

# **Protocol for Monitoring Springs at Ozark National Scenic Riverways, Missouri. Heartland I&M Network**

## **SOP 5: Aquatic Vegetation Sampling**

**Version 2.00 (10/29/2019)**

### **Revision History Log:**

Previous Version #	Revision Date	Author	Changes Made	Reason for Change	New Version #
1.0	10/29/2019	D.E. Bowles	Plant inventory for springs updated, guide to common plants revised	Added information content	2.0

This SOP describes field procedures for assessing aquatic vegetation in the spring-runs.

### **I. Assessing the Aquatic Vegetation Community**

#### **Procedures:**

- A. Prior to assessing the aquatic vegetation community and taking habitat measurements, always complete data sheet information for spring name, date and time of survey, and initials of personnel who collect the samples.
- B. Aquatic vegetation will be assessed in three equally-spaced 1 m<sup>2</sup> sample cells located on transects 1, 3, 5, 7, 9 and 11 (see Fig. 1 in SOP #3, Reach Selection).
- C. Place sampling frame securely on substrate centered on the transect (Fig. 1). The observer should be positioned downstream of the sampling frame. Use a view bucket to assess the coverage of aquatic vegetation within the frame.



Figure 1. Placement of the sampling frame on the stream bottom and using a view bucket to assess coverage. A second team member records data.

1. Record composition of vegetation using a modified Daubenmire scale (Daubenmire 1959, Table 1) within each sampling cell (Fig. 2). The sampling frame is divided into four equal quarters that the observer estimates percentage composition within the entire sampling area. Combined cover may exceed 100% due to overlapping vegetation of different species.

Table 1. Modified Daubenmire cover value scale.

Cover Class Codes	Range of Cover (%)
7	95-100
6	75-95
5	50-75
4	25-50
3	5-25
2	1-5
1	0-0.99

2. Only rooted vegetation and floating species (*e.g., Lemna*) are counted as occurring in a given plot. Vegetation rooted outside of the plot, but with leaves floating over the plot is not counted.

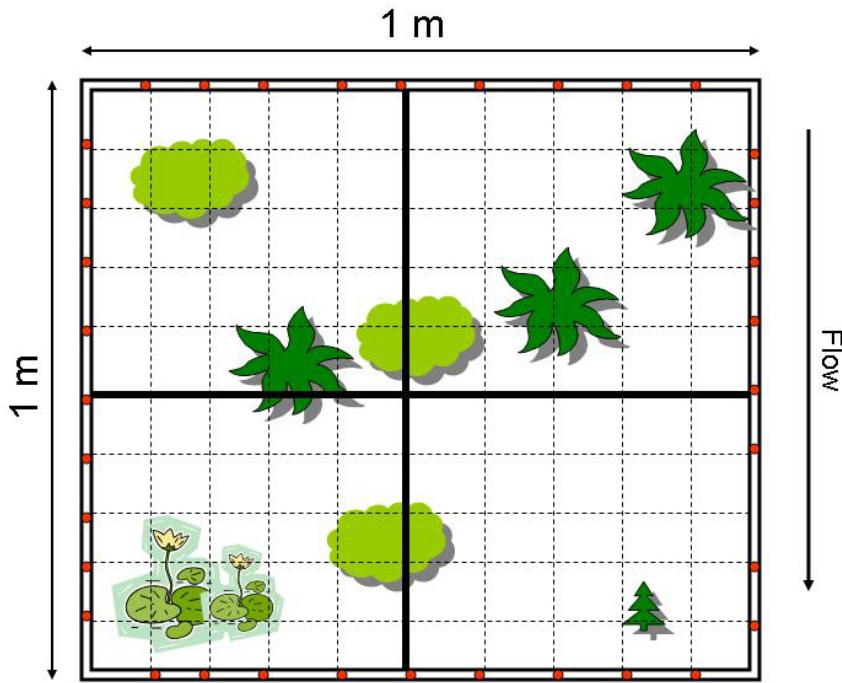


Figure 2. Sampling frame showing hypothetical distribution of aquatic vegetation in sampling area. Dashed lines are only intended to show the approximate visual grid the observer uses to estimate percentage composition. Each subsection equals 1% of the total sample cell area.

3. Mosses and liverworts are classified into those two broad groups, respectively. Algae are classified as macroalgae (*Nitella*), filamentous red algae (*Batrachospermum*), filamentous green algae (*Cladophora*, *Spirogyra*, *Draparnaldia*, *Chaetophora*), filamentous blue-green algae (*Lyngbya*) other filamentous algae, and globular algae (*Nostoc*). All other aquatic plants are identified to species.
  4. When the field crew is unable to make a specific determination of an aquatic plant found in a survey plot, the plant should be properly recorded on the Unknown Species Sheet, and a specimen should be collected for later examination in the lab or for sending to an aquatic plant expert.
- D. A list of aquatic vegetation known to or suspected of occurring in large springs at OZAR is presented in Table 2. Suspected occurrence is based on records of those species in the regional proximity of OZAR.
- E. An identification guide to the aquatic vegetation of the large springs at OZAR is presented in Table 3. However, this guide is not intended to be a definitive identification source.
- F. Preferred taxonomic keys for identifying aquatic plants in the field or lab include Correll and Correll (1975), Godfrey and Wooten (1979, 1981), Redfearn (1981), and Yatskievych (1999, 2006, 2013).

## **II. QA/QC**

### **Procedures:**

In order to ensure accurate identification and assigning appropriate cover codes in the field, the following procedures will be used.

- A. Prior to field work, each new staff member (trainee) conducting field identifications and assigning cover class codes will be evaluated for certification by a staff member (typically the Project Lead) who has previously been certified as meeting QA/QC criteria (see bullets C and D for criteria of certification).
- B. Initial steps toward certification include gaining familiarity with cover class codes and how to estimate those codes as well as learning species-level identification of aquatic plants known to occur in the springs. The latter step can be assisted using an in-house field guide developed for the program (see below) along with field practice alongside a certified staff member.
- C. At the selected practice field site (ideally Alley or Round springs, OZAR due to their high diversity), the trainee shall call plant identifications and cover classes for no less than 9 randomly selected cells as established by the project lead. Once each cell is completed by the certified staff member (out of hearing range for the trainee), the trainee will call the same cell. Data will be recorded on field sheets and compared for accuracy.
- D. In order to become certified, the trainee must correctly identify all plants (90%) attempted. Cover classes for individual plant taxa can differ by no more than one cover class, and there can be no more than three such variances per sample cell.
- E. Failure to meet these criteria will result in no certification. The trainee can make three attempts at this certification effort, but thereafter will not be permitted to assess plant communities if the requisite accuracy cannot be met.
- F. If a plant is especially difficult to identify, specimens will be returned to the lab where they will be keyed, compared to herbaria material, or sent to a person with taxonomic expertise on aquatic plants. It is also important that the primary plant identifiers maintain contact with other botanist through professional societies and other interactions and stays current with the pertinent published literature.

## **III. Collecting and Preserving Aquatic Plants**

- A. A representative reference collection of aquatic plant species occurring in the various springs will be collected, properly preserved, and stored in the Missouri State University Herbarium, Springfield, MO.

- B. Plant specimens should be placed in a plant press with an identification label indicating state (Missouri), county, spring name, GPS coordinates, date, collector, and general habitat type. After the first day plants have been pressed, the blotters should be changed to ensure maximum drying potential. When the plants have dried sufficiently, they should be mounted on acid free, white card stock, about 11 x 16 inches (~279 x 406 mm), labeled, and stored in herbarium cabinets. High quality photographic vouchers are also acceptable.
- C. Alternatively, aquatic plants can be stored in 4% formalin for short term storage until positive identification can be made, or they can be placed in zip-lock type storage bags along with a small amount of water, and placed in a cooler or refrigerator. Plants stored in this manner ideally should be examined within 24 hours of collection.

#### **IV. References**

- Correll, D.S., and H.B. Correll. 1975. Aquatic and wetland plants of the southwestern United States, vol. 1 and 2. Stanford University Press, Stanford, CA.
- Godfrey, R. K., and J. W. Wooten. 1979. Aquatic and wetland plants of the southeastern United States, Monocotyledons. University of Georgia Press, Athens, GA.
- Godfrey, R. K., and J. W. Wooten. 1981. Aquatic and wetland plants of the southeastern United States, Dicotyledons. University of Georgia Press, Athens, GA.
- Redfearn, P. L, Jr. 1981. Bryophytes in springs and spring branches of Missouri. Transactions of the Missouri Academy of Science 15:5-19.
- Yatskievych, G. 1999. Steyermark's flora of Missouri, Volume 1 (revised edition). Missouri Department of Conservation, Jefferson City, MO.
- Yatskievych, G. 2006. Steyermark's flora of Missouri, Volume 2 (revised edition). Missouri Botanical Garden Press, St. Louis, MO.
- Yatskievych, G. 2013. Steyermark's flora of Missouri, Volume 3. Missouri Botanical Garden Press, St. Louis, Missouri

**AQUATIC VEGETATION ASSESSMENT FORM**

**Daubenmire Scale Range of Cover\***

**Spring Name:** \_\_\_\_\_ **Transect No.** 11 9 7 5 3 1

**Crew Members:** \_\_\_\_\_

**Date:** \_\_\_\_\_

LOCATION	L	M	R	LOCATION	L	M	R
<b>Moss</b>				<i>Myriophyllum heterophyllum</i>			
				<i>Myriophyllum spicatum</i>			
				<i>Persicaria hydropiperoides</i>			
				<i>Persicaria</i> spp.			
				<i>Physostegia virginiana</i>			
				<i>Pilea pumila</i>			
				<i>Plantago cordata</i>			
				<i>Poa annua</i>			
				<i>Potamogeton foliosus</i>			
				<i>Potamogeton illinoensis</i>			
				<i>Potamogeton nodosus</i>			
				<i>Ranunculus aquatilis</i>			
				<i>Rumex obtusifolius</i>			
				<i>Sagittaria latifolia</i>			
				<i>Scirpus</i> spp.			
				<i>Sparganium americanum</i>			
				<i>Veronica catenata</i>			
				<i>Veronica anagallis-aquatica</i>			
				<i>Zannichellia palustris</i>			
<b>Angiosperms</b>				<b>Other</b>			
<i>Agrostis stolonifera</i>							
<i>Callitricha heterophylla</i>							
<i>Cardamine bulbosa</i>							
<i>Carex</i> spp.							
<i>Ceratophyllum demersum</i>							
<i>Cyperus</i> spp.							
<i>Eleocharis acicularis</i>							
<i>Elodea canadensis/nuttallii</i>							
<i>Glyceria striata</i>							
<i>Heteranthera dubia</i>							
<i>Impatiens capensis</i>							
<i>Justicia americana</i>							
<i>Lemna minor</i>							
<i>Lemna minuta</i>							
<i>Lemna trisulca</i>							
<i>Lobelia cardinalis</i>							
<i>Ludwigia palustris</i>							
<i>Lysimachia nummularia</i>							
<i>Nasturtium officinale</i>							
<i>Mentha aquatica</i>							
<b>CHECK WHEN COMPLETED:</b>							

\*1= 0-0.99. 2= 1-5. 3= 5-25. 4= 25-50. 5= 50-75. 6= 75+ BARE SUBSTRATE

CHECK WHEN COMPLETED:

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Notes:

Date entered into database:

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## AQUATIC VEGETATION Unknown Species Sheet

Table 2. List of Aquatic Vegetation Known to or Suspected of Occurring in Large Springs at Ozark National Scenic Riverways, Missouri<sup>1,2</sup>. A black square (■) indicates known occurrences.

NOMENCLATURE		SPRINGS							HABITAT FORM <sup>3</sup>			
Taxon	Common Name	Alley Spring	Big Spring	Blue Spring	Phillips Spring	Pultite Spring	Round Spring	Welch Spring	Floating Not-rooted	Floating Rooted	Rooted Submerged	Rooted Emergent
<b>Algae</b>												
Batrachospermaceae												
<i>Batrachospermum</i> spp.	Red algae	■	■	■	■	■	■	■	■			
Characeae												
<i>Nitella acuminata</i>	Nitella		■								■	
Nostocaceae												
<i>Nostoc</i> sp.	Globular algae	■	■	■	■	■	■	■	■			
Oscillatoriaceae												
<i>Lyngbya</i> sp.	Filamentous blue-green algae	■	■	■	■	■	■	■	■			
Xanthophyceae												
<i>Vaucheria</i>	Vaucheria	■	■	■	■	■	■	■	■			
Chlorophyta												
Unidentified	Filamentous green algae	■	■	■	■	■	■	■	■			
<b>Mosses, Liverworts</b>												
Amblystegiaceae												
<i>Leptodictyum</i>	Moss		■			■	■	■			■	■

<i>fluviatile</i>											
<i>Leptodictyum laxirete</i>	Moss	■								■	■
<i>Leptodictyum noterophilum</i>	Moss			■						■	■
<i>Leptodictyum riparium</i>	Moss	■		■		■	■	■		■	■
<i>Leptodictyum tenax</i>	Moss	■	■	■						■	■
Brachytheciaceae											
<i>Brachythecium rivulare</i>	Moss	■	■	■		■		■		■	■
<i>Rhynchostegium riparoides</i>	Moss		■							■	■
Fontinalaceae											
<i>Fissidens fontanus</i>	Moss	■	■	■						■	■
<i>Fissidens grandifrons</i>	Moss	■	■	■		■	■			■	■
<i>Fissidens duriaeii</i>	Moss	■	■	■		■	■	■		■	■
<i>Fissidens filiformis</i>	Moss			■						■	■
<i>Fissidens minutulus</i>	Moss	■	■	■						■	■
<i>Fissidens missourica</i>	Moss			■						■	■
Pottiaceae											
<i>Hyophila involuta</i>	Moss	■	■			■		■		■	■
Thuidiaceae											
<i>Thuidium pygmaeum</i>	Moss		■			■				■	■
Conocephalaceae											
<i>Conocephalum conicum</i>	Liverwort		■			■	■			■	■

Marchantiaceae											
<i>Dumortiera hirsuta</i>	Liverwort		■	■		■				■	■
<i>Marchantia polymorpha</i>	Liverwort	■	■	■			■	■		■	■
Porellaceae											
<i>Porella pinnata</i>	Liverwort	■	■	■		■	■			■	■
<b>Vascular Plants</b>											
Acanthaceae											
<i>Justicia americana</i>	American water willow						■			■	■
Alismataceae											
<i>Sagittaria latifolia</i>	Broad-leaved arrowhead				■		■		■	■	
Brassicaceae											
<i>Cardamine bulbosa</i>	Spring-cress	■	■	■		■	■			■	■
<i>Nasturtium officinale</i> <sup>1</sup>	Water-cress	■	■	■	■	■	■	■		■	■
Callitrichaceae											
<i>Callitriche heterophylla</i>	Water starwort	■	■	■	■	■	■	■		■	■
Campanulaceae											
<i>Lobelia cardinalis</i>	Cardinal flower				■					■	■
Ceratophyllaceae											
<i>Ceratophyllum demersum</i>	Coon's tail or hornwort	■	■				■			■	
Cyperaceae											
<i>Eleocharis</i>	Slender			■	■						■

<i>acicularis</i>	spike rush											
Haloragidaceae												
<i>Myriophyllum heterophyllum</i>	Twoleaf water milfoil	■	■			■	■	■		■		■
Hydrocharitaceae												
<i>Elodea canadensis</i>	Canadian waterweed	■	■	■		■	■	■		■		
<i>Elodea nuttallii</i>	Western waterweed	■	■	■		■	■	■		■		
Lamiaceae												
<i>Mentha piperita</i> <sup>1</sup>	Peppermint	■			■			■		■		■
<i>Physostegia virginiana</i>	False dragon-head			■						■		■
Lemnaceae												
<i>Lemna minor</i>	Cpmmon duckweed	■							■			
<i>Lemna minuta</i>	Least duckweed						■		■			
<i>Lemna trisulca</i>	Star duckweed	■	■	■		■			■			
Onagraceae												
<i>Ludwigia palustris</i>	Marsh seedbox		■		■		■			■		■
Plantaginaceae												
<i>Veronica anagallis-aquatica</i>	Water speedwell	■	■	■		■	■	■		■		■
Poaceae												
<i>Agrostis stolonifera</i> <sup>1</sup>	Creeping bentgrass			■						■		■
<i>Glyceria striata</i>	Fowl			■			■			■		■

	meadow grass, Manna grass											
<i>Poa annua</i> <sup>1</sup>	Blue grass	■	■				■	■			■	■
Pontederiaceae												
<i>Heteranthera dubia</i>	Water star- grass		■	■							■	
Potamogetonaceae												
<i>Potamogeton amplifolius</i>	Largeleaf pondweed	■	■								■	
<i>Potamogeton foliosus</i>	Narrow- leaved pondweed	■	■				■	■		■	■	
<i>Potamogeton illinoensis</i>	Illinois pondweed	■	■	■			■	■	■		■	
Ranunculaceae												
<i>Ranunculus longirostris</i>	Longbeak buttercup	■	■	■			■		■		■	
Sparganiaceae												
<i>Sparganium americanum</i>	Bur-reed	■	■	■	■	■	■	■			■	■
Zannichelliaceae												
<i>Zannichellia palustris</i>	Horned pondweed		■	■			■	■			■	
<b>Wetland Plants<sup>2</sup></b>												
Alismataceae												
<i>Alisma subcordatum</i>	American water plantain		■					■				■

Balsaminaceae											
<i>Impatiens capensis</i>	Jewelweed	■		■		■	■				■
Crassulaceae											
<i>Penthorum sedoides</i>	Ditch stonecrop			■							■
Juncaceae											
<i>Juncus acuminatus</i>	Tapertip rush						■	■			■
<i>Juncus dudleyi</i>	Dudley's Rush							■			■
<i>Juncus tenuis</i>	Slender rush							■			■
Polygonaceae											
<i>Persicaria</i> spp.	Smartweeds	■	■	■		■	■	■			■
<i>Persicaria hydropiperoides</i>	Swamp smartweed		■			■	■				■
<i>Persicaria hydropiper</i>	Marshpepper knotweed	■	■			■	■				

<sup>1</sup> Non-native species known or possibly occurring in OZAR spring-runs. Some researchers consider *Nasturtium officinale* to be a naturalized species introduced from Europe, but this has not been conclusively demonstrated. *Myriophyllum spicatum* has not yet been reported from the springs proper, but it is quite possible that it may eventually be introduced into some of the springs.

<sup>2</sup> Wetland species that may be at waters edge.

<sup>3</sup> Most mosses and bryophytes do not have true roots, but have rhizoids (thread-like structures) used for attachment to the substrate.

**Table 3. Identification Guide to Aquatic Vegetation Occurring at Large Springs at Ozark National Scenic Riverways\***

Line drawings adapted and modified from Correll and Correll (1975); Godfrey and Wooten (1979, 1981); U.S. Department of Agriculture Plant Database; and West Virginia University Extension Service. Photographs by David E. Bowles, National Park Service

Filamentous Algae

**Globular** – A ball of algal growth that is usually gelatinous or jelly-like. These are usually blue-green algae (such as *Nostoc*).



*Nostoc* sp.

**Short to medium filaments** – Filamentous algae form hairlike strands that are branched, to give a bushy appearance, or unbranched. Some filaments are quite tenacious and difficult to break while others break apart easily.

**Green** – Filamentous green algae are quite diverse. Green filaments that are coarse to the touch and difficult to break are usually *Cladophora* or *Rhizoclonium*. *Vaucheria* (actually classified as a yellow-green alga) forms a felt-like mat of filaments that may or may not be attached to the substrate. Attached filaments that are slippery or gelatinous to the touch may be *Ulothrix*, *Draparnaldia*, or *Stigeoclonium*.



*Vaucheria* sp.



*Cladophora* sp.

*Brown* – Short filaments that are reddish brown and break apart when touched are likely diatoms and are usually found in slow flows. Filamentous green algae that are senescent (dead or dying) usually appear brown because of the breakdown of their pigments. Brown color may also indicate a filamentous green alga that is covered by epiphytic diatoms (diatoms that grow on other plants: ‘epi’ – on, ‘phyte’ – plant).

*Black* – Black filaments indicate blue green algae. Common filamentous blue-greens include *Lyngbya* and *Oscillatoria*.



*Lyngbya* sp.

*Reddish to olive* – Blue-green algae can appear reddish or olive (especially in the sunlight) due to the presence of phycoerythrin or phycocyanin pigments. Freshwater red algae also contain these pigments and are particularly found in clean, clear, cool water. *Batrachospermum* is a particularly attractive red alga that is slippery or gelatinous to the touch and has a characteristic beaded appearance (like a strand of beads) at close inspection.



*Batrachospermum* sp.

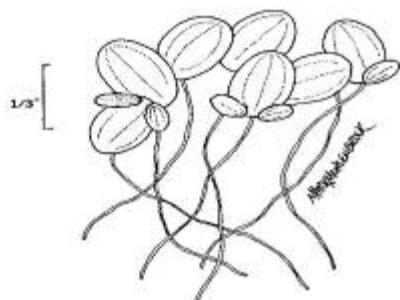
**Long filaments** – Most algae described above can develop filaments or tufts longer than three inches. Large areas of long, green filaments almost always indicate nutrient enrichment (either prolonged high levels or frequent pulses of nutrients). In extreme cases, the filaments can cover the entire stream bottom.

**Free floating** – Many filamentous algae can form free-floating, unattached, mats or cloud-like growths in the water column in slow-flow areas. These are almost always green or yellowish-green and are usually formed by *Spirogyra*, *Zygnema*, *Oedogonium*, *Mougeotia*, or *Vaucheria*.

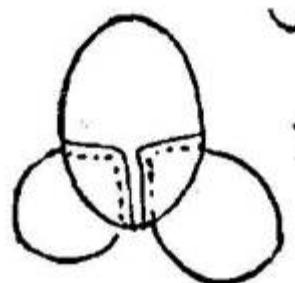
## Aquatic Plants and Plant-like Algae

### **Lemna and Spirodela**

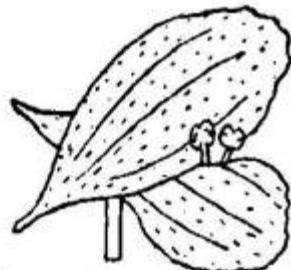
- Plants with one root.....*Lemna*  
Plants with several roots.....*Spirodela polyrhiza*



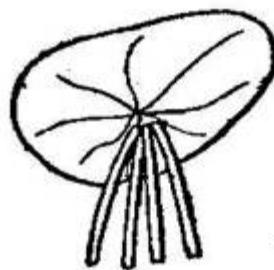
**Lemna minor**



**Lemna minuta**



**Lemna trisulca**



**Spirodela polyrhiza**

- Plants with one faint vein, extending only about half the distance from root to apex; tips rounded.....*Lemna minuta*

- Leaves with three distinct veins, tips rounded, with a single root. Always floating.....*Lemna minor*

- Leaves with three distinct veins, oblong-lanceolate to elliptic, tapering at base into a long, slender stipe (stalk); tips pointed Rootless or with a single root. Generally submersed with vegetative plant body flattened.....*Lemna trisulca*



*Lemna minor*



*Lemna minuta*



*Lemna trisulca*



*Spirodela polyrhiza*

***Chara* and *Nitella***

With a “main stalk” with regularly arranged whorls of shorter branches; abrasive and rough to the touch; distinct musky odor.....*Chara*



*Chara* sp.

With many branches but no apparent “main stalk”, leaflets arranged in numerous whorls; smooth to the touch; without musky odor.....*Nitella*



*Nitella acuminata*

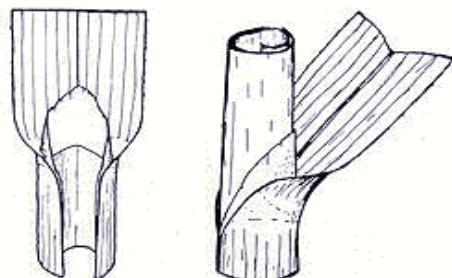
## Grasses

Leaves long and unequal in length, originating from base of plant, 2.5 to 5 mm wide, 5 to 25 cm long, flat or V-shaped, abruptly acute and boat-shaped at tip, glabrous, faintly ridged, two conspicuous median lines; color blue- or gray-green, not glossy. Sheath flattened or elliptical but not keeled, slightly scabrous, pale-green to purple or tinged with purple, prominently cross-nerved, closed almost to the summit but splitting easily due to its membranous nature. Collar not conspicuous, glabrous, pale, divided by midrib; Ligule thin-membranous, 2 to 4 mm long, acute entire. No adventitious roots at nodes.....*Agrostis stolonifera*

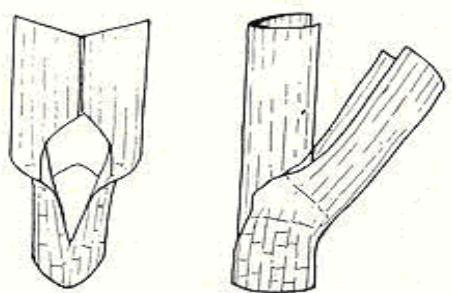
Leaves of equal length, appearing all along stem, 2 to 7 mm wide, 5 to 20 cm long, tapering to a sharp point, prominently ridged on upper surface, midrib distinct below, surfaces scabrous or smooth; color grass green. Sheath not compressed or keeled, glabrous, green, longer than the internode on the basal shoots, split with margins overlapping. Collar prominent, glabrous, pale green, V-shaped, usually oblique. Ligule membranous, thin, 1.5 to 4.0 mm long, rounded to acute, irregularly toothed or split, minutely hairy on back. No adventitious roots at nodes.....*Glyceria striata*

Leaves mostly occurring on lower half or third of stem; roots at nodes, 1.5 to 4 mm wide, 2 to 8 cm long, flat or V-shaped, two distinct light lines may be seen along the midvein, margins glabrous, slightly scabrous towards tip; color pale blue-green, not glossy. Sheath compressed and slightly keeled, glabrous, light green, split part way only; Collar distinct, glabrous, pale green,

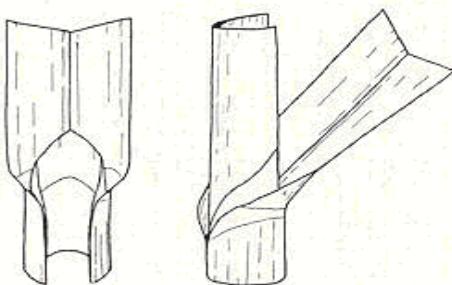
V-shaped. Ligule conspicuous membranous, white, 1.0 to 3.0 mm (usually 1.2 to 1.8 mm) long, acute, entire. Adventitious roots at nodes. .... ***Poa annua***



*Agrostis stolonifera*



*Glyceria striata*



*Poa annua*



*Glyceria striata*



*Poa annua*

**Plants with grass-like leaves**

***Heteranthera-Najas-Zannichellia-Sparganium* group**

Leaves mostly alternate, tips pointed, no conspicuous midrib, up to 5mm in width; flowers at end of stem and yellow.....*Heteranthera dubia*



*Heteranthera dubia*

Leaves mostly opposite, but sometimes appearing alternate or whorled, 2-8 cm long, margins smooth, without conspicuous midrib; flowers and fruits sessile and located at base of leaf axil giving the appearance of small "horns".....*Zannichellia palustris*



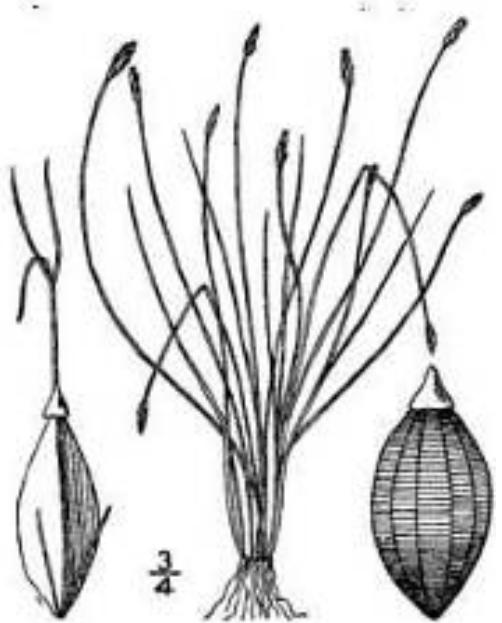
*Zannichellia palustris*

Leaves mostly opposite, 0.5-3.0 cm long, tips rounded, with margins minutely serrate (not visible with eye).....*Najas guadalupensis*



*Najas guadalupensis*

Stem round in cross section (<2 mm); nutlet as one terminal spikelet; plants essentially leafless.....*Eleocharis*



*Eleocharis acicularis*

Leaves broad, up to 2.5 cm wide, with a prominent ventral keel, erect, and often emergent.  
Flowers white.....*Sparganium americanum*



*Sparganium americanum*

**Plants with finely dissected leaves**

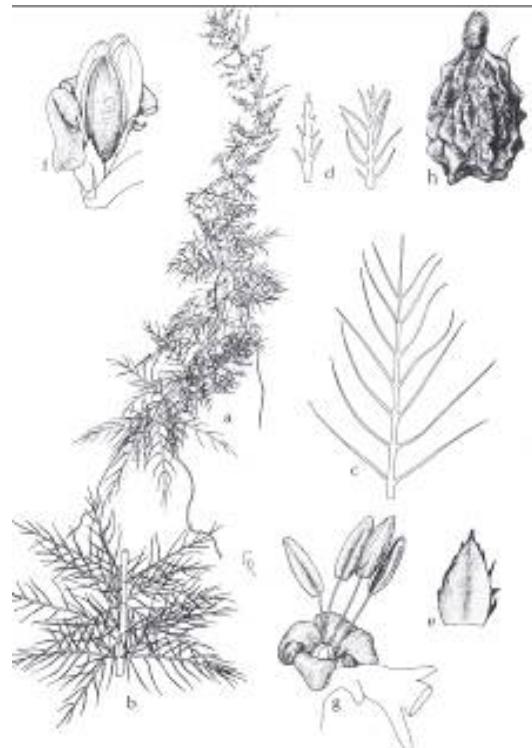
***Myriophyllum***

Foliage of leaves with 12-28 capillary divisions; submersed leaves in whorls of 5 to 6; primary bracts or bracteal leaves ovate-lanceolate to lanceolate in shape, margins with short serrations or the lower ones entire..... *Myriophyllum heterophyllum*



*Myriophyllum heterophyllum*

Foliage of leaves with 8-10 capillary divisions; submersed leaves in whorls of 3 to 4; primary bracts or bracteal leaves with long serrations, usually sub-pectinately toothed..... *Myriophyllum pinnatum*



*Myriophyllum pinnatum*

Foliage of leaves with a grayish cast, the segments distributed on the axis of the stem in pair or sub-opposite, those on each side extending outward nearly paralleling each other giving the plant a feathery appearance..... *Myriophyllum spicatum*



*Myriophyllum spicatum*

Leaves bright green and of two types: 1) floating leaves are rounded and crowded toward the tip, often forming a floating rosette at the water surface, and 2) submersed leaves are opposite, and blade-like in shape. Leaves usually 2.5 cm or less long, stems are generally short usually less than 0.5 meter.....*Callitricha heterophylla*



*Calitricha heterophylla*

Leaves are arranged in whorls located at nodes with 5-12 leaflets in each whorl; each leaf may be forked and each division of the leaf are toothed along the margins and tipped with a spine; lacking true roots .....*Ceratophyllum demersum*



*Ceratophyllum demersum*

Stems slender and long (<1 meter) that branch at points along the main stem; leaves sessile, arranged in whorls of three, taper abruptly to a blunt point, and range up to 4 mm in width and 15 mm in length. Leaves generally become more crowded towards the tips of the stems.

.....*Elodea*

**Caution: Hybrids of these two species occur in all springs**

Leaves ~2 (1-4) mm wide, tapered abruptly to a blunt point; white female flowers stalked, male flowers a vase-shaped spathe borne on a long stalk .....*Elodea canadensis*



*Elodea canadensis*

Leaves 1.5 (0.3 to 1.5) mm wide, tapered to a slender point; white female flowers stalked, male flowers sessile..... *Elodea nuttallii*



*Elodea nuttallii*

Stems are 15 to 80 cm in length. Leaves dark green and highly dissected and nodes widely spaced. Typically with prominent, light colored adventitious roots.....*Ranunculus aquatilis*



*Ranuculus aquatilis*

### Plants with broad leaves

Leaves at end of stem usually singular, rounded to heart-shaped .....*Cardamine bulbosa*





*Cardamine bulbosa*

Leaves at end of stem usually in three part, rounded to broad oval in shape.....*Nasturtium officinale*





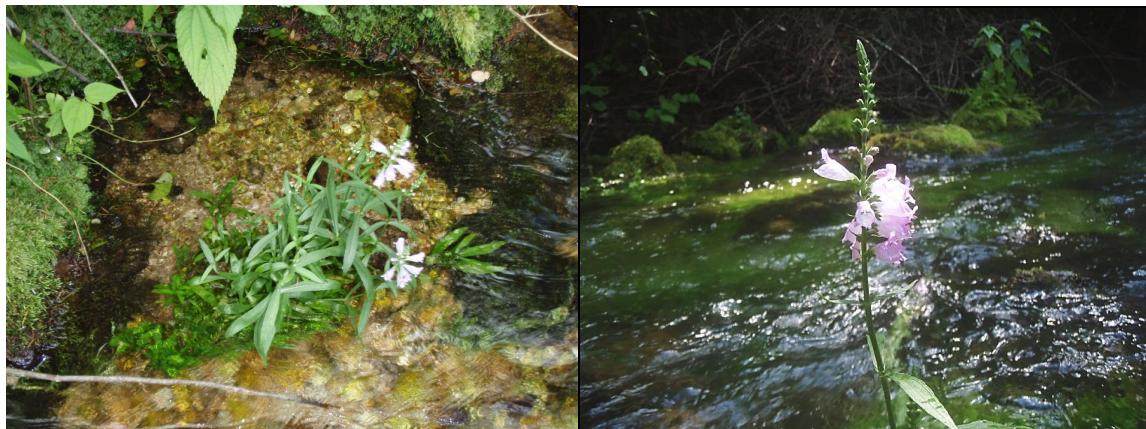
*Nasturtium officinale*

Leaves alternate, long, lanceolate in shape, margins serrate; flowers, if in bloom, bright red.....***Lobelia cardinalis*** (Phillips Spring only)



*Lobelia cardinalis*

Leaves opposite, long, lanceolate in shape, margins serrate; flowers, if in bloom, light pink.....***Physostegia virginiana*** (Blue Spring only)



*Physostegia virginiana*

***Potamogeton***

All *Potamogeton* have alternate leaves

Leaves entirely submerged, grass-like, up to 2 mm wide, with 3-5 main veins.....*Potamogeton foliosus*



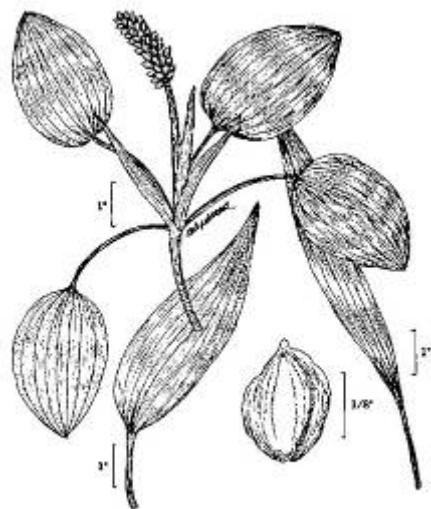
*Potamogeton foliosus*

Leaves usually entirely submerged and folded, up to 50 mm wide, with 9-19 main veins.....*Potamogeton illinoensis*



*Potamogeton illinoensis*

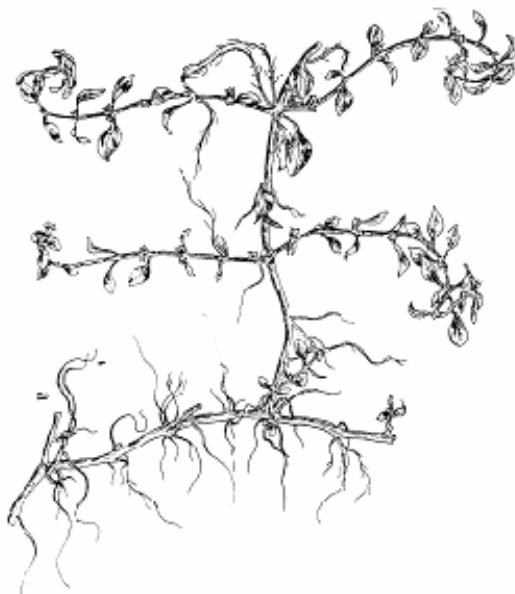
Leaves both floating and submerged, submerged leaves strongly folded, up to 75 mm wide, with 25-39 leaf veins.....*Potamogeton amplifolius*



*Potamogeton amplifolius*

*Ludwigia*

Leaf blade narrowly elliptic to subovate, often reddish in color. Sprawling growth form.  
..... *Ludwigia palustris*



*Ludwigia palustris*

Erect or sprawling, with stems up to 1 m in length. Leaves narrow and lanceolate in shape, usually less than 3 cm wide. With a characteristic nodal sheath or ocrea. Flowers are white to light pink in color.....*Persicaria hydropiperoides*



*Persicaria hydropiperoides*

*Veronica*

Stems growing from 10 centimeters to about a one meter in length.; leaves opposite smooth-edged or toothed, and sometimes clasping the stem where the leaf pairs meet at the bases; flowers borne on stalks arising from leaf axils.....*Veronica*

Leaf blades about 1.5 to 3.0 times as long as wide. Flowers pink to light purple.....*Veronica anagallis-aquatica*



*Veronica anagallis-aquatica*

Leaves 3.0-5.0 times long as wide, olive green in color; flowers white to light pink.....*Veronica catenata*



*Veronica catenata*

Stems green or purple in color, distinctly square in cross section variably hairy to almost hairless; leaves opposite, ovate to ovate-lanceolate, and 2 to 6 cm long and 1 to 4 cm wide—leaf color ranges from green to purplish; flowers purple to pinkish in color, small and densely crowdedStems; leaves highly fragrant when crushed.....*Mentha aquatica*



*Mentha aquatica*