



Long Term Resource Monitoring Program

Program Report

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Long Term Resource Monitoring Program Procedures: Aquatic Vegetation Monitoring



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Long Term Resource Monitoring Program Procedures: Aquatic Vegetation Monitoring

by

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Preface

The Long Term Resource Monitoring Program (LTRMP) was authorized under the Water Resources Development Act of 1986 (Public Law 99-662) as an element of the U.S. Army Corps of Engineers' Environmental Management Program. The LTRMP is being implemented by the Upper Midwest Environmental Sciences Center (UMESC), a U.S. Geological Survey science center, in cooperation with the five Upper Mississippi River System (UMRS) States of Illinois, Iowa, Minnesota, Missouri, and Wisconsin. The U.S. Army Corps of Engineers provides guidance and has overall Program responsibility. The mode of operation and respective roles of the agencies are outlined in a 1988 Memorandum of Agreement.

The UMRS encompasses the commercially navigable reaches of the Upper Mississippi River, as well as the Illinois River and navigable portions of the Kaskaskia, Black, St. Croix, and Minnesota Rivers. Congress has declared the UMRS to be both a nationally significant ecosystem and a nationally significant commercial navigation system. The mission of the LTRMP is to provide decision makers and river managers with information for maintaining the UMRS as a sustainable large river ecosystem given its multiple-use character. The long-term goals of the Program are to understand the system, determine resource trends and effects, develop management alternatives, manage information, and develop useful products.

Goal 2 of the LTRMP Operating Plan (U.S. Fish and Wildlife Service 1993) is simply stated: *Monitor Resource Change*. Strategies for monitoring resource components are listed under this goal. This report was developed with funding provided by the Long Term Resource Monitoring Program.

1. Monitoring Aquatic Vegetation

1.1 Stratification

The procedures described in this manual are for collecting point data of aquatic vegetation over a large area. Each point represents a 2-m-wide area around the perimeter of the sampling boat. For the Long Term Resource Monitoring Program (LTRMP), the standard is a regular 16-foot boat, approximately 5 m long and 2 m wide. The area of the sampling site is approximately 44 m². The presence of aquatic plants at a site and at six subsampling areas within the site is recorded by species and species group. Water depth, substrate sediment type, and the presence of detritus are also recorded. The location of each site is recorded using a Universal Transverse Mercator (UTM) global positioning system (GPS). Data collected using these procedures can be used to quantify the abundance of individual species and species groups at each site as well as over a large area where many sites have been surveyed at random. Because site locations are recorded using a GPS, the data can also be used for spatial and causal relation analyses.

The areas to be surveyed are divided into strata and given discrete sampling efforts to increase efficiency and effectiveness. Each stratum represents a major aquatic geomorphic feature in the Upper Mississippi and Illinois Rivers (Table 1). A few strata will not be sampled. The main navigation channel and deepwater areas (>3 m deep at flat pool condition) will not be sampled because aquatic vegetation is unlikely to grow in these areas in the prevailing water quality conditions. The aquatic areas near the navigation dams (650 feet above and 200 feet below) will not be sampled because of safety considerations. Also, remote areas difficult to access and privately owned areas for which access permits have not been acquired will not be sampled. Maps of the stratified aquatic areas for the five monitoring reaches are created using geographic information system (GIS) software.

When the procedures were designed, the target survey areas were Pools 4, 8, 13, and 26 of the Upper Mississippi River, and the La Grange Pool of the Illinois River. The lower 12 miles of the Illinois River is included in the Pool 26 reach.

1.2 Site Selection

Sites to be investigated are selected in several steps on a computer. A 50- x 50-m grid is generated and laid onto the GIS map (coverage) of the stratified aquatic areas. Nodes of the grid are geo-spatially registered (UTM coordinates), and nodes that fall

Table 1. Aquatic area strata and the number of sites for the 1998 sampling season.

Stratum description	Stratum numeric code	Stratum letter code	Pool				
			4	8	13	26	La Grange
Main channel border - Illinois River (Pool 26)	1502	MCB				50	
Main channel border	1503	MCB	60	70	70	140	120
Side channel	1504	SC	120	100	70	90	40
Backwater contiguous	1510	BWC		175	170	50	190
Backwater contiguous - lower Pool 4	1511	BWC	75				
Backwater contiguous - upper Pool 4	1512	BWC	160				
Lake Pepin - upper	1513	TDL	65				
Lake Pepin - lower	1514	TDL	35				
Impounded	1520	IMP		175	210	30	
Backwater isolated/managed	1530	BWI	35	30	30	30	200
Backwater isolated/managed - Illinois River (Pool 26)	1531	BWI				160	
Total			550	550	550	550	550

in the sampling strata are eligible for selection as sites. The number of sites in each stratum is based on the total number of eligible nodes and the perceived habitat heterogeneity in the stratum. The minimum number of sites for a stratum is 30. The sites are selected (by lottery) separately in each stratum; all the eligible nodes in the stratum have equal probability of being selected. The GIS coverage of the stratified aquatic areas, the grid system, and the selected sites are documented by the Upper Midwest Environmental Sciences Center (UMESC). Hard copy of the maps and site files is sent to LTRMP field station vegetation specialists.

1.3 Equipment and Definitions

The rake (Figure 1) used for collecting vegetation samples is a long-handled, double-headed rake (modified from Jessen and Lound [1962] and Deppe and Lathrop [1992]). It is 36 cm (14 inches) wide, has 14, 5-cm-long (2-inch) teeth on each side, and is made by welding two square-headed garden rakes together. The rake head is marked into five equal parts (or 20% increments). The handle is approximately 3 m long, with a rope extension, and is scaled at 10-cm increments so it can be used to measure water depth.



Figure 1. Vegetation collecting rake.

Throughout the procedure manual, aquatic vegetation or aquatic species refer to the following plant types (Life form, Appendix A and Appendix B): submersed (S), rooted floating-leaved (F), nonrooted floating-leaved (N), emergent (E), and filamentous algae (A). The nonrooted

floating-leaved category is composed of *Lemnaceae* and *Azolla* sp. Filamentous algae are treated as if they were a single species.

Most sampling will be conducted from a boat. The sampling procedures are designed in reference to a regular 16-foot boat, approximately 5 m long and 2 m wide. The actual site is the 2-m area extending out from the perimeter of the boat (a 2-m-wide ring).

1.4 Sampling

1.4.1 Navigation

The field crew will use an enlarged field map to navigate to the general area of a site and then switch to a GPS unit with differentially corrected signals to pick the spot of the site. The boat is anchored when both the easting and northing coordinates displayed on the GPS unit are within 10 m (- or +) of their respective target readings. The actual stratum of the site may or may not match the stratum indicated on the map (the aquatic area stratification GIS coverage). Site location should not be altered because of a mismatch in stratum classification or for any other reason. If a site cannot be accessed, record the reason under the **Comments** field of the data sheet (refer to *Unusual Situations* section below).

1.4.2 Technique and Recording

The technique uses a combination of visual examination, rake samples, and subsampling to quantify the abundance of aquatic species. Each site has six subsampling areas, each of which is a rectangular area approximately 1.5 m long and 0.36 m wide (the width of the rake head). One subsampling area is located off each corner of the boat and the other two are located, one each, off the left and right sides (Figure 2). The subsampling areas are numbered from 1 to 6 clockwise starting at the front right corner of the boat. The exact locations of the six subsampling areas may vary among the types of boats used (e.g., canoe or airboat; also refer to *Unusual Situations* section

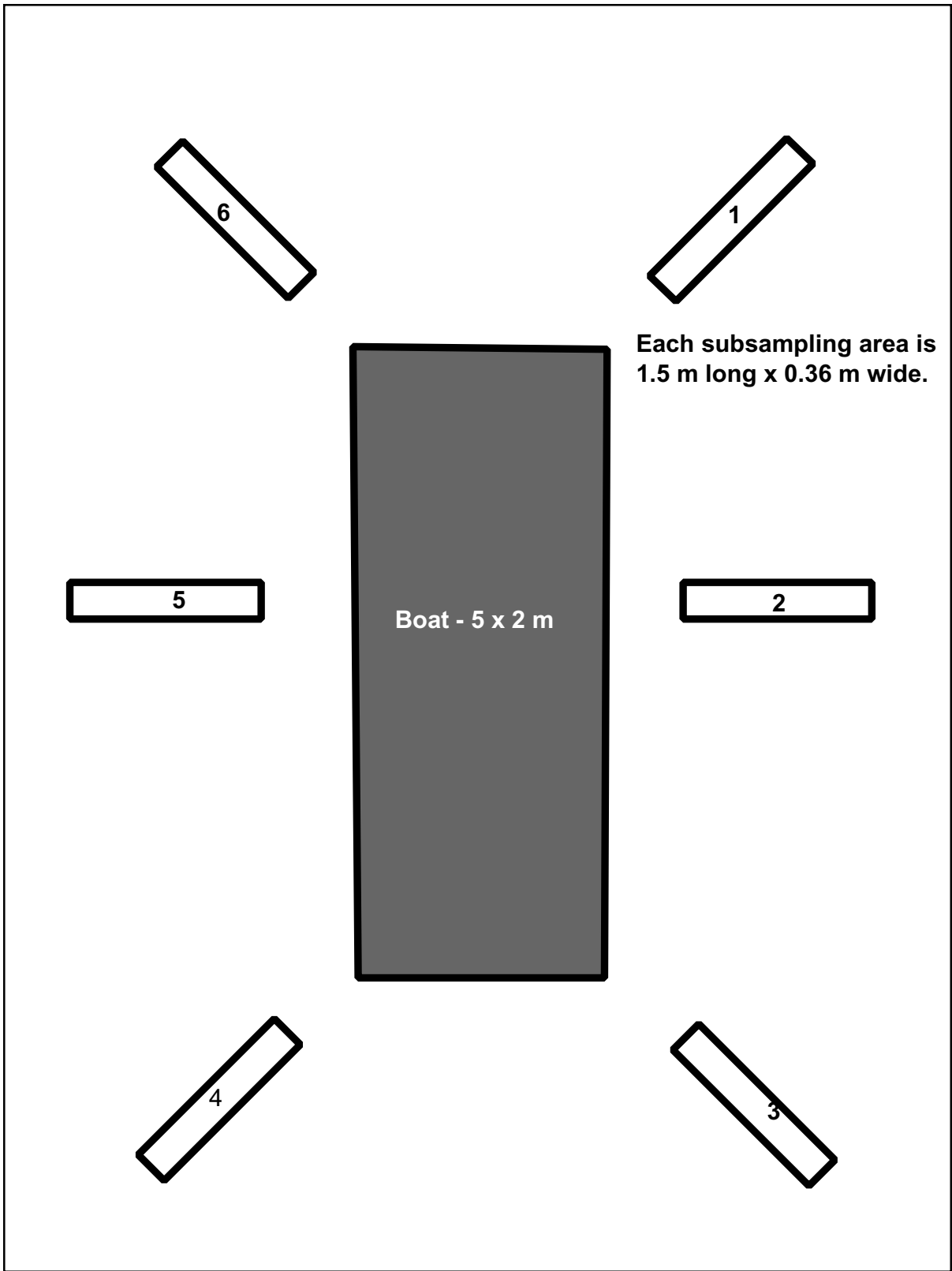


Figure 2. Placement of the six subsampling areas around the boat.

below); however, the six points in each boat will be marked ahead of time.

The data sheet (Appendix B) is divided into four sections, **Site information**, **Subsampling area information**, **Species information**, and **Reminder information**. The **Reminder information** contains the choices of data to be entered in the major data fields (boxes). All data fields on the data sheet are explained in detail in Appendix C.

The sampling operation is composed of multiple steps, beginning with recording **Site information**. Steps 2–8 are to collect **Subsampling area information** and **Species information**, beginning with the first subsampling area. Steps 9–13 are to complete the sampling at the site.

Step 1. After locating the site, anchor the boat securely at the front and rear. Immediately read and record the UTM coordinates of the site in the **1st UTM Coordinates** boxes. Record all site information except the **# Rows**, **Substrate**, **Detritus**, and **Life form**, which will be recorded later. If the actual stratum at the site differs from the stratum indicated on the map, record the actual stratum on the data sheet (**Site information**), otherwise the box is left blank. Visually estimate by life form the percentage of cover of nonrooted floating-leaved, rooted floating-leaved, and emergent species in the 2-m-wide ring area. Rate the percentage of cover according to Table 2, and record them in the appropriate **Cover** box. Emergent, rooted floating-leaved, and nonrooted floating-leaved plants intercept sunlight at or above the water surface and may shade submersed plants growing in the water column, therefore, the percentage of cover is important site information.

Step 2. Visually search each subsampling area (the imaginary rectangle) for aquatic species. Record the species code in the **Species code** box and a “1” in the **V** (visual) box for every submersed, rooted floating-leaved, and emergent species, and algae observed (**Species information**). Record a “1” in the **Additional species** box for every nonrooted floating

species observed. Record nonrooted floating-leaved species in the **Additional species** box only; do not record them in the **V** and **R** boxes even if found in the subsampling areas. If the subsampling area is land or exposed rock, refer to the **Unusual situations** section below.

Table 2. Vegetation cover ratings.

Cover (%)	Cover rating
81–100	5
61–80	4
41–60	3
21–40	2
1–20	1
None	0 ^a

^a For individual species other than rooted floating-leaved and emergent species under **Species information**, leave the **Cover** box blank.

Step 3. Extend the rake outward from the boat and lower it to the bottom of the river, thereby placing the rake at the top of the imaginary rectangle. Drag the rake along the bottom toward the boat for 1.5 m.

Step 4. Hold the rake handle vertically with the rake head resting on the bottom and read and record the water depth (**Subsampling area information**).

Step 5. Twist the rake 180 degrees as it is lifted off the river bottom and pull the rake and vegetation into the boat. The twisting minimizes the loss of plants from the rake teeth, but more than 180 degrees may cause the plants to fall off.

Step 6. Add the plant biomass hanging on the metal rake head to the rake teeth; ignore plant strands hanging off of the rake. Sweep the rake head through the water to compact and rinse the vegetation. Rate the amount of vegetation of all the submersed species and macro algae (not including filamentous algae) combined according to Table 3, and record this value in the **Plant density** box.

Step 7. Estimate the single-species plant density for every submersed species and algae found in

the rake sample; rate the density according to Table 3; and record the plant density rating in the **R** (rake) box (**Species information**). Record a “1” in the **R** box for every rooted floating-leaved and emergent species to indicate that the species was found in the rake sample. Leave the **R** boxes blank for nonrooted floating-leaved species and for species not found in the rake sample.

Table 3. Plant density ratings^a.

Rake teeth filled (%)	Density rating ^b
81–100	5
61–80	4
41–60	3
21–40	2
1–20	1
No plants retrieved	0 ^c

^a Ratings are modified from Deppe and Lathrop (1992).

^b Rating for rooted floating-leaved and emergent species is universally a “1”.

^c For the **R** box of a single species under **Species information**, leave box blank instead of recording a “0”.

Step 8. Repeat steps 2 to 7 for subsampling areas 2 to 6.

Step 9. Visually search the site (in the 2-m wide ring) for any species that are not present in the six subsampling areas. Record the new species in the **Species code** box and put a “1” in the **Additional species** box (**Species information**). Record nonrooted floating-leaved species in the **Additional Species** box only and do not record them in the **V** or **R** boxes even if found in the subsampling areas.

Step 10. Estimate the single-species percentage of cover at the site (in the 2-m wide ring) for every floating-leaved and emergent species, rate the cover according to Table 2, and record the rating in the **Cover** box (**Species information**). *Lugwigia* sp. is treated as a floating-leaved species (Appendix A) and its cover should be recorded. Leave the **Cover** box blank if the species is algae or a submersed or nonrooted floating-leaved species.

Step 11. If the choice of species code fits the

definition in Appendix A, leave the **QE** box blank. Otherwise, assign a code (Table 4) in the **QE** box to flag each uncertain choice of species code. Voucher specimens should be collected for any species that is not in the field station herbarium or of which the identity is uncertain or unknown. When a voucher is collected for a species, record a “1” (not sent for identification) or a “2” (sent for identification) in the **Voucher** box (Appendix C). If no voucher

Table 4. Plant identification quality evaluation codes.

Identification certainty	QE code
Species code follows the definition in Appendix A	blank
Hybrid of the species (with another taxon)	1
Genus certain, species suspected	2
Both genus and species suspected	3
Unknown	4

is collected, leave the box blank.

Step 12. Examine, by sight and touch, the sediment brought up from the bottom with the rake or on the boat anchors, classify the sediment into a type according to Table 5, and record the sediment type code in the **Substrate** box (**Site information**). If detritus is present, record a “1” in the **Detritus** box. For each life form present in the site, record the code for that life form (Appendix C) in the appropriate **Life form** box. Record the number of rows with information in the **Species information** area

Table 5. Substrate types and codes.

Substrate type	Code
Silt/clay	1
Mostly silt with sand	2
Mostly sand with silt	3
Hard clay	4
Gravel/rock	5
Sand	6

in the **# Rows** box.

Step 13. At the end of the sampling, before boat anchors are retrieved, read and record the UTM coordinates and record them in the **2nd UTM Coordinates** boxes.

Step 14. After a data sheet is complete, a bar code sticker is placed in the bar code box at the top of the data sheet. The stickers are provided by UMESC. The bar code uniquely identifies that data sheet.

1.4.3 Unusual Situations

a. No aquatic vegetation. If a subsampling area has no aquatic vegetation, regardless of the reasons, put “NOAQVG” in the **Species Code** box and a “1” in the **R** box, but leave the rest of the **Species information** boxes (**V**, **Additional Species**, **Cover**, **QE**, and **Voucher**) blank. Put a zero (0) in the **Plant Density** box. (**Subsampling area information**)

b. Nonaquatic subsampling area. A subsampling area is assumed to be an aquatic habitat, therefore, the **Habitat QA** box will be left blank. If a subsampling area is on land or exposed rock, however, put a “T” in the **Habitat QA** box and zeros in the **Water Depth** (0.0) and **Plant Density** (0) boxes. Refer to *No aquatic vegetation* above for recording **Species information**.

c. Nonaquatic stratum. If a site is on an island or floodplain, put “LND” in the **Actual Stratum** box (**Site information**), a “U” in the correct **Life form** box, and zeros (0) in all three **Cover** boxes (**Site information**). Refer to *Nonaquatic subsampling area* for recording **Subsampling Area Information**. Refer to *No aquatic vegetation* for recording **Species information**. Treat temporarily dewatered aquatic sites the same as regular aquatic sites, except that the water depth will be zero (0.0).

d. Off-boat sampling. If a site must be sampled on foot or in a canoe, conduct the sampling as if from a regular boat in regards to the placement of the six subsampling areas and vegetation cover estimates.

e. Inaccessible sites. If a site cannot be accessed, put “NOSMPL” in the **Species Code** box, and “1” in each of the six **R** boxes. Leave the rest of the boxes in the **Subsampling area**

information and **Species information** sections blank. Record the UTM coordinates of the boat stop location and the reason for not sampling in the **Comments** field.

f. Unable to rake. If physical conditions such as depth and current velocity preclude raking the river bottom for aquatic vegetation, the site should be treated the same as *Inaccessible sites* described above. However, the same physical conditions often preclude the existence of aquatic vegetation. The investigators are encouraged to make a careful assessment of the probability of aquatic vegetation growth under the conditions. If the probability is less than 5%, the site should be treated the same as *No aquatic vegetation* described above. Record the reason for not raking in the **Comments** field.

2. Taxonomy and Species Codes

Whenever possible, identify plants to the species level using the following taxonomic keys: Fassett (1957), Winterringer and Lopinot (1966), Voss (1972, 1985), Crow and Hellquist (1982, 1983, 1985), Hellquist and Crow (1980, 1982, 1984), and Gleason and Cronquist (1991). Most of the aquatic species found in the five survey areas are listed in Appendix A. Species codes not available in Appendix A can usually be found in the U.S. Department of Agriculture’s plant database (available on the Internet at <http://plants.usda.gov/plants/>). If the genus of a plant is known and species unknown, make up a new code with the first four letters of the genus name and a question mark (?) inserted between the second and third letters—for example, “PO?TA” for *Potamogeton* sp. and “MY?RI” for *Myriophyllum* sp. (Using a taxon suggested by the vegetation specialist is preferable.) Flag in the QE code (Table 4) the uncertainty of identification. If the genus is unknown, make a unique code (e.g., “UNKN01”, “UNKN02”, etc.) for each unknown taxon. Collect two or more voucher specimens for each uncertainly identified or unknown plant for follow-up identification in the office or by external taxonomists. Upon positive identification, uncertain and unknown species codes will be confirmed or replaced with new codes.

The field vegetation specialists are obligated to confirm every species code additional to Appendix A with the vegetation specialist at the UMESC. The species code database will be maintained at UMESC and the most recent list sent to field station vegetation specialists after revisions have been made.

3. Sampling Efforts and Schedule

Five hundred and fifty (550) sites will be investigated in each of the five river reaches in 1998 between June 15 and August 15. The number of sites in each stratum and timetable should be regarded as an initial year trial. Adjustments in future years are expected.

4. Acknowledgments

In the process of formulating the sampling procedures, we had many rounds of discussions with T. Blackburn, T. Cook, J. Nelson, and S. Lubinski. T. Blackburn developed the initial draft of the data sheet (Appendix B). J. Rogala spent many hours on the project and produced the stratified aquatic areas GIS maps and generated randomized sites for the five river reaches being monitored. Drs S. Nichols, J. Madsen, and D. Soballe advised on the general approaches of aquatic vegetation sampling. W. Popp, T. Dukerschein, and D. Blodgett advised on the stratification of aquatic areas and the allocation of sampling efforts in the respective river reaches. We gratefully acknowledge their assistance.

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Appendix A

Species codes for the Long Term Resource Monitoring Program Aquatic Vegetation Stratified Random Sampling

Species code	Scientific name	Common name	Life form
ALGA	Any species of filamentous alga (including <i>Spyrogyra</i> , <i>Cladophora</i> , <i>Hydrodictyon</i>)		A
AZME	<i>A. mexicana</i>		N
CEDE4	<i>Ceratophyllum demersum</i>	coontail	S
CH?AR	<i>Chara</i> sp.	a chara species	S
ELCA7	<i>Elodea canadensis</i>	Canadian waterweed	S
ELNU2	<i>E. nuttalli</i>	western waterweed	S
LELE2	<i>Leersia lenticularis</i>	cut grass	E
LEMI3	<i>Lemna minor</i>	small or common duckweed	N
LEMN	Species within the Lemnaceae	duckweeds	N
LEOR	<i>L. oryzoides</i>	rice-cut grass	E
LETR	<i>L. trisulca</i>	star duckweed	N
LEVI2	<i>L. virginica</i>	white grass	E
LUDE4	<i>Ludwigia decurrens</i>	primrose-willow	F
LWVORT	<i>Riccia</i> sp., <i>Ricciocarpus</i> sp.	a liverwort species	N
MYSI	<i>Myriophyllum sibiricum</i>	northern watermilfoil	S
MYS2	<i>M. spicatum</i>	Eurasian watermilfoil	S
NAFL	<i>Najas flexilis</i>	slender naiad	S
NAGR	<i>N. gracillima</i>	slender waternymph	S
NAGU	<i>N. guadalupensis</i>	southern waternymph	S
NAMI	<i>N. minor</i>	brittle waternymph	S
NELU	<i>Nelumbo lutea</i>	American lotus	F
NI?TE	<i>Nitella</i> sp.	a nitella species	S
NLPW	<i>Potamogeton foliosus</i> , <i>P. pusillus</i> , or other unidentified narrow-leaved pondweeds	narrow-leaved pondweeds	S
NOAQVG	No aquatic vegetation		
NOSMPL	Site not sampled		
NULU	<i>Nuphar variegata</i> (also known as <i>N. luteum</i>)	yellow pond-lily	F
NYTU	<i>Nymphaea tuberosa</i> (aka <i>N. odorata</i>)	American white waterlily	F
PHAR3	<i>Phalaris arundinaceae</i>	reed canary grass	E
POAL8	<i>Potamogeton alpinus</i>	red or alpine pondweed	S
POCO14	<i>Pontedaria cordata</i>	pickerelweed	E
POCR3	<i>Potamogeton crispus</i>	curly-leaf pondweed	S
POEP2	<i>P. epihydrus</i>	ribbon-leaf pondweed	S
POFO3	<i>P. foliosus</i>	leafy pondweed	S
POGR8	<i>P. gramineus</i>	variable pondweed	S
POIL	<i>P. illinoensis</i>	Illinois pondweed	S
PONO2	<i>P. nodosus</i> (aka <i>P. americanus</i>)	American pondweed	S
POPE6	<i>P. pectinatus</i>	sago pondweed	S
POPR5	<i>P. praelongus</i>	white-stemmed pondweed	S
POPU7	<i>P. pusillus</i>	small pondweed	S
PORI2	<i>P. richardsonii</i>	Richardson's pondweed	S
POZO	<i>P. zosteriformis</i>	flat-stem pondweed	S
RAFL	<i>Ranunculus flabellaris</i>	yellow water buttercup	S
RALO2	<i>R. longirostris</i> (including <i>R. trichophylus</i>)	rigid white water buttercup	S

Species code	Scientific name	Common name	Life form
SALA2	<i>Sagittaria latifolia</i>	broad-leaved arrowhead	E
SARI	<i>S. rigida</i>	stiff arrowhead	E
SCAC	<i>Scirpus acutus</i>	hardstem bulrush	E
SCFL	<i>S. fluviatilis</i>	river bulrush	E
SCVA	<i>S. validus</i>	softstem bulrush	E
SPEU	<i>Sparganium eurycarpum</i>	giant bur-reed	E
SPPO	<i>Spirodela polyrhiza</i>	greater duckweed	N
TYAN	<i>Typha angustifolia</i>	narrow-leaved cattail	E
TYLA	<i>T. latifolia</i>	broad-leaved cattail	E
UNKN01		unknown specimen number 1	
UNKN02		unknown specimen number 2	
UTMA	<i>Utricularia vulgaris</i> (aka <i>U. macrorhiza</i>)	common bladderwort	S
VAAM3	<i>Vallisneria americana</i>	wild celery	S
WOCO	<i>Wolffia columbiana</i>	Columbian watermeal	N
ZAPA	<i>Zannichellia palustris</i>	horned pondweed	S
ZIAQ	<i>Zizania aquatica</i>	wild rice	E
ZODU	<i>Zosterella dubia</i> (aka <i>Heteranthera dubia</i>)	water stargrass	S

Appendix B

Aquatic Vegetation Stratified Random Sampling Data Sheet

Aquatic Vegetation Stratified Random Sampling Data Sheet

Long Term Resource Monitoring Program
 Upper Midwest Environmental Sciences Center
 2630 Fanta Reed Road, La Crosse, WI 54603

Bar code

Page ___ of ___

Site information		Location name: _____		# Rows <input type="text"/>	
Field station	Project code	Date	Crew leader code	Recorder code	Detritus Substrate
<input type="text"/>	M <input type="text"/>	M M D D Y Y Y Y	<input type="text"/>	<input type="text"/>	<input type="text"/>
Site ID	Map stratum	Actual stratum	River mile	Life form	Cover
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	S F E A N U N F E	<input type="text"/>

1st UTM Coordinates		
Easting	<input type="text"/>	<input type="text"/>
Northing	<input type="text"/>	<input type="text"/>
Zone	Accuracy	Method
<input type="text"/>	<input type="text"/>	<input type="text"/>
2nd UTM Coordinates		
Easting	<input type="text"/>	<input type="text"/>
Northing	<input type="text"/>	<input type="text"/>
	Accuracy	<input type="text"/>

Subsampling area information <table style="width: 100%; text-align: center;"> <tr> <td></td> <td>1</td> <td>2</td> <td>3</td> <td>4</td> <td>5</td> <td>6</td> </tr> <tr> <td>Habitat QA</td> <td><input type="text"/></td> <td><input type="text"/></td> <td><input type="text"/></td> <td><input type="text"/></td> <td><input type="text"/></td> <td><input type="text"/></td> </tr> <tr> <td>Water depth (m)</td> <td><input type="text"/></td> <td><input type="text"/></td> <td><input type="text"/></td> <td><input type="text"/></td> <td><input type="text"/></td> <td><input type="text"/></td> </tr> <tr> <td>Plant density (0-5)</td> <td><input type="text"/></td> <td><input type="text"/></td> <td><input type="text"/></td> <td><input type="text"/></td> <td><input type="text"/></td> <td><input type="text"/></td> </tr> </table>		1	2	3	4	5	6	Habitat QA	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	Water depth (m)	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	Plant density (0-5)	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	Reminder Information <table style="width: 100%; font-size: small;"> <tr> <td>Method: D=D GPS G=GPS F=D FOM X=FOM B=Base Map O=Other</td> <td>Detritus: 1=Present blank=Absent</td> <td>Habitat QA: blank=Aquatic T=Terrestrial</td> <td>V: 1=Present blank=None</td> <td>Cover: 0=None 1=1-20% 2=21-40% 3=41-60% 4=61-80% 5=81-100%</td> </tr> <tr> <td>Stratum: BWC MCB BWI SC IMP TDL LND</td> <td>Plant density: 0=None 1=1-20% 2=21-40% 3=41-60% 4=61-80% 5=81-100%</td> <td>R: blank=None 1=1-20%, F, E 2=21-40% 3=41-60% 4=61-80% 5=81-100%</td> <td>QE Code: blank(0)=as defined 1=Hybrid 2=Species suspected 3=Genus suspected 4=Unknown</td> <td>Voucher: blank=Not taken 1=Taken, not sent 2=Taken, sent</td> </tr> <tr> <td>Substrate: 1=Silt/Clay 2=Silt w/ Sand 3=Sand w/ Silt 4=Hard Clay 5=Gravel/Rock 6=Sand</td> <td>Life form: U=Unvegetated S=Submergent F=Floating E=Emergent A=Algae N=Nonrooted float</td> <td colspan="3"></td> </tr> </table>	Method: D=D GPS G=GPS F=D FOM X=FOM B=Base Map O=Other	Detritus: 1=Present blank=Absent	Habitat QA: blank=Aquatic T=Terrestrial	V: 1=Present blank=None	Cover: 0=None 1=1-20% 2=21-40% 3=41-60% 4=61-80% 5=81-100%	Stratum: BWC MCB BWI SC IMP TDL LND	Plant density: 0=None 1=1-20% 2=21-40% 3=41-60% 4=61-80% 5=81-100%	R: blank=None 1=1-20%, F, E 2=21-40% 3=41-60% 4=61-80% 5=81-100%	QE Code: blank(0)=as defined 1=Hybrid 2=Species suspected 3=Genus suspected 4=Unknown	Voucher: blank=Not taken 1=Taken, not sent 2=Taken, sent	Substrate: 1=Silt/Clay 2=Silt w/ Sand 3=Sand w/ Silt 4=Hard Clay 5=Gravel/Rock 6=Sand	Life form: U=Unvegetated S=Submergent F=Floating E=Emergent A=Algae N=Nonrooted float			
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Habitat QA	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>																																						
Water depth (m)	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>																																						
Plant density (0-5)	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>																																						
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Row	Species code	Subsampling areas						Additional species	Cover	QE	Voucher						
		1		2		3						4		5		6	
		V	R	V	R	V	R	V	R	V	R	V	R				
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Comments (limit to 80 characters): _____

Appendix C

Explanations of Fields on the Aquatic Vegetation Stratified Random Sampling Data Sheet

Data sheet field	Explanation
Bar code	Each data sheet requires a bar code sticker that uniquely identifies each sheet.
Site information	
Location name	A field used solely by the resident vegetation specialist. This information is not entered into the official database.
# Rows	The total number of detail records (rows) in Species information that contain data on this particular data sheet.
Field station	The number assigned to each field station. 1 = Pool 4 2 = Pool 8 3 = Pool 13 4 = Pool 26 5 = Open River (not participating in the aquatic vegetation stratified random sampling) 6 = La Grange Pool
Project code	The project code is “M-98A” (code identifies that the project is a Long Term Resource Monitoring Program [LTRMP] project initiated in 1998).
Date	The month (MM), day (DD), and year (YYYY) on which a site was sampled. Zeros (0) must be written in so that all boxes are filled.
Crew leader code	A number that uniquely identifies the individual responsible for certifying that the samples and the data on the form were collected in compliance with current LTRMP procedures and are, to the best of their knowledge, complete and free of errors. This code underscores the importance of LTRMP methods and is one of the chain-of-custody procedures.
Recorder code	A number that uniquely identifies the individual recording the data.
Detritus	A “1” identifies the presence of coarse organic (usually refractory) material in the sediment. The default is a blank space.
Substrate	A qualitative code assigned to substrate type following tactile and visual examination of sediment at the six subsampling areas. Substrate is rated on on a scale of 1 to 6 according to Table 5.
Site ID	Three-digit number assigned to uniquely identify each site. Accuracy of the Site ID is critical because it links field data to be collected with data already available in the database (such as Universal Transverse Mercator [UTM] coordinates and map stratum). Zeros must be written so that all boxes are filled.
Map stratum	The habitat stratum of the site according to the Aquatic Area Stratum geographic information system (GIS) coverage. The information can be copied from the materials provided by the Upper Midwest Environmental Sciences Center (UMESC). The letter codes are listed in Table 1.
Actual stratum	If the habitat stratum in the field differs from that identified as the Map Stratum, then the Actual Habitat Stratum is recorded on the data sheet, using the same coding system listed in Table 1 and an additional stratum code of “LND” for dry land. Otherwise, if the habitat is correct, leave the field blank (default).

Data sheet field	Explanation
River mile	An alphanumeric code that approximates the location of the site in reference to the Navigation River Miles used by the U.S. Army Corps of Engineers. A prefix “M” indicates the Mississippi River and an “I” indicates the Illinois River. Round down to the nearest whole number.
Life form	This letter code identifies each type of life form encountered at a site. <i>Nelumbo</i> and <i>Ludwigia</i> spp. are considered floating-leaved species. <i>Chara</i> and <i>Nitella</i> are considered submersed species (Appendix A). S = submersed F = rooted floating-leaved E = emergent A = filamentous algae N = nonrooted floating-leaved U = unvegetated
Cover	N = The percent cover of all nonrooted floating-leaved species combined at the site (a 2-m wide ring) using the ratings described in Table 2. F = The percent cover of all rooted floating-leaved species combined at the site (a 2-m wide ring) using the ratings described in Table 2. E = The percent cover of all emergent species combined at the site (a 2-m wide ring) using the ratings described in Table 2.
1st UTM Coordinates	(Recorded when first arriving at the site.)
Easting	The UTM Easting coordinate for the site. The coordinate is recorded from the GPS unit.
Northing	The UTM Northing coordinate for the site. The coordinate is recorded from the GPS unit.
Zone	The number that identifies the correct grid from which the UTM coordinates were taken. All the coordinates provided by UMESC are Zone 15 readings, even though part of the La Grange Pool is Zone 16.
Accuracy	The GPS measure of possible error related to the geometry of satellites. This number value is recorded when the UTM coordinates are recorded. The method field indicates whether the scale is PDOP (Percent dilution of precision) or FOM (Figure of Merit).
Method	A code that identifies the method used to locate the site and the type of accuracy measurement used by the equipment. B = Base Map D = GPS with differential corrections and PDOP G = GPS without differential corrections and PDOP F = GPS with differential corrections and FOM X = GPS without differential corrections and FOM O = other (explain in the Comments field)
2nd UTM Coordinates	(Recorded after samples are taken and before leaving the site.)
Easting	The UTM Easting coordinate for the site. The coordinate is recorded from the GPS unit.
Northing	The UTM Northing coordinate for the site. The coordinate is recorded from the GPS unit.
Accuracy	The GPS measure of possible error related to the geometry of satellites. This number value is recorded when the UTM coordinates are recorded. The method field indicates whether the scale is PDOP (Percent dilution of precision) or FOM (Figure of Merit).

Data sheet field	Explanation
Subsampling area information	
Habitat QA	A code denoting whether a subsampling area was on land or water. “T” = Terrestrial or nonaquatic blank (default) = water or aquatic habitat. If “T” is used, then the Water depth (0.0) and plant density (0) should be zero.
Water depth	Depth of each subsampling area recorded to a tenth of a meter.
Plant density	A rating assigned to the total amount of submersed aquatic vegetation retrieved on a rake drag. The 0–5 rating scale is based on the percentage of the rake teeth covered (in 20% increments) by submersed plants and macro algae but not including filamentous algae. Floating-leaved and emergent plants are excluded (Table 3). It is recorded separately for the six subsampling areas.
Reminder Information	(Abbreviated glossary of codes used in the data fields.)
Species information	
Species code	The alphanumeric code (up to six digits) for a species based on the U.S. Department of Agriculture plant database (http://www.plants.usda.gov/plants/). Most of the species codes are available in Appendix A. If the genus of a plant is known and species unknown, then a new code is made up with the first four letters of the genus name and a ‘?’ (question mark) inserted between the second and third letters. For examples, “PO?TA” for <i>Potamogeton</i> sp., and “MY?RI” for <i>Myriophyllum</i> sp. Using the species code of a suspected species is preferable, however, when based on the suggestion of the vegetation specialist. The confidence level of identification will be reflected in the QE code.
V	A code for presence/absence information of species. A “1” is recorded for a species that is found during visual observation in the subsampling area, otherwise the box is left blank (default). For nonrooted floating-leaved species, the V box is always left blank.
R	An integer (1–5) for plant density measurement rated according to Table 3 for each submersed species found in the rake sample of vegetation. A floating-leaved or emergent species receives a “1” regardless of its plant density as long as the species was collected in the rake sample of vegetation. Leave blank (default) for species not sampled by the rake. For nonrooted floating-leaved species, the R box is always left blank.
Additional species	A “1” is recorded for each species that is present at a site (the 2-m wide ring) but not in any of the six subsampling areas. Otherwise the box is left blank (default). A “1” is also used to indicate which species of nonrooted floating-leaved plants are present in the site (which are not recorded by subsampling area).
Cover	The visually estimated percent cover, rated as in Table 3, for each rooted floating-leaved and emergent species by site (not by subsampling area).
QE	A number (0–4) used to flag the taxonomic identification uncertainty (Table 4).
Voucher	A code denoting whether a voucher specimen was taken of the species. Blank = no voucher taken 1 = voucher taken, and not sent out for identification 2 = voucher taken, and sent out for identification
Comments	A field for recording any additional observations. Limit comments to 80 characters.

The Long Term Resource Monitoring Program (LTRMP) for the Upper Mississippi River System was authorized under the Water Resources Development Act of 1986 as an element of the Environmental Management Program. The mission of the LTRMP is to provide river managers with information for maintaining the Upper Mississippi River System as a sustainable large river ecosystem given its multiple-use character. The LTRMP is a cooperative effort by the U.S. Geological Survey, the U.S. Army Corps of Engineers, and the States of Illinois, Iowa, Minnesota, Missouri, and Wisconsin.

