Water Resources Development Act of 1986 (Public Law 99–662). The UMRR is a multi-federal and state agency partnership among the USACE, the U.S. Geological Survey's (USGS) Upper Midwest Environmental Sciences Center (UMESC), the U.S. Fish and Wildlife Service (USFWS), and the five Upper Mississippi River System (UMRS) states of Illinois, Iowa, Minnesota, Missouri, and Wisconsin. The USACE provides guidance and has overall Program responsibility. The UMESC provides science coordination and leadership for the LTRM element.

The UMRS encompasses the commercially navigable reaches of the Upper Mississippi River, as well as the Illinois River and navigable portions of the Kaskaskia, Black, St. Croix, and Minnesota Rivers. Congress has declared the UMRS to be both a nationally significant ecosystem and a nationally significant commercial navigation system. The mission of the LTRM element is to support decision makers with the information and understanding needed to manage the UMRS as a sustainable, large river ecosystem, given its multiple use character. The long-term goals of the LTRM element are to better understand the UMRS ecosystem and its resource problems, monitor and determine resource status and trends, develop management alternatives, and proper management and delivery of information.

This project supports efforts outlined in the Strategic and Operational Plan for the Long Term Resource Monitoring element on the Upper Mississippi River System, Fiscal Years 2010–14 (Outcome 4). Critical to the success of the UMRR is providing decision makers with targeted, easily accessible, and usable information regarding the Upper Mississippi River ecosystem. Information summarized in this report can be used for development of any step-down document prepared for the "Involvement of LTRM with monitoring on other rivers, nationally and internationally" (UMRR LTRM FY 2013 Scope of Work).

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Documenting the Use of the Long Term Resource Monitoring Element's Fish Monitoring Methodologies Throughout the Midwest

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Abstract

The Upper Mississippi River Restoration (UMRR) Program's Long Term Resource Monitoring (LTRM) element is designed to monitor and assess long term trends in the Upper Mississippi River System (UMRS). To accomplish this, standardized methods are used that allow for comparisons across pools and rivers. In recent years, other projects and other agencies have adopted the LTRM fish methodologies for use outside the UMRR. To determine how widespread the use of the Fish Component's methods are, a twelve question survey was delivered via SurveyMonkey.com through the states comprising the American Fisheries Society (AFS) North Central Division and the Upper Mississippi River Conservation Committee. Approximately 2,000 professionals were reached with ≈11 percent participating. Results indicate that nearly all (95 percent) respondents use standardized methods in their sampling and 48 percent are familiar with the LTRM fish methodologies. Roughly one-third (35 percent) of all respondents have used the methods in the past and most (78 percent) of those have modified the methods to suit the information needs specific to their fishery. Results indicate that the LTRM methods have indeed spread outside the UMRR and are now a well-known and potentially widely used technique to sample fish communities.

Introduction

Lack of standardized methods used by fisheries scientists can lead to a lack of comparability and interpretability among data (Bonar and others, 2009). This is especially true when data are collected by multiple teams or agencies in multiple habitats. At a regional scale, some of this lack of standardization is a result of the inherent morphological, geographic, and seasonal variability of rivers (Fausch and others, 2002) and at a local level, is a result of differing goals of scientists collecting the data (that is, targeted sport fish sampling versus community assessment). Lack of standardization can lead to non-comparable data being discarded, resulting in a substantial amount of effort expended (gear deployment, data collected, recorded, entered, and data sheets archived) being rendered essentially useless (Bonar and others, 2009), which can be an impediment to creating cohesive large scale regional and integrative fish assessment programs. The use of standard sampling techniques has the potential to remedy these issues and allows more utility of data collected (Bonar and others, 2009). One example of the use of standardized methods is the U.S Army Corps of Engineers' (USACE) Upper Mississippi River Restoration (UMRR) Long Term Resource Monitoring (LTRM) element.

The UMRR's LTRM element is a large river research and monitoring program currently (2016) operating on the Upper Mississippi River System (UMRS). The UMRR's LTRM element is implemented by the U.S. Geological Survey's Upper Midwest Environment Sciences Center (UMESC), in cooperation with the five UMRS states of Illinois, Iowa, Minnesota, Missouri, and Wisconsin, and the USACE has overall responsibility for the UMRR program. This multi-state, multi-stakeholder, multi-million dollar program collects data on several key attributes of the UMRS, including fisheries data from six monitoring reaches of the UMRS (see Ickes and others [2014] and Ratcliff and others [2014] for additional details). The LTRM standard sampling fish protocols were designed to ensure consistent and comparable data, emphasizing basic fish population and community characteristics that pertain to the indexed abundance, size structure, and community characterization of fishes (Gutreuter and others, 1995; Ickes and others, 2014; Ratcliff and others, 2014). All fisheries data collected for the LTRM are based on these standardized methods, which allow analysis of broad spatial and temporal trends (Ickes and others, 2014; Ratcliff and others, 2014). Implemented in 1993 and first outlined by Gutreuter and others (1995) (and later updated by Ratcliff and others [2014]), the standard methods used to sample fish for the LTRM component are based on a stratified random sampling design complemented by limited fixed site sampling.

During the past 22 years of data collection, the LTRM has become a model of large river research and monitoring and gained global recognition. Subsequently, the influence, impact, and footprint of the LTRM have grown in many ways. Through various collaborations, contributions in local and national meetings and conferences, as well as internal reports and peer-reviewed publications, the UMRR coordinators and LTRM specialists have discussed and disseminated the meth-

odologies and approaches to outside agencies and scientists. The LTRM methods outlined by Gutreuter and others (1995) were also cited by Guy and others (2009) in "Standard Methods for Sampling North American Freshwater Fishes", a book published by the American Fisheries Society, the oldest and largest professional society for fisheries scientists in the world. In addition, Burkhardt and Gutreuter (1995) (a peer-reviewed manuscript summarizing standard LTRM electrofishing methods) was cited by Curry and others (2009) and Miranda (2009) in "Standard Methods for Sampling North American Freshwater Fishes."

Scientists from across the world have come to see firsthand the LTRM element's standard methods and learn about the rationale driving LTRM monitoring and research. For example, Russian scientists from the Institute of Research on Inland Waters (July of 1993) and Peruvian scientists from the Peruvian National University of Peru (two visits in 1995), visited the LTRM's Open River and Wetlands Field Station in Jackson, Missouri. Sponsored and facilitated by outside agencies, these visits included tours of field station facilities, field demonstrations of LTRM equipment and standard methodologies of gear deployment, and an overview of concepts driving research. More recently, an ongoing information exchange between LTRM scientists and Chinese scientists facilitated by The Nature Conservancy's Great River Partnership began in 2008. A few of the highlights include LTRM scientists traveling to China and also hosting visiting Chinese scientists, both on multiple occasions. Chinese scientists have also visited individual field stations as part of the information exchange, seeing firsthand the standard methods of gear deployment and fisheries sampling. Additional highlights of LTRM collaborations can be found in appendix 1.

Despite these high profile proliferations of LTRM methodologies, there has not been an effort to estimate or quantify the spread and use of these methodologies, despite the apparent relevance. Speculation exists that many fisheries professionals from across the Midwestern United States (the initial footprint of the program) have adopted the LTRM methods in their fisheries research; however, this has never been officially investigated. So, to fill this knowledge gap, we created and distributed a survey to fisheries professionals from across the Midwestern United States to attempt to quantify the spread of and use of the LTRM standard methodologies.

Methods

A 12 question, multiple choice survey (appendix 2) was built on SurveyMonkey.com and distributed via email to members of the 11 state American Fisheries Society (AFS) chapters of the AFS North Central Division (NCD). States included the Dakota chapter (North and South Dakota), Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, Ohio, and Wisconsin; the survey was also distributed through the Upper Mississippi River Conservation Committee (UMRCC). The AFS NCD was chosen because all the states (with the exception of Ohio) either border the five UMRS states (Minnesota, Wisconsin, Iowa, Illinois, and Missouri) or house an LTRM research pool (Minnesota, Wisconsin, Iowa, Illinois, and Missouri). Distribution was through individual states rather than the AFS NCD, as individuals within a state chapter may not be a member of the AFS NCD. We sent the survey to the UMRCC to target any additional professionals or students who may not be on a state chapter distribution list or who may not be a member of AFS. The first request for participation was sent February 25, 2013, to representatives of all state chapters and the UMRCC. If a state had no participants after 2 weeks, the initial request for participation was re-sent. A second and final request for participation was sent to all states 1 month after that state's initial participation. The last request for participation was sent on April 8, 2013. Total number of scientists reached and total participation rates were estimated based on the number of members in the distribution list of states and the UMRCC.

Results were compiled online via SurveyMonkey.com and associated data were downloaded May 22, 2013. Results compiled automatically by SurveyMonkey.com were total number of respondents to each question, number of participants who skipped each question, and results of each question with number and percentage of respondents that chose each answer. Additional data summaries included amount of time spent filling out the survey, participation rates by state, and breakdown of results by identified title (for example, administrator, researcher, manager, student, other).

A literature search was done on February 24, 2015, by accessing Web of Science, Google Scholar, Microsoft Academic Search, and Proquest Dissertations and Theses to identify how many documents (peer reviewed literature and non-peer reviewed "gray" literature [internal reports, dissertations and theses, etc.]) available cited the methodologies. Reference librarians from the Prairie Research Institute Library at the University of Illinois were consulted in the completion of the literature search.

Results

The survey reached approximately 2,000 scientists across the Midwestern United States, 2,026 through state AFS listserves and 526 through the UMRCC (table 1). A precise number of scientists reached was difficult to determine because (1) state chapter representatives only provided estimates of the number of members, (2) of overlap among state memberships, and (3) of overlap between state memberships and the UMRCC. Two hundred twenty-seven scientists participated in the survey from February 25, 2013, to May 2, 2013, for a participation rate of ≈11 percent. Participation rates varied by state, ranging from 2 to 21 percent (2 percent, Indiana and Nebraska; 21 percent, Minnesota) (table 1). Two participants were from outside the targeted states (Connecticut and Pennsylvania), whereas the home state of 49 participants could not be established (that is, imprecise answer such as USGS, USFWS, DNR, or IDNR with "I" being Iowa or Illinois). Participation from the UMRCC

was impossible to determine as the UMRCC is an organization made up of scientists from the respective member states (Illinois, Iowa, Minnesota, Missouri, and Wisconsin) and has no unambiguous membership. Participants spent between 1 and 50 minutes filling out the survey with 80 percent of participants filling out the survey in 5 minutes or less and 91 percent in 10 minutes or less. Average time spent was 4:05 minutes.

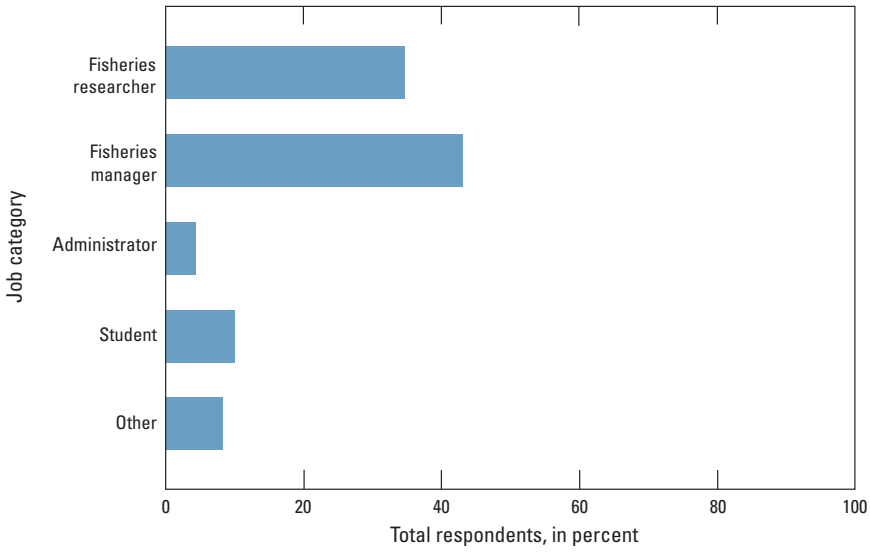
In response to Question 1, the majority of all respondents (77 percent) self-identified as either fisheries managers (43 percent) or researchers (34 percent), with students (10 percent), administrators (4 percent), and "other" (8 percent) making up the rest (fig. 1). In response to Question 2, just more than one-half (57 percent) of all respondents represented state natural resource agencies, whereas 23 percent worked for a university and 12 percent for a federal agency, with the remainder divided among private (3 percent) or some other type of employment (5 percent) (fig. 2). Responses to Question 4 indicate the vast majority (95 percent) of all respondents use standardized methods of some kind; however, responses to Question 5 indicate the sources from which those methods were derived varied widely (fig. 3). All respondents answered Questions 1, 2, and 4, whereas seven respondents skipped Question 5. Responses to Question 6 indicate nearly one-half (48 percent) were aware of LTRM methods, and responses to Question 7 indicate 35 percent have used the methods in their career (fig. 4). Questions 6 and 7 were answered by all respondents. Responses to Question 8 (answered by 85 and skipped by 142 respondents) indicate 77 percent of respondents modify the methodologies to suit their needs. Many respondents to Question 9 (answered by 73 and skipped by 154 respondents) indicated that they modify the gears (fig. 5) and apply them to lakes, ponds, streams, and wetlands (fig. 6).

Table 1. Estimated membership, survey participants, and estimated participation by each state/organization.

[UMRCC, Upper Mississippi River Conservation Committee; ND, not determined. Survey participants from UMRCC were not determined because all UMRCC members were counted by state membership and not solely UMRCC membership.]

State/ organization	Estimated membership	Number of participants	Estimated participation (in percent)
Dakotas	193	17	9
Illinois	340	45	13
Indiana	110	2	2
Iowa	125	15	12
Kansas	99	10	10
Michigan	275	31	11
Minnesota	194	20	21
Missouri	200	11	5
Nebraska	124	2	2
Ohio	91	6	7
Wisconsin	275	18	7
UMRCC	526	ND	ND

Figure 1. Participants' responses to Question 1: "How would you describe yourself?"



Job category	Total respondents (in percent)	Number of responses
Fisheries researcher	34.36	78
Fisheries manager	43.17	98
Administrator	4.41	10
Student	9.69	22
Other	8.37	19

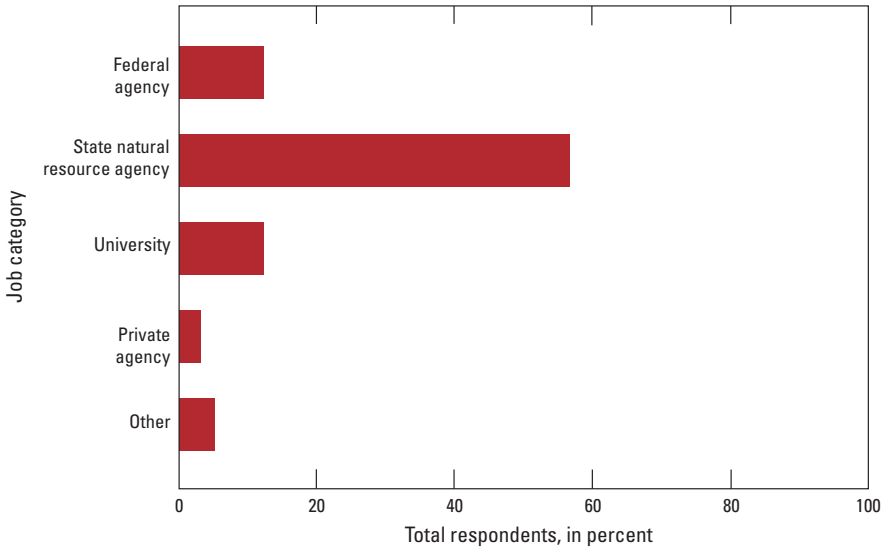


Figure 2. Participants' responses to Question 2: "What type of organization do you work for?"

Job category	Total respondents (in percent)	Number of responses
Federal agency	12.33	28
State natural resource agency	56.83	129
University	22.47	51
Private agency	3.08	7
Other	5.29	12

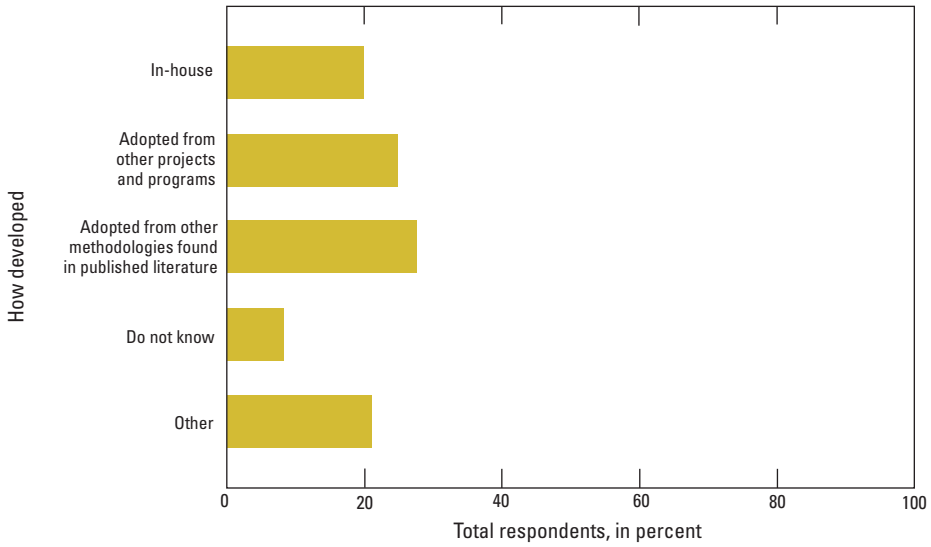
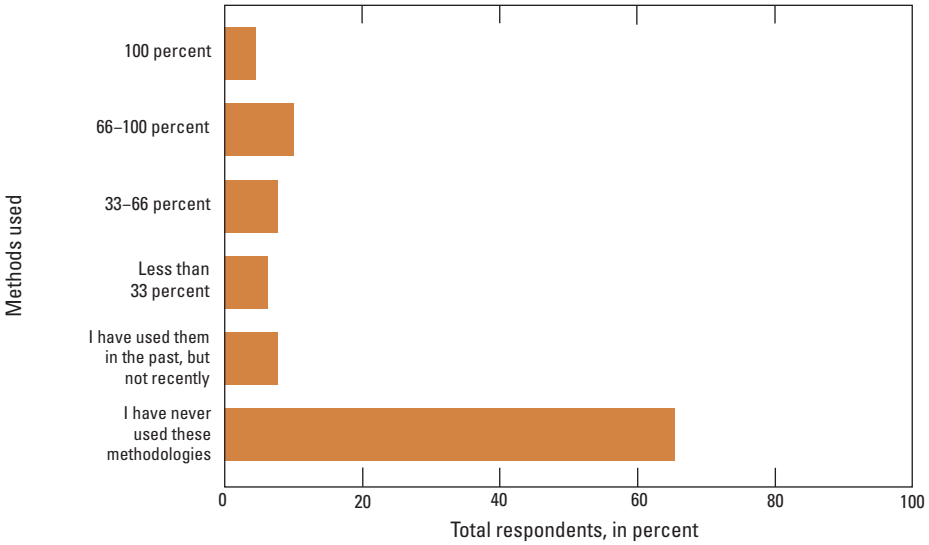


Figure 3. Participant's responses to Question 5: "If yes, how were those methodologies developed?"

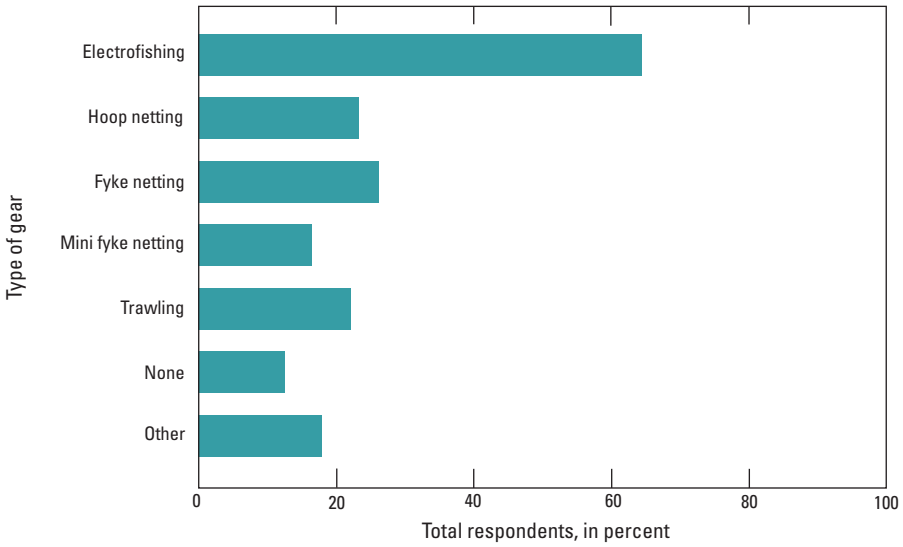
How developed	Total respondents (in percent)	Number of responses
In-house	19.55	43
Adopted from other projects/ programs	24.55	54
Adopted from methodologies found in published literature	27.27	60
Do not know	7.73	17
Other	20.91	46

Figure 4. Participants' responses to Question 7: "How often do you use the methodologies found in Gutreuter and others (1995)?"



Methods used	Total respondents (in percent)	Number of responses
100 percent of fisheries sampling	4.41	10
66–100 percent of fisheries sampling	9.69	22
33–66 percent of fisheries sampling	7.49	17
Less than 33 percent of fisheries sampling	5.73	13
I have used them in the past, but not recently	7.49	17
I have never used these methodologies	65.20	148

Figure 5. Participants' responses to Question 9: "If yes, which gears do you modify? (Check all that apply)"
This is a follow up to Question 8: "Do you ever modify the methodology to suit your sampling needs?"



Type of gear	Total respondents (in percent)	Number of responses
Electrofishing	64.38	47
Hoop netting	23.29	17
Fyke netting	26.03	19
Mini fyke netting	16.44	12
Trawling	21.92	16
None	12.33	9
Other (please specify)	17.81	13

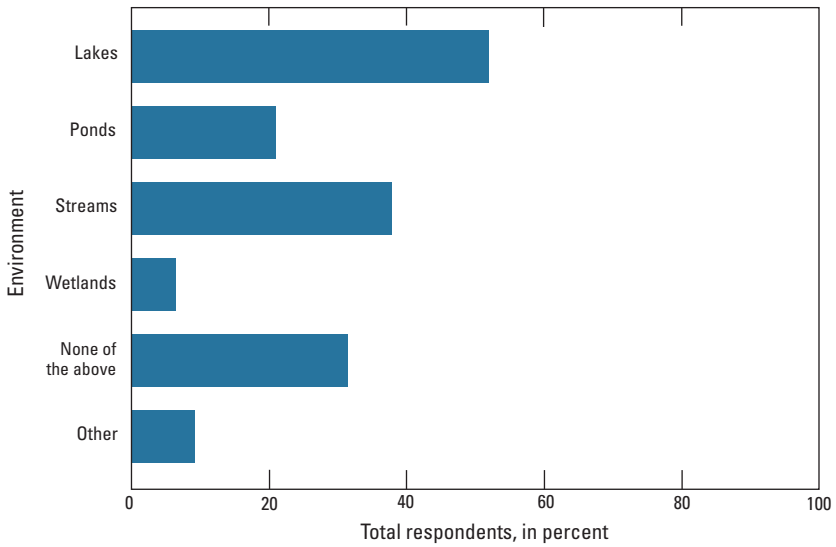


Figure 6. Participants' responses to Question 10: "Although the sampling methodologies were designed for a large river environment, do you apply them to: (Check all that apply)"

Environment	Total respondents (in percent)	Number of responses
Lakes	51.95	40
Ponds	20.78	16
Streams	37.66	29
Wetlands	6.49	5
None of the above	31.17	24
Other (please specify)	9.09	7

Respondents provided opinions to answer questions concerning what is most convenient about the methods and their strengths and weaknesses. Concerning 47 responses to Question 11, many cited the convenience of standardization (8) and comparability of data to that collected by other agencies (8), whereas others noted their versatility and transferability (7) and ease of documentation (5). Question 12 received 52 responses, with respondents again citing the strength of standardization (4), statistically defensible sampling design (4), and ability to study long term trends (3) and comparability (2). Several potential weaknesses were suggested, including LTRM methods not being suitable to all habitats/conditions (9), shortcomings in the sampling design (7), not suitable for scientist's needs (3), or the lack of ability to look at site specific trends such as a particular backwater of interest (2).

A breakdown of selected answers by only respondents identifying as fisheries managers (which were 43 percent of respondents) indicated that 98 percent use standardized methods, 48 percent were familiar with the LTRM methods, and 31 percent have used LTRM methods during their career (fig. 7). A similar breakdown of only respondents identifying as fisheries researchers (34 percent of respondents) indicated that 95 percent use standardized methods, 53 percent were familiar with the methods, and 42 percent have used them in their career (fig. 8). Similar breakdowns of students, administrators, and "other" were not possible due to low numbers of participation.

A search of the existing literature resulted in 80 unique documents, with a total of 43 from Web of Science, 57 from Google Scholar, 16 from Microsoft Academic Research (with many documents found by multiple methods), and 4 Proquest Dissertations and Theses. Of these 80 documents, 11 are UMRR LTRM reports, 66 were authored or co-authored by personnel previously or presently affiliated with the UMRR LTRM, and 14 were authored by personnel not affiliated with the UMRR LTRM. The majority (54) were peer reviewed publications or chapters in books, whereas 26 (21 found by Google Scholar, 1 by Microsoft Academic Search, and 4 by Proquest Dissertations and Theses) were non-peer reviewed gray literature.

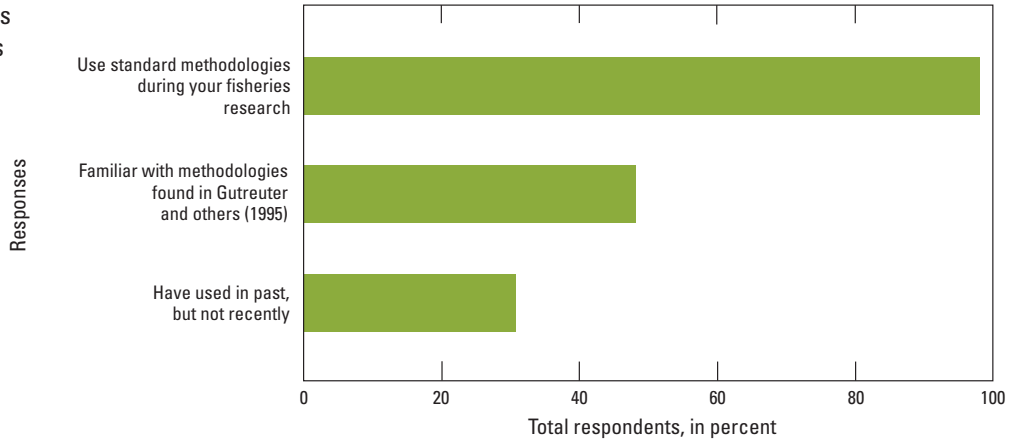


Figure 7. Responses by scientists identifying themselves as fisheries managers.

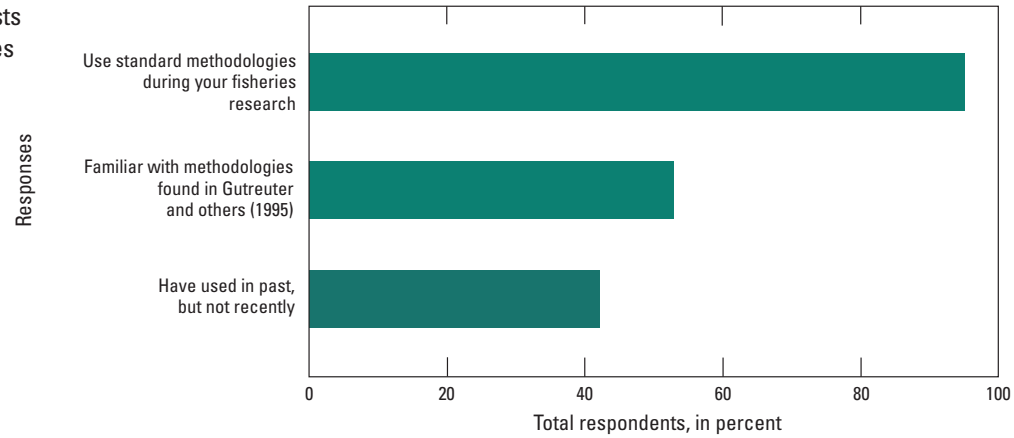


Figure 8. Responses by scientists identifying themselves as fisheries researchers.

Discussion

This survey reached a large number of scientists across the Midwestern United States via SurveyMonkey.com, which was a fast and inexpensive method of delivering it to a large number of scientists. Results of the survey indicate that the LTRM methods have grown beyond the use of only LTRM field stations, and the methods use could potentially expand in the future. The reason for past and any potential future expansion could be a result of the fact that the methods are standardized, versatile, scientifically and statistically sound, and easily defendable. The methods are also easily accessible, as a quick Google search of "LTRM fish methods" leads directly to a downloadable .pdf of the published methodologies.

Participation by state varied, with Minnesota, Illinois, Iowa, and Michigan all having greater than the estimated 11 percent overall participation. This could partially be explained by scientists in Minnesota, Illinois, and Iowa potentially receiving the survey through their state list-serve and the UMRCC, as the UMRCC represents the five UMRS states.

Results indicating the vast majority of respondents use standardized methods of some form were surprising. Previous work done by Bonar and Hubert (2002) listed six reasons why standard sampling methodologies have been rejected by fisheries professionals in the past, and these same reasons were supported by Hayes and others (2003). Bonar and Hubert (2002) also indicate that widely available standard metrics/methods (that is, relative weight by Wege and Anderson [1978] or relative growth by Hubert [1999]) have been slow to develop and state that improvements are still needed. Our results could indicate that adoption of standard methods has become more prevalent in the fisheries community in the years since publication of those works.

Nearly one-half of respondents were aware of the LTRM methods, whereas one-third had used them at some point of their career. Although these numbers should not be extrapolated to the target audience, they do indicate that the methods have been adopted outside the UMRR. Responses to Question 10 also support adoption outside the UMRR, as 24 percent of respondents apply the methods to habitats outside the UMRS. These responses support the belief that the methods have indeed spread beyond their original scope and are potentially widely used by non-LTRM personnel on habitats outside the UMRS. These responses also highlight the adaptability of the LTRM methods, as scientists take the time to evaluate the methods and use them in other habitats or as a guide when designing studies in other habitats.

In responding to Question 11 and 12, participants had the opportunity, via a short answer, to discuss the conveniences and strengths of the methodologies. Many participants pointed to standardization, comparability, and statistical defensibility of the LTRM methodologies while also noting their versatility, adaptability to other habitats and needs, and being well known and easily documented. These responses indicate that the methods are performing as designed, which is outlined by Gutreuter and others (1995), Ickes and others (2014), and Ratcliff and others (2014), and provide additional evidence to the belief that the methods have indeed spread beyond their original scope and have become a well-known and utilized resource.

Question 12 also allowed participants to discuss weaknesses of the LTRM methods. The most common weaknesses identified were that the LTRM methods are unsuitable to all habitats/conditions/individual needs and related shortcomings in the sample design. Although this is potentially true of the methodologies, it should be clear that the methods were designed to sample the UMRS over large spatial (Mississippi River kilometer 32–1,282; Pool 4 to the Open River Reach) and temporal scales to detect large-scale changes over time (Ickes and others, 2014; Ratcliff and others, 2014). Additionally, this criticism could be directed at any standardized sampling design, as the authors know of no "one size fits all" sample design versatile enough to cover all habitats and environmental conditions. Fitting the individual needs of the fisheries community would be extremely difficult, as these needs can range from targeting a single species for focused research to assessing community structure. Additional weaknesses listed include the lack of ability to look at site specific (that is, one individual backwater) or species specific (that is, invasive Asian carp) trends. Despite these potential criticisms, emerging literature (such as Bonar and others, 2009) encourages the use of standardized methodologies, despite their source. Also, scientists should focus on the benefits of existing data collected by the community-focused program (Ickes and others, 2014), which, in many cases, may be the only data available without pursuing and obtaining funding for more focused research.

Breakdowns of fisheries managers and fisheries researchers yielded results similar to overall results, as managers and researchers were the majority of respondents. Fisheries researchers were the primary focus of the survey as they are the individuals most likely to adopt or develop methods to undertake new research projects across multiple habitats and are most likely to seek out the LTRM methods. The higher percentage of fisheries researchers that have used the methods in their career supports this hypothesis. Students were also a primary focus, as they are currently learning methodologies they will take with them into their careers; however, too few students participated in the survey from too few states (15 of 22 student participants from only three states) to gain any usable insight. A more targeted approach to surveying students, such as contacting presidents of individual AFS student chapters, could lead to additional data to further investigate use among students.

Our search of the literature did not identify large numbers of documents or studies that used LTRM methods and were authored by scientists not affiliated with the LTRM. We considered our search of the peer-reviewed literature to be very efficient because of the assistance from professional librarians and the high amount of overlap among Web of Science, Google Scholar, and Microsoft Academic Search engines.

However, other issues exist when searching for documents that cited the methods. One issue is that the methods are published under an agency report format (albeit a fully available agency report) that adds complexity to the searches that would not exist should it be a peer-reviewed journal.

Additionally, many studies may not be available in the peer-reviewed literature for any number of reasons, often being summarized in the non-peer reviewed gray literature (that is, internal reports, newsletters of various organizations with limited distribution, unpublished theses/dissertations) that generally is not well integrated into search engines. Our literature search did identify 26 documents from the non-peer reviewed gray literature, including 11 LTRM reports. The authors know of a number of additional LTRM reports that cite the LTRM methods that were not found, confirming the current inefficiencies in searching the non-peer reviewed gray literature. These inefficiencies leave the possibility that a large number of additional documents exist within the non-peer reviewed gray literature that reference the LTRM methods.

One potential bias of the survey included its participation by past and present LTRM personnel that could inflate the use of the methods. This bias would be limited, however, because the LTRM Fisheries component only directly supports a few scientists and indirectly supports a handful of others and because the UMRR has had relatively low attrition rates since the inception of the program in the early 1990s. This low attrition minimizes the numbers of former LTRM staff members that are still in the fisheries field that can bias the results. Of the staff that have left the LTRM, many have moved on to prominent positions in various partnering agencies whereas others have moved up within the program (that is, from temporary technician to component specialist or component specialists to a field station team leader). Rather than seeing this as a potential bias to this survey, it should be viewed as the UMRR's ability to recruit outstanding technicians and component specialists and provide the training necessary for them to acquire the skill set needed to move on through their career.

The goal of this document is to attempt to indicate and quantify what many within the UMRR believe has happened during the past 20 plus years: that the methodologies designed for the LTRM fish component have spread beyond the program and have become a valuable resource for the fisheries community. Additional research should focus on further review of the full extent of adoption of methods in the scientific community and documenting the adaptations that have been made to the LTRM methods by those using them outside the UMRR program. Part of this potential future research could be an effort by all UMRR staff to document known adoptions of the methodology, which may produce an extensive list. Additionally, this effort could produce an extensive list of agencies who have traveled (or supported travel of UMRR staff) to see the methods first hand. Preliminary review of the literature did not do a thorough review of non-peer reviewed gray literature, and future efforts to fill this knowledge gap could provide additional information about the spread of the methodologies.

Acknowledgments

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Appendix 1. Selected Highlights of the Extensive Amount of Collaboration and Information Exchange Between Personnel Affiliated with the Upper Mississippi River Restoration (UMRR) Long Term Resource Monitoring (LTRM) and Scientists Outside the Program.

Listed in chronological order and courtesy of Brian Ickes and Jennifer Sauer.

1999	Host scientists from the Three River Ecological Research Center, Pennsylvania, to discuss developing their own research center to study five of Pennsylvania's large rivers.
2002	Invited to workshop in Albany, Georgia, by The Nature Conservancy (TNC) to discuss ecological monitoring of large rivers at a basin wide scale and assist in providing foundation for monitoring plans for Alabama-Coosa-Tallapoosa and Apalachicola-Chattahoochee-Flint River Basins.
2002–3	Host four scientists from Brazil to discuss large scale ecosystem assessments, collaboration also included reciprocal visit to the Pantanal Region of the Amazon Basin.
2007	The Nature Conservancy and Illinois Natural History Survey implement LTRM style fisheries and vegetation sampling on the Emiquon Preserve, now designated a "Wetland of International Importance" by the Ramsar Convention.
2008	Delegation hosted by Yangtze Valley Water Environmental Monitoring Center of China to brief them on background and technical aspects of LTRM, explore benefits of continued collaboration, and build strong relationships in support of the partnership.
2009	Invited to Third Yangtze Forum in Shanghai, China to discuss science conducted on the Upper Mississippi River System (UMRS).
2009	Hosted by the Colorado River Partners to provide updated science and management efforts and adaptive management approaches to the Colorado River System.
2009	Hosted four Chinese scientists and provide 2 weeks training in technical aspects of LTRM and large river ecosystem assessment methods.
2009–11	Served as science adviser to Pennsylvania's efforts to initiate large scale ecosystem monitoring on the Ohio, Allegheny, Monongahela, Delaware, and Susquehanna Rivers.
2010	Illinois Department of Natural Resources and Illinois Natural History Survey implement LTRM style fisheries monitoring on additional reaches/pools of the Illinois, Mississippi, Ohio, and Wabash Rivers.
2011	Hosted, with assistance from Dr. Curt Meine of the Leopold Foundation, visiting scientist from Guatemala to discuss lessons in large scale monitoring that have resulted in conservation impacts.
2011	Hosted delegation of five Chinese administrators and scientists and TNC representatives to discuss partnership approaches to monitoring large interjurisdictional ecosystems.
2011	Develop and deploy sonic receiver network in 300-kilometer reach of the Yangtze River.
2011	Consult on large scale monitoring designs and plans for the Yangtze River.
2014 and 2015	Invited talks at the First and Second Annual Mississippi/Yangtze River Basin Symposia in Little Rock, Arkansas, and Wuhan, China.

Appendix 2. All Questions Posed by the Survey.

[et al., and others; %, percent; <, less than]

Question 1: How would you describe yourself?

- Fisheries researcher
- Administrator
- Other (please specify)
- Fisheries manager
- Student

Question 2: What type of organization do you work for?

- Federal agency
- University
- Other (please specify)
- State natural resource agency
- Private agency

Question 3: What is the name of your organization?

Question 4 :Do you use standardized sampling methodologies during your fisheries research?

- Yes
- No

Question 5: If yes, how were those methodologies developed?

- In-house
- Adopted from methodologies found in published literature
- Other (please specify)
- Adopted from other projects/programs
- Do not know

Question 6: Are you familiar with the standard fish sampling methodology used by the Long Term Resource Monitoring Program (LTRMP) found in Gutreuter et al. (1995)?

- Yes
- No

Question 7: How often do you use the methodologies found in Gutreuter and others (1995)?

- 100% of fisheries sampling
- 33–66% of fisheries sampling
- I have used them in the past, but not recently
- 66–100% of fisheries sampling
- <33% of fisheries sampling
- I have never used these methodologies-**STOP HERE** and thank you for participating

Question 8: Do you ever modify the methodology to suit your sampling needs?

- Yes
- No

Question 9: If yes, which gears do you modify? (Check all that apply)

- Electrofishing
- Fyke netting
- Trawling
- Other (please specify)
- Hoop netting
- Mini fyke netting
- None

Question 10: Although the sampling methodologies were designed for a large river environment, do you apply them to: (Check all that apply)

- Lakes
- Streams
- None of the above
- Ponds
- Wetlands
- Other (please specify)

Question 11: What do you find most convenient (transferability, etc.) about using LTRMP methodologies?

Question 12: What do you perceive as strengths or weaknesses of the LTRMP methodologies?

Appendix 3. Initial Contact Email Sent to Representatives of the 11 State List Serves (North and South Dakota Being Served by the Dakota Chapter) and the Upper Mississippi River Conservation Committee (UMRCC):

[<, less than; min, minute; AFS, American Fisheries Society]

Dear Sir or Madam,

I would like to ask a favor of your Chapter of the American Fisheries Society. I have a short survey (<5 min) I want to circulate to a large number of fisheries professionals across the Midwest. This would be easiest using existing list-serves. The survey will be sent out via a link to an online survey site, all answers will be confidential and we will not have access to any of your members email addresses, so there is no risk of spam.

The Illinois Chapter has agreed to distribute our survey and I hope you are able to do the same. Please let me know if you are willing to accommodate by distributing the survey through your state AFS list-serve. If you are able to assist, details will follow.

Due to our collective responsibilities with meetings etc., and field work beginning in the spring for many biologists across the region, I would appreciate a response by February 22, 2013.

Thank you in advance for your time and your cooperation,

Levi Solomon

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Appendix 4. Request for Participation Sent to Each Member of Each Respective American Fisheries Society (AFS) State List-Serve and the Upper Mississippi River Conservation Committee (UMRCC).

[et al., and others;<, less than; min, minute; LTRMP, Long Term Resource Monitoring Program]

Dear Sir or Madam,

We are interested in finding out how widespread the use of standardized fish sampling methodology is among the different fisheries oriented programs and agencies. As an active fish ecologist you are no doubt familiar with many different sampling protocols; some adopted from other sources and some developed within your institution. Specifically we would like to know if you, or the projects you have supervised, have used the methodologies (or modifications of) found in "Long Term Resource Monitoring Program Procedures: Fish Monitoring" published by Gutreuter et al. (1995) (citation below).

To accomplish our goal, we would like you to complete an anonymous twelve (12) question survey. We intend to compile and publish the results in a publicly available format. All responses will remain confidential, held within our office, and not to be distributed for any reason. We are especially interested in use of the protocols in internal reports, thesis, dissertations or other non peer-reviewed works (that can be commonly found in publication databases) that cite Gutreuter et al. (1995). We also encourage the use of the protocols found in Gutreuter et al. (1995).

We appreciate your assistance with this request. Should you choose to complete the short (<5 min) survey you will be providing the LTRMP with valuable insights on how our protocols are used across a wide range of institutions and aquatic systems. Again, we encourage the use of LTRMP protocols and wish you luck in your future scientific endeavors.

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

(PDF version at http://www.umesc.usgs.gov/documents/reports/1995/95p00201.pdf)

The Upper Mississippi River Restoration (UMRR) Program, including its Long Term Resource Monitoring (LTRM) element, was authorized by the Water Resources Development Act (WRDA) of 1986. The mission of the LTRM element is to provide river managers with information for maintaining the Upper Mississippi River System as a sustainable large river ecosystem given its multiple use character. The LTRM element is implemented by the U.S. Geological Survey, Upper Midwest Environment Sciences Center, in cooperation with the five Upper Mississippi River System states of Illinois, Iowa, Minnesota, Missouri, and Wisconsin; overall management responsibility of the UMRR is vested with the U.S. Army Corps of Engineers.

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