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1994 Annual Status Report

A Summary of Aquatic Vegetation Monitoring at Selected Locations in Pools 4, 8, 13, and 26 and La Grange Pool of the Upper Mississippi River System

July 1998

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A Summary of Aquatic Vegetation Monitoring at Selected Locations in Pools 4, 8, 13, and 26 and La Grange Pool of the Upper Mississippi River System

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Contents

Tables

Figures

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 Environmental Management Technical Center, 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 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.

This report presents the results of aquatic vegetation surveys conducted by field station personnel under direction of the Environmental Management Technical Center (EMTC) during the 1994 growing season. Selected areas in Pools 4, 8, 13, and 26 of the Upper Mississippi River and La Grange Pool on the Illinois River were surveyed. This report satisfies, for 1994, Task 2.2.4.6, *Evaluate and Summarize Annual Present-Day Results* under Goal 2, *Monitor Resource Change* of the Operating Plan (U.S. Fish and Wildlife Service 1993). The purpose of this report is to provide a summary of data regarding the distribution and abundance of submersed aquatic vegetation collected from the field stations for 1994. This report was developed with funding provided by the Long Term Resource Monitoring Program.

1994 Annual Status Report
A Summary of Aquatic Vegetation Monitoring at Selected Locations in Pools 4, 8, 13, and 26 and La Grange Pool of the Upper Mississippi River System

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Sara Rogers, Theresa Blackburn, Heidi Langrehr, John Nelson, and Andrew Spink

Abstract

Aquatic vegetation of the Upper Mississippi River System is monitored as part of the Long Term Resource Monitoring Program. This report summarizes the 1994 effort of monitoring submersed aquatic vegetation (SAV) along transects permanently established in vegetated locations within four navigation pools of the Upper Mississippi River and one navigation pool of the Illinois River. A total of 17 species of SAV were found along transects during the 1994 season. Several additional species were found during informal surveys. More species of submersed aquatic macrophytes were found along transects in lower Pool 4 than in any other reach. Across all pools, sago pondweed (*Potamogeton pectinatus*) was the species most frequently found. Several species of SAV were seasonally dynamic at the transect locations, with changes in frequencies especially common among sago pondweed and curly pondweeds (*P. crispus*). The proportion of sites with SAV decreased significantly in Pool 4, increased in Pool 13, but did not change within other pools. Pool 26, however, was not sampled during the summer sampling season because the transect locations were dewatered to promote growth of annual plant species. Mean depths of sites with SAV ranged from 0.4 m in Pool 26 during spring sampling to 1.5 m in La Grange Pool during spring and summer sampling.

Introduction

Aquatic vegetation of the Upper Mississippi River System (UMRS) is monitored as part of the Long Term Resource Monitoring Program (LTRMP; U.S. Fish and Wildlife Service 1993). The trends in the status of the vegetation are reported in annual status reports, and the data provides a baseline of information to which future observations can be compared and to help evaluate the trends. In combination with other monitoring conducted for the LTRMP, the overall mission is to provide decision makers with scientifically sound and useful information for effective river management. The purpose of this report is to document transect sampling at selected locations in 1994. This report also provides an initial indication of features of submersed aquatic vegetation (SAV) that can be compared with future monitoring efforts.

Historically, submersed macrophytes have played an important role in the UMRS ecosystem. These plant communities provide food for migratory waterfowl (Korschgen et al. 1988) and improvement to the water quality by stabilizing sediments, filtering out suspended materials, and taking up nutrients that can otherwise support nuisance algal growth (Barko et al. 1991). Submersed aquatic macrophytes also provide nursery areas for young fish, serve as spawning habitat, and support invertebrate populations by providing structure and surface area (Engel 1990).

We have been unable to understand or anticipate many changes in the distribution of SAV within the UMRS, in part because few studies have adequately addressed the questions. Biologists, however, have high interest and concern for this important component, especially following the mid- to late-1980s when widespread and sudden declines in the abundance of wild celery (*Vallisneria americana*) from Pools 5 to 19 were observed (E. Nelson and C. Cheap, U.S. Fish and Wildlife Service, Winona, Minnesota, unpublished data; C. Korschgen, Northern Prairie Wildlife Research Center, Jamestown, North Dakota, unpublished data; J. Lyons, U.S. Fish and Wildlife Service, McGregor, Iowa, personal communication; R. Anderson, Western Illinois University, Macomb, personal communication; W. Thrune, U.S. Fish and Wildlife Service, La Crosse, Wisconsin, personal communication). Among those especially concerned were biologists familiar with the history of the Illinois River. Submersed aquatic vegetation in much of the river rapidly disappeared during the 1950s and only remnant populations now survive (Talkington and Semonin 1991).

Long-term monitoring can play a substantial role in increasing our understanding of trends in this resource by addressing the following questions:

(1) How temporally and spatially dynamic is SAV in the UMRS?
(2) Are we observing short-term fluctuations in one or more species or is SAV becoming irreparably lost?
(3) Based on patterns observed, what factors most likely contribute to the observed changes?

The 1994 growing season was the fourth year we conducted field surveys for the LTRMP specifically to collect data on the distribution and relative abundance of SAV throughout each resource trend analysis pool. The objectives for monitoring aquatic vegetation in the UMRS are to

(1) document the presence and distribution of SAV within selected locations of the UMRS,
(2) compare current distribution of SAV with past or future distribution, and
(3) identify environmental factors potentially responsible for both long- and short-term changes in the distribution of SAV.

This report partially fulfills the first and second objectives. Fulfillment of the second objective would be accomplished over the course of the LTRMP beginning in the second year, gaining more significance with each subsequent year. Fulfillment of the third objective requires research in addition to monitoring. The effect of environment on abundance and distribution requires focused initiatives to explore plant response to key factors, singly or in combination with one another.

Study Areas

The LTRMP vegetation study areas include river reaches within the UMRS, four on the Mississippi River and one on the Illinois River (Figure 1). Study areas are referred to herein by the navigation pool designations according to the U.S. Army Corps of Engineers lock and dam system. Mississippi River navigation pools studied are Pool 4 (Mississippi River mile [M] 752 to 797), Pool 8 (M679 to 703), Pool 13 (M523 to 557), Pool 26 (M202 to 242), and La Grange Pool of the Illinois River (Illinois River mile [I] 80 to 158). River miles for the Mississippi River are measured from the confluence of the Mississippi and Ohio Rivers and the Illinois River from the confluence of the Mississippi and Illinois Rivers.

These study pools were chosen, in part, to reflect important differences in geomorphology, floodplain land use, and water level management strategies that exist with the UMRS. Qualitatively, Pools 4, 8, and 13 are geomorphically complex with numerous backwaters and richly braided side channels and contain the highest values of total cover for aquatic vegetation (Peck and Smart 1986). Relatively high percentages of the total aquatic area in these study reaches are composed of contiguous (to the main channel) backwaters, and relatively low percentages are composed of main channel (Table 1). Pool 26, in a lower impounded reach, is characterized by relatively low percentages of open water and aquatic vegetation and a high percentage of agriculture in the floodplain. A low percentage of the total aquatic area is composed of contiguous backwaters, and commensurately, a high percentage is composed of the main channel. La Grange Pool is similar to Pool 26 in floodplain composition, but is similar to Pools 8 and 13 in composition of the aquatic area. In fact, La Grange Pool has the greatest percentage (52.2%) of contiguous backwaters among the LTRMP study areas, but aquatic vegetation is not present in most of them.

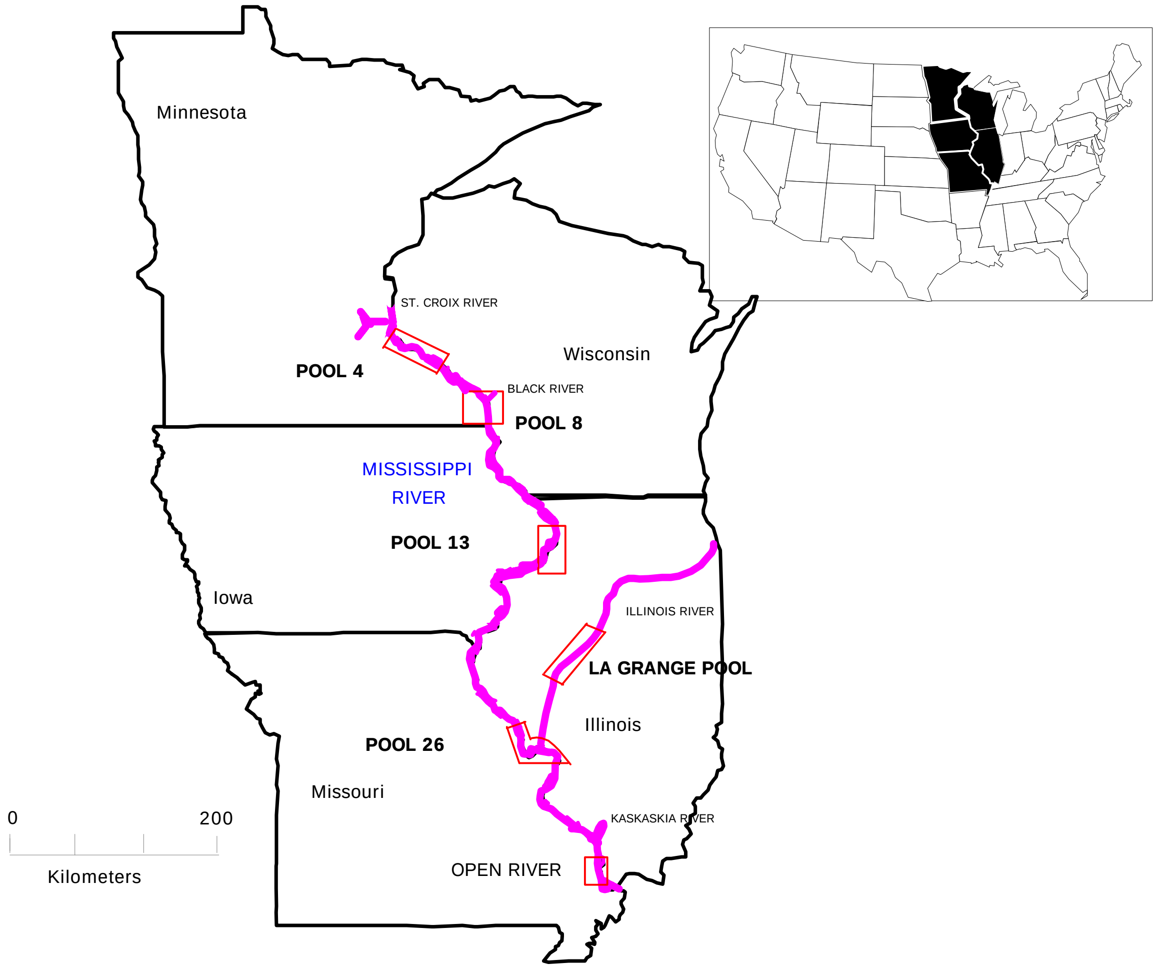

Figure 1. Main stem of the Upper Mississippi River System with the study reaches used in the Long Term Resource Monitoring Program submersed vegetation surveys of 1994 (Pools 4, 8, 13, and 26 and La Grange Pool). The Open River reach was not selected as a study site because of the lack of habitat for submersed vegetation.

During 1994, we monitored vegetation in Pools 4, 8, 13, and 26 of the Mississippi River, and in La Grange Pool of the Illinois River (Figure 1). Permanent transects, most of which were established in 1991, were monitored at several locations throughout each pool where vegetation has grown for most of the postimpoundment period.

In Pool 4, we sampled SAV at 11 backwater locations, of which 10 were monitored for the fourth year (Figure 2). The transect locations were distributed in both the upper and lower portions of the pool, but not in Lake Pepin. Upper pool locations included Dead Slough Lake, Goose Lake, Upper Mud Lake (added in 1993), Mud Lake, and Bay City Flats. Lower pool locations (below Lake Pepin) included Big Lake, Robinson Lake, Peterson Lake, and Lower Peterson Lake. We also monitored Rice Lake and Big Lake Bay, part of the Big Lake area (Appendix A). All locations except Upper Mud Lake are contiguous with the main channel of the river.

Table 1. Key features of the floodplain and aquatic area compositions of the five Mississippi and Illinois River study reaches monitored for vegetation in 1994 for the Long Term Resource Monitoring Program.[a]

		Floodplain composition (%)[b]			Aquatic area composition (%)[c]	
Study reach	**Floodplain area (ha)**	**Open water[d]**	**Aquatic vegetation[e]**	**Agriculture**	**Contiguous backwater**	**Main channel**
Pool 4	28,358	50.5	10.0	12.1	21.3	10.5
Pool 8	19,068	40.1	14.4	0.9	30.6	14.2
Pool 13	34,528	29.7	8.6	27.9	28.5	24.7
Pool 26	51,688	13.4	1.4	65.4	17.3	54.4
La Grange Pool, Illinois River	89,554	15.7	2.2	59.6	52.2	21.3

[a] Table from Gutreuter et al. (1997).

[b] Data on floodplain composition are from Laustrup and Lowenberg (1994).

[c] Aquatic area is that portion of the floodplain that is inundated at normal water elevations. Data on the composition of aquatic areas are from the Long Term Resource Monitoring Program aquatic areas spatial database.

[d] Submersed vegetation, when detectable, was merged with the open water class. Main channel includes area in the navigation channel and main channel border areas.

[e] Aquatic vegetation includes rooted floating aquatics and emergents only.

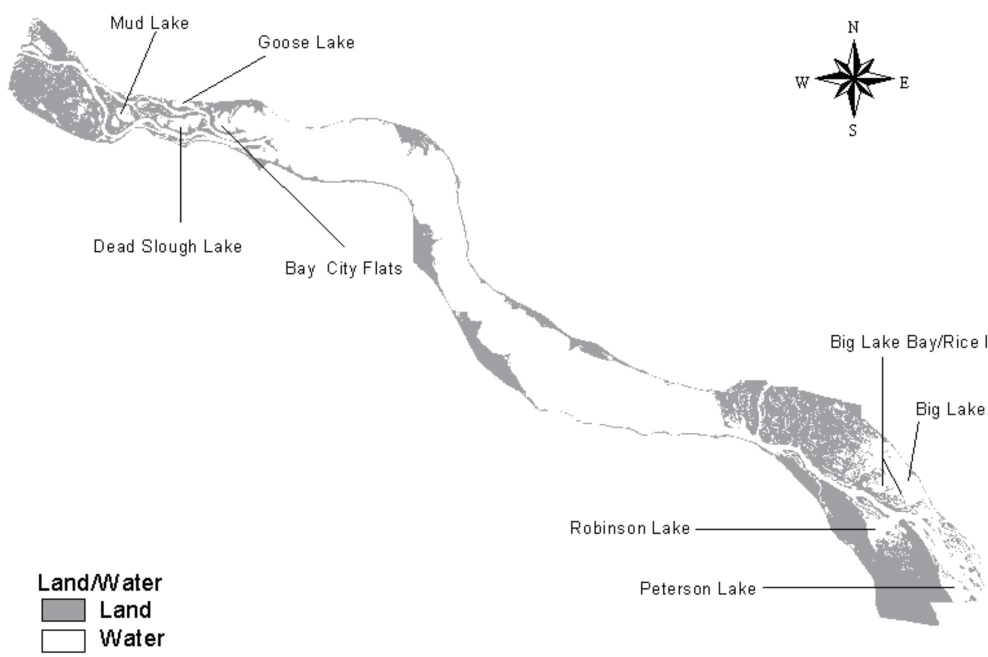

Figure 2. Pool 4, Upper Mississippi River, transect locations for the 1994 monitoring of submersed aquatic vegetation for the Long Term Resource Monitoring Program.

In Pool 8, we sampled SAV for the fourth year at five locations including Target Lake, Lawrence Lake, a backwater area near Goose Island, Shady Maple, and the interior of Horseshoe Island (Figure 3). A small isolated backwater near Stoddard, Wisconsin, added in 1992, and two locations added in 1993 (Blue Lake and Pool 8 Islands) were also monitored (Appendix A).

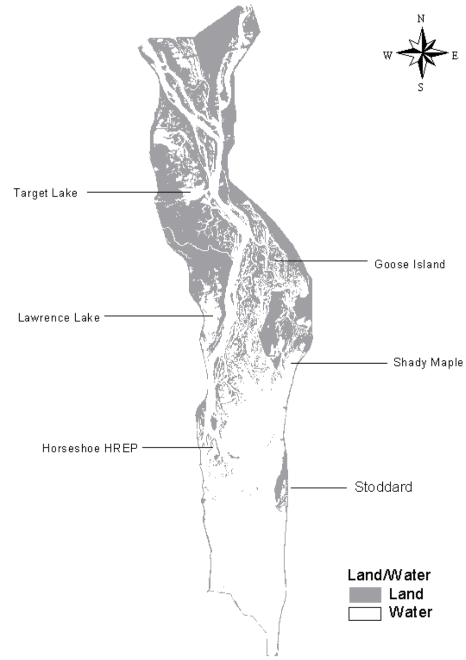

Figure 3. Pool 8, Upper Mississippi River, transect locations for the 1994 monitoring of submersed aquatic vegetation for the Long Term Resource Monitoring Program.

In Pool 13, we sampled SAV at seven locations (Figure 4). All locations were selected in 1991 and were distributed primarily in the middle and lower portions of the pool. Locations included Brown's Lake, Savanna Bay, Spring Lake, Pomme de Terre, Potter's Marsh, Lower Johnson Creek, and an aquatic area along the Johnson Creek Levee (Appendix A).

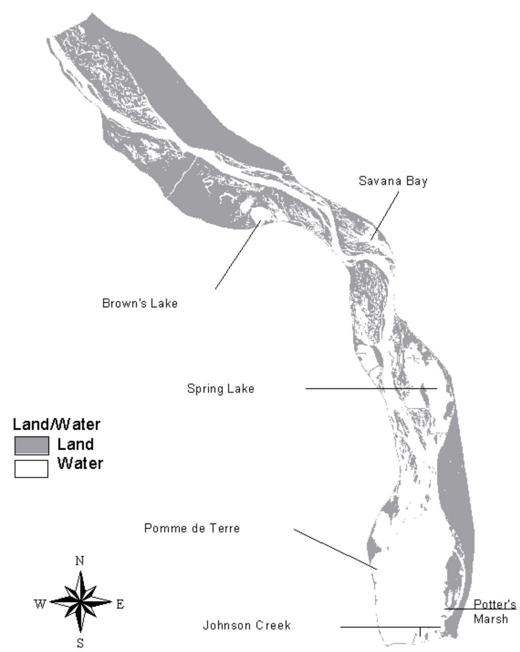

Figure 4. Pool 13, Upper Mississippi River, transect locations for the 1994 monitoring of submersed aquatic vegetation for the Long Term Resource Monitoring Program.

In Pool 26, we sampled SAV for the fourth year at three backwater locations (Figure 5). Transect locations were distributed in Swan Lake, Stump Lake, and in the Calhoun Point area, which consists of several backwater lakes, sloughs, and wet-weather ponds (Appendix A). Both Stump Lake and Calhoun Point areas are managed by the Illinois Department of Natural Resources, which conducts water drainage with control structures and pumping for waterf owl management. Fuller Lake, located at the northern end of Swan Lake, was monitored for the third year.

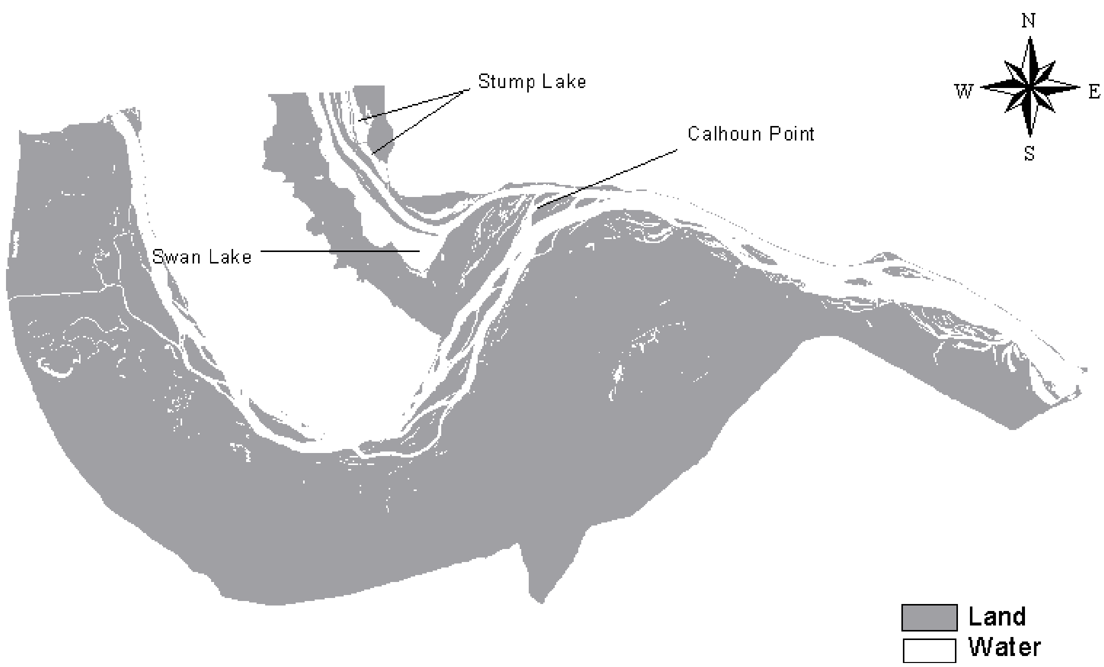

Figure 5. Pool 26, Upper Mississippi River, transect locations for the 1994 monitoring of submersed aquatic vegetation for the Long Term Resource Monitoring Program.

In La Grange Pool, we sampled SAV for the fourth year at three backwater locations including Point Lake, Spring Lake, and Banner Marsh (Bulrush Pond; Figure 6). The three backwaters are among the few locations where submersed vegetation can still be found within this river reach. These backwaters are classified as isolated and are protected from the main stem of the Illinois River by agricultural levees. However, Point Lake often receives overflow water from the main channel of the Illinois River. Banner Marsh and Spring Lake are actively managed for fishing and are completely isolated. A fourth location added in 1992, a channel border location by Grape Island, was also monitored.

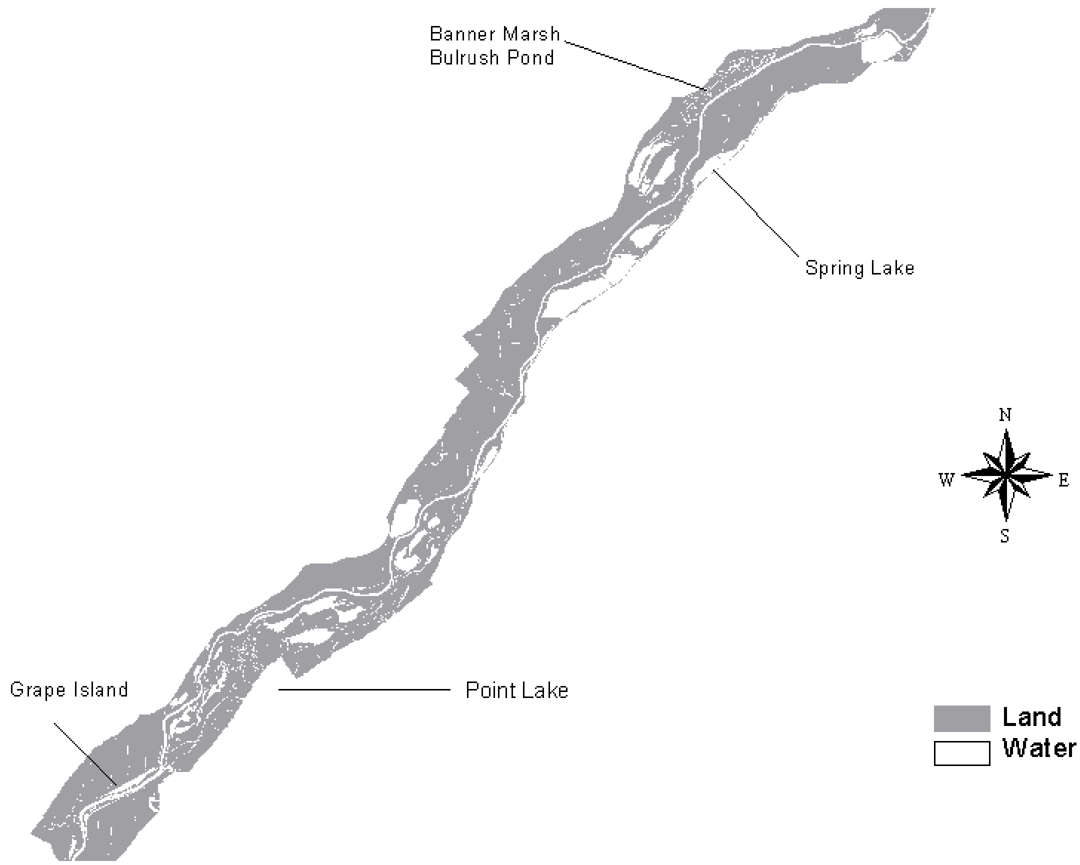

Figure 6. La Grange Pool, Illinois River, transect locations for the 1994 monitoring of submersed aquatic vegetation for the Long Term Resource Monitoring Program.

Methods

Transect Sampling

We positioned transects at regular intervals, from 50 to 200 m apart depending on the size of the area, and perpendicular to shorelines. In some large backwaters, we positioned transects in groups of three or four and placed several groups throughout the backwater. For example, Peterson Lake (Pool 4) has three transects in the upper portion, three transects in the middle portion, and four transects in the lower portion. We did no sampling in the areas between the groups.

Sampling was performed twice in most transect locations during the growing season to observe seasonal changes in species composition and relative frequencies. We were not able to conduct sampling during the summer period in Pool 26 because the transect locations were dewatered to promote annual vegetation growth for waterfowl. Sampling dates for each pool location and for each sampling period are listed in Appendix A.

Sampling along the transects was at regularly spaced intervals (sites) such that a grid-like sampling scheme of evenly distributed sampling sites was imposed over a backwater or vegetated area. Sites were generally 15 m apart in Pools 8, 13, and 26 and La Grange Pool, but were 30 m apart in Pool 4 because several of the backwaters were too large to sample at the 15-m interval. The sampling technique was modified from a technique used by Jessen and Lound (1962). At each site along a transect, a 2-m diameter sampling area was visualized and divided into three portions. We sampled plants once within each of the three portions by casting a long-handled thatching rake to the bottom and twisting it to snag plants—instead of dragging it as did Jessen and Lound. The thatching rake has a 15-inch head with 20, 5-inch-long teeth and sampled about 0.1 m^2. The submersed species on the rake were identified and recorded. After all three casts were made, each species recovered was assigned a rating from 1 to 4—instead of from 1 to 5 as did Jessen and Lound—based on the number of times each species appeared on the rake at each sampling site. A rating of 4 was assigned only if a species completely covered the rake teeth on all three casts.

If floating-leaved species were present, they were recorded and assigned a rating based on four cover classes (1–25%, 26–50%, 51–75%, and 76–100% visible vegetative cover within the sample area). Floating-leaved species are listed in the taxa list (Appendix B).

Fassett (1966) and Gleason and Cronquist (1991) were the primary keys used for plant identification. Scientific nomenclature and common names were taken from the U.S. Department of Agriculture PLANTS Database on the Internet (www.itis.usda.gov/). A list of common and scientific names of plants is in Table 2.

Table 2. Submersed and floating-leaved aquatic vegetation most likely to be found in the area covered by the Long Term Resource Monitoring Program, arranged alphabetically by common name within family.

Family	Common name[a,b]	Scientific name[a]
Ceratophyllaceae	Coon's tail, coontail	*Ceratophyllum demersum*
Characeae	Chara	*Chara* spp.
Characeae	Nitella	*Nitella* spp.
Haloragaceae	Shortspike watermilfoil, Northern watermilfoil[b]	*Myriophyllum sibiricum* Komarov
Haloragaceae	Spike watermilfoil Eurasian watermilfoil[b]	*Myriophyllum spicatum* L.
Hydrocharitaceae	Canadian waterweed	*Elodea canadensis*
Hydrocharitaceae	Western waterweed	*Elodea nuttallii* Planch.
Hydrocharitaceae	Wild celery[b], American eelgrass	*Vallisneria americana* Michx.
Lentibulariaceae	Common bladderwort	*Utricularia macrorhiza* Le Conte
Najadaceae	Brittle waternymph	*Najas minor* All.
Najadaceae	Nodding waternymph, bushy pondweed	*Najas flexilis* (Willd.) Rostk. & Schmidt
Najadaceae	Slender waternymph	*Najas gracillima* (A. Braun ex Engelm.) Magnus
Najadaceae	Southern waternymph	*Najas guadalupensis* (Spreng.) Magnus
Nymphaeaceae	American lotus	*Nelumbo lutea* (Willd.) Pers.
Nymphaeaceae	White waterlily	*Nymphaea odorata* Ait.
Nymphaeaceae	Yellow pondlily	*Nuphar lutea* (L.) Sm
Onagraceae	Floating primrosewillow	*Jussiaea repens* L.

Table 2. Continued.

Family	Common name[a,b]	Scientific name[a]
Pontederiaceae	Water stargrass, grassleaf mudplantain	*Heteranthera dubia* (Jacq.) MacM.
Potamogetonaceae	Curly pondweed, curlyleaf pondweed	*Potamogeton crispus* L.
Potamogetonaceae	Flatstem pondweed	*Potamogeton zosteriformis* Fern.
Potamogetonaceae	Illinois pondweed	*Potamogeton illinoisensis* Morong.
Potamogetonaceae	Leafy pondweed	*Potamogeton foliosus* Raf.
Potamogetonaceae	Longleaf pondweed, river pondweed[b]	*Potamogeton nodosus* Poir
Potamogetonaceae	Ribbonleaf pondweed	*Potamogeton epihydrus* Raf.
Potamogetonaceae	Richardson's pondweed	*Potamogeton richardsonii* (Benn.) Rydb.
Potamogetonaceae	Sago pondweed	*Potamogeton pectinatus* L.
Potamogetonaceae	Small pondweed	*Potamogeton pusillus* L.
Potamogetonaceae	Variableleaf pondweed	*Potamogeton gramineus* L.
Ranunculaceae	Longbeak buttercup	*Ranunculus longirostris* Godron.
Ranunculaceae	White water-crowfoot	*Ranunculus trichophyllus* Chauix.
Zannichelliaceae	Horned pondweed	*Zannichellia palustris* L.

[a] Scientific nomenclature and common names follow the U.S. Department of Agriculture PLANTS Database on the Internet (www.itis.usda.gov/).

[b] Common names most often used by Upper Mississippi River managers are also included if different from the common names listed in the U.S. Department of Agriculture PLANTS Database.

If a species was not collected during the 1991, 1992, or 1993 seasons, or could not be identified in the field, it was collected for reference and archiving. After drying, pressing, mounting, and labeling, specimens were stored at each field station. Two species of narrow-leaved pondweeds, small pondweed *(Potamogeton pusillus*) and leafy pondweed *(P. foliosus*), collectively referred to as small and leafy pondweeds were not distinguished from each other during field sampling and were also combined during analysis. Two species of macroalgae, chara (*Chara* spp.) and nitella (*Nitella* spp.), were included in the analyses with the vascular plants.

Environmental Factors

To acquire information on the relation between macrophyte presence and sediment texture, we recorded the sediment type most often found for each transect. The sediment types were cataloged subjectively into three categories (silt/clay, mostly silt with sand, mostly sand with silt) based on visual and tactile characteristics. Water depth was measured at each transect site with a depth pole.

Statistical Analysis

The frequency of a species is defined as $f_i = j_i/n$ where j_i = number of sample sites containing species *I* on at least one of the three rake casts, and *n* = total number of sample sites. Relative frequency of a species is defined as $rf_i = e_i/Ef$ where e_i = the number of rake grabs for species *I*, and Ef = number of rake grabs for all species. Species of floating-leaved vegetation were not included in the calculations because our primary concern with this sampling methodology is with changes in submersed vegetation. To test for significant changes in frequencies for a species between the two sampling periods, a value for Z was calculated using the following formula:

$$Z = p_1 - p_2 / \sqrt{pq[(1/n_1)+(1/n_2)]}$$

where

$p = j_1 + j_2/n_1 + n_2$;

$q = 1-p$;

p_1 and p_2 are the spring and summer proportions, respectively;

n_1 and n_2 equal the number of sampling sites, spring and summer, respectively;

j_1 and j_2 = number of times species *j* was found during the spring and summer sampling periods, respectively; and

Z-values were calculated for each species and for each location within a pool.

Chi-square tests were used to test for significant changes in the proportion of sites with SAV to the total number of sites sampled between sampling periods. All analysis was done using the Statistical Analysis System (SAS; SAS Institute, Inc., Cary, North Carolina).

Informal Surveys

To gain perspective on the distribution and composition of SAV in habitats other than transect locations, we surveyed many portions of each pool where vegetation was likely to be present. Aerial photographs and bathymetry maps were used to locate sites supporting or likely to support SAV. Pools 4, 8, and 13 were surveyed by boating along channel border habitats and through other areas most likely to support vegetation not covered by transect sampling. If vegetated areas or patches of vegetation were seen at or near the surface, samples were gathered with a rake. An estimate of abundance (rare, common, abundant) was given to each species. Species composition, approximate bed size, water depth, substrate type, and location of the vegetated areas and patches were recorded. Informal surveys were not conducted in Pool 26 or in La Grange Pool because previous surveys revealed that areas vegetated with SAV are generally scarce.

Results

All Pools

During 1994, we found 17 species of submersed aquatic plants along transects across study pools. One of the species found is a macroalgae, belonging to the muskgrass family (Characeae), which was included in the analysis. We also found four species of floating-leaved plants (Appendix B), which were not included in the analysis. The greatest number of submersed aquatic species found at transect sites during a sampling period was 14 (Pool 8 during spring sampling) and the fewest was one (Pool 26 during spring sampling). Sago pondweed was the only species present in every study pool during both spring and summer sampling, and tended to be present at frequencies generally above 10%, at least within the upper three pools. Coon's tail, curly pondweed, and Eurasian watermilfoil were also prevalent species, found in four of the five pools. For some unknown reason, Eurasian watermilfoil has not been found in Pool 26. Wild celery was most common in Pools 4 and 13, but was present at a frequency less than 1% in Pool 8 and was not found in Pool 26 or La Grange Pool. Many species remained at frequencies below 10% throughout all pools, especially in Pool 4 during summer where no species reached a frequency above 8% (Table 3).

Table 3. Frequencies and relative frequencies (%) of species in Pools 4, 8, 13, and 26 of the Upper Mississippi River and La Grange Pool (LG) of the Illinois River in 1994.[a]

	Spring										Summer									
	4		8		13		26		LG		4		8		13		26		LG	
Species	Freq	Rel Freq	Freq	Rel. Freq	Freq	Rel. Freq	Freq	Rel Freq	Freq	Rel Freq	Freq	Rel Freq	Freq	Rel Freq	Freq	Rel Freq	Freq	Rel Freq	Freq	Rel Freq
Canadian waterweed	1.5	3.1	5.2	3.1	2.9	3.9	–[b]	–	–	–	1.4	5.1	13	9	4.9	4.6	–	–	–	–
Chara	–	–	–	–	0.1	0.1	–	–	3.7	2.8	–	–	–	–	–	–	–	–	5.1	4.4
Common bladderwort	–	–	0.5	0.2	–	–	–	–	–	–	–	–	0.6	0.2	–	–	–	–	–	–
Coon's tail	2.6	5	35	30	6.1	7.6	–	–	21	15	5.6	17	44	42	11	8.2	–	–	22	19
Curly pondweed	14	40	28	26	6.9	6.1	–	–	40	26	3.5	12	9.6	6.3	14	9.6	–	–	6	2.6
Eurasian watermilfoil	0.9	2.6	22	20	5.4	7	–	–	62	49	2.4	7.1	27	21	7.7	7.8	–	–	63	64
Flatstem pondweed	–	–	4.9	2.9	0.3	0.2	–	–	–	–	–	–	0.8	0.5	0.1	<0.1	–	–	–	–
Horned pondweed	–	–	0.1	<0.1	–	–	–	–	0.5	0.3	0.1	0.2	–	–	–	–	–	–	1.4	1.4
Longbeak buttercup	–	–	0.1	<0.1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Longleaf pondweed	–	–	0.2	0.1	0.2	0.1	–	–	2.3	1.3	0.3	1	1	0.8	1.9	1.3	–	–	3.2	2.9
Nodding waternymph	–	–	1.9	1.5	0.4	0.4	–	–	–	–	0.3	1	4.3	3	2.5	2.3	–	–	0.9	0.7
Sago pondweed	16	48	21	14	47	68	9	100	2.8	1.4	7.6	23	19	12	44	46	–	–	2.3	1
Small and leafy pondweeds	0.3	0.5	1.9	1.7	–	–	–	–	1.4	1.3	0.8	2.5	7.4	4.5	–	–	–	–	1.4	0.5
Southern waternymph	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1.3	1.6	–	–	–	–
Water stargrass	0.5	0.9	0.2	0.1	4.2	4.8	–	–	–	–	0.5	1.3	0.5	0.2	14	12	–	–	–	–
Western waterweed[c]	–	–	–	–	–	–	–	–	4.6	2.8	–	–	–	–	–	–	–	–	6	4.3
Wild celery	0.3	0.5	0.2	0.1	1.3	1.5	–	–	–	–	6.8	30	0.2	0.1	6.6	6.3	–	–	–	–

[a] Data are based on all transect locations that were sampled during both periods within a pool. Rounding may cause the relative frequency columns to not total 100%.

[b] The symbol "–" indicates the species was not found.

[c] Verification of specimen needed for positive identification.

A few species dominated the relative frequencies within the pools. Sago pondweed ranked at least fourth, and usually first or second, among relative frequencies in Pools 4, 8, and 13 during spring and summer sampling and was the only species found in Pool 26. Curly pondweed also ranked high among the relative frequencies in these pools, although frequencies tended to drop during the season. Coon's tail had the highest relative frequency in Pool 8 during both spring and summer sampling and ranked a distant second or third in

Pools 4 and 13 and La Grange Pool. Eurasian watermilfoil reached the highest relative frequency across all pools in La Grange Pool during spring and summer sampling. Wild celery reached the highest relative frequency in Pool 4 during summer in spite of a low frequency (Table 3).

The proportion of sites vegetated with SAV to the total number of sampling sites decreased significantly (based on Chi-square tests) in Pool 4, increased in Pool 13, but remained similar in Pool 8 and La Grange Pool (Table 4). Decreases of SAV sites in Pool 4 were a result of declines in the frequencies of sago and curly pondweeds between sampling periods. Increases in SAV sites in Pool 13 were a result of increases in frequencies of several species. Pool 26 was not sampled during the summer sampling period. The proportion of sites with submersed vegetation at our transect locations in La Grange Pool was relatively high compared to other pools. The backwaters where transects are located are small and protected by levees from high turbidity associated with the main channel of the Illinois River and most are managed for fishing or waterfowl hunting. Thus, SAV tends to cover the water surfaces, at least during years when flooding does not occur.

Table 4. Proportion of sites with submersed aquatic vegetation to total number of sites sampled at transect locations during the 1994 spring and summer sampling periods.

Location	Spring	Summer
Pool 4	32.5	20.4 ($P < 0.01$)[a]
Pool 8	62	62.2 ($P > 0.90$)
Pool 13	54.5	62.7 ($P < 0.01$)
Pool 26	8.9	not sampled
La Grange Pool	82.3	76.7 ($P > 0.15$)

[a] Probability values for differences between sampling periods is given in parentheses. P-values are based on Chi-square tests with a 0.05 level of significance.

Water Depths and Substrates

Mean water depths at transect sites where submersed aquatic plants grew were from 0.4 m in Pool 26 during spring sampling to 1.5 m in La Grange Pool (Table 5). La Grange Pool, where transects are located in backwaters protected from high turbidity levels of the Illinois River main channel, was the only pool where water depths reached more than 1 m.

Table 5. Mean depths of submersed aquatic vegetation along sampling transects in Pools 4, 8, 13, and 26 of the Upper Mississippi River and La Grange Pool of the Illinois River during the 1994 spring and summer sampling periods.

Location	Mean depth spring sampling	Standard deviation	*N*	Mean depth summer sampling	Standard deviation	*N*
Pool 4	1	0.3	322	0.7	0.3	195
Pool 8	0.8	0.4	774	0.6	0.3	771
Pool 13	0.7	0.2	508	0.6	0.2	646
Pool 26	0.4	0.2	58	–	–	–
La Grange Pool	1.5	0.5	127	1.5	0.5	114

Generally, SAV was present on silt substrates for at least 55% of the total sampled throughout all pools. All pools also reported between 5 and 28% of substrate types as either silt with sand or mostly sand substrates SAV (Table 6).

Table 6. Relative presence (%) of substrate types along transects containing submersed aquatic vegetation during the 1994 spring and summer sampling periods.

	Relative presence				
Substrate type	**Pool 4** (*n* = 105)	**Pool 8** (*n* = 89)	**Pool 13** (*n* = 123)	**Pool 26** (*n* = 40)	**La Grange Pool** (*n* = 36)
Silt/clay	74.3	87.6	64.2	100	58.4
Mostly silt with sand	9.5	6.7	17.1	–[a]	27.8
Mostly sand with silt/clay	16.2	5.6	18.7	–	13.8

[a] The symbol "–" indicates the substrate type was not found.

Pool 4

We found eight species of SAV along Pool 4 transects during the spring sampling period and 11 species during the summer sampling period (Table 7). More species were found along transects in lower Pool 4 (below Lake Pepin) than along transects in the upper pool (above Lake Pepin; Appendix B). Species with the highest frequencies during the spring sampling periods were sago pondweed (16.4%) and curly pondweed (13.5%). The frequency of curly pondweed declined to 3.5% between sampling periods; this decline was not unexpected as the species is a "cool season strategist" and typically completes its annual cycle early in the growing season (Nichols and Shaw 1986). The frequency of sago pondweed also declined to 7.6% (Table 7).

Table 7. Frequencies and relative frequencies (%) of species in Pool 4 during the 1994 spring and summer sampling periods.

	Frequencies[a]		Relative frequencies[a]	
Species	**Spring**	**Summer**	**Spring**	**Summer**
Canadian waterweed	1.5	1.4	3.1	5.1
Coon's tail	2.6	5.6	5	16.7
Curly pondweed	13.5	3.5	39.8	11.7
Eurasian watermilfoil	0.9	2.4	2.6	7.1
Horned pondweed	–[b]	0.1	–	0.2
Longleaf pondweed	–	0.3	–	1
Nodding waternymph	–	0.3	–	1
Sago pondweed	16.4	7.6	47.5	23.1
Small and leafy pondweeds	0.3	0.8	0.5	2.5
Water stargrass	0.5	0.5	0.9	1.3
Wild celery	0.3	6.8	0.5	30.2

[a] Frequencies and relative frequencies are based collectively on all transect locations where sampling was performed twice during the growing season. Rounding may cause relative frequency columns to not total 100%.
[b] The symbol "–" indicates the species was not found.

Four additional species were found during informal surveys that were not found along transects. Species found were all members of the pondweed family: Illinois pondweed, ribbonleaf pondweed, variableleaf pondweed, and Richard's pondweed (Appendix B).

Most species, with the exception of sago pondweed and curly pondweed, were present at frequencies less than 10% during the spring and summer sampling. Several species were found only during the summer sampling period including horned pondweed, longleaf pondweed, and nodding waternymph. Although curly pondweed and sago pondweed contributed to more than 85% of the relative frequencies during spring sampling, by summer sampling, wild celery, sago pondweed, coon's tail, and curly pondweed shared the four highest relative frequencies, contributing to more than 80% of the total relative frequencies (Table 7).

Although most species remained at similar frequencies at most locations, sago and curly pondweeds decreased significantly (based on z-tests) at individual locations during the season, while wild celery increased at four locations. Although sago pondweed was found distributed throughout all transect locations, significant declines between spring and summer sampling occurred only at some of the upper pool locations (Table 8).

Table 8. Locations in Pool 4 where species were present during the 1994 spring and summer sampling periods.

Species	Decreased between spring and summer sampling periods[a]	No change between spring and summer sampling periods[b]	Increased between spring and summer sampling periods[a]
Canadian waterweed		Big Lake	
		Big Lake Bay	
		Lower Peterson Lake	
		Peterson Lake	
		Rice Lake	
		Robinson Lake	
		Upper Mud Lake	
Chara		Big Lake	
Coon's tail		Big Lake	Robinson Lake
		Big Lake Bay	
		Dead Slough Lake	
		Lower Peterson Lake	
		Peterson Lake	
		Rice Lake	
		Upper Mud Lake	
Curly pondweed	Lower Peterson Lake	Bay City Flats	
	Robinson Lake	Big Lake	
		Big Lake Bay	
		Peterson Lake	
		Rice Lake	
Eurasian watermilfoil		Big Lake	
		Big Lake Bay	
		Lower Peterson Lake	
		Peterson Lake	
		Rice Lake	
		Robinson Lake	

Table 8. Continued.

Species	Decreased between spring and summer sampling periods[a]	No change between spring and summer sampling periods[b]	Increased between spring and summer sampling periods[a]
Flatstem pondweed		Big Lake Mud Lake Peterson Lake	
Horned pondweed		Robinson Lake	
Longleaf pondweed		Big Lake Robinson Lake	
Nitella		Big Lake	
Nodding waternymph		Robinson Lake	
Sago pondweed	Bay City Flats Dead Slough Lake Upper Mud Lake	Big Lake Big Lake Bay Goose Lake Lower Peterson Lake Mud Lake Peterson Lake Rice Lake	Robinson Lake
Small and leafy pondweeds		Peterson Lake Rice Lake Robinson Lake	
Water stargrass		Big Lake Big Lake Bay Lower Peterson Lake Peterson Lake Robinson Lake	
Wild celery		Rice Lake	Big Lake Lower Peterson Lake Peterson Lake Robinson Lake

[a] Species that increased or decreased in frequency at a location are significant at the 0.05 probability level (based on z-tests).
[b] Species that did not change significantly may have been untestable due to small sample size during one or both sampling periods.

Most species were distributed throughout transect locations in lower Pool 4, except for chara and nitella, which were found only in the Big Lake area and horned pondweed, found only in Robinson Lake. Species found in upper Pool 4 were curly pondweed, Eurasian watermilfoil, flatstem pondweed, longleaf pondweed, and sago pondweed (Table 8).

Pool 8

We found 14 species along Pool 8 transects during the spring sampling period and 12 species at the same transect locations during the summer sampling period. Longbeak buttercup and horned pondweed were found during spring sampling but not during summer sampling. Coon's tail, Eurasian watermilfoil, curly pondweed, and sago pondweed all reached frequencies greater than 20% during the spring sampling period, contributing to nearly 90% of the relative frequencies. The frequency of coon's tail reached more than 40% during the summer sampling period, and along with Eurasian watermilfoil and sago pondweed occupied over 75% of the relative frequencies. Species that were sampled rarely (< 2% frequency) included common bladderwort, small and leafy pondweeds (spring), nodding waternymph (spring), horned pondweed, water stargrass, flatstem pondweed (summer), longleaf pondweed, and wild celery (Table 9). No additional species were found during the informal surveys that were not found during the transect surveys.

Table 9. Frequencies and relative frequencies (%) of species in Pool 8 during the 1994 spring and summer sampling periods.

	Frequencies[a]		Relative frequencies[a]	
Species	**Spring**	**Summer**	**Spring**	**Summer**
Canadian waterweed	5.2	13.3	3.1	9.0
Common bladderwort	0.5	0.6	0.2	0.2
Coon's tail	35.0	44.2	29.5	41.5
Curly pondweed	27.9	9.6	26.4	6.3
Eurasian watermilfoil	21.9	26.5	20.0	21.1
Flatstem pondweed	4.9	0.8	2.9	0.5
Horned pondweed	0.1	–[b]	<0.1	–
Longbeak buttercup	0.1	–	<0.1	–
Longleaf pondweed	0.2	1.0	0.1	0.8
Nodding waternymph	1.9	4.3	1.5	3.0
Sago pondweed	20.9	18.7	14.2	12.4
Small and leafy pondweeds	1.9	7.4	1.7	4.5
Water stargrass	0.2	0.5	0.1	0.2
Wild celery	0.2	0.2	0.1	0.1

[a] Frequencies and relative frequencies are based on all locations sampled during both sampling periods pooled together. Rounding may cause the relative frequencies columns to not total 100%.

[b] The symbol "–" indicates the species was not found.

Most species were distributed in at least two transect locations, except for longbeak buttercup found only at Lawrence Lake, and horned pondweed found only at the Pool 8 Islands. Significant increases were noted in at least one location for several species found during the spring sampling, especially in Target Lake. Conversely, sago pondweed, curly pondweed, and flatstem pondweed revealed significant decreases at many locations where they were present (Table 10).

Table 10. Locations in Pool 8 where species were present during the 1994 spring and summer sampling periods.

Species	Decreased between spring and summer sampling periods[a]	No change between spring and summer sampling periods[b]	Increased between spring and summer sampling periods[a]
Canadian waterweed	Goose Island	Shady Maple	Blue Lake Lawrence Lake Stoddard Target Lake
Common bladderwort		Blue Lake Lawrence Lake Target Lake	
Coon's tail		Blue Lake Goose Island Horseshoe Island Lawrence Lake Pool 8 Island Shady Maple	Stoddard Target Lake
Curly pondweed	Lawrence Lake Stoddard	Blue Lake Goose Island Horseshoe Island Pool 8 Islands Shady Maple	Target Lake
Eurasian watermilfoil		Goose Island Horseshoe Island Lawrence Lake Pool 8 Islands Shady Maple	Target Lake
Flatstem pondweed	Blue Lake Lawrence Lake	Goose Island Pool 8 Islands Target Lake	
Horned pondweed		Pool 8 Islands	
Longbeak buttercup		Lawrence Lake	
Longleaf pondweed		Goose Island Lawrence Lake Target Lake	
Nodding waternymph		Goose Island Horseshoe Island Lawrence Lake	Blue Lake Target Lake
Sago pondweed	Horseshoe Island Lawrence Lake Pool 8 Islands	Blue Lake Goose Island Shady Maple	Stoddard Target Lake
Small and leafy pondweeds		Horseshoe Island Lawrence Lake Stoddard	Blue Lake Goose Island Target Lake
Water stargrass		Horseshoe Island Lawrence Lake	
Wild celery		Lawrence Lake Shady Maple Target Lake	

[a] Species that increased or decreased in frequency at a location are significant at the 0.05 probability level (based on z-tests).

[b] Species that did not change significantly may have been untestable due to small sample size during one or both sampling periods.

Pool 13

We found 11 species along Pool 13 transects during the 1994 spring sampling period, and 10 species were found during the summer sampling period (Appendix B). During both spring and summer sampling, sago pondweed had at least 3 times the frequency of any other species, and thus dominated the relative frequencies. Sago pondweed was the only species that reached a frequency above 10% during the spring sampling period, declining only slightly between periods. By summer sampling, several species had increased in frequencies. Those reaching above 10%, in addition to sago pondweed, were water stargrass, curly pondweed, and coon's tail. These three species contributed to an additional 30% of the relative frequencies while sago pondweed reached 45.8% of the relative frequencies. Species that were rarely found (<2% frequency) during at least one sampling period included chara, flatstem pondweed, longleaf pondweed, nodding waternymph (spring), and wild celery (spring; Table 11).

Table 11. Frequencies and relative frequencies (%) of species in Pool 13 during the 1994 spring and summer sampling periods.

	Frequencies[a]		**Relative frequencies[a]**	
Species	**Spring**	**Summer**	**Spring**	**Summer**
Canadian waterweed	2.9	4.9	3.9	4.6
Chara	0.1	–[b]	0.1	–
Coon's tail	6.1	10.7	7.6	8.2
Curly pondweed	6.9	14.4	6.1	9.6
Eurasian watermilfoil	5.4	7.7	7	7.8
Flatstem pondweed	0.3	0.1	0.2	<0.1
Longleaf pondweed	0.2	1.9	0.1	1.3
Nodding waternymph	0.4	2.5	0.4	2.3
Sago pondweed	47.1	43.5	68.2	45.8
Southern waternymph	–	1.3	–	1.6
Water stargrass	4.2	13.5	4.8	12.2
Wild celery	1.3		1.5	6.3

[a] Frequencies and relative frequencies are based on all transect locations pooled together. Rounding may cause relative frequencies columns to not total 100%.

[b] The symbol "–" indicates the species was not found.

Most species were distributed throughout two or more locations, except for chara and flatstem pondweed found only at the Johnson Creek area. Many species showed significant increases in frequencies in at least one location in Pool 13 during the 1994 growing season. The only species that significantly declined was sago pondweed at Potter's Marsh and the Johnson Creek area (Table 12).

Table 12. Locations in Pool 13 where species were present during the 1994 spring and summer sampling periods.

Species	Decreased between spring and summer sampling periods[a]	No change between spring and summer sampling periods[b]	Increased between spring and summer sampling periods[a]
Canadian waterweed		Johnson Creek Johnson Creek Levee Pomme de Terre	
Chara		Johnson Creek Johnson Creek Levee	
Coon's tail		Johnson Creek Johnson Creek Levee Pomme de Terre Savanna Bay	Brown’s Lake Spring Lake
Curly pondweed		Johnson Creek Johnson Creek Levee Potter's Marsh Savanna Bay Spring Lake	Brown's Lake
Eurasian watermilfoil		Johnson Creek Johnson Creek Levee Pomme de Terre Potter's Marsh Spring Lake	
Flatstem pondweed		Johnson Creek Johnson Creek Levee	
Longleaf pondweed		Brown's Lake Johnson Creek Johnson Creek Levee Pomme de Terre Savanna Bay Spring Lake	
Nodding waternymph		Spring Lake	Johnson Creek Johnson Creek Levee
Sago pondweed	Johnson Creek Johnson Creek Levee Potter's Marsh	Pomme de Terre Savanna Bay Spring Lake	Brown’s Lake
Water stargrass		Pomme de Terre Savanna Bay Spring Lake	Johnson Creek Johnson Creek Levee Potter's Marsh
Wild celery		Pomme de Terre Potter's Marsh Spring Lake	Johnson Creek Johnson Creek Levee

[a] Species that increased or decreased in frequency at a location are significant at the 0.05 probability level (based on z-tests).

[b] Species that did not change significantly may have been untestable due to small sample size during one or both sampling periods.

Pool 26

We found only one species of SAV during the spring sampling period in Pool 26 (Table 13). We were not able to conduct sampling during the summer sampling period because the transect locations were dewatered by the summer sampling period to promote annual vegetation growth for waterfowl.

Table 13. Frequencies and relative frequencies (%) of species in Pool 26 during the 1994 spring and summer sampling periods.

	Frequencies[a]		Relative frequencies[a]	
Species	**Spring**	**Summer**	**Spring**	**Summer**
Sago pondweed	9	–[b]	100	–

[a] Frequencies and relative frequencies are based on two locations pooled together; Calhoun Point and Swan Lake.

[b] The symbol "–" indicates the species was not found.

La Grange Pool

We found a total of 10 species of SAV at transect locations in the La Grange Pool during the 1994 period (Table 14). Species frequencies in La Grange Pool were dominated by Eurasian watermilfoil, curly pondweed and coon's tail during the spring sampling period. These three species contributed to 90% of the relative frequencies during the spring sampling. During the summer sampling period, coon's tail and Eurasian watermilfoil shared more than 80% of the relative frequencies whereas curly pondweed dropped to less than 3% relative frequency. All other species were present at frequencies below 10% during both sample periods. La Grange Pool backwaters are the only locations within our study areas where we found western waterweed.

Table 14. Frequencies and relative frequencies (%) of species in La Grange Pool, Illinois River, during the 1994 spring and summer sampling periods.

	Frequencies[a]		Relative frequencies[a]	
Species	**Spring**	**Summer**	**Spring**	**Summer**
Chara	3.7	5.1	2.8	4.4
Coon's tail	20.9	22.3	15	18.5
Curly pondweed	40	6	26.1	2.6
Eurasian watermilfoil	62.3	63.2	48.8	63.7
Horned pondweed	0.5	1.4	0.3	1.4
Longleaf pondweed	2.3	3.2	1.3	2.9
Nodding waternymph	0.4	0.9	0.4	0.7
Sago pondweed	2.8	2.3	1.4	1
Small and leafy pondweeds	1.4	1.4	1.3	0.5
Western waterweed	4.6	6	2.8	4.3

[a] Frequencies and relative frequencies are based on all transect locations pooled together. Rounding may cause the relative frequencies columns to not total 100%.

Based on z-tests, there was little significant change in species frequencies between sampling periods. The one exception was curly pondweed which declined in Spring Lake (Table 15).

Table 15. Locations in La Grange Pool, Illinois River, where species were present during the 1994 spring and summer sampling periods.

Species	Decreased between spring and summer sampling periods[a]	No change between spring and summer sampling periods[b]	Increased between spring and summer sampling periods[a]
Chara		Spring Lake	
Coon's tail		Banner Marsh Point Lake Spring Lake	
Curly pondweed	Spring Lake	Banner Marsh	
Eurasian watermilfoil		Banner Marsh Spring Lake	
Horned pondweed		Banner Marsh	
Longleaf pondweed		Banner Marsh	
Sago pondweed		Grape Island Point Lake Spring Lake	
Small and leafy pondweeds		Banner Marsh Point Lake	
Western waterweed		Point Lake Spring Lake	

[a] Species that increased or decreased in frequency at a location are significant at the 0.05 probability level (based on z-tests).
[b] Species that did not change significantly may have been untestable due to small sample size during one or both sampling periods.

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Appendix A

Locations, Number of Transects and Sites, Sampling Dates, and Distances Between Sites Sampled in Pools 4, 8, 13, and 26 of the Upper Mississippi River and La Grange Pool of the Illinois River During the 1994 Sampling Season

Location	Number of transects	Number of sites in spring	Number of sites in summer	Dates sampled in spring	Dates sampled in summer	Distance between sites (m)
Pool 4						
Bay City Flats (Catherine Pass;[a] M787.0)[b]	3	78	62	6/6	8/5	30
Big Lake (M757.5)	5	156	149	5/24, 26–27	7/28; 8/1	30
Big Lake (M758.0)	3	29	23	5/20	7/27	30
Big Lake Bay (M758.5)	3	52	30	5/20	7/27	30
Dead Slough Lake (M789.2, M788.5, M788.0)	9	139	136	6/3, 6	8/4–5	30
Goose Lake (M788.G)[c]	3	26	27	6/6	8/5	30
Lower Peterson Lake (M753.5)	4	115	132	5/17	7/19–20	30
Mud Lake (M791.3)	3	59	53	6/1	8/4	30
Peterson Lake (M754.8, M754.5)	6	69	72	5/16	7/19	30
Robinson Lake (M758.R)	9	223	221	5/18–19	7/21–22, 25–26	30
Upper Mud Lake (M791.5)	4	44	46	6/13	8/3–4	30
Total Pool 4	**52**	**990**	**951**	**15**	**15**	
Pool 8						
Blue Lake (M697.0)	3	112	110	5/31	7/29; 8/2	15
Goose Island (M692.0)	5	112	112	6/2	8/4	15
Horseshoe HREP[d] (M687.0)	5	76	78	6/1	8/11	15
Lawrence Lake (M691.0)	6 (spring) 10 (summer)	392	407	6/6, 8–9, 13, 16–17, 20	8/12, 15–16, 18, 22–25	15
Pool 8 Islands (M686.0)	3	107	102	5/23–24	8/28	15
Shady Maple (M690.0)	3	100	105	6/3	8/29	15
Stoddard (M684.0)	4	48	47	5/27	7/28	15

Location	Number of transects	Number of sites in spring	Number of sites in summer	Dates sampled in spring	Dates sampled in summer	Distance between sites (m)
Target Lake (M696.0)	11	298	278	5/16–19	7/20–22, 25–26	15
Total Pool 8	**44**	**1,245**	**1,239**	**11**	**18**	
Pool 13						
Brown's Lake (M545.1, M544.5)	25	379	390	6/1–3, 7	8/1–5, 8	15
Johnson Creek Levee (M523.5)	4	83	89	6/9	8/17	15
Lower Johnson Creek (M523.0)	2	41	59	5/20	7/26–27	15
Pomme de Terre (M526.0)	5	74	82	5/19	8/15	15
Potter's Marsh (M524.0)	6	77	101	6/8	8/16	15
Savanna Bay (M541.5, M540.5, M539.5)	12	151	134	5/20, 25	7/28–29	15
Spring Lake (M534.8, M533.6, M532.0)	12	136	176	5/25, 27, 31	8/9, 11	15
Total Pool 13	**66**	**941**	**1,031**	**16**	**12**	
Pool 26						
Calhoun Point (I003.0)[e,f]	17	155	not sampled	6/1	not sampled	15
Fuller Lake (I011.5)	2	45	not sampled	6/12		
Stump Lake (I010.0)	8	169	not sampled	157	not sampled	15
Swan Lake (I005.5)	11	276	not sampled	5/24–25	not sampled	15
Total Pool 26	**38**	**645**	**0**	**7**	**6**	
La Grange Pool						
Bulrush Pond (I140.7)[a]	2	26	22	5/25–26	8/1	15
Grape Island (I086.4)	3	18	21	5/24	7/29	15
Point Lake (I100.0)	6	25	26	6/14	9/2	15
Spring Lake (I135.5)	5	146	146	5/18–20, 23	8/4, 12, 16	15
Total La Grange Pool	**16**	**215**	**215**	**9**	**8**	

[a] Locally recognized name.
[b] Mississippi River miles, measured from the confluence of the Mississippi and Ohio Rivers.
[c] “G” and “R” to distinguish this lake from another lake with the same river mile.
[d] Habitat Rehabilitation and Enhancement Project.
[e] Illinois River miles, measured from the confluence of the Mississippi and Illinois Rivers.
[f] Pool 26 is located at the confluence of the Illinois and Mississippi Rivers and the portions named here extend up the Illinois River, are managed by the Illinois Department of Natural Resources, and are designated by Illinois River miles.

Appendix B

Species of Submersed and Floating-leaved Aquatic Macrophytes Present at Transect Sites in Pools 4, 8, 13, and 26 of the Upper Mississippi River and the La Grange Pool (Illinois River)

Species	Pool 4	Pool 8	Pool 13	Pool 26	La Grange Pool
Submersed Aquatic Species					
Canadian waterweed (*Elodea canadensis* L.)	x[a]	x	x	–[b]	–
Chara (*Chara* spp.)	–	–	x	–	x
Common bladderwort (*Utricularia macrorhiza* L.)	–	x	–	–	–
Coon's tail (*Ceratophyllum demersum* L.)	x	x	x	–	x
Curly pondweed (*Potamogeton crispus* L.)	x	x	x	–	x
Eurasian watermilfoil (*Myriophyllum spicatum* L.)	x	x	x	–	x
Flatstem pondweed (*Potamogeton zosteriformis* Fern.)	–	x	x	–	–
Horned pondweed (*Zannichellia palustris* L.)	x	x	–	–	x
Longbeak buttercup (*Ranunculus longirostris* Godron.)	–	x	–	–	–
Longleaf pondweed (*Potamogeton nodosus* Poiret.)	x	x	x	–	x
Nodding waternymph (*Najas flexilis* [Willd.] Rostke & Schmidt)	x	x	x	–	x
Sago pondweed (*Potamogeton pectinatus* L.)	x	x	x	x	x
Small and leafy pondweeds (*Potamogeton pusillus and P. foliosus* L.)	x	x	–	–	x
Water stargrass (*Heteranthera dubia* L.)	x	x	x	–	–
Western waterweed (*Elodea nuttallii* [Planch.] St. John)	–	–	–	–	x
Wild celery, American eelgrass (*Vallisneria americana* Michx.)	x	x	x	–	–

Species	Pool 4	Pool 8	Pool 13	Pool 26	La Grange Pool
Floating-leaved Species					
American lotus (*Nelumbo lutea* [Willd.] Pers.)	x	x	x	–	x
American white waterlily (*Nymphaea tuberosa* Ait.)	x	x	–	–	x
Yellow pondlily (*Nuphar lutea* [L.] Sm.)	x	x	–	–	–
Total per pool					
Submersed aquatic species	**11**	**14**	**11**	**10**	**10**
Floating-leaved species	**3**	**3**	**1**		**2**
Additional Species Found During Informal Surveys					
Illinois pondweed (*Potamogeton illinoisensis* Morong.)	x	–	–	–	–
Longbeak buttercup (*Ranunculus longirostris* Godron.)	x	–	–	–	–
Ribbonleaf pondweed (*Potamogeton epihydrus* Raf.)	x	–	–	–	–
Richard's pondweed (*Potamogeton richardsonii* [Benn.] Rydb.)	x	–	–	–	–
Variable leaf pondweed (*Potamogeton gramineus* L.)	x	–	–	–	–
Total number of submersed aquatic vegetation and floating-leaved species[c]	**19**			**1**	

[a] The symbol "x" indicates the species was present during at least one sampling period.
[b] The symbol "–" indicates the species was not found.
[c] Total per pool is the total number of species present regardless of sampling period, including informal sampling.

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13. ABSTRACT (Maximum 200 words)

Aquatic vegetation of the Upper Mississippi River System is monitored as part of the Long Term Resource Monitoring Program. This report summarizes the 1994 effort of monitoring submersed aquatic vegetation (SAV) along transects permanently established in vegetated locations within four navigation pools of the Upper Mississippi River and one navigation pool of the Illinois River. A total of 17 species of SAV were found along transects during the 1994 season. Several additional species were found during informal surveys. More species of submersed aquatic macrophytes were found along transects in lower Pool 4 than in any other reach. Across all pools, sago pondweed (*Potamogeton pectinatus*) was the species most frequently found. Several species of SAV were seasonally dynamic at the transect locations, with changes in frequencies especially common among sago pondweed and curly pondweeds (*P. crispus*). The proportion of sites with SAV decreased significantly in Pool 4, increased in Pool 13, but did not change within other pools. Pool 26, however, was not sampled during the summer sampling season because the transect locations were dewatered to promote growth of annual plant species. Mean depths of sites with SAV ranged from 0.4 m in Pool 26 during spring sampling to 1.5 m in La Grange Pool during spring and summer sampling.

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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.