Multi-Use Management on the Upper Mississippi River System: Public Preferences for Future Management Actions

A THESIS
SUBMITTED TO THE FACULTY OF THE GRADUATE SCHOOL
OF THE UNIVERSITY OF MINNESOTA
BY

Bruce David Carlson

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF
MASTER OF SCIENCE

July 1999

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INTRODUCTION

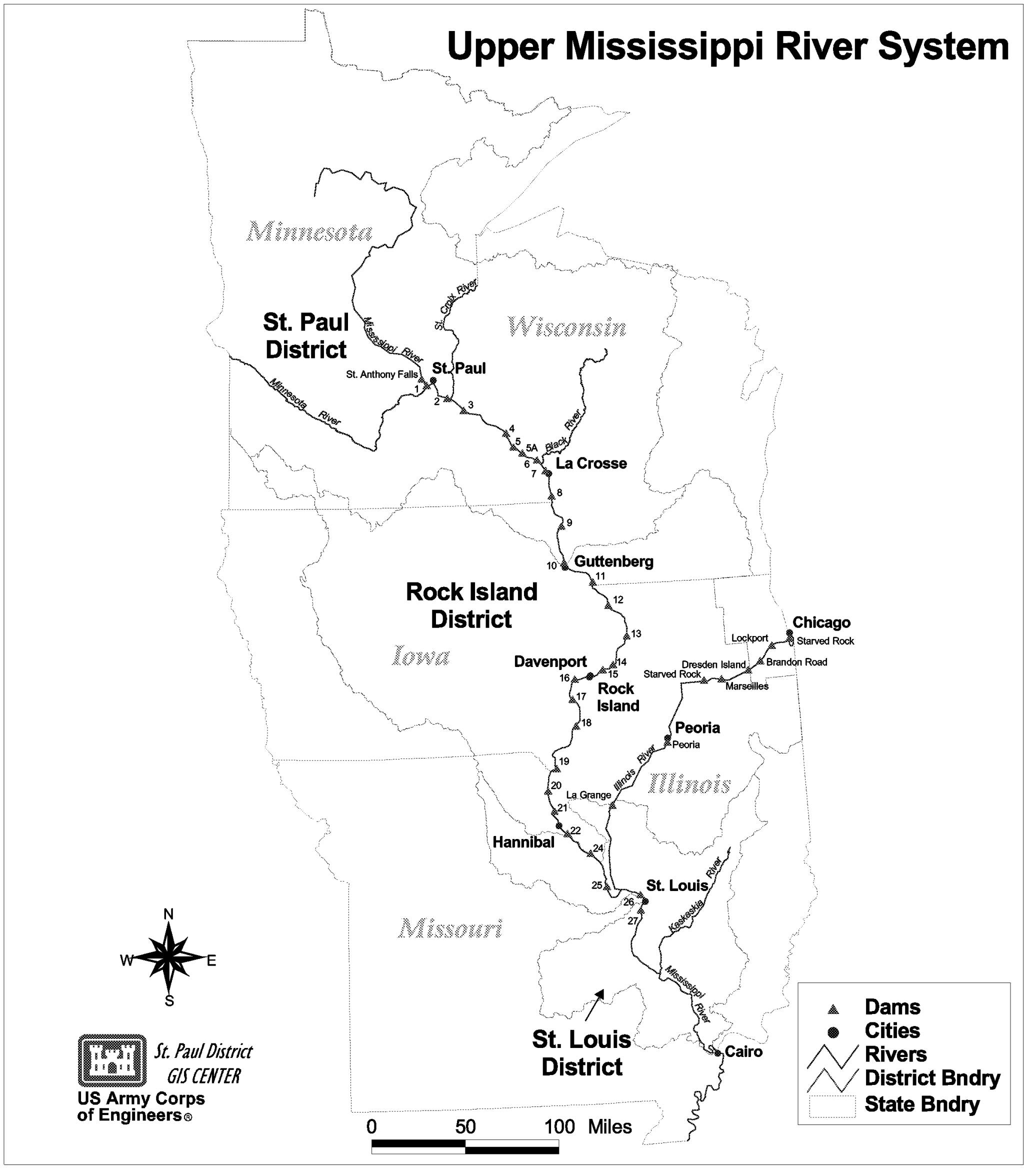
Management of the Upper Mississippi River System (UMRS) falls under a complex aggregation of agencies at the federal, state, and local levels that represent multiple jurisdictions and multiple uses of the river resource. Numerous legislative responsibilities and directives help shape public policy in the watershed, as do the interests of the many non-governmental stakeholders who actively seek to influence management of the UMRS. The general public is recognized as an important constituent in the planning process, but representative information regarding their interests has generally been lacking. The need for such information was recognized in the Fiscal Year 1995 Annual Work Plan for the Long Term Resource Monitoring Program of the Environmental Management Program for the UMRS (U.S. Department of the Interior 1995), which directed that a survey be conducted. In response to that directive, this research has been designed and conducted to identify how the general public values the river resource, and to identify their preferences for future river management alternatives. This information will help inform public policy and process among the many management agencies and stakeholders that share an interest in the management of the UMRS.

BACKGROUND

The Upper Mississippi River System is an important environmental and socioeconomic resource for the Nation. The river system is regulated by locks and dams (29 on the mainstem Mississippi River and 7 on the Illinois River) to serve as a reliable waterway for transporting bulk commodities by barge. The river also hosts approximately 12 million recreational visitors annually, who access the river from over 600 developed recreation areas, 18,000 marina slips, and 2,500 privately permitted docks (Carlson 1995). The river continues to serve as an important habitat for migratory birds and an important fishery.

The UMRS is defined as the commercially navigable portions of five rivers: the Mississippi (from Minneapolis, Minnesota to Cairo, Illinois), Illinois, St. Croix, Minnesota, and Kaskaskia. The UMRS is composed of nearly 1,300 miles of commercially navigable waters (see Figure 1). The area

FIGURE 1: Map of the Upper Mississippi River System



also contains side channels, sloughs, and lakes associated with these rivers. The UMRS is contained within the states of Minnesota, Wisconsin, Iowa, Illinois, and Missouri. There are 76 counties (plus the City of St. Louis) that border the rivers.

RIVER MANAGEMENT

Humans have attempted to shape the UMRS to meet their needs since the times of Territorial development. Capitalists and conservationists have promoted their interest for the use of the river ever since. More than one hundred years ago, the adherents of one movement dreamed of making the river a commercial highway. Backers of the other hoped to preserve and develop it for fish and wildlife and for its scenic beauty. The natural river met neither group's needs, and both worked to change it. "The development of the upper Mississippi River thus represents a compromise--albeit an uneven one--between the proponents of these two movements and speaks to their differing visions for the river." (Anfinson 1993).

Today's river is not considered to be as healthy as a natural system, although it retains some natural characteristics of a large floodplain river system (Sparks et al. 1990). In general, the ecological health declines from the upper reach of the Mississippi River to the lower reaches, and the Illinois River is considered generally unhealthy. These assessments have been made through development of an "ecological report card" for the UMRS (USACE 1997).

STATEMENT OF THE PROBLEM

River management responsibility falls under a complex set of governmental agencies at the federal, state and regional/local levels. Federal agencies include the U.S. Fish and Wildlife Service, the Environmental Protection Agency, the Corps of Engineers, the National Park Service, the U.S. Coast Guard and the U.S. Geological Survey. State agencies include Departments of Natural Resources or Conservation, Pollution Control agencies, and Departments of Transportation. Regional organizations that are active in river management include the Upper Mississippi River Basin Association and the Minnesota-Wisconsin Boundary Area Commission. Responsibilities of local governments include law enforcement and recreation. Non-governmental organizations are also active in shaping policy on the river, including American Rivers, the navigation industry group MARC 2000, the Sierra Club, the National Audubon Society, the World Wildlife Fund, the Upper Mississippi Basin Alliance, and the McKnight Foundation. No single agency or unit is responsible for coordinating overall river management or policy. The most important river management responsibilities across the agencies and interest groups include:

- Fish and Wildlife
- Flood Control
- Navigation
- Pollution Control
- Recreation and Tourism
- Water Supply

Managing for both biological and sociological diversity frequently involves a clash of basic values among various interest groups (Kellert 1995). Recently published perspectives from non-governmental organizations on the UMRS reveal values that extend toward both ends of the potential development spectrum. The Upper Mississippi River Conservation Committee has issued a "call for action" on the UMRS, warning of a potential ecosystem collapse similar to the one that occurred on the Illinois River in the 1950's (Upper Mississippi River Conservation Committee 1993). Private organizations have also called for restoring the UMRS (MacWilliams, et al. 1996; Robinson and Marks 1994). In contrast, a study from an engineering group in the Netherlands commissioned by UMRS commercial interests concludes that compared to European rivers the UMRS is a grossly underutilized resource that could benefit from significant development and still retain a natural character (Delft Hydraulics 1997).

The general public constitutes an important constituency in the planning processes conducted on the UMRS. The public is encouraged to participate through a variety of mechanisms including attending public meetings and hearings, participating in small group discussions, providing written input and commentary, and subscribing to informational newsletters. Since these forums are self-selecting, however, the input gathered does not necessarily reflect the viewpoints of the public at large. Additionally, potential differences in public attitudes and preferences that may exist geographically throughout the UMRS basin cannot be adequately ascertained.

Within this context, a survey of the general public was designed and conducted to representatively assess river resource values, attitudes, and preferences for future management actions. The two primary research questions motivating this research are:

1) What values and attitudes do the general public have about the Upper Mississippi River and Illinois Waterway

2) What are their preferences regarding future management actions on the waterways?

LITERATURE REVIEW

VALUES AND ATTITUDES

Social psychologists define a value as "an ethical principle to which people feel a strong emotional commitment and which they employ in judging behavior" (Vander Zanden 1981). Attitudes are based on a person's underlying values, and represent "a learned and relatively enduring tendency or predisposition to evaluate a person, event or situation in a certain way" (Vander Zanden 1981).

Past surveys on the UMRS offer some insight into public values and attitudes toward the river. A 1980 survey of residents in the 5 UMRS states demonstrated that the river system is important for multiple uses and purposes. Over 90 percent of the general public viewed the river as important "just knowing it's there" as well as for environmental, historical and cultural, and commercial and industrial reasons. Over 80 percent of those surveyed responded that the river was important for recreational purposes. When identifying priorities, however, environmental uses were considered more important than either commercial/industrial uses or recreational uses of the river (Biocentic 1980a, 1980b, 1981).

A 1971 survey of Minnesota residents used an open-ended, multiple-response format to ask respondents to identify desirable and undesirable qualities about the Mississippi River. Beauty and scenery were the desirable qualities mentioned by the largest number of respondents (43 percent).

Various forms of recreation accounted for the largest overall number of uses mentioned as desirable: boating and sailing, fishing, and recreation (unspecified) were all identified by between 31 and 33 percent of respondents; swimming, picnics, relaxing, and riverboats were each mentioned by fewer than 10 percent of respondents. The other major uses identified as desirable were transportation (17 percent), wildlife (17 percent) and historic traits (14 percent). Undesirable qualities were overwhelmingly identified as various forms or sources of pollution, as well as development-related concerns and flooding. An associated survey administered to youth in select schools throughout Minnesota resulted in similar findings (Baron, et al. 1972).

A 1995 survey confirmed that pollution remains the overwhelming concern among members of the general public regarding problems facing the Mississippi River. People are not optimistic about the future for the river’s environment: only 16 percent were “proud and confident” about the future, whereas 56 percent were concerned or frustrated, and 27 percent didn’t know. Improving the environment on the river was seen as important by 83 percent of respondents. Concern over the safety of drinking water was determined to be the greatest factor for motivating people to become active in improving the river’s environment (MacWilliams et al. 1996).

PREFERENCES FOR MANAGEMENT ACTIONS

Past surveys also offer some insight into public preferences for uses of the UMRS. The 1971 survey found that Minnesotans ranked fish and wildlife habitat as the highest management priority, followed in order by: public water supply; water sports and recreation; transportation; industrial and commercial uses; and waste disposal. Respondents indicated that they believed the river was actually being managed in nearly the reverse order of these priorities. The associated youth survey resulted in similar findings (Baron, et al. 1972).

Preferences for future management actions were framed in terms of potential tradeoffs between commercial uses, recreational uses, and the environment in the 1980 survey of residents of the five UMRS states. The vast majority of respondents indicated environmental uses outweighed either commercial uses (69 percent) or recreational uses (79 percent) where those uses might be in conflict. Tradeoffs between commercial and recreational uses were viewed much more evenly (commercial: 44 percent; recreation: 33 percent). These figures correspond closely with indicators of personal importance to the respondents, which were similarly measured as tradeoffs among the three purposes (Biocentic 1980b).

LINKING VALUES AND ATTITUDES TO ACTIONS

Fishbein and Ajzen have developed a framework for assessing values and attitudes and their relationship to predicting behavior in their "Theory of Reasoned Action" (Ajzen and Fishbein 1980). They stress the importance of specificity in defining the action being considered as well as the accessibility of the attitudes and the importance of the context in which the action would take place. They have developed applications in many areas, including dieting, family planning, alcoholism, and voting behavior (Ajzen and Fishbein 1980); anti-abortion attitudes (Patkova, Ajzen and Driver 1995); leisure participation (Ajzen, Nichols III and Driver 1995); and practicing "safe sex" (Fishbein, Chan and O'Reilly 1992). Common to the development of these applications is the use of multiple indicators to measure the level to which respondents engage in the respective activities.

Kellert has been instrumental in investigating the relationship between values, attitudes, and behavior in relation to environmental issues, and in furthering methods associated with these applications. He has developed a broad body of work in this area since the late 1970s, including investigations of public attitudes toward predator reintroduction (Reading and Kellert 1993; Kellert 1991; Kellert 1985a), endangered species management (Kellert 1985b), and comprehensive (ecosystem) management (Reading, Clark and Kellert 1994; Kellert 1984). Support for management actions is commonly used as a proxy for behavior in these efforts.

Manfredo, Bright and colleagues have also developed a body of work on public attitudes toward environmental management issues, primarily in Colorado. They have typically focused on a single (frequently volatile) management action under consideration, such as wolf reintroduction (Bright and Manfredo 1996; Pate, Manfredo, Bright and Tischbein 1996), grassland burns (Bright, Fishbein, Manfredo and Bath 1993; Manfredo, Fishbein, Haas and Watson 1990), and urban wildlife management such as goose or deer population control (McGlincy 1997). Like Kellert, they have also focused on methodological research, specifically testing measurement approaches germane to applications of the theory of reasoned action (Bright 1997; Bright and Manfredo 1995).

The current effort to elicit values, attitudes, and preferences for future management actions on the UMRS differs from the applications in Colorado in that it focuses on a full spectrum of management possibilities applicable to the broad and diverse resource of the Mississippi/Illinois river system. Collecting information to assist in management across purposes and across jurisdictions is the primary concern. Since this research precedes the development of specific management plans it cannot serve as a referendum on a particular proposal. However, it can serve the purpose of informing the process of developing future management actions, which is its primary purpose.

METHODOLOGY

SURVEY INSTRUMENT

The first step in the survey development process was to conduct a meeting with a variety of stakeholders to discuss the purpose and scope of the project. Dr. Gary Nelson, a sociologist with the U.S. Army Corps of Engineers, led this process. Eighteen river professionals representing 10 organizations attended the March 1993 meeting (Figure 2). Participants identified past survey efforts they had been involved in that might prove helpful to the current effort, and discussed topical areas that were of interest to their organizations. The meeting resulted in the identification of a large range of subject interests to be considered, and yielded reports of several past attitudinal and behavioral surveys on the UMRS.

Drawing from past research, consultations with organizational stakeholders, and discussions with the general public (in several focus groups held with citizens familiar with river issues) the following conceptual areas were selected by Dr. Nelson for inclusion in the survey. The first seven items represent independent variables that are hypothesized to explain variation in preferences for future management actions:

- Values toward the river
- Familiarity with the river
- Knowledge and beliefs about the river
- River related behavior
- Perspectives on river regulation and laws
- Comparison of river issues with other social problems
- Characteristics of the individual
- Preferences for future management actions

FIGURE 2: Agencies involved in the survey development process

Federal Agencies:

- Army Corps of Engineers
- Department of Transportation
- Environmental Protection Agency
- Fish and Wildlife Service
- National Biological Service
- National Park Service
- U.S. Geological Survey

State Agencies (varying by state):

- Department of Conservation
- Department of Natural Resources
- Department of Transportation

Regional Organizations:

- Minnesota-Wisconsin Boundary Area Commission
- Upper Mississippi River Basin Association
- Mississippi River Basin Alliance

Wording and question format were developed by Dr. Nelson in part by referring to examples used in the previously cited surveys on the UMRS as well as investigations on the Wisconsin River and Chesapeake Bay (Nelson, 1996; Blair, Slater, and McLaughlin 1994). The questionnaire development and entire survey process were guided by procedures and recommendations described in

Dillman's Total Design Method (Dillman 1978). A draft survey instrument was distributed for comment to all of the organizations listed in Figure 2 plus several others, and revised by Dr. Nelson and the author based on comments received. From this point on, the author was responsible for administering and completing the survey process, including selecting and overseeing the work of a professional marketing research firm (Survey Center Marketing Research of Chicago) to conduct the interviews and prepare the data set under government contract. This research puts forth the analysis conducted by the author of these data.

SAMPLING

The sample of 2,500 was based on a stratified random selection of households, divided to include 500 households in each of the states of Illinois, Iowa, Minnesota, Missouri, and Wisconsin. Within each state, the sample was further divided to distinguish between residents of counties bordering the navigable portions of the river system (300 per state) and residents of each state's remaining counties (200 per state). Within households, the adult with the next birthday was selected to be interviewed.

PRETEST

A pretest was conducted by Survey Center, Inc. to judge the survey's effectiveness and discover problems in the instrument or procedures. A number of factors were monitored, including: length of interviews; respondent understanding of questions; questionnaire flow; and effectiveness of the survey introduction. A total of 50 pretest interviews were conducted (five interviews for each of the ten sampling strata).

Several revisions to the questionnaire design were made in response to observations made in the pretest. The pretest response rate of just over 50 percent was lower than anticipated so the introduction to the survey was modified to increase respondent interest in participation. The modified introduction included specific mention of the respondent's state of residence as one of the project participants. Several minor changes in wording were made to increase clarity, and one multi-part question was completely revised since it was found to be confusing and resulted in some interview terminations. Finally, the question regarding the respondent's income level was placed last in the sequence of demographic questions. These refinements were made collaboratively by the author, the contractor, and Dr. Nelson. A copy of the final survey instrument is contained in Appendix A.

GENERAL ADMINISTRATION

The 2,500 interviews were conducted by telephone between September 7th and October 24th 1996 by professionally trained interviewers from Survey Center, Inc. The interviewing was completed using a Computer Aided Telephone Interview (CATI) system. Telephone numbers were selected at random from each of the ten sampling strata. For each number selected, the contractor was required to make up to eight calling attempts at various times during the day and throughout the week to yield completed interviews. After eight attempts, the number could be replaced by another random number from within the same stratum. Replacement numbers were also drawn for numbers that did not meet the sampling specification of a household: disconnected numbers, business phones, and fax or modem lines. Attempts to get a completed interview were terminated if a respondent refused to participate or if the interview was stopped before completion. Through successive waves of sampling, subsampling and intensive follow-up of non-response an effective response rate of 61 percent was realized. Details of the general administration performed and reported by Survey Center, Inc. are contained in Appendix B. Their reports include summarization of the following: counties designated as riparian; sampling weights; survey response computations; and statistical reliability for responses.

DATA MANAGEMENT

Data was computerized by the contractor as the interviews took place using the Info Zero-One CATI program. Interviewers were trained in the specific procedures required for this instrument, and supervisory staff selectively monitored interviews to assure accurate implementation by each interviewer. Mathematical checks were incorporated into the CATI software to reduce the possibility of coding errors. During data collection, groups of questions concerning changed river conditions (Q6-Q8), values toward the river (Q16a-Q16j), laws and regulation (Q17a-Q17c), comparative problem priority (Q18-Q20), and preferences for future management actions (Q22a-Q22z) were rotated to avoid ordering bias. The contractor further checked and reviewed the data upon completion for data integrity within and across questions, and to code the two open-end response questions. Frequencies and descriptive statistics were generated using Survey Center Inc.'s UNCLE database system, and reported for both weighted and unweighted data. The data were then translated into SPSS format and provided to the Corps of Engineers for acceptance and further analysis. The author scrutinized the data set for completeness and accuracy and required the contractor to correct a small number of errors and omissions in the data and associated reports before accepting the products. A final and complete set of frequency tables prepared by Survey Center, Inc. (weighted to represent the full population) for the entire five-state region and for each regional stratum is contained in Appendix C.

RESULTS: DESCRIPTIVE STATISTICS

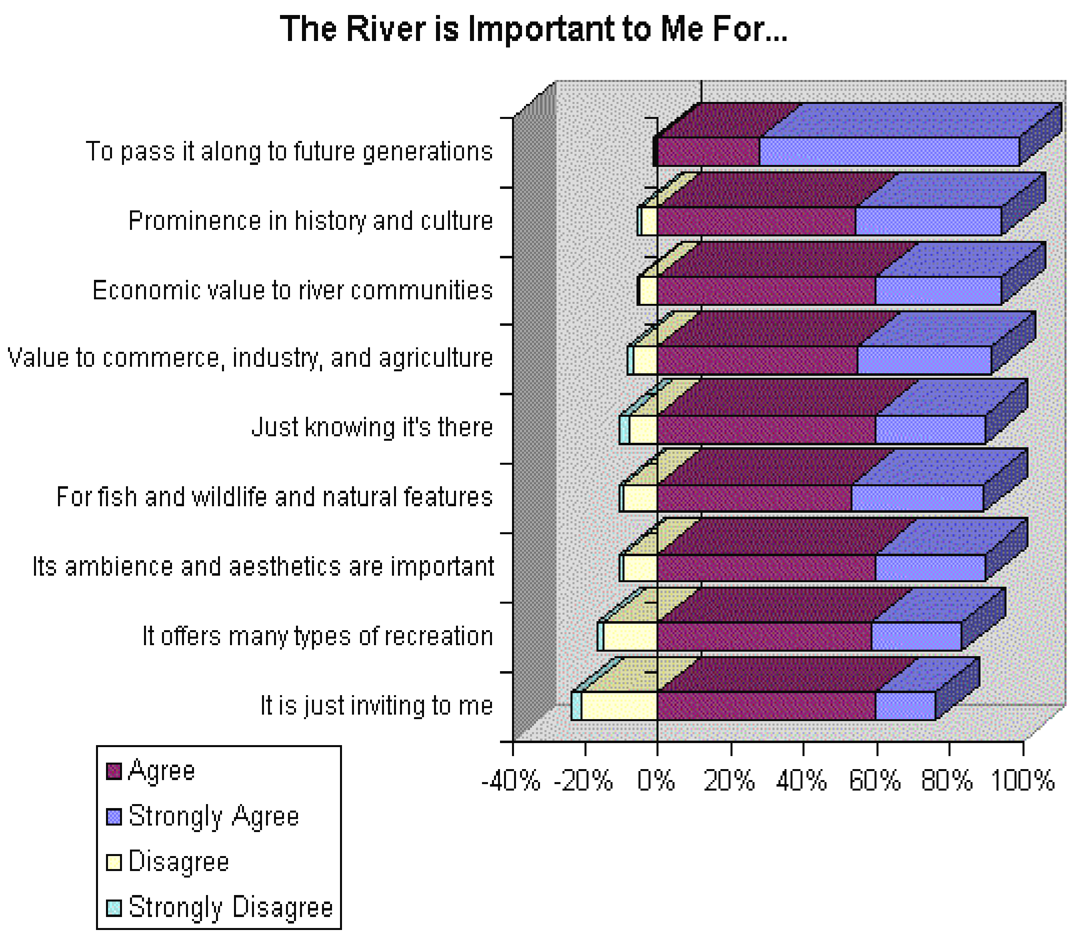
Public responses to questions eliciting their values toward the river, their preferences for future management actions, their assessment of problem priority, and their attitudes toward river regulation are described in this section. These combine the information collected for all respondents, providing a regional composite. Potential differences in responses between geographic sub-populations are explored later in this research.

VALUES RELATED TO THE RIVER

Value is measured by various indicators of river attributes. Respondents were asked to consider a series of ten statements related to the importance of various river attributes. The statements covered a wide range of river attributes, including commercial uses, natural features, historical importance, recreation value, and aspects of personal attachment. Four response categories indicating the strength of importance (and value) to the respondent were strongly agree, agree, disagree, and strongly disagree.

Overall, the results show people value the river system for a wide variety of reasons. Figure 3 lists the responses in descending order of their mean scores. There was virtually unanimous agreement (99%) that it is important to take care of the river system so that we can pass it along to future generations for their enjoyment. There also was a high level of agreement (over 80% for most indicators) that the river is important for commercial and economic, historical, environmental,

FIGURE 3: Values related to the river



recreational, and aesthetic reasons. An additional question from this series (not shown in Figure 3) found that 28% of the respondents stated that the river has no particular importance to them personally.

PREFERENCES FOR FUTURE MANAGEMENT ACTIONS

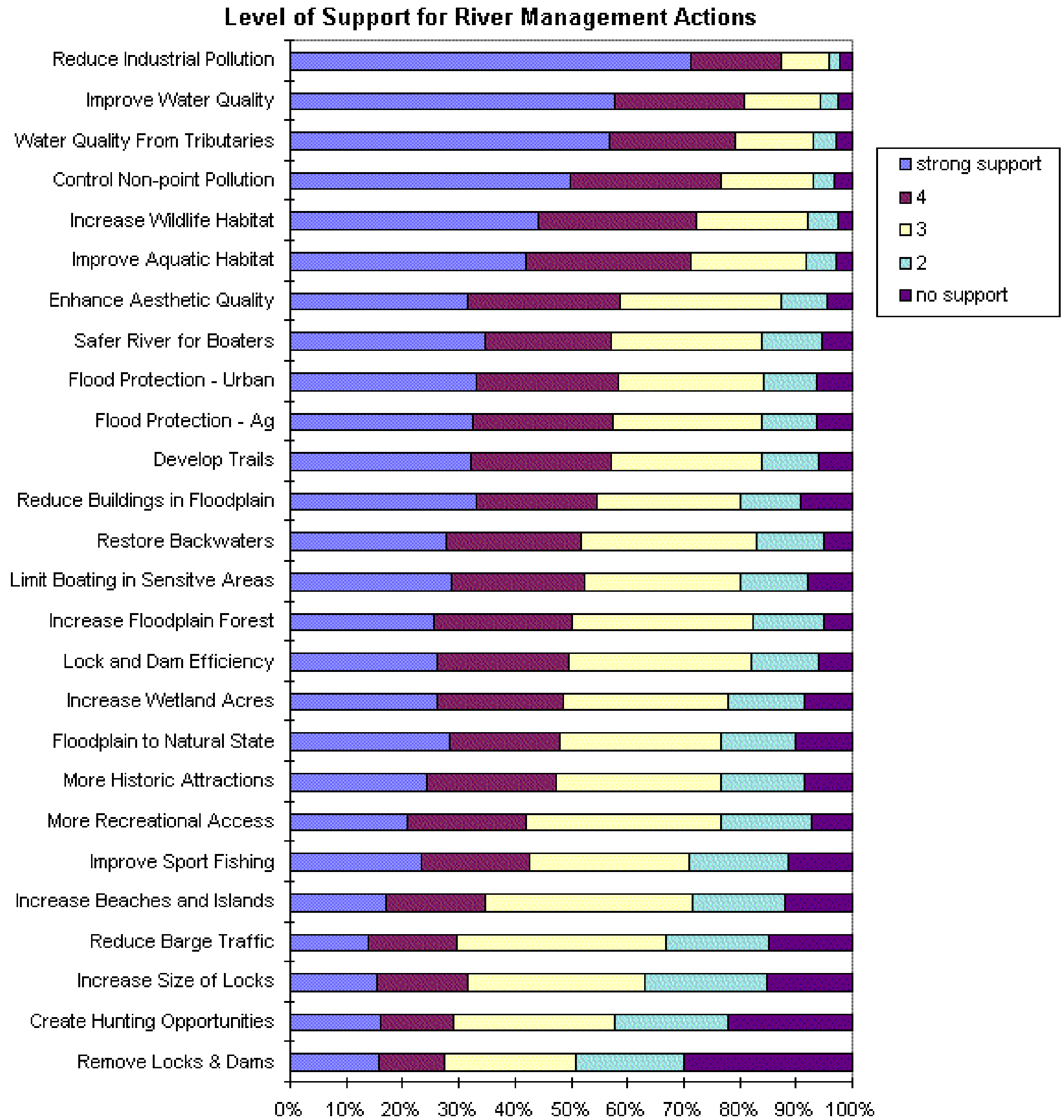
Information about respondents' assessment of river problems and their preferences for future management actions was gathered in three separate sections of the survey. Early on in the interviews, respondents were asked in an open-ended format to identify the most important problem on the stretch of the river most familiar to them. Water quality and pollution are overwhelmingly the biggest concerns. Three-quarters of respondents who had an opinion mentioned a water quality issue. Flooding issues were the only other category to be mentioned by more than 10% of the respondents with an opinion.

The second section relating to preferences for future management actions involved a structured assessment of a wide range of potential river management actions. Respondents were asked to identify their level of support for 26 various river management actions using a five-point scale ranging from 1=no support through 5=strong support. Responses to these 26 potential management actions are listed in descending order of mean response in Figure 4.

Efforts to improve water quality and reduce pollution received the strongest support, with more than half of the respondents indicating strong support, and less than 5% indicating no support. Efforts to improve and increase habitat and the aesthetic quality of the river system ranked next highest, followed by safety for recreational boaters, and flood control measures.

The lowest overall support was indicated for efforts to reduce barge traffic, increase the size of the locks, remove the locks and dams, and create more hunting opportunities. For example, efforts to remove the locks and dams were strongly supported by only 15% of the respondents, and were not supported at all by 30% of the respondents.

FIGURE 4: Level of support for potential future management actions



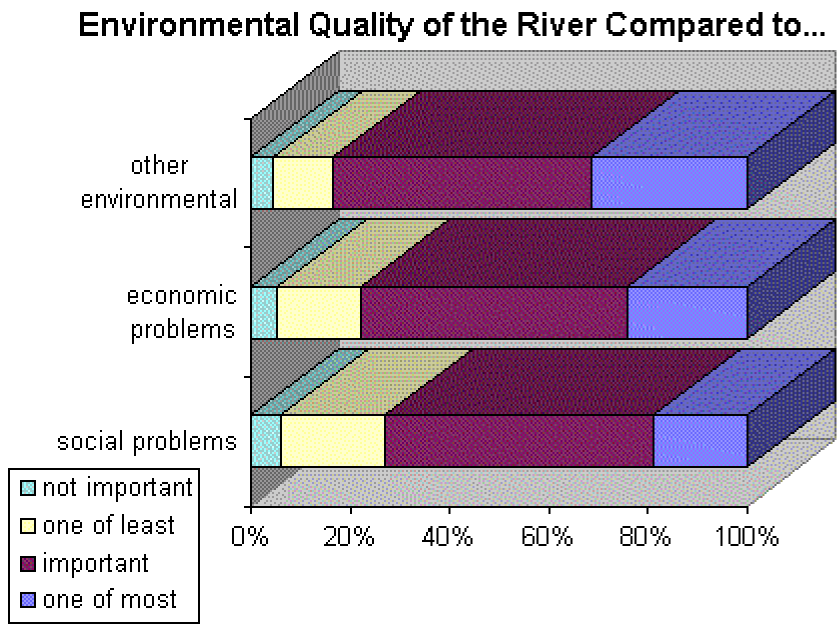
As an additional indicator of relative importance, respondents were asked a final open-ended question to identify what they felt were the three most important management efforts for the river system. Efforts aimed at reducing pollution were again the most commonly identified (62%), followed by efforts related to improving habitat (15%), recreation (9%), flood protection (7%), reducing barge traffic or removing dams (5%), and increasing lock size or efficiency (3%).

COMPARATIVE PROBLEM PRIORITY

Respondents were asked to compare the importance of the river system's environmental problems to other societal problems, specifically social, economic, and environmental problems. Overall, the river's environmental problems are considered important, but not among society's most important problems (Figure 5).

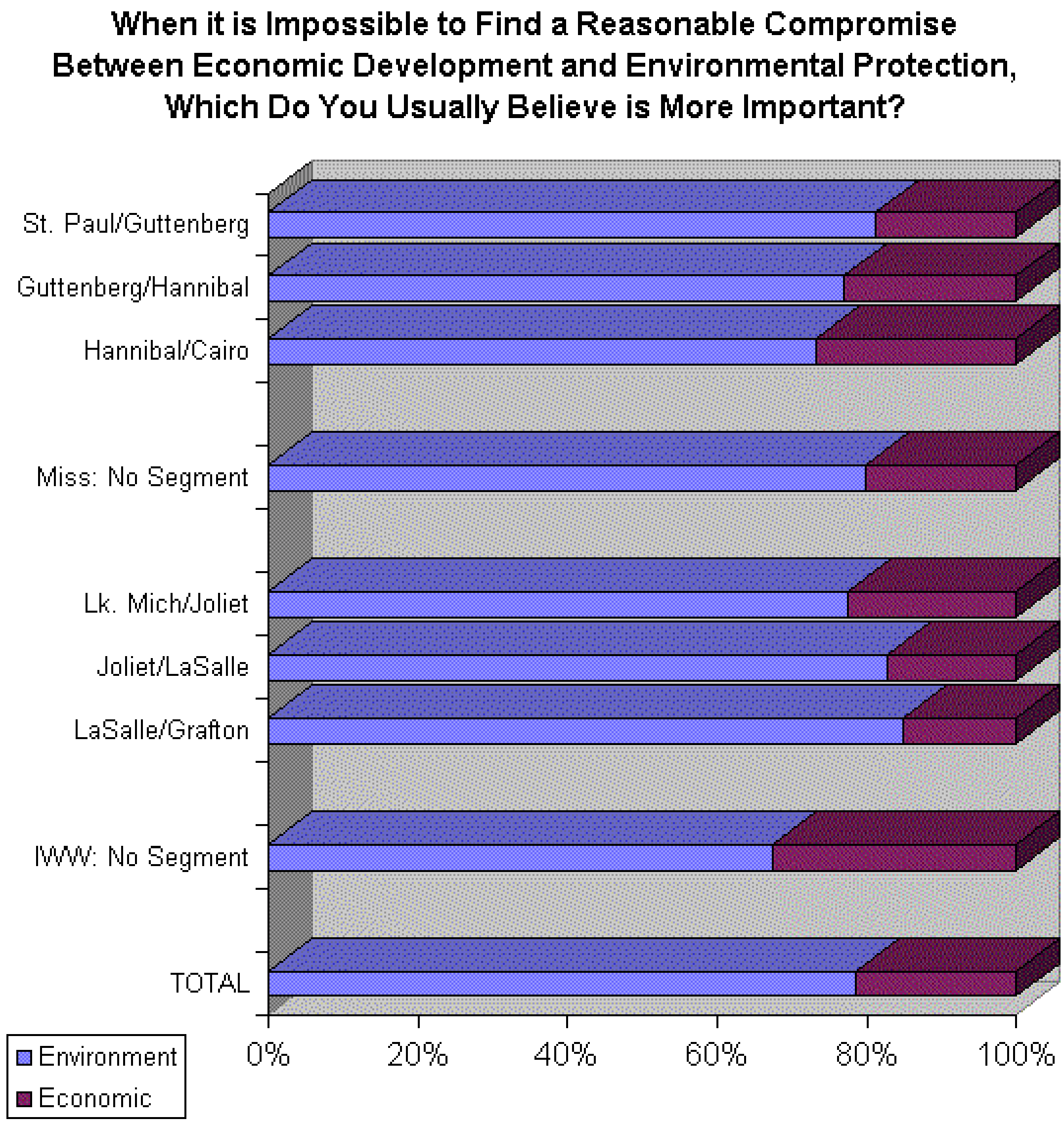
River environmental issues were considered relatively least important compared to other social problems, where 19% of respondents felt river environmental issues were among the most important problems, 54% considered them important but not the most important, and 27% considered them among the least important problems or not important at all. River environmental issues were considered slightly more important compared to economic problems (24% among the most important, 54% important but not among the most important, and 22% among the least important or not important at all). Finally, river environmental issues were seen as relatively more important compared to other environmental problems (31% among the most important, 52% important, 17% among the least important or not important at all).

FIGURE 5: Comparative problem priority



When it is impossible to find a reasonable compromise between economic development and environmental protection, 75% of respondents believe environmental protection is usually more important, and 20% believe economic development is more important (Figure 6). Some variation is evident among persons most familiar with different stretches of the river system (or those unfamiliar with any stretches) but the differences are generally not large. National data suggest that most people believe environmental protection and economic development can be achieved together (Times Mirror 1994).

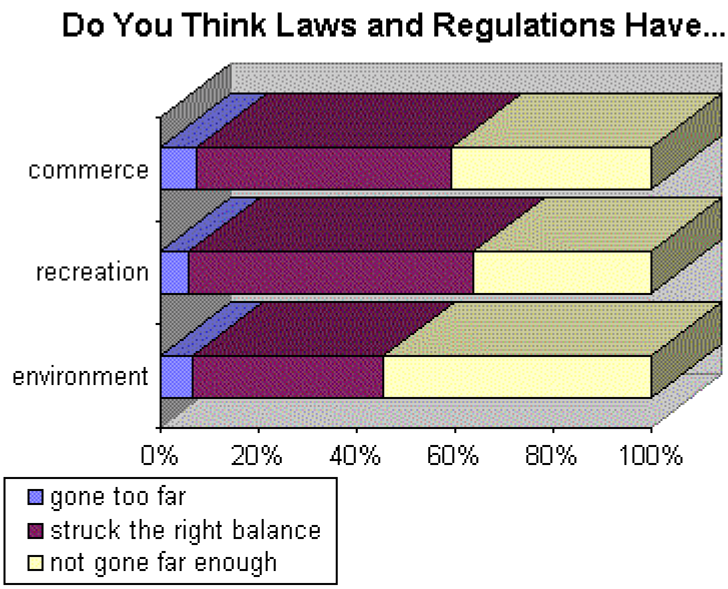
FIGURE 6: Economic development versus environmental protection



REGULATORY PERSPECTIVE

Respondents were asked to consider how the river is regulated for recreation, commerce, and the environment. Fewer than 10% of respondents reported that laws and regulations in these areas have "gone too far," and the majority of respondents are fairly evenly split between feeling the laws have "struck about the right balance" or "haven't gone far enough" (Figure 7). Support for stronger regulation was highest for the environment, with more than half of the respondents feeling that laws and regulations "haven't gone far enough."

FIGURE 7: Regulatory perspective



ANALYSIS: PREFERENCES FOR MANAGEMENT ACTIONS

GROUPING VARIABLES: FACTOR ANALYSIS

. The purpose of the factor analysis was to confirm that preferences for individual management options would group consistently with the broader management areas identified earlier in this paper.

Factor analysis is a data reduction technique used to identify and clarify relationships among variables (Norusis 1994). The goal is to identify a small number of factors that represent these relationships, identified through correlations between the variables. The variables within a factor can be seen as indicators or attributes of a broader concept that may not itself be directly observable. For a factor analysis to be effective, the resultant factors should be simple and interpretable. Factor analysis is frequently used to confirm theoretical expectations about how variables are related. Arriving at a solution that satisfies both goodness of fit and psychological or theoretical interpretation ultimately requires some discretion on the part of the researcher (Kim et al. 1978; Joreskog et al. 1979).

A factor analysis usually proceeds in four steps (Norusis 1994):

- Computation of correlation matrix for all variables
- Factor extraction
- Rotation (to make the matrix easier to interpret)
- Computation of factor scores

The factor analysis for the UMRS data was conducted using SPSS 7.5, which contains automated procedures for conducting and reporting the results of each step. Each of the twenty-six potential management options considered by respondents was included in the factor analysis

The first step of the factor analysis involved computing the correlation matrix. Examination of the matrix revealed that many of the variables were correlated at more than small levels (0.3 or greater), suggesting a factor model would be appropriate. The appropriateness of using a factor model was further supported by the results of the Bartlett's Test of Sphericity. Figure 8 shows that this test produced a high Chi-Square score and associated level of significance, thereby rejecting the hypothesis that the coefficient matrix is an "identity matrix" (where variables are perfectly correlated with themselves, but not correlated with any other variables). A printout of the correlation matrix has not been included here due to size considerations (twenty pages).

FIGURE 8: Appropriateness of using factor model

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.925
Bartlett's Test of Sphericity	Approx. Chi-Square	24082.977
	df	325
	Sig.	.000

The second step of the factor analysis was extracting the factors. The principal components analysis, which is the most frequently employed method, was used. This method identifies the combination of variables that accounts for the largest amount of variance explained, then repeats the process for subsequent (uncorrelated) factors in descending order of variance explained. Five factors were identified through this process, which had a cut-off criterion of Eigenvalues greater than one. The five factors collectively explain 57.6 percent of the total variance among the 26 variables.

The third step of the factor analysis was the rotation phase. This phase is intended to make the information about the factors more interpretable. Rotation helps to differentiate the factors by identifying which variables are highly correlated with each factor. Ideally, each variable would be highly correlated with only one factor, and have correlation coefficients near zero for the other factors. This would result in factors that could be easily distinguished and identified.

The varimax method of rotation was used first. This is the most commonly used method, which is designed to simplify the factors. A total of five factors were identified in this step, as shown in the results contained in Figure 9. The variables have been sorted in descending order of the coefficient value for each of the respective factors. Only abbreviated labeling of the variables is shown in this figure, but it is the ordering and loading of variables that is more important in this step. The variables are identified with their full descriptions in Appendix D.

The first six variables clearly load into factor one, with values ranging from .794 to .662 for that factor and generally low values for all other factors. These variables represent water quality and general habitat improvement, and were the most popular management measures in the survey. The next three variables also have their strongest relative associations with factor one, but the relationships are less clear since the variables have coefficient values in the .4 to .5 range across several factors. These variables represent floodplain restoration and aesthetics as management responsibilities.

To test the sensitivity of the factor loadings to the method employed, the equamax method of rotation was used for comparison. Under the equamax method, these variables were more closely associated with factors two and four, respectively, demonstrating that the results are sensitive to the method for these variables (only). The quality of the fit for these variables with the various factors is given further consideration below.

The next six variables load most closely with factor two. Management options represented by these variables include various measures to reduce development and increase natural attributes in the floodplain. The first three of these variables show relatively strong association with only factor two (.703 to .663), while the latter three have more muddled associations across several factors.

Factor three is more clearly identified, with four variables that load strongly (.785 to .678). These variables represent initiatives to improve navigation and flood control on the river. Factor four has two variables with strong loading coefficients (.823 and .792) and a third variable with less clearly defined association. The variables in Factor four include measures to improve hunting, fishing, and boating safety. Factor five is plainly distinguished, comprised of the final four variables (with coefficients from .653 to .447). These variables represent improvements to various attractions, including boat access and beaches, hiking trails and historical sites.

FIGURE 9: Factor matrix for management actions

	Compon				
...support	1	2	3	4	5
reduce pollutio	.79	-4.98E-	.13	-1.52E-	.11
...support the quality of water..	.76	5.245E-	.18	5.264E-	.13
...support control non- sources of	.72	.11	9.831E-	2.996E-	.10
...support develop programs...imp water	.70	.13	.14	.10	.20
...support improved habit	.70	.30	9.664E-	.23	.16
...support increase in amount...of habit	.66	.32	1.820E-	.23	.18
...suppo restoration of river	.46	.42	.12	.17	8.130E-
...support enhance aesthetic	.46	.27	7.680E-	.36	.29
...support reduction in buildi developme	.45	.41	2.485E-	.19	-
...support to remove locks...retur natur	-	.70	8.757E-	-5.25E-	.25
...support restore floodplai	.28	.69	.12	.15	-2.87E-
...support of the barge	8.102E-	.66	4.597E-	-7.34E-	.22
...support increase in number of acres.	.44	.58	-4.93E-	.27	-3.77E-
...support efforts woul increase...flood fores	.45	.50	7.841E-	.30	6.997E-
...support limit boating	.36	.36	7.112E-	-4.09E-	8.647E-
...support increase the congested	-9.38E-	5.289E-	.78	.19	-9.18E-
...support make locks dams efficient	.21	-8.10E-	.70	.25	4.950E-
...support to provide urban protectio	.19	.16	.70	-3.00E-	.20
...support provide more flood	.15	.11	.67	-3.05E-	.33
...support create more opportuniti	-2.16E-	8.160E-	.12	.82	.10
...support improve fishin	.18	1.039E-	.15	.79	.20
...support create a safer for	.24	-5.56E-	.40	.44	.33
...support develop trails for	.33	.20	7.475E-	8.502E-	.65
...support provide recreational area	.11	.10	.27	.37	.63
...support increase of of beaches islands	.17	.27	4.830E-	.40	.47
...support historic along or near rive	.21	.14	.29	.22	.44

Extraction Method: Principal

a. Rotation converged in 7

While the results of the Factor Analysis were positive, the ambiguity in the variable loadings between Factor One and Factor Two was not completely satisfying. Enhancement of water quality and habitat are typically seen as distinct management areas by managers, and are typically under the authority of different agencies. Water quality was a major concern during the 1970's, while habitat depletion and degradation are seen as the most pressing issues today (Johnson 1996). The general public still overwhelmingly focuses on water quality as the issue of greatest concern (Carlson 1996; MacWilliams et al. 1996) but general measures for habitat improvement were nearly as strongly supported as the water quality initiatives (see Figure 4).

As a test, an additional Factor Analysis was conducted with the four water quality variables excluded. This configuration was selected for two main reasons: Factor One seemed to be comprised of the most broadly supported management measures, even though they were associated with different management areas; and including four water quality variables may have had a disproportionate effect on the loadings. This test resulted in much clearer identification of factors, both in the factor loadings and the conceptual fit (Figure 10). This analysis also identified five factors, splitting the previous Factor Two more clearly between "floodplain restoration" measures (new Factor One) and "navigation reduction" measures (new Factor Five). The other three Factors remained unchanged. Since the results of this Factor Analysis appear to be more satisfying than the first one from a conceptual standpoint, both configurations of factors will be examined using Reliability Analysis to see how well they serve as measurement scales.

FIGURE 10: Factor matrix for management actions, excluding all water quality variables

Rotated Component Matrix[a]

	Component				
	1	2	3	4	5
...support an improved aquatic habitat	.754	5.846E-02	.323	.114	-1.83E-03
...support an increase in the amount...of wildlife habitat	.739	6.851E-02	.336	.106	1.366E-02
...support an increase in the number of wetland acres...	.728	-1.91E-02	7.261E-02	.156	.257
...support a reduction in all building development...	.700	6.109E-02	-.124	6.536E-02	5.330E-02
...support efforts that would increase...floodplain forest	.672	.109	.186	.184	.202
...support restoration of the river backwaters	.598	.146	.189	8.048E-02	.182
...support efforts to restore the floodplain...	.546	.132	9.495E-03	.130	.538
...support efforts to enhance the aesthetic quality...	.524	.104	.393	.283	7.564E-02
...support efforts to limit recreational boating in...sensit	.494	.101	.203	-.172	.105
...support efforts to increase the size of congested locks..	-3.86E-02	.773	-7.55E-02	.183	3.027E-02
...support initiatives to provide greater urban flood protection..	.157	.718	.198	-2.06E-02	.153
...support efforts to make locks and dams more efficient...	.179	.714	.139	.204	-.116
...support efforts to provide more ag. flood protection...	7.549E-02	.690	.318	-1.38E-02	.149
...support efforts to develop additional trails for hiking/w	.280	9.404E-02	.732	-5.61E-04	.112
...support efforts to provide more recreational access areas	6.019E-02	.270	.662	.345	.134
...support more historic attractions along or near the river	.209	.307	.541	.129	2.887E-02
...support an increase of number of beaches and islands...	.256	4.650E-02	.537	.321	.162
...support efforts to create more hunting opportunities	9.863E-02	.102	9.546E-02	.855	9.018E-02
...support efforts to improve sport fishing	.197	.143	.237	.801	-1.56E-02
...support efforts to create a safer river for boaters	.126	.409	.354	.465	-3.30E-02
...support initiatves to remove the locks...return to natura	.107	5.884E-02	.120	2.630E-02	.811
...support reduction of the barge traffic...	.248	3.384E-02	.121	3.676E-03	.714

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 6 iterations.

ASSESSING SCALES: RELIABILITY ANALYSIS

Reliability analysis is a statistical approach intended to study measurement scales and the variables that comprise them. The main purpose is to demonstrate how well questionnaire items relate to each other. This can be done to test the internal consistency of the scale, and to identify problematic items that should be excluded from the scale (Norusis 1997).

This procedure has been used on the UMRS survey data to see how well the variables in the factors identified represent measurement scales. The variables within each factor can be thought of as multiple indicators of a single concept that is being measured. Strong correlation among the variables would suggest internal consistency among the indicators in the scale, and a stronger representation of the concept being measured.

Several statistics can be used to assess the strength of the scale (Norusis 1997). Four of these have been used most in this analysis: Corrected Item-Total Correlation; Squared Multiple Correlation; Cronbach's Alpha; and Alpha if Item Deleted. These statistics, computed for each variable in each factor (for factors created from the full list of 26 variables), are presented in Tables 1A through 1E below. Higher scores (those approaching one) indicate stronger relationships between the variables.

The first two indicators relate to individual items in the scale. The Corrected Item-Total Correlation is the Pearson correlation coefficient between the score of each individual item and the sum of the other items in the scale. Values of this coefficient across variables and factors range from .4 to near .7, demonstrating that relationships among the respective variables exist, although none demonstrate high correlation. The highest correlations appear in Factor 1 and Factor 3.

The Squared Multiple Correlation denotes the amount of observed variability for a given item that can be explained by the other items in the scale. This statistic is the R-squared statistic computed from a multiple regression equation of this relationship. The highest coefficient for the UMRS variables is .64 (Factor 1, variable III22T); the lowest is .19 (Factor 2, variable III22F). A number of the variables have a fairly low R-squared (.2 to .3).

Chronbach's Alpha is an indicator of overall scale reliability. It can be interpreted as a correlation coefficient, thereby ranging in value from 0 to 1. The Alpha is a function of the variances, covariances, and the total number of items in the scale. If all other values are held constant, adding items to the scale will increase the Alpha score. There are several possible interpretations of Alpha; perhaps the most straightforward is that the Alpha measures how well the scale would correlated with all other possible scales (with the same number of items) which measure the same thing (Norusis 1997). The factors are constructed in a way that results in the factor with the highest Alpha being created first. The Alpha scores for the UMRS factors range from .8767 for Factor 1 to .7264 for Factor 5.

The relative effect of adding or subtracting a particular value from the scale is computed as the Alpha if Item Deleted statistic. This statistic is helpful in understanding the overall contribution of each item to the scale. For most of the variables from the UMRS data, the Alpha would show little change if an individual item were deleted. This suggests relative stability in the scales, which is a desirable trait for a multiple indicator scale. Variables in Factor 4 show the most sensitivity, presumably because this is only a three-item scale which would be expected to be less robust. All but one of the variables positively contribute to their respective Alpha scores. The Alpha score for Factor 4 would be higher if item III22Z was deleted, a sure sign that this variable does not fit well with this factor. Based on this observation, item III22Z (Efforts to create a safe river for boaters) was deleted from the Factors. A key to the variable codes in these figures is contained in Appendix D.

TABLE 1A: Reliability analysis, Factor 1

FACTOR 1: R E L I A B I L I T Y   A N A L Y S I S - S C A L E (A L P H A)

N of Cases = 2436.0

Item-total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Alpha if Item Deleted
III22M	24.5956	22.9859	.6609	.5002	.8574
III22L	24.8510	21.9141	.6712	.4940	.8549
III22N	24.9647	22.3421	.6106	.4107	.8628
III22A	24.8251	22.0943	.6765	.4656	.8544
III22T	25.1281	21.1310	.7312	.6416	.8466
III22S	25.1154	21.3793	.6948	.6124	.8516
III22W	25.3945	22.1864	.5597	.3348	.8709

Reliability Coefficients 7 items

Alpha = .8749 Standardized item alpha = .8767

TABLE 1B: Reliability analysis, Factor 2

FACTOR 2: R E L I A B I L I T Y   A N A L Y S I S - S C A L E (A L P H A)

N of Cases = 2289.0

Item-total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Alpha if Item Deleted
III22B	23.8676	34.0039	.4009	.2485	.7963
III22P	22.9799	31.5739	.6259	.4305	.7587
III22O	23.4692	34.4039	.4592	.2524	.7851
III22Q	22.9454	31.9004	.6327	.4548	.7583
III22V	22.8619	33.2030	.5984	.4040	.7653
III22G	22.7453	33.9749	.5311	.3164	.7748
III22R	22.7772	33.9468	.4561	.2597	.7860
III22F	22.8152	35.0825	.4022	.1901	.7934

Reliability Coefficients 8 items

Alpha = .7999 Standardized item alpha = .8025

TABLE 1C: Reliability analysis, Factor 3

FACTOR 3: R E L I A B I L I T Y   A N A L Y S I S   -   S C A L E   (A L P H A)

N of Cases = 2427.0

Item-total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Alpha if Item Deleted
III22I	10.8508	8.2506	.5236	.3071	.7170
III22K	10.2592	8.6068	.5532	.3273	.6997
III22H	10.1372	8.3031	.5722	.3734	.6888
III22D	10.1347	8.3541	.5657	.3717	.6924

Reliability Coefficients 4 items

Alpha = .7563 Standardized item alpha = .7572

TABLE 1D: Reliability analysis, Factor 4

FACTOR 4: R E L I A B I L I T Y   A N A L Y S I S   -   S C A L E   (A L P H A)

N of Cases = 2478.0

Item-total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Alpha if Item Deleted
III22X	7.0517	4.6949	.6032	.4350	.6545
III22Y	6.6029	4.5641	.6959	.4994	.5414
III22Z	6.1308	5.8892	.4718	.2429	.7922

Reliability Coefficients 3 items

Alpha = .7562 Standardized item alpha = .7545

TABLE 1E: Reliability analysis, Factor 5

FACTOR5: R E L I A B I L I T Y A N A L Y S I S - S C A L E (A L P H A)

N of Cases = 2458.0

Item-total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Alpha if Item Deleted
III22C	9.8641	7.9921	.5153	.2714	.6645
III22E	10.2030	7.8029	.5751	.3317	.6297
III22U	10.4076	8.1105	.4822	.2420	.6842
III22J	10.0936	8.1304	.4889	.2431	.6801

Reliability Coefficients 4 items

Alpha = .7258 Standardized item alpha = .7264

A Reliability Analysis was also conducted for the three factors that differed when generated with the water quality variables excluded from the Factor Analysis. These results can be compared with those in the previous analysis for their relative suitability as measurement scales. Reliability statistics for the “new” Factor One, comprised of items relating to floodplain restoration, are shown in Table 2A. The variables have generally good correlation coefficients, and the Alpha score of .8675 is superior to the Alpha from the factor that contained most of these variables in the previous grouping (Table 1B). The factor containing measures to reduce navigation and remove the locks and dams proves to be the weakest scale analyzed, with an Alpha score of .5676 (Table 2B). A sixth factor including the four water quality variables (Table 2C) also demonstrates good attributes of a scale, and the Alpha score of .8278 compares favorably with the scores of other scales considered in this analysis.

TABLE 2A: Reliability analysis, new factor: floodplain restoration indicators

FACTOR 1: R E L I A B I L I T Y A N A L Y S I S - S C A L E (A L P H A)

N of Cases = 2311.0

Statistics for	Mean	Variance	Std Dev	N of Variables
Scale	32.8278	54.8751	7.4078	9

Inter-item Correlations	Mean	Minimum	Maximum	Range	Max/Min	Variance
	.4211	.2523	.7730	.5208	3.0644	.0106

Item-total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Alpha if Item Deleted
III22T	28.7997	43.9412	.7038	.6428	.8399
III22S	28.7875	43.9700	.6936	.6357	.8407
III22Q	29.4171	42.1922	.6743	.4777	.8407
III22R	29.2466	44.4430	.5043	.2698	.8583
III22V	29.3349	43.2964	.6702	.4637	.8417
III22G	29.2228	44.4633	.5810	.3550	.8500
III22P	29.4500	43.2225	.5729	.3650	.8514
III22W	29.0740	45.1456	.5701	.3583	.8511
III22F	29.2895	46.2075	.4200	.1950	.8658

Reliability Coefficients 9 items

Alpha = .8635 Standardized item alpha = .8675

TABLE 2B: Reliability analysis, new factor: navigation reduction indicators

FACTOR 5: R E L I A B I L I T Y   A N A L Y S I S   -   S C A L E   (A L P H A)

N of Cases = 2419.0

Statistics for	Mean	Variance	Std Dev	N of Variables
Scale	5.3543	4.9303	2.2204	2

Inter-item Correlations	Mean	Minimum	Maximum	Range	Max/Min	Variance
	.3962	.3962	.3962	.0000	1.0000	.0000

Item-total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Alpha if Item Deleted
III22B	2.8723	1.5474	.3962	.1570	.
III22O	2.4820	1.9917	.3962	.1570	.

Reliability Coefficients 2 items

Alpha = .5643 Standardized item alpha = .5676

TABLE 2C: Reliability analysis, new factor: water quality indicators

WQFACTOR: R E L I A B I L I T Y   A N A L Y S I S   -   S C A L E   (A L P H A)

N of Cases = 2471.0

Statistics for	Mean	Variance	Std Dev	N of Variables
Scale	17.3395	10.1207	3.1813	4

Inter-item Correlations	Mean	Minimum	Maximum	Range	Max/Min	Variance
	.5458	.4717	.6147	.1430	1.3032	.0020

Item-total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Alpha if Item Deleted
III22L	13.0457	5.7513	.6811	.4723	.7653
III22M	12.7912	6.2544	.6972	.4892	.7628
III22N	13.1631	5.9584	.6159	.3882	.7968
III22A	13.0186	6.1333	.6176	.3879	.7946

Reliability Coefficients 4 items

Alpha = .8253 Standardized item alpha = .8278

FACTOR IDENTIFICATION

The statistical analyses conducted to this point suggest that suitable factors can be identified when all 26 variables are considered together as well as when the water quality variables are considered separately. Since the resulting factors more closely coincide with stated management responsibilities under the second approach, these factors have been chosen for the final configuration. The six factors, identified with the descriptions of their component variables, are listed in Figure 11. The factors are listed in descending order of overall support (based on normalized means, adjusted for the number of variables for comparability) as are the specific management measures within each group. The measurement scale used was “1=no support, 5=strong support.” Note that one item, boating safety did not fit any of the other groups. Figure 12 depicts the relative level of support for these six groups of management actions.

FIGURE 11: Factor groupings of preferences for future management actions for the UMRS

FACTOR 1: Water Quality (mean 4.33)

- Efforts to reduce industrial pollution of the river (4.54)
- Efforts to develop new programs to improve water quality (4.32)
- Improving the quality of the water that flows into the river from its tributaries (4.29)
- Efforts to control non-point sources of pollution; for example, agricultural or urban runoff (4.17)

FACTOR 2: Floodplain restoration (mean: 3.65)

- An increase in the amount and quality of wildlife habitat (4.03)
- An improved aquatic habitat (4.01)
- Efforts to enhance the aesthetic quality of the river (3.76)
- Restoration of the river backwaters (3.61)
- A reduction in all building development in the floodplain (3.59)
- Efforts to limit recreational boating in environmentally sensitive area (3.53)
- Efforts that would increase the amount of floodplain forest (3.49)
- An increase in the number of wetland acres along the river (3.39)
- Efforts to restore the floodplain to its natural state (3.38)

FACTOR 3: Infrastructure and development (mean 3.45)

- Initiatives to provide greater flood protection for urban areas (3.66)
- Efforts to provide more flood protection for agriculture (3.66)
- Efforts to make the locks and dams more efficient for navigation (3.54)
- Efforts to increase the size of congested locks so that they can handle more barge traffic (2.94)

FACTOR 4: Non-consumptive recreation (mean 3.38)

- Efforts to develop additional trails for hiking and walking (3.66)
- More historic attractions along or near the river (3.42)
- Efforts to provide more recreational access area (3.32)
- An increase in the number of islands and beaches along and within the river (3.12)

FACTOR 5: Hunting and Fishing (mean 3.07)

- Efforts to improve sport fishing (3.29)
- Efforts to create more hunting opportunities (2.84)

FACTOR 6: Navigation reductions (mean 2.68)

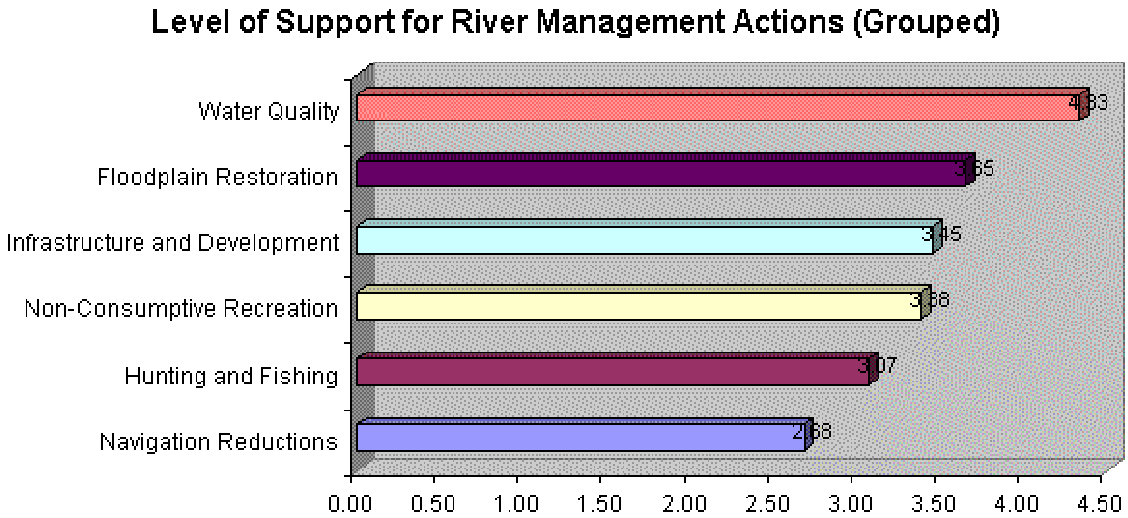
- Reduction of barge traffic on the river (2.87)
- Initiatives to remove the locks and dams and return the river to its natural state (2.48)

DROPPED VARIABLES*

- Efforts to create a safe river for boaters (3.76)

*Variable dropped due to poor fit with other variables based on Reliability Analysis

FIGURE 12: Level of support for river management actions (grouped)



COMPARING MANAGEMENT PREFERENCES BY LOCATION

The purpose of this step was to compare geographic sub-populations of the five-state study area to see if there are any differences in preferences toward the six major management areas. Analysis of variance (ANOVA) between sub-groups was used to determine any statistically significant differences. Comparisons in preferences were checked between the following: residents of the five UMRS states; residents familiar with different stretches of the Mississippi or Illinois Rivers; and residents of river-border counties (riparian) versus non-river county residents (non-riparian).

Table 3 lists the mean score for respondents from each state (rows 1 through 5) as well as for the entire sample (bottom row) for each of the six management preference factors (displayed in columns). The states are represented by the following codes: 1=Illinois; 2=Iowa; 3=Minnesota; 4=Missouri; and 5=Wisconsin. There are observable differences in the factor means across each state, but these differences are quite small in relation to the size of the respective scales. Analysis of variance statistics have been computed to test for statistically significant differences in these means. The results are displayed in Table 4. Differences in the means for each state for Factors 1 and 2 are not statistically significant, while the differences for Factors 3 through 6 are significant at the .05 level or less.

TABLE 3: Differences in factor means by state

Report

STATE		FACTOR1	FACTOR2	FACTOR3	FACTOR4	FACTOR5	FACTOR6
Illinois	Mean	17.4817	32.8152	14.4392	13.8411	6.0081	5.5556
	N	492	460	485	491	495	486
	Std. Deviation	3.1946	7.7278	3.7822	3.6982	2.5139	2.2273
Iowa	Mean	17.4810	32.6740	14.2370	13.5467	6.3092	4.9380
	N	499	454	481	492	498	484
	Std. Deviation	2.7951	7.3198	3.6813	3.6092	2.3335	2.3005
Minnesota	Mean	17.2687	32.7198	12.4362	13.1022	5.7022	5.4477
	N	495	464	486	489	497	478
	Std. Deviation	3.2286	7.3366	3.5294	3.5026	2.3725	2.1418
Missouri	Mean	17.3763	33.2092	14.5288	13.5508	6.1230	5.4538
	N	489	459	486	492	496	487
	Std. Deviation	3.3039	7.7555	3.6159	3.8436	2.4877	2.2401
Wisconsin	Mean	17.0907	32.7236	13.3374	13.5709	6.5181	5.3760
	N	496	474	489	494	496	484
	Std. Deviation	3.3536	6.9002	3.5220	3.3634	2.3484	2.1437
Total	Mean	17.3395	32.8278	13.7940	13.5228	6.1322	5.3543
	N	2471	2311	2427	2458	2482	2419
	Std. Deviation	3.1813	7.4078	3.7116	3.6119	2.4261	2.2204

TABLE 4: Significance of differences in factor means by state

ANOVA Table

			Sum of Squares	df	Mean Square	F	Sig.
FACTOR1 * STATE	Between	(Combined)	53.776	4	13.444	1.329	.257
	Within Groups		24944.351	2466	10.115		
	Total		24998.127	2470			
FACTOR2 * STATE	Between	(Combined)	88.115	4	22.029	.401	.808
	Within Groups		126673.3	2306	54.932		
	Total		126761.5	2310			
FACTOR3 * STATE	Between	(Combined)	1556.611	4	389.153	29.579	.000
	Within Groups		31864.381	2422	13.156		
	Total		33420.992	2426			
FACTOR4 * STATE	Between	(Combined)	138.053	4	34.513	2.653	.032
	Within Groups		31915.171	2453	13.011		
	Total		32053.224	2457			
FACTOR5 * STATE	Between	(Combined)	189.047	4	47.262	8.122	.000
	Within Groups		14413.607	2477	5.819		
	Total		14602.654	2481			
FACTOR6 * STATE	Between	(Combined)	112.778	4	28.194	5.764	.000
	Within Groups		11808.605	2414	4.892		
	Total		11921.383	2418			

Table 5 displays factor means comparing preferences of residents of counties bordering the navigable portions of the river system (riparian) with preferences of counties in the remainder of the states (non-riparian). Differences in factor means are very small except for Factor 6, which indicates residents who live in counties along the river are less supportive of reducing navigation than the other residents. Table 6 indicates that only the differences in Factor 6 are significant at the .05 level or less.

TABLE 5: Differences in factor means by river proximity

Report

riparian		FACTOR1	FACTOR2	FACTOR3	FACTOR4	FACTOR5	FACTOR6
non-riparian	Mean	17.2591	32.9881	13.8570	13.5239	6.1269	5.7318
	N	988	926	972	985	993	962
	Std. Deviation	3.1455	7.3127	3.7222	3.5729	2.4000	2.1809
riparian	Mean	17.3931	32.7206	13.7519	13.5221	6.1357	5.1050
	N	1483	1385	1455	1473	1489	1457
	Std. Deviation	3.2049	7.4714	3.7052	3.6389	2.4441	2.2118
Total	Mean	17.3395	32.8278	13.7940	13.5228	6.1322	5.3543
	N	2471	2311	2427	2458	2482	2419
	Std. Deviation	3.1813	7.4078	3.7116	3.6119	2.4261	2.2204

TABLE 6: Significance of differences in factor means by river proximity

ANOVA Table

			Sum of Squares	df	Mean Square	F	Sig.
FACTOR1 * riparian	Between	(Combined)	10.649	1	10.649	1.052	.305
	Within Groups		24987.478	2469	10.120		
	Total		24998.127	2470			
FACTOR2 * riparian	Between	(Combined)	39.724	1	39.724	.724	.395
	Within Groups		126721.7	2309	54.882		
	Total		126761.5	2310			
FACTOR3 * riparian	Between	(Combined)	6.437	1	6.437	.467	.494
	Within Groups		33414.555	2425	13.779		
	Total		33420.992	2426			
FACTOR4 * riparian	Between	(Combined)	.002	1	.002	.000	.990
	Within Groups		32053.222	2456	13.051		
	Total		32053.224	2457			
FACTOR5 * riparian	Between	(Combined)	.046	1	.046	.008	.930
	Within Groups		14602.608	2480	5.888		
	Total		14602.654	2481			
FACTOR6 * riparian	Between	(Combined)	227.643	1	227.643	47.052	.000
	Within Groups		11693.740	2417	4.838		
	Total		11921.383	2418			

Differences in means were also tested for residents most familiar with different stretches of the Mississippi and Illinois Rivers. Results for those most familiar with the Mississippi River are displayed in Table 7 (means) and Table 8 (ANOVA). Again, all differences between the respective means appear to be small. For the Mississippi River, the differences for Factor 3 (infrastructure and development) are statistically significant at the .05 level, indicating that individuals most familiar with the uppermost reach of the Mississippi River are somewhat less supportive of further infrastructure actions. Results for those most familiar with the Illinois River are displayed in Table 9 (means) and Table 10 (ANOVA). For the Illinois River, none of the differences among factor means are significant at the .05 level or less.

TABLE 7: Differences in factor means by Mississippi River segment

Report

...following segments		FACTOR1	FACTOR2	FACTOR3	FACTOR4	FACTOR5	FACTOR6
The Mississippi River between Minneapolis/St. Paul, Minneso	Mean	17.2967	32.9778	12.9356	13.3453	6.1146	5.3354
	N	1011	946	994	999	1012	987
	Std. Deviation	3.1452	6.8715	3.5143	3.4496	2.4023	2.1297
The Mississippi River between Guttenberg, Iowa and Hanniba	Mean	17.4885	32.7707	14.2720	13.4462	6.1185	5.1262
	N	520	484	511	520	523	507
	Std. Deviation	3.0519	7.6054	3.7608	3.6884	2.3532	2.3431
The Mississippi River between Hannibal, Missouri and Cairo,	Mean	17.4187	32.7034	14.3472	13.4804	6.0668	5.1860
	N	461	435	458	460	464	457
	Std. Deviation	3.0653	7.5261	3.5291	3.5758	2.4286	2.1147
Total	Mean	17.3750	32.8601	13.6128	13.4032	6.1046	5.2460
	N	1992	1865	1963	1979	1999	1951
	Std. Deviation	3.1022	7.2200	3.6469	3.5418	2.3946	2.1846

TABLE 8: Significance of differences in factor means by Mississippi River segment

ANOVA Table

			Sum of Squares	df	Mean Square	F	Sig.
FACTOR1 * ...following segments you are familar with? Mississippi Rive	Between	(Combined)	13.765	2	6.883	.715	.489
	Within Groups		19147.110	1989	9.627		
	Total		19160.875	1991			
FACTOR2 * ...following segments you are familar with? Mississippi Rive	Between	(Combined)	27.652	2	13.826	.265	.767
	Within Groups		97140.822	1862	52.170		
	Total		97168.474	1864			
FACTOR3 * ...following segments you are familar with? Mississippi Rive	Between	(Combined)	924.886	2	462.443	36.012	.000
	Within Groups		25168.870	1960	12.841		
	Total		26093.756	1962			
FACTOR4 * ...following segments you are familar with? Mississippi Rive	Between	(Combined)	7.047	2	3.524	.281	.755
	Within Groups		24805.172	1976	12.553		
	Total		24812.219	1978			
FACTOR5 * ...following segments you are familar with? Mississippi Rive	Between	(Combined)	.866	2	.433	.075	.927
	Within Groups		11456.283	1996	5.740		
	Total		11457.149	1998			
FACTOR6 * ...following segments you are familar with? Mississippi Rive	Between	(Combined)	16.799	2	8.400	1.761	.172
	Within Groups		9289.107	1948	4.769		
	Total		9305.907	1950			

TABLE 9: Differences in factor means by Illinois River segment

Report

...following segments		FACTOR1	FACTOR2	FACTOR3	FACTOR4	FACTOR5	FACTOR6
The Illinois Waterway between the Chicago River and the Chi	Mean	18.0494	34.3973	14.4051	14.7375	5.9136	5.9241
	N	81	73	79	80	81	79
	Std. Deviation	2.9703	7.3876	3.9403	3.5248	2.5942	2.3026
The Illinois River between Joliet, Illinois and LaSalle	Mean	16.8478	32.3043	14.4681	14.1042	6.8511	5.2292
	N	46	46	47	48	47	48
	Std. Deviation	3.1620	8.1864	3.2226	3.6040	2.2935	2.3085
The Illinois River between LaSalle, Illinois and Grafton	Mean	17.4706	32.6735	13.5745	14.4706	6.4423	5.5625
	N	51	49	47	51	52	48
	Std. Deviation	3.1071	8.7116	4.4367	4.1778	2.7110	1.8555
Total	Mean	17.5730	33.3214	14.1965	14.4916	6.3111	5.6343
	N	178	168	173	179	180	175
	Std. Deviation	3.0823	8.0197	3.9024	3.7302	2.5703	2.1980

TABLE 10: Significance of differences in factor means by Illinois River segment

ANOVA Table

			Sum of Squares	df	Mean Square	F	Sig.
FACTOR1 * ...following segments you are familar with? Illinois Waterwa	Between	(Combined)	43.107	2	21.554	2.302	.103
	Within Groups		1638.443	175	9.363		
	Total		1681.551	177			
FACTOR2 * ...following segments you are familar with? Illinois Waterwa	Between	(Combined)	152.649	2	76.324	1.189	.307
	Within Groups		10587.994	165	64.170		
	Total		10740.643	167			
FACTOR3 * ...following segments you are familar with? Illinois Waterwa	Between	(Combined)	25.088	2	12.544	.822	.441
	Within Groups		2594.229	170	15.260		
	Total		2619.318	172			
FACTOR4 * ...following segments you are familar with? Illinois Waterwa	Between	(Combined)	12.065	2	6.032	.431	.651
	Within Groups		2464.673	176	14.004		
	Total		2476.737	178			
FACTOR5 * ...following segments you are familar with? Illinois Waterwa	Between	(Combined)	27.398	2	13.699	2.099	.126
	Within Groups		1155.179	177	6.526		
	Total		1182.578	179			
FACTOR6 * ...following segments you are familar with? Illinois Waterwa	Between	(Combined)	14.758	2	7.379	1.537	.218
	Within Groups		825.836	172	4.801		
	Total		840.594	174			

Taken collectively, the tests shown in Figures 15 through 22 demonstrate that there are no major differences in preferences across any of these geographic variables. While statistically significant differences were identified, most involved differences of less than 5 percent of the ranking scale, which are quite small. These differences are summarized in Figure 13:

FIGURE 13: Differences in preferences toward management actions based on state, river stretch, and proximity to the river*

FACTOR 1: Water Quality

- No statistically significant differences in support based on geographic distribution were identified

FACTOR 2: Floodplain Restoration

- No statistically significant differences in support based on geographic distribution were identified

FACTOR 3: Infrastructure and Development

- Residents of Minnesota and Wisconsin are somewhat less supportive of these measures than residents of Iowa, Illinois, and Missouri
- Respondents most familiar with the St. Paul to Guttenberg stretch of the Mississippi River are somewhat less supportive of these measures than respondents most familiar with the two lower stretches of the Mississippi River

FACTOR 4: Non-consumptive Recreation

- Residents of Illinois are most supportive of these measures; residents of Minnesota are least supportive; residents of Iowa, Missouri and Wisconsin fall in between

FACTOR 5: Hunting and Fishing

- Residents of Wisconsin and Iowa are most supportive of these measures; residents of Minnesota are least supportive; residents of Illinois and Missouri fall in between

FACTOR 6: Navigation Reductions

- Residents of riparian counties are somewhat less supportive of these measures than residents of non-riparian counties
- Residents of Iowa are less supportive of these measures than residents of Minnesota, Wisconsin, Illinois and Missouri

*Only statistically significant differences, $p<.05$, have been reported.

COMPARING VALUES AND PERCEPTIONS BY LOCATION

Regional differences in values and in perceptions of river habitat, river healthiness, and the relative importance of river environmental problems were also assessed using the same methods applied to preferences for future management actions. Procedures documenting the grouping of variables and the testing of factor means are presented in Appendix E. Although some statistically significant differences in values and perceptions do exist across the basin, the differences are quite small. A summary of findings in geographic differences is presented in Figure 14.

FIGURE 14: Differences in values and perceptions based on state, river stretch, and proximity to the river*

VALUES – INTRINSIC: Fish and wildlife; aesthetics; recreation; culture and history; etc.

- Residents of Illinois and Missouri expressed slightly lower values for these attributes than residents of the other three states
- Values expressed decrease slightly from the upper to lower stretches of the Mississippi River
- Residents of riparian counties expressed slightly higher values for these attributes than residents of non-riparian counties

VALUES – INSTRUMENTAL: Commerce, industry and agriculture; economic value to communities

- Residents of Minnesota and Wisconsin expressed slightly lower values for these attributes than residents of the other three states
- Values expressed increase slightly from the upper to lower stretches of the Mississippi River
- Residents of riparian counties expressed slightly higher values for these attributes than residents of non-riparian counties

PERCEIVEDCHANGES IN RIVER HABITAT: Quantity and quality of fish and wildlife habitat

- Habitat change is perceived as somewhat declining in all three Mississippi River stretches, and slightly worse in the Hannibal to Cairo stretch compared to the upper two stretches
- Habitat change is perceived to be slightly improving in the Joliet to La Salle stretch, and perceived to be slightly declining in the other two Illinois River stretches

PERCEIVED RIVER HEALTHINESS: Water quality safety for swimming, eating fish, and health of aquatic life

- River healthiness is considered somewhat unsafe in all three Mississippi River stretches, and decreases slightly from the upper to lower stretches of the Mississippi River

COMPARATIVE PROBLEM PRIORITY: Relative importance of river environmental problems compared to other social, economic, and environmental problems

- River environmental problems are considered slightly more important in the Guttenberg to Hannibal stretch of the Mississippi River compared to the other two stretches

*Only statistically significant differences, $p<.05$, have been reported.

EXPLAINING DIFFERENCES IN PREFERENCES: A LIMITED REGRESSION MODEL

A preliminary regression model has been developed to test how well values, attitudes, and other socio-economic indicators explain variation in preferences for future management actions on the UMRS. The independent variables included in this model (including grouped variables discussed in Appendix E) are:

- CHARACTERISTICS OF THE INDIVIDUAL, INCOME: Respondent's household income level (6 point scale, 1=$25,000 or less through 6=over $70,000)
- CHARACTERISTICS OF THE INDIVIDUAL, EDUCATION: Respondent's highest level of completed education (7 point scale, 1=grade school through 7=graduate school)
- VALUES – INTRINSIC: A grouped variable representing intrinsic values toward the river (7 items in factor; potential range from 7=low to 28=high)
- VALUES – INSTRUMENTAL: A grouped variable representing instrumental values toward the river (2 items in factor; potential range from 2=low to 8=high)
- FAMILIARITY: Respondent's reported level of familiarity with the river (5 point scale, 1=not familiar at all through 5=very familiar)
- PERCEIVED CHANGES IN RIVER HABITAT: A grouped variable measuring perceptions of changes in river habitat quantity and quality (4 items in factor; potential range from 4=less/worse to 12=more/better)
- PERCEIVED RIVER HEALTHINESS: A grouped variable measuring perceptions of river healthiness (3 items in factor; potential range from 3=unhealthy to 12=healthy)
- RECREATIONAL USE: A dummy variable indicating whether or not respondents use the river for recreation (1=recreational use; 0=no recreational use)
- COMPARATIVE PROBLEM PRIORITY: A grouped variable representing the importance of river environmental problems compared to other social problems (3 item scale; potential range from 3=not important at all to 12=one of the most important)
- ECONOMIC DEVELOPMENT VERSUS ENVIRONMENTAL PROTECTION: a dummy variable indicating whether respondents report environmental (value=0) or economic (value=1) issues are more important when compromise cannot be achieved.

The model was tested with each of the six management factors (Figure 11) as dependent variables using linear regression in SPSS 7.5. A summary of the six model results is presented in Table 11. The table reports the adjusted R^2, F statistic, and respective standardized Beta coefficients for the independent variables (including level of significance for statistically significant relationships in the model). A brief discussion interpreting the results of the model for Factor 2 (floodplain restoration) follows the table.

TABLE 11: Regression model statistics and coefficients for each of the six Factors (dependent variables)

	FACTOR 1		FACTOR 2		FACTOR 3		FACTOR 4		FACTOR 5		FACTOR 6	
Adj. R^2	0.148		0.211		0.105		0.069		0.086		0.100	
F	29.036	**	43.069	**	19.933	**	12.980	**	16.194	**	18.694	**
Variable	Beta		Beta		Beta		Beta		Beta		Beta	
Familiar	0.065	**	0.030		0.025		0.063	*	0.068	**	-0.077	**
Habitat	-0.059	*	-0.105	**	0.035		0.041		0.122	**	-0.099	**
Healthy	-0.164	**	-0.146	**	-0.046		-0.074	**	0.073	**	-0.056	*
Important	0.083	**	0.123	**	0.071	**	0.052	*	0.096	**	0.092	**
Val-Inst	0.025		-0.010		0.240	**	0.027		0.087	**	-0.162	**
Val-Intr	0.204	**	0.249	**	-0.096	**	0.194	**	0.065	*	0.016	
Education	-0.026		-0.025		-0.142	**	-0.087	**	-0.134	**	-0.027	
Income	0.011		0.004		-0.119	**	-0.032		-0.034		-0.116	**
Recreate	0.009		-0.036		-0.027		-0.034		0.012		-0.039	
Econ/Env	-0.171	**	-0.228	**	0.035		-0.088	**	-0.048		-0.101	**

* significant at the .05 level or less
** significant at the .01 level or less

The model exhibiting the highest level of explanation of variance was for Factor 2, floodplain restoration. The adjusted R^2 of .211 (Table 12A) indicates that approximately 20 percent of the variance in preferences toward floodplain restoration can be explained by this set of independent variables. The associated F statistic for the model is 43.069 (Table 12B), significant below the .01 level. Coefficients for the independent variables in the equation are displayed in Table 12C.

TABLE 12A: Regression model summary for Factor 2 (floodplain restoration)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.465[a]	.216	.211	6.4104

a. Predictors: (Constant), ...more important: economic development/environmental protec, ...income, household, VAL_INST, REC_DUM, IMPORTNT, HEALTHY, FAMILIAR, ...highest level of education..., HABITAT, VAL_INTR

TABLE 12B: ANOVA report for regression model, Factor 2 (floodplain restoration)

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	17698.535	10	1769.854	43.069	.000[a]
	Residual	64064.974	1559	41.094		
	Total	81763.509	1569			

a. Predictors: (Constant), ...more important: economic development/environmental protec, ...income, household, VAL_INST, REC_DUM, IMPORTNT, HEALTHY, FAMILIAR, ...highest level of education..., HABITAT, VAL_INTR

b. Dependent Variable: FACTOR2

TABLE 12C: Independent variable coefficients for regression model, Factor 2 (floodplain restoration)

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	23.192	1.617		14.345	.000
	FAMILIAR	.169	.134	.030	1.265	.206
	HABITAT	-.345	.081	-.105	-4.262	.000
	HEALTHY	-.539	.091	-.146	-5.933	.000
	IMPORTNT	.467	.089	.123	5.253	.000
	VAL_INST	-6.63E-02	.153	-.010	-.433	.665
	VAL_INTR	.607	.063	.249	9.648	.000
	...highest level of education...	-.117	.117	-.025	-1.003	.316
	...income, household	1.856E-02	.106	.004	.175	.861
	REC_DUM	-.638	.422	-.036	-1.514	.130
	...more important: economic development/environmental protec	-4.002	.410	-.228	-9.770	.000

a. Dependent Variable: FACTOR2

Five of the independent variables in the model for Factor 2 have statistically significant relationships (all significant below the .01 level). Indicators of river health (Habitat, Healthy) both have coefficients with negative signs, indicating that beliefs that the river is healthier are associated with somewhat less support for floodplain restoration activities. The belief that economic issues are generally more important than environmental issues (when compromise cannot be reached) are also negatively associated with support for floodplain restoration activities. The relative importance of river environmental issues compared to other social issues and the level of intrinsic values held toward the river are both positively associated with support for floodplain restoration activities.

CONCLUSION

DISCUSSION AND CONCLUSIONS

The general public constitutes an important constituency in the planning processes conducted on the UMRS. This research was designed and conducted to representatively assess river resource values, attitudes, and preferences for future management actions held by the general public. It adds significantly to the information available to decision makers by specifically measuring public support toward a wide range of management measures. The analysis of the survey data confirms that the general public continues to value the UMRS strongly and for multiple purposes, consistent with findings of studies conducted in the previous two decades.

Further, this research was designed to include geographic variables in the data, allowing any regional differences in public support to be assessed for the first time. Analysis of the data across geographic sub-groups shows that values toward the resource and preferences for future management action do not differ substantially within the five-state area. Factors other than geography account for the bulk of the differences in preferences toward management actions. Therefore, with respect to the interests of the general public, resource management agencies can treat the UMRS as a single management unit, and base resource allocation decisions on other factors pertinent to the management of the UMRS. This is consistent with the legislation that established the UMRS as a management entity under the EMP. It should also be beneficial for emerging approaches to manage the UMRS at the watershed or ecosystem level.

Treating the UMRS as one management unit does not imply that a regional consensus exists regarding future management of the UMRS. There are differing levels of public support for the various management measures. It also does not imply uniform management throughout the basin, since the distribution of resources (and the associated responsiveness to various management measures) differs throughout the basin. These circumstances may lead to a different level of policy debate, since resource allocations that may be most beneficial to the UMRS as a whole could conflict with established expectations for equitable distribution of management funds across states. Distributions based on some other measure of equity could be quite different depending on whether they are determined on the basis of state population, regional population, resource length, relative resource need, or some other measure. Regardless of the basis chosen for distributing management resources, the tradeoffs between these allocations should be explicitly considered to identify the overall effectiveness of alternative proposals.

Water quality remains the greatest concern among the public, and support for management initiatives focused on improving water quality is highest. This presents a challenge to management agencies since water quality has improved dramatically during this century, and most resource agencies are now focusing on other objectives for the UMRS. However, the public remains largely misinformed about these improvements, with a majority believing that water quality has gotten worse in the last decade and continues to worsen. Education is commonly offered as a means of directing public interest to other objectives, but the literature suggests that preferences for management actions are more strongly influenced by values than knowledge.

Floodplain restoration measures are the next most strongly supported measures among the public, especially the broadly defined measures aimed at habitat improvement. This support is evident for measures aimed at increasing environmental features (forests, wetlands) as well as for measures reducing human impacts (reducing building development and recreational boating in sensitive areas). However, support for restoration appears to be bounded with respect to the existing locks and dams. This is illustrated by comparing two management measures that include the concept of returning the river to its natural state. While lowest among the floodplain restoration measures considered, "restoring the floodplain to its natural state" (mean=3.38) is supported much more strongly than "removing the locks and dams to return the river to its natural state" (mean=2.48). These findings illustrate that support for river restoration measures has constraints regarding the man-made structural changes in the flood plain. This is consistent with findings of the broader literature identifying the expectation that both economic and environmental goals can be met through compromise and balanced use of resources. It is also consistent with current restoration programs that seek to improve environmental conditions within the context of a human-modified, multi-purpose river system.

Flood protection was distinguished in the survey between urban and agricultural protection, and both management measures received virtually identical support from respondents. Support for urban flood protection was nearly equal to support for reducing building development in the floodplain, which demonstrates support for alternative approaches to reducing flood damages. Levels of support for the flood protection measures were also similar to the levels of support for most environmental measures, reinforcing policies that institute balanced use of the resource. The issue of removing agricultural levees to reconnect portions of the floodplain with the river for environmental restoration was not directly addressed in this research, but proposed policies relying on willing sellers for potential restoration efforts appear most prudent given the general public support for balanced use of the UMRS.

Issues surrounding the question of whether the Corps of Engineers should be authorized to increase the size of congested locks on the UMRS have proven to be among the most controversial issues among river policy makers and interest groups in the 1990's. Respondents reported stronger support for increasing the efficiency of the existing system of locks and dams than for any changes to the infrastructure. Efforts to either build up or tear down the locks and dams were among the least supported measures included in the survey. Although each measure was strongly supported by 15 percent of respondents, larger numbers reported no support for the measures. Interest groups and advocates for both of these positions have been very energetic in the ongoing debate, but it appears that there is limited support for these positions among the general public.

Support for recreation measures as a whole was slightly less strong than for other management measures considered in the survey, although this support varies substantially by type. This may be seen as consistent with federal policy that typically considers river-related recreation beneficial, but incidental to other economic or fish and wildlife purposes. An important finding of the limited regression models is that recreational participation was not a significant factor in explaining support for any of the management action factors. Like the findings for geographic variables, this is contrary to the notion that recreationists have substantially different views toward managing the river than non-recreationists in the basin.

The data support several conclusions regarding the types of values the public holds toward the UMRS. Environmental concerns overwhelmingly outweigh economic concerns in circumstances where compromise cannot be reached (see Figure 6. It is important to reiterate that national data identifies the expectation that both can be achieved through compromise or balanced use.) Option values and non-use values are also clearly evident. There is nearly unanimous agreement (99 percent) that the river is important for future generations to enjoy, even though fully 25 percent state that the river has no particular importance to them personally. Proximity to the river is not a substantial factor in explaining the importance of the resource or preferences for management measures. Similarly, respondents have reported that the river is nearly equally important for economic value to local river communities as it is to the broader economy (Figure 3). Taken together, these findings suggest that the economic importance of the river is valued across economic sectors and regions, further supporting the argument that the UMRS can be treated as a single management unit. It is also valued for both traditional economic values, and intrinsic and environmental values. As a consequence, estimates of the value of the UMRS based on direct uses of the resource will fall far short of identifying all of the values that should to be considered in managing the resource for its fullest societal benefit.

The general public's emphasis on water quality above all other river concerns is consistent with the findings of another recent study designed to assess the potential for activating grassroots citizen support for environmental improvement of the UMRS (MacWilliams et al. 1996). The authors concluded that water quality is the only issue strong enough to draw wide citizen interest and participation in river issues, which was identified as a significant impediment to developing widespread citizen activism. This research adds to that conclusion by documenting that UMRS environmental issues are generally considered important, but not among society's most important. These circumstances should lead decision makers to reconsider approaches for involving the public in UMRS planning processes, since self-selected forums like public meetings are unlikely to yield results representative of the general public. Focus groups, panels, or periodic surveys could better represent broader public perspectives.

RECOMMENDATIONS FOR FURTHER RESEARCH

There are many opportunities for further analysis of the data collected in this effort, as well as opportunities for replicating this research across populations. Several possibilities are listed below:

- *Accuracy of perceptions of resource changes*. Respondent accuracy in perceiving resource changes could be investigated for its potential effect on preferences for future management actions. However, establishing a baseline measure of actual changes across river stretches could require significant effort.

- *Differences between urban and rural residents.* While not reported here, differences in preferences were compared between residents of counties in the Standard Metropolitan Statistical Areas (SMSA) along the Mississippi River corridor and those in non-SMSA corridor counties. The initial findings were consistent with the other geographic comparisons made in this paper (that is, differences were insubstantial), but further analysis could more completely document this comparison.

- *Analysis of particular interest groups.* Characteristics of respondents who show strong support (or, conversely, no support) for a particular activity, such as lock and dam expansion or removal, could be examined to see if any patterns are evident in explaining these preferences. Collecting new data by surveying members of particular interest groups (such as commercial, agricultural, or environmental groups) could also be used for further investigation.

- *Refining the predictive model.* The preliminary regression model developed here could be expanded and more carefully tested to fully explore the predictive relationships of values, attitudes, and other attributes on preferences for future management actions on the UMRS. Other analytic approaches, such as logits, could also be employed.

- *Replication in other river basins.* Similar applications in the lower half of the Mississippi River System or in other river basins could lead to a greater understanding of public preferences for management of large river systems.

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APPENDIX A

Survey Instrument

Please note that the survey instrument in its original CATI form is not available electronically. However, all of the non-administrative questions (and responses) are available on the St. Paul District Corps of Engineers home page either in FRAMES:

http://www.mvp.usace.army.mil/enviro_protection/resource_values/questions/

or NON-FRAMES:

http://www.mvp.usace.army.mil/enviro_protection/resource_values/questions/nonframesindex.htm

The original CATI survey instrument is reproduced in the hard copy of this thesis, which can be obtained on loan from the University of Minnesota library or libraries of the Corps of Engineers.

APPENDIX B

Sampling and General Administration

Details of the sampling plan and telephone administration are available in hard copy only, which can be obtained on loan from the University of Minnesota library or libraries of the Corps of Engineers. Descriptive statistics for the sample as a whole are available on the Internet as cited in Appendix A

APPENDIX C

Descriptive Statistics for all Variables (weighted)

The tables of descriptive statistics are available in hard copy only, which can be obtained on loan from the University of Minnesota library or libraries of the Corps of Engineers. Descriptive statistics for the sample as a whole are available on the Internet as cited in Appendix A

APPENDIX D

Key to Coded Variables

Variable codes used in Factor and Reliability analyses

Variable	Management Alternative
III22A	Efforts to develop new programs to improve water quality
III22B	Initiatives to remove the locks and dams and return the river to its natural state
III22C	Efforts to develop additional trails for hiking and walking
III22D	Efforts to provide more flood protection for agriculture
III22E	Efforts to provide more recreational access area
III22F	Efforts to limit recreational boating in environmentally sensitive area
III22G	Restoration of the river backwaters
III22H	Initiatives to provide greater flood protection for urban areas
III22I	Efforts to increase the size of congested locks so that they can handle more barge traffic
III22J	More historic attractions along or near the river
III22K	Efforts to make the locks and dams more efficient for navigation
III22L	Improving the quality of the water that flows into the river from its tributaries
III22M	Efforts to reduce industrial pollution of the river
III22N	Efforts to control non-point sources of pollution; for example, ag. or urban runoff
III22O	Reduction of barge traffic on the river
III22P	Efforts to restore the floodplain to its natural state
III22Q	An increase in the number of wetland acres along the river
III22R	A reduction in all building development in the floodplain
III22S	An increase in the amount and quality of wildlife habitat
III22T	An improved aquatic habitat
III22U	An increase in the number of islands and beaches along and within the river
III22V	Efforts that would increase the amount of floodplain forest
III22W	Efforts to enhance the aesthetic quality of the river
III22X	Efforts to create more hunting opportunities
III22Y	Efforts to improve sport fishing
III22Z	Efforts to create a safe river for boaters

Variable	Values related to the river
III16A	The (river) has no particular importance to me
III16B	The (river) is important to me knowing it's there
III16C	The (river) is important to me because of its prominence in history and culture
III16D	The (river) is important to me for its fish, wildlife, and natural features
III16E	The (river) is important to me because it offers many types of recreation
III16F	The (river) is just inviting to me
III16G	The (river)'s ambience and aesthetics are important to me
III16H	It is important to take care of the (river) so that we are able to pass it along to future generations for their enjoyment
III16I	The (river) is important to me of its value to commerce, industry, and agriculture
III16J	The (river) is important because of its economic value to river communities

Variable	Perceived changes in habitat
II9A	Fish habitat quantity (more/less/same)
II9B	Fish habitat quality (better/worse/same)
II10A	Wildlife habitat quantity (more/less/same)
II10B	Wildlife habitat quality (better/worse/same)

Variable	Perceived river healthiness
II13	Water quality related to swimming safety
II14	Water quality related to safety of eating fish
II15	Water quality related to aquatic life health

Variable	Comparative problem priority
III18	River environmental quality compared to other social problems in the area
III19	River environmental quality compared to economic problems in the area
III20	River environmental quality compared to other environmental problems in the area

APPENDIX E

Regional Differences in Values and other Independent Variables

Regional differences in values and other independent variables

To test for regional differences in other variables, analytic steps comparable to those performed on the preferences for future management actions were conducted. Several groups of independent variables were first tested with factor analysis (values only) and reliability analysis to see how well the variables represent grouped measurement scales. When the relative strength of the multiple-indicator scales was confirmed, analysis of variance tests were conducted to test for regional differences for the respective sets of indicators. The groups of indicators examined in this appendix account for several sections of the questionnaire, relating to the following conceptual areas:

- Values related to the river
- Perceived changes in habitat
- Perceived river healthiness
- Comparative problem priority

Regional differences in values related to the river

A factor analysis was conducted first on the ten variables related to river values to confirm a distinction between intrinsic and instrumental values. Factor loadings computed by SPSS 7.5 are displayed in Figure E-1. Five variables load strongly with the first factor, comprising intrinsic values. These variables measured respondent values toward fish and wildlife, aesthetics, recreation, and two statements about personal attachment to the river. The next two variables (cultural/historical and another statement about personal attachment) also load with the first factor, but the association is weaker.

The second factor, comprising instrumental values, is defined by strong loading from two variables: commerce, industry, and agriculture; and economic value to communities. A third variable, concerned with taking care of the river for future generations, loads weakly loads weakly with this second factor.

FIGURE E-1: Factor matrix for values toward the river

Rotated Component Matrix[a]

	Component	
	1	2
...agree/disagree...River is important...wildlife, fish...	.703	.105
...agree/disagree...River...ambiance and aesthetics...	.681	.182
...agree/disagree...River...offers many types of recreation.	.672	.155
...agree/disagree...River is...inviting to me.	.602	9.107E-02
recoded	.506	4.206E-02
...agree/disagree...River is important...prominance in cultu	.477	.444
...agree/disagree...River is important to me knowing its the	.394	.316
...agree/disagree...River...commerce, industry, and agricult	2.594E-02	.848
...agree/disagree...River...economic value to ...communities	.116	.830
...agree/disagree...take care of River...for future...	.412	.423

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 3 iterations.

Results of the reliability analysis show that both the intrinsic and instrumental value grouped variables are suitable as measurement scales. Figure E-2A shows the Alpha score for intrinsic values factor is .7280. The instrumental values scale proves to be superior with two variables (Figure E-3B, Alpha=.7050), rather than three (Figure E-3A, Alpha=.6335) so the variable relating to future generations was dropped from the scale in further analysis. The actual question wording associated with the abbreviated codes shown in the Figures is located in Appendix D.

FIGURE E-2: Reliability analysis, Values - intrinsic

R E L I A B I L I T Y   A N A L Y S I S   -   S C A L E   (A L P H A)

Item-total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Alpha if Item Deleted
III16D	18.7668	6.5885	.5083	.2817	.6668
III16G	18.8078	6.7073	.5207	.2814	.6658
III16E	18.9440	6.5359	.4996	.2876	.6683
III16F	19.1155	6.7749	.4183	.2109	.6888
III16B	18.8453	7.1261	.3504	.1681	.7045
III16A2	19.0155	6.7665	.3033	.1113	.7263
III16C	18.6759	6.9902	.4557	.2411	.6815

Reliability Coefficients   7 items

Alpha =   .7185   Standardized item alpha =   .7280

FIGURE E-3A: Reliability analysis, Values - instrumental (3 variables)

R E L I A B I L I T Y   A N A L Y S I S   -   S C A L E   (A L P H A)

Item-total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Alpha if Item Deleted
III16H	6.6078	1.2239	.3143	.0990	.7029
III16I	7.0089	.7758	.5251	.3113	.4317
III16J	7.0044	.8531	.5369	.3148	.4148

Reliability Coefficients   3 items

Alpha =   .6406   Standardized item alpha =   .6335

FIGURE E-3B: Reliability analysis, Values - instrumental (2 variables)

R E L I A B I L I T Y   A N A L Y S I S   -   S C A L E   (A L P H A)

Item-total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Alpha if Item Deleted
III16I	3.3060	.3625	.5444	.2964	.
III16J	3.3012	.4308	.5444	.2964	.

Reliability Coefficients   2 items

Alpha =   .7033   Standardized item alpha =   .7050

Analysis of variance (ANOVA) between geographic sub-groups was used to determine any statistically significant differences in intrinsic or instrumental values. Figure E-4A and A-4B show that differences among states for both intrinsic and instrumental values are statistically significant but rather small. Differences in values among respondents most familiar with different stretches of the Mississippi River are also significant (but small) for both intrinsic and instrumental values (Figure E-5A and A-5B). There are no statistically significant differences among respondents most familiar with different stretches of the Illinois river (Figure E-6A and A-6B). Differences in values between riparian and non-riparian respondents are statistically significant but small (Figure E-7A and A-7B).

FIGURE E-4A: Differences in factor means (instrumental and intrinsic values) by state

Report

STATE		VAL_INST	VAL_INTR
1	Mean	6.6040	21.5174
	N	495	460
	Std. Deviation	1.0745	3.0079
2	Mean	6.7838	22.4617
	N	495	470
	Std. Deviation	1.0159	2.9871
3	Mean	6.4779	22.2945
	N	498	472
	Std. Deviation	1.2122	2.8202
4	Mean	6.6903	21.3982
	N	494	447
	Std. Deviation	1.0880	3.0004
5	Mean	6.4819	22.4268
	N	498	471
	Std. Deviation	1.1027	2.8662
Total	Mean	6.6073	22.0284
	N	2480	2320
	Std. Deviation	1.1062	2.9699

FIGURE E-4B: Significance of differences in factor means (instrumental and intrinsic values) by state

ANOVA Table

			Sum of Squares	df	Mean Square	F	Sig.
VAL_INST * STATE	Between	(Combined)	34.999	4	8.750	7.222	.000
	Within Groups		2998.470	2475	1.212		
	Total		3033.469	2479			
VAL_INTR * STATE	Between	(Combined)	494.044	4	123.511	14.325	.000
	Within Groups		19960.079	2315	8.622		
	Total		20454.122	2319			

FIGURE E-5A: Differences in factor means (instrumental and intrinsic values) by Mississippi River segment

Report

...following segments		VAL_INST	VAL_INTR
The Mississippi River between Minneapolis/St. Paul, Minneso	Mean	6.5257	22.5847
	N	1012	956
	Std. Deviation	1.1642	2.7603
The Mississippi River between Guttenberg, Iowa and Hanniba	Mean	6.7238	22.2242
	N	525	495
	Std. Deviation	1.0548	2.9831
The Mississippi River between Hannibal, Missouri and Cairo,	Mean	6.7952	21.6221
	N	459	426
	Std. Deviation	1.0309	2.8681
Total	Mean	6.6398	22.2712
	N	1996	1877
	Std. Deviation	1.1122	2.8691

FIGURE E-5B: Significance of differences in factor means (instrumental and intrinsic values) by Mississippi River segment

ANOVA Table

			Sum of Squares	df	Mean Square	F	Sig.
VAL_INST * ...following segments you are familar with? Mississippi Rive	Between	(Combined)	27.968	2	13.984	11.422	.000
	Within Groups		2440.034	1993	1.224		
	Total		2468.002	1995			
VAL_INTR * ...following segments you are familar with? Mississippi Rive	Between	(Combined)	274.572	2	137.286	16.961	.000
	Within Groups		15168.399	1874	8.094		
	Total		15442.971	1876			

FIGURE: E-6A: Differences in factor means (instrumental and intrinsic values) by Illinois River segment

Report

...following segments		VAL_INST	VAL_INTR
The Illinois Waterway between the Chicago River and the Chi	Mean	6.5556	21.6622
	N	81	74
	Std. Deviation	1.0607	3.4493
The Illinois River between Joliet, Illinois and LaSalle	Mean	6.5000	21.9583
	N	48	48
	Std. Deviation	1.0518	2.7596
The Illinois River between LaSalle, Illinois and Grafton	Mean	6.8000	21.6939
	N	50	49
	Std. Deviation	1.0302	3.3616
Total	Mean	6.6089	21.7544
	N	179	171
	Std. Deviation	1.0510	3.2283

FIGURE E-6B: Significance of differences in factor means (instrumental and intrinsic values) by Mississippi River segment

ANOVA Table

			Sum of Squares	df	Mean Square	F	Sig.
VAL_INST * ...following segments you are familar with? Illinois Waterwa	Between	(Combined)	2.626	2	1.313	1.191	.306
	Within Groups		194.000	176	1.102		
	Total		196.626	178			
VAL_INTR * ...following segments you are familar with? Illinois Waterwa	Between	(Combined)	2.805	2	1.403	.133	.875
	Within Groups		1768.879	168	10.529		
	Total		1771.684	170			

FIGURE E-7A: Differences in factor means (instrumental and intrinsic values) by river proximity

Report

riparian		VAL_INST	VAL_INTR
non-riparian	Mean	6.5536	21.8215
	N	988	930
	Std. Deviation	1.0682	3.0106
riparian	Mean	6.6428	22.1669
	N	1492	1390
	Std. Deviation	1.1296	2.9353
Total	Mean	6.6073	22.0284
	N	2480	2320
	Std. Deviation	1.1062	2.9699

FIGURE E-7B: Significance of differences in factor means (instrumental and intrinsic values) by river proximity

ANOVA Table

			Sum of Squares	df	Mean Square	F	Sig.
VAL_INST * riparian	Between	(Combined)	4.721	1	4.721	3.862	.049
	Within Groups		3028.749	2478	1.222		
	Total		3033.469	2479			
VAL_INTR * riparian	Between	(Combined)	66.475	1	66.475	7.558	.006
	Within Groups		20387.648	2318	8.795		
	Total		20454.122	2319			

PERCEIVED RIVER CONDITIONS AND COMPARATIVE PROBLEM PRIORITY

Statistics from the reliability analysis demonstrate that three groups of questions tested in this section are suitable as multiple-indicator scales. Indicators of perceived changes in the quantity and quality of fish and wildlife habitat are associated with an Alpha score of .7895 (Figure E-8). Indicators of perceptions in river healthiness have an Alpha score of .7746 (Figure E-9). Finally, indicators of the relative importance of river environmental issues compared to other societal issues have an Alpha score of .7642 (Figure E-10). Since the questions in these sections relate specifically to the specific stretch of the river system most familiar to the respondent, geographic differences associated with river stretches only are tested here.

Figures A-11A and A-11B contain analysis of variance (ANOVA) statistics comparing respondents most familiar with different stretches of the Mississippi River against each of these three grouped variables. Statistically significant differences among the geographic stretches exist for each of the three variables, but these differences are small (less than five percent of the scale).

Figures A-12A and A-12B contain analysis of variance (ANOVA) statistics comparing respondents most familiar with different stretches of the Illinois River against each of these three grouped variables. For the indicators of habitat quality and quantity, statistically significant differences exist between respondents most familiar with the middle stretch compared of the Illinois River compared to those most familiar with the upper and lower stretches. For perceptions of river healthiness and the comparative problem priority, no statistically significant differences exist among respondents most familiar with various stretches of the Illinois River.

FIGURE E-8: Reliability analysis, changes in river habitat

R E L I A B I L I T Y   A N A L Y S I S   -   S C A L E   (A L P H A)

Item-total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Alpha if Item Deleted
II9A	5.3164	3.0468	.5689	.3730	.7505
II9B	5.2985	2.9763	.5935	.3984	.7385
II10A	5.1893	2.7683	.6015	.4265	.7358
II10B	5.1225	2.9085	.6265	.4451	.7221

Reliability Coefficients   4 items

Alpha =   .7888   Standardized item alpha =   .7895

FIGURE E-9: Reliability analysis, perceived river healthiness

R E L I A B I L I T Y   A N A L Y S I S   -   S C A L E   (A L P H A)

Item-total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Alpha if Item Deleted
II13	4.4552	2.1857	.5522	.3138	.7464
II14	4.3196	1.8328	.6109	.3968	.6907
II15	4.3902	2.1228	.6643	.4439	.6341

Reliability Coefficients   3 items

Alpha =   .7703   Standardized item alpha =   .7746

FIGURE E-10: Reliability analysis, comparative problem priority

```
  R E L I A B I L I T Y   A N A L Y S I S   -   S C A L E   (A L P H A)


Item-total Statistics

               Scale          Scale      Corrected
                Mean        Variance       Item-         Squared         Alpha
              if Item        if Item       Total        Multiple        if Item
              Deleted        Deleted    Correlation    Correlation      Deleted

III18          6.1591         1.8310        .5942          .3530          .6854
III19          6.0450         1.8517        .5976          .3571          .6815
III20          5.8954         1.8526        .5955          .3547          .6838



Reliability Coefficients     3 items

Alpha =   .7641           Standardized item alpha =   .7642
```

FIGURE E-11A: Differences in factor means (changes in habitat, perceived river healthiness, comparative problem priority) by Mississippi River segment

Report

...following segments		HABITAT	HEALTHY	IMPORTNT
The Mississippi River between Minneapolis/St. Paul, Minneso	Mean	6.9241	6.8171	8.9831
	N	896	946	944
	Std. Deviation	2.1711	1.9538	1.9781
The Mississippi River between Guttenberg, Iowa and Hanniba	Mean	7.1198	6.6319	9.2929
	N	459	489	495
	Std. Deviation	2.1969	2.0574	1.7830
The Mississippi River between Hannibal, Missouri and Cairo,	Mean	6.6519	6.0853	9.0773
	N	405	434	440
	Std. Deviation	2.1560	1.9976	1.8518
Total	Mean	6.9125	6.5987	9.0867
	N	1760	1869	1879
	Std. Deviation	2.1794	2.0119	1.9024

FIGURE E-11B: Significance of differences in factor means (changes in habitat, perceived river healthiness, comparative problem priority) by Mississippi River segment

ANOVA Table

			Sum of Squares	df	Mean Square	F	Sig.
HABITAT * ...following segments you are familar with? Mississippi Rive	Between	(Combined)	47.365	2	23.683	5.009	.007
	Within Groups		8307.160	1757	4.728		
	Total		8354.525	1759			
HEALTHY * ...following segments you are familar with? Mississippi Rive	Between	(Combined)	160.086	2	80.043	20.181	.000
	Within Groups		7400.951	1866	3.966		
	Total		7561.037	1868			
IMPORTNT * ...following segments you are familar with? Mississippi Rive	Between	(Combined)	31.233	2	15.617	4.330	.013
	Within Groups		6765.627	1876	3.606		
	Total		6796.860	1878			

FIGURE E-12A: Differences in factor means (changes in habitat, perceived river healthiness, comparative problem priority) by Illinois River segment

Report

...following segments		HABITAT	HEALTHY	IMPORTNT
The Illinois Waterway between the Chicago River and the Chi	Mean	7.3182	6.0800	9.0633
	N	66	75	79
	Std. Deviation	2.6727	2.0252	1.8697
The Illinois River between Joliet, Illinois and LaSalle	Mean	8.5250	6.9286	8.9778
	N	40	42	45
	Std. Deviation	2.4598	2.1114	2.0834
The Illinois River between LaSalle, Illinois and Grafton	Mean	7.3478	6.4118	8.9583
	N	46	51	48
	Std. Deviation	2.5141	2.0898	1.9674
Total	Mean	7.6447	6.3929	9.0116
	N	152	168	172
	Std. Deviation	2.6077	2.0822	1.9436

FIGURE E-12B: Significance of differences in factor means (changes in habitat, perceived river healthiness, comparative problem priority) by Illinois River segment

ANOVA Table

			Sum of Squares	df	Mean Square	F	Sig.
HABITAT * ...following segments you are familar with? Illinois Waterwa	Between	(Combined)	42.088	2	21.044	3.184	.044
	Within Groups		984.728	149	6.609		
	Total		1026.816	151			
HEALTHY * ...following segments you are familar with? Illinois Waterwa	Between	(Combined)	19.413	2	9.706	2.273	.106
	Within Groups		704.659	165	4.271		
	Total		724.071	167			
IMPORTNT * ...following segments you are familar with? Illinois Waterwa	Between	(Combined)	.399	2	.199	.052	.949
	Within Groups		645.578	169	3.820		
	Total		645.977	171			

APPENDIX F

Summary from U.S. Army Corps of Engineers Web Site

A summary of the results of this report is available on the home page of the St. Paul District Corps of Engineers:

http://www.mvp.usace.army.mil/enviro_protection/resource_values/