A Citizen's Guide to Biological Assessment of Wetlands

The Vegetation Index of Biological Integrity (IBI)

Field and Laboratory protocols,
Pictorial Key to the Common Wetland Plants

Minnesota Pollution Control Agency

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The Vegetation Index of Biological Integrity (IBI)

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Numerous people contributed comments and suggestions to earlier drafts as part of the plant training component of the Wetland Health Evaluation Program (WHEP). Darcy Tathum produced the original version of the field data sheet listing the common wetland taxa which has been revised in this manuscript. Steve Chesebrough, a volunteer from the Plymouth WHEP team, created the original "Wetland Vegetation Key at a Glance" which has also been revised and included in Appendix 3. Chris Kline provided many suggestions to improve the quality of the resulting field data. Many thanks to Mary Kay Lynch who demonstrated undaunted patience awaiting the release of this guide and along the way made many useful comments and dedicated many hours to keeping teams on track in their wetland field work. Daniel Huff and Jenny Schaust gave countless words of encouragement throughout the making of this guide. Without their undying passion and leadership WHEP would not be the success that it has become. Finally, though all the volunteers and team leaders are too numerous to list individually they should be acknowledged for their dedication and support for helping to develop WHEP into a viable wetland component of the citizen science movement in Minnesota.

The authors provided the following line drawings: the nonvascular plants and small floating aquatics; the leaf morphology and arrangement diagrams; the lanceolate, ovate and branching leaf shapes; the stem and leaf cross sections; as well as the panicle, two, and three-ranked diagrams. The remaining line drawings were obtained from the USDA-NRCS PLANTS Database (http://plants.usda.gov). All of these drawings are in the public domain (not copyrighted) but are herein recognized and fully acknowledged. Line drawings for *Agrostis, Calamagrostis, Echinochloa, Spartina pectinata,* and *Zizania aquatica* were originally published in Hitchcock, A.S. (rev. A. Chase). 1950. Manual of the grasses of the United States. USDA Misc. Publ. No. 200. Washington, DC. All other drawings were originally published in Britton, N.L., and A. Brown. 1913. Illustrated flora of the northern states and Canada. Vol. 1: 168.

INTRODUCTION

This guide provides the basic framework for trained citizens to monitor and assess the condition, or health, of depressional wetlands in Central Minnesota. The field sampling protocols and biological assessment criteria presented in this guide are based on similar work by professional wetland biologists at the Minnesota Pollution Control Agency (MPCA).

The basic approach is to use standard sampling methods to gather wetland plant community data, evaluate the data using multiple plant metrics, and determine a wetland condition assessment. A metric is a measurement of a plant community characteristic that is known to change in a predictable way in response to varying degrees of human influence from undisturbed to extremely disturbed conditions. The combination of multiple metrics into a single composite index results in a robust and reliable indicator of wetland condition (Figure 1). The final result is called an Index of Biological Integrity or IBI.

This guide includes wetland sampling protocols, data sheets, and metric scoring sheets used to score the IBI. A wetland plant identification guide is also included to help users identify the common wetland plants of Central Minnesota. The materials within this guide serve as primary training materials for the Minnesota Wetland Health Evaluation Program (WHEP) citizen volunteer monitoring group. This guide may also be well suited for wetland education purposes outside of WHEP.

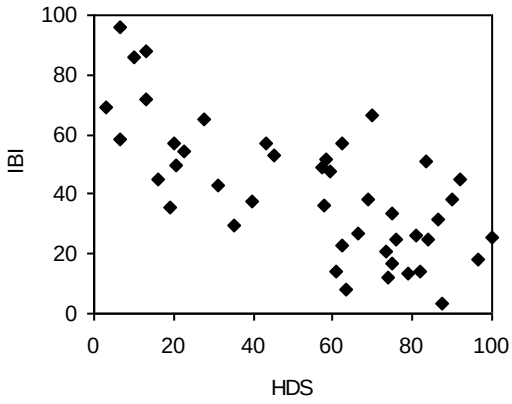


Figure 1. Vegetation IBI scores plotted against Human Disturbance Scores (HDS). HDS incorporates a variety of human disturbance factors such as landscape, hydrologic, and chemical disturbances. HDS is used as a proxy, or baseline, of wetland condition to test metrics and develop an IBI. As HDS increases we can assume that wetland condition decreases. Metrics that respond along this gradient are combined to produce an IBI that can differentiate levels of condition.

Why Wetlands?

Wetlands are an often neglected water resource. Water quality issues often revolve around higher profile lakes and streams. This is natural given the recreational opportunities and drinking water that lakes and streams provide, as well as the aesthetic beauty of many of these water bodies. Many wetland conservation efforts are initiated under the auspices of improving the quality of lakes and streams. Wetlands however, are a valuable water resource in their own right and deserve similar attention.

Historically, wetlands have often been thought of as "wastelands", and many have been destroyed in favor of more economically productive land or more efficient waterways. Putting this idea into perspective, it has been estimated that Minnesota has lost approximately 50% of its pre-European settlement wetland acreage due to draining and filling activities. In addition to this loss in area, the biological condition of many existing wetlands is decreasing due to a variety of factors such as pollution, hydrologic changes, and introduced invasive species. As environmental awareness increased during the latter half of the twentieth century, wetland conservation issues began to receive attention. By the late 1980's and early 90's the federal government adopted a national policy to achieve "no net loss" of wetland acreage in an attempt to halt the loss of wetlands. In addition, the Clean Water Act (1972) and the Minnesota Wetland Conservation Act (1991) set forth clear goals of maintaining and promoting the biological integrity and diversity of wetlands in Minnesota. While some of these legislative goals have been in place for over thirty years it is only now that the tools are being developed to begin to assess and monitor the condition of wetlands.

Why Plants?

Along with algae, plants are primary producers and are the base of the wetland food chain. This is reason enough for plants to be recognized as important to wetland ecology. Plants, however, do much more. They play important roles in many of the physical and chemical processes that occur in wetlands. They provide habitat and structure for other aquatic life. Wetland plants are associated with many of the services from wetlands that we find valuable. For example, plants can slow the movement of water, thereby allowing sediments to settle out of the water column and increasing downstream water quality. Wetland plants can also increase water quality by taking up nutrients and chemicals from the water column and sediments and incorporate them into their tissues.

Wetland plants have adapted to the natural conditions present in wetlands and are therefore often ill adapted to changes in those conditions. This includes nutrient regimes, water clarity, hydrology and many other factors. Thus, plants are responsive to their environment and often can indicate a past or ongoing disturbance. Plants are found in almost all wetlands and they are relatively easily identified by people with a minimum amount of training. As a result, plants can be effective indicators of wetland condition and the IBI is an important tool that can be used to interpret often complex changes occurring in wetlands.

CITIZEN VEGETATION IBI

Humans have developed a multitude of indicators that range in use from assessing our personal health to assessing the global economy. In the most basic sense, an indicator is a measurement that we can easily obtain that helps to explain a complex phenomenon. An example of this is human body temperature and human health. In general, human health is a very complex subject that depends on many factors and definitions. However, we know that when we are "healthy" we have a fairly constant body temperature. If there is a deviation from that temperature, such as a fever, this *indicates* an "unhealthy"

condition. The purpose behind the citizen vegetation IBI is to indicate whether a wetland is "healthy" or "unhealthy".

The IBI, or multimetric, approach consists of determining multiple attributes of the biological community that change in predictable ways in response to human disturbances from sites with the least amount of human disturbance to sites that are very disturbed. Once individual metrics are identified, scoring criteria are established so that the different metrics can be combined together to produce an IBI. The advantage of this approach is that different aspects of the biological community can be integrated into one encompassing index. IBI methodology was first developed for fish communities in streams during the 1980's. Since then, IBIs have been applied to many different types of organisms, ecosystems, and geographic settings.

The citizen vegetation IBI presented here is an outgrowth from a technical IBI developed by biologists at the MPCA. There are two main differences between these two IBIs. The first is the level of plant identification. The technical IBI relies on species level identification, whereas the citizen IBI more or less relies on genus level identification. In the hierarchy of biological naming, the genus level of classification is slightly less detailed than species. The second difference is the number of metrics. The technical IBI has ten metrics and the citizen IBI has seven.

Both the technical and citizen IBIs were developed for use in depressional wetlands (i.e. wetlands not associated with a stream or a lake) that have marsh vegetation in the North-Central Hardwood Forest region of the state (commonly known as the deciduous forest which includes most of the Twin Cities metro area). Marshes are characterized as being open (i.e. they do not have trees growing over the entire basin), having standing water for the majority of the growing season (up to a meter deep), with a mixture of herbaceous (non-woody) emergent and aquatic plants. Because the citizen IBI was developed within these constraints, users are not advised to apply the IBI for management purposes to other wetland types or wetlands in other regions of the state.

Citizen IBI Metrics

The citizen vegetation IBI includes the following seven metrics:

1) *Vascular Genera*

   In many different ecosystems, it has been observed that the number of different organisms (i.e. richness) decreases as human disturbance increases. In wetlands, undisturbed plant communities usually have a rich set of native plants, but as they become more disturbed they are often overrun by a handful of tolerant species (these tend to be introduced invasive species). Based on this principle, the Vascular Genera metric measures the richness, or number of different kinds, of vascular plant genera.

2) *Nonvascular Taxa*

This metric is similar to the Vascular Genera metric in principle, but it evaluates a different group of wetland plants, the nonvascular plants which includes mosses, liverworts, and lichens. With the exception of blue-green and green filamentous algae, which are not included in this metric, the richness of nonvascular plants tends to decrease with increased disturbance.

3) *Grasslike Genera*

The Grasslike Genera metric is also similar to the Vascular Genera metric but it measures the richness of a more specific type of vascular plant. The grasslike plants include the Grasses as well as the Sedges, Bulrushes, true Rushes, and related genera that have similar growth forms and structure. A minimally disturbed wetland typically supports five or more genera of Grasslikes, some of which are dominant (i.e. very abundant) and some that are more sparsely growing.

4) Carex *Cover*

This metric is based on the extent of the wetland covered by members of the genus *Carex* (Sedge). There are several *Carex* species that are common dominant wetland species in Minnesota. The abundance of these species tends to decrease with an increase in disturbance, therefore the greater extent of *Carex* in the wetland the higher the score.

5) Utricularia *Presence*

Utricularia (Bladderwort) is a genus of carnivorous plants that feed on microinvertebrates. As such, presence or absence of *Utricularia* is indicative of stresses to both wetland plants and animals. Bladderwort's presence in a wetland suggests good condition.

6) *Aquatic Guild*

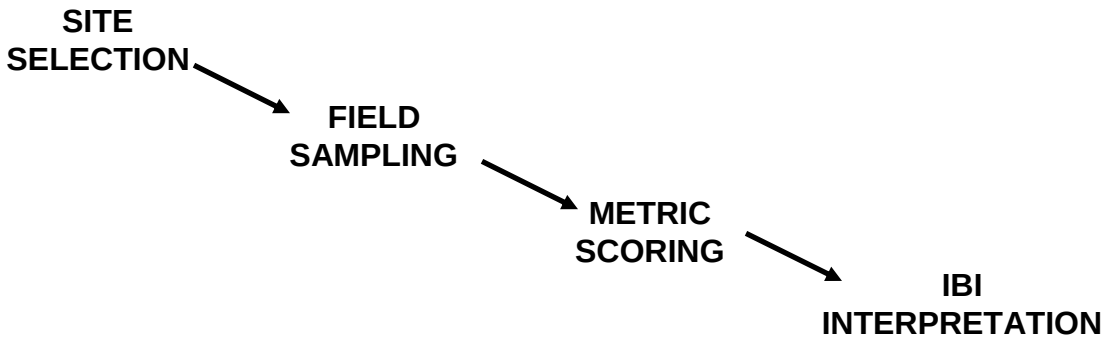
Ecologists have long sought to classify plants into groups based on growth forms or how they function in the environment. This metric specifically considers the aquatic plants (plants that float on the water surface or grow entirely underwater). Because of their habitat requirements, aquatic plants can be sensitive to changes in the aquatic environment, such as turbidity. The richness of aquatic plants tends to decrease as human disturbance increases.

7) *Persistent Litter*

This metric measures the abundance of certain plants whose leaves and stems decompose very slowly after senescence. The greater the abundance of these plants in a wetland means that more nutrients are tied up in undecomposed plant material for a longer time. The extent of persistent litter plants tends to increase with increased disturbance.

WETLAND CONDITION ASSESSMENT

Wetland condition assessment using the citizen vegetation IBI can be broken down into four basic steps:



Before you can go through this process it is important that you identify why you want to do a wetland condition assessment. What are the specific questions that need to be answered by conducting assessments? Is this a WHEP sponsored activity and if so are there any specific outcomes? Are there specific educational goals? These are just some of the possible questions you should answer before beginning the wetland assessment process. A good plan will aid you throughout the entire process by highlighting some overall goals and objectives.

Site Selection

If you have already selected your wetlands, feel free to move ahead to the next section.

There are three major factors that need to be considered when you are selecting potential wetland study sites:

1) Is the site samplable?

   The IBI is designed for use in depressional wetlands with emergent marsh vegetation in Central Minnesota. The applicability of the IBI in other wetland types and geographic areas has not been tested; therefore, it is unknown whether the IBI can perform well as an indicator in other wetland settings. Use of the IBI for assessing river floodplain wetlands, lake shoreline, temporary forest pools, bogs, forested wetlands, and wet meadows is not encouraged because of this.

2) What are the needs of your WHEP sponsor?

   If you are assessing wetlands as part of a WHEP sponsored effort, the sponsor (e.g. city, county, etc) may have specific wetlands they need to have assessed.

3) Is the wetland or access to the wetland on private property; and if so, do you have permission to sample?

   Many of the wetlands in the Twin Cities metro area are on public lands. However, smaller wetlands and wetlands outside of the metro may be privately owned. Also, a wetland may be publicly owned but completely surrounded by private land. *Always* obtain landowner permission before entering private property.

Field Sampling

The vegetation IBI requires information about the different kinds of plants growing in the wetland as well as information about how abundant those plants are. There are numerous ways to sample plant communities to gather these data. You may have heard about sample plots or sampling along transects. The sampling technique presented here is a method adapted from the Department of Natural Resources County Biological Survey and Natural Heritage Program (http://www.dnr.state.mn.us/ecological_services). This sampling method originates from Europe and is called a releve (pronounced rel-eh-vay) sample. Essentially a releve is one large plot which is used to characterize the target plant community.

Protocol

1) *Record site information*

Some basic site information should be recorded when you arrive at a selected wetland. Please record this in the site information field sheet (p. 12). You should record location information, a brief site description, and draw a rough sketch of the wetland.

The location information is extremely important to document because wetlands can sometimes be confused with each other, particularly in an area that has many wetlands. If a Global Positioning System (GPS) unit is available from your local sponsor or someone in your team has one, please record the coordinates of the wetland in UTM (Universal Transverse Mercator) units, giving the easting (x) and northing (y) coordinates and the datum that the GPS is set to. If a GPS is not available, the next preferred method of location information is recording Township, Range, and Section coordinates from US Geological Survey topographic maps. Your local sponsor may be able to provide the maps to you. Finally, if neither of these two options is available, please record detailed street directions to the wetland.

The site description and site sketch should include a lot of the same information. Please describe/sketch the different vegetation zones in the wetland, the approximate wetland size, the water pathways, surrounding land use practices, and any point source pollution inputs such as stormwater pipes.

2) *Determine the major plant communities in the wetland*

The releve sampling method relies on the observer finding a "representative" location in the wetland that best characterizes the vegetation of the entire wetland to place the sampling plot. Keeping this in mind, you should spend some time determining the major plant communities in the wetland. This can be done while you are completing part 1. Ideally, you should find a place to view the entire wetland. If this can't be done, spend some time walking around the margin of the wetland. Note the major vegetation types in the wetland. Don't focus on specific plant species; instead look at the general vegetation patterns.

3) *Locate a spot for a representative plot*

After you have identified the major vegetative patterns, determine where you would place one 100 m^2 sampling plot that would best capture or represent the vegetation types found in that wetland. This is usually at the emergent/aquatic vegetation interface (Figure 2). If the wetland has predominantly emergent vegetation, locate the plot in the wettest location of the wetland. If there is not an extensive emergent community present, locate the plot where you think one should be. Show the location of your plot on the site sketch.

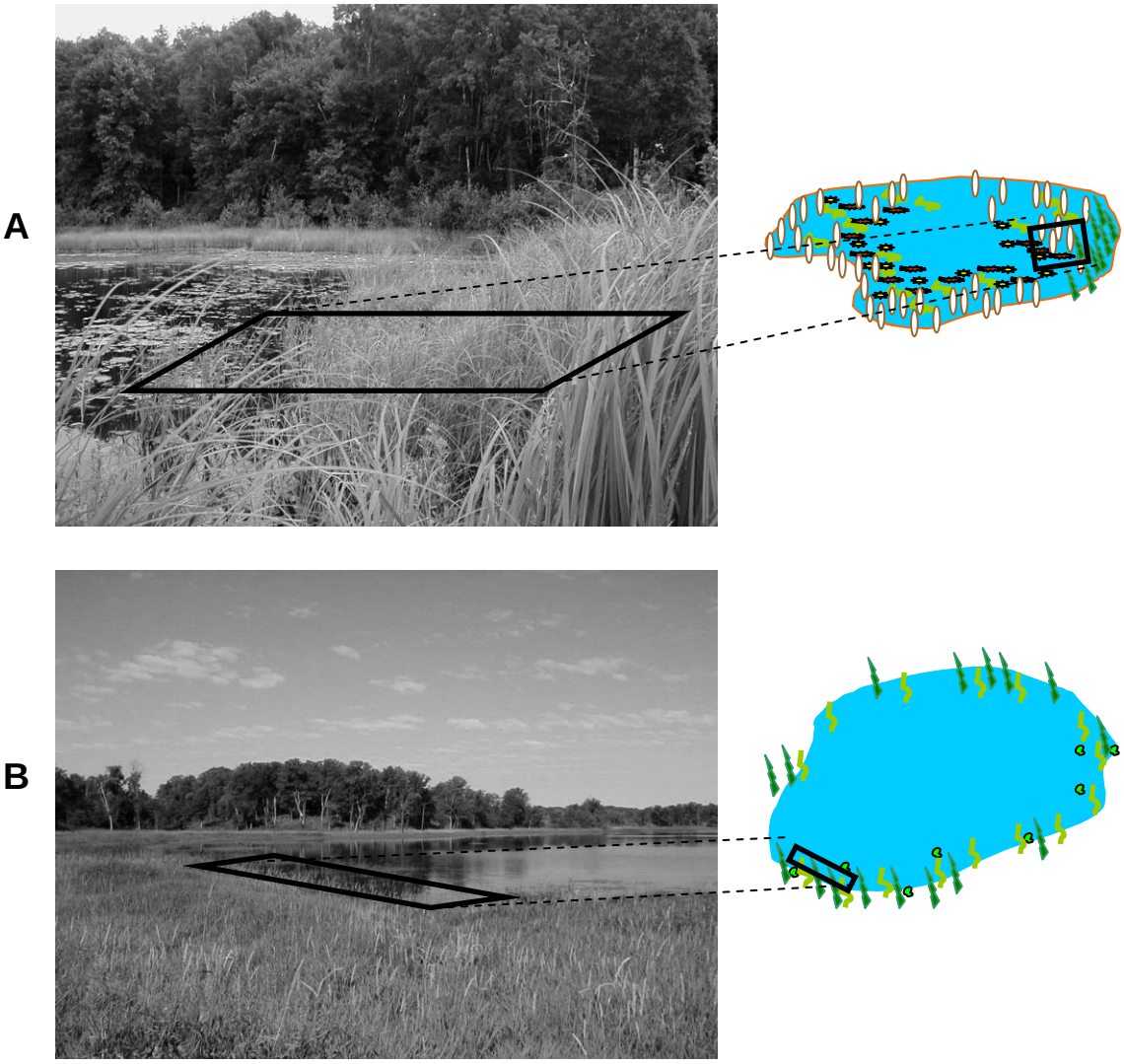


Figure 2. Hypothetical lay-out of a 10 x 10 m (A) and a 5 x 20 m (B) plot in two wetlands. In wetland A there is a relatively wide and diverse emergent wetland fringe. Wetland B, on the other hand, has a very narrow emergent fringe. In the diagrams on the right the symbols represent different vegetation communities. In both cases the plots are located at the emergent/aquatic vegetation interface to capture as many of the different vegetation types as possible.

4) *Determine the plot shape*

The sampling methods presented here rely on a sampling plot with a standard size (100 m^2). The shape of the plot though can be altered depending on the wetland vegetation. The majority of the time, you will use a sampling plot that is square and is 10 m on each side. However, when a wetland has a very narrow emergent fringe the plot can be altered to better capture the emergent/aquatic interface (Figure 2B). In this case you should lay-out a plot that is 5 m wide x 20 m long. As a general rule, only use the 5 x 20 m plot shape when the emergent vegetation fringe is < 5 m wide from the upland boundary to the aquatic vegetation/open water boundary.

5) *Lay-out the plot*

Once you have decided on the location and shape of the plot, you can begin to lay-out the plot. Keep in mind that you want to capture the emergent/aquatic vegetation interface; therefore a portion of the plot should be in each vegetation type. To lay-out the plot, first pick a point to be corner #1. Stake this corner with a tall gardening pole or wooden dowel. Using a tape measure (a 50 m vinyl tape measure is recommended), mark off the first side of the plot, holding the tape measure away from your body and walking outside of the plot area to avoid excessive trampling of the vegetation inside the plot. Stake this point (corner #2). Now turn 90 degrees using a compass, or your best visual judgment, and measure out the second side to corner #3. Repeat these steps, establishing corner #4 and enclosing the plot with four sides. The plot should have an area equal to 100 m^2. Adjust the corners and sides if necessary.

6) *Record releve information*

A releve data sheet is provided on p. 13. At the top of this sheet there is space to record information about the sample plot. Record the releve shape, whether the location of the releve represents the vegetation of the wetland, the shallowest and deepest water depth in the plot, and a brief description of the wetland bottom, or substrate, in this space.

7) *Identify plants within the plot*

Next, inventory the plants within the plot. This is done by "walking the plot" (Figure 3). You must be careful to minimize trampling within the plot. It is ideal if only one or two people walk the plot while a third person records data. For the 10 x 10 m plot shape, begin by starting in corner #1 and walk just inside the plot toward corner #2. Identify and record plants as you go. Proceed around the remaining edge of the plot. After passing corner #4 go about 1/3 of the way down the remaining side of the plot and cut through to the opposite side to observe the vegetation in the interior. When you get to the opposite side, move down another 1/3 of that side and cut through the plot again. Finally, return to corner #1. The plant inventory should now be complete. In very dense emergent vegetation it may be necessary to do a third

interior path to be able to see the entire plot. For the 5 x 20 m plot shape, 4-5 interior paths maybe necessary to complete the plant inventory.

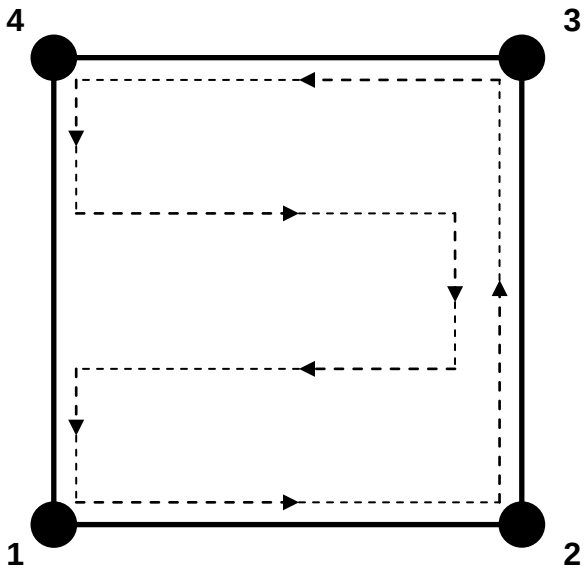


Figure 3. Walking the plot. Begin at corner #1 and follow the arrows until the entire plot has been observed.

Plants need to be identified to the genus level (there are two general exceptions, see the identification guide p. 20). The common wetland plant genera for Central Minnesota are listed on the releve data sheet alphabetically within a descriptive grouping. These are the same plants described in the identification guide. There are also blank spaces provided to record plants that are not already listed on the releve data sheet. Record the genera you encounter in the plot by checking the "Pres", or present, box on the releve data sheet for a corresponding genus.

Plants that are rooted outside of the plot but have stems or leaves extending over and into the plot, should also be included in the sample. For example, if there is a shrub that is clearly rooted outside of the plot, but the branches overhang the vegetation in the plot, that shrub should be recorded as present and the overhanging portion should be given a cover estimate.

There will be plants that you will not be able to identify in the field. It is still important to record these. The data can be used because most of the metrics don't require that you know exactly what a plant is, only that it's in a different genus than the others. If you can't identify a plant in the field, label it as an unknown plant (e.g. unknown grass #1) on the releve sheet. If you think you can identify the plant at home or in a lab, collect the plant in a plastic bag. Be sure to clearly label the bag with the site name, date, unknown plant name assigned to the plant, and the collector name. Plants can keep for several days in the refrigerator. If you can't get to the plant within this time period your best option is to press and dry the plant. Once you have identified the plant please make any necessary corrections to the releve data sheets before scoring the metrics.

8) *Estimate Cover*

Once all of the plants have been identified within the plot, the abundance of those plants can be estimated. Along with richness, abundance data is a basic ecological measurement. Abundance data can be collected in many ways, but probably the easiest method for plants is called cover estimation. Cover is the proportion, or percentage, of the plot area taken up by a particular plant when looking straight down on the plot. Cover estimations have been simplified by using a Cover Class (CC) system. A CC is a representation of a range of cover values (Table 1). Therefore, the observer only has to determine the range of cover a plant has instead of determining the exact cover percentage, making data collection easier.

Table 1. Cover Classes and corresponding ranges of cover.

Cover Class (CC)	Percent Cover Range
6	75-100%
5	50-75%
4	25-50%
3	5-25%
2	1-5%
1	0-1%

Determine a CC (1 – 6) for each plant found in the plot and record this in the corresponding CC box on the Releve Data sheet. An easy way to do this is to visually pack plants into a corner and use that area as a reference (Figure 4). Another way to estimate cover for plants that are sparse is to count individual percentage points and add them up. As a point of reference for this approach, 1% of the plot equals 1 m^2. This is because each plot is 100 m^2. Don't labor over determining CC values. Discuss differing values as a team, and come to a decision as soon as possible.

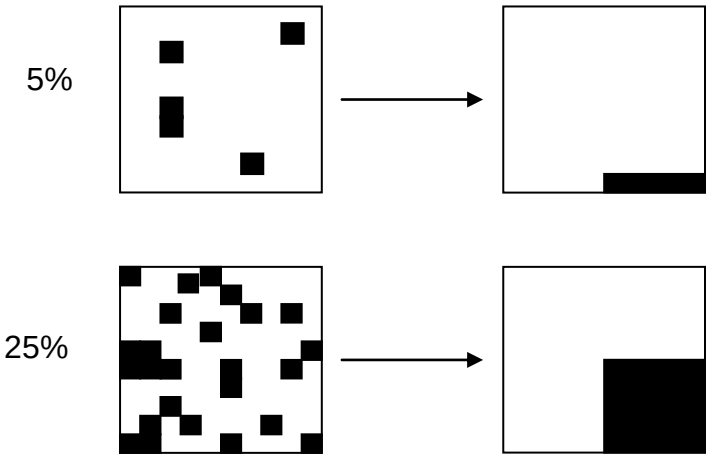


Figure 4. Estimating cover and visual packing. The black squares represent the area that a plant could occupy in a sample plot. If you can visually pack that area into one corner, you have a better frame of reference for making cover estimations.

Additional Sampling Comments

- A field equipment list is provided in Appendix 1 (p. 77).

- A worked example is given in Appendix 2 (p. 78). The example includes completed site information, releve data, and metric scoring sheets.

- The field sheets provided on pp. 12-14 are templates. Please photocopy these and record data on the photocopies.

- Sample during July and early August. The majority of wetland plants can be identified and peak annual growth occurs during this time frame.

- Because of the way that the plants are listed in the releve data sheet, two genera are listed multiple times. The two genera are *Potamogeton* and *Polygonum*. *Potamogeton* has members that are either submergent or floating leaved aquatic forbs. *Polygonum* is a special case because one species (*Polygonum amphibium*) is a floating leaved aquatic forb and is counted in the Aquatic Guild metric, while the other species in the genus are all emergent forbs. If, or when, you encounter these particular duplicates you should count these separately and determine individual CCs *and* record a CC for the entire genus combined in the space for additional comments. This is because in some metrics they should be counted separately and in others they need to be combined.

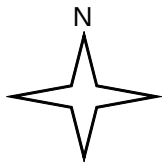
MN WHEP VEGETATION SURVEY FIELD SHEET: SITE INFORMATION

Site Name:_____	Date/Time:_____
Team Leader/Observer:_____	Team Name:_____
Local Sponsor:	County:

Location Information (UTM coordinates from GPS unit, Township Range Section coordinates, or street directions):

Site Description (Include vegetation, water pathway, and immediate land use descriptions. Note any unique plants or plant communities within the wetland but occurring outside of the releve. Did you observe any wildlife while at this site?):

Site Sketch (Include vegetation zones, water inlets and outlets, point source pollution inputs such as stormwater pipes, immediate land use practices, any landmarks, and the location of the releve in the wetland):



MN WHEP VEGETATION SURVEY FIELD SHEET: RELEVE DATA

Site Name:_____ Date/Time:_____
Team Leader/Observer:_____ Team Name:_____
Local Sponsor: County:

Releve Dimensions (circle one): **10 m x 10 m** or **5 m x 20 m** = 100 m^2
Is the releve typical of the wetland plant community ? (circle one): **Yes** or **No** (explain below)
Water depth in the plot (meters): Shallowest:_____m Deepest:_____m
Substrate/bottom description:

Comments:

Note: *Numbers in ( ) refer to the metrics where the data are used*

Pres	CC	NONVASCULAR (2, 6)
		Chara (Muskgrass)
		Lichen
		Moss
		Riccia fluitans (Slender Riccia)
		Ricciocarpus natans (Purple-Fringed Riccia)

Pres	CC	LOW VASCULAR (1)
		Equisetum (Horsetail)
		Onoclea sensibilis (Sensitive Fern)
		Osmunda (Osmunda)
		Thelypteris palustris (Marsh-Fern)

Pres	CC	WOODY (1)
		Vines
		Parthenocissus (Virginia Creeper)
		Vitis riparia (Grape)
		Shrubs or Trees with Opposite Leaves
		Acer (Maple, Box Elder)
		Cornus (Dogwood)
		Fraxinus (Ash)
		Rhamnus cathartica (Common Buckthorn)
		Shrubs or Trees with Alternate Leaves
		Alnus (Alder)
		Frangula alnus (Alder-Buckthorn)
		Populus (Aspen, Cottonwood)
		Quercus (Oak)
		Rubus (Raspberry, Dewberry, Blackberry)
		Salix (Willow)
		Spiraea alba (Meadowsweet)
		Ulmus (Elm)

Pres	CC	GRASSLIKE (1, 3, 4, 7)
		Sedges, Bulrushes, Rushes
		Carex (Sedge)
		Cyperus (Flatsedge)
		Dulichium arundinaceum (Three-Way Sedge)
		Eleocharis (Spike-Rush)
		Juncus (Rush)
		Scirpus (Bulrush)
		True Grasses
		Agrostis (Bent Grass)
		Alopecurus (Foxtail)
		Calamagrostis (Reed Grass)
		Echinochloa (Barnyard-Grass)
		Glyceria (Manna-Grass)
		Leersia (Cut Grass)
		Phalaris arundinacea (Reed Canary-Grass)
		Phragmites australis (Giant Reed)
		Poa (Blue Grass)
		Spartina pectinata (Prairie Cord-Grass)
		Zizania aquatica (Wild Rice)

Cover Class (CC)	Percent Cover Range
6	75-100%
5	50-75%
4	25-50%
3	5-25%
2	1-5%
1	0-1%

Pres	CC	FORBS (1, 5, 6, 7)
Submergent Aquatic Forbs		
		Ceratophyllum (Coontail)
		Elodea (Waterweed)
		Megalodonta beckii (Water Beggar-Ticks)
		Myriophyllum (Water-Milfoil)
		Najas (Water-Nymph)
		Potamogeton (Pondweed)
		Ranunculus (Water-Crowfoot)
		Utricularia (Bladderwort)
		Vallisneria americana (Water-Celery)
		Zannichellia palustris (Horned Pondweed)
Floating Leaved Aquatic Forbs		
		Brasenia schreberi (Water-Shield)
		Lemna (Duckweed)
		Nuphar (Yellow Water-Lily)
		Nymphaea (White Water-Lily)
		Polygonum amphibium (Water-Smartweed)
		Potamogeton (Pondweed)
		Spirodela polyrhiza (Greater Duckweed)
		Wolfia (Water-Meal)
Emergent Forbs with Basal Leaves		
		Acorus (Sweet Flag)
		Alisma (Water-Plantain)
		Calla palustris (Water-Arum)
		Caltha palustris (Marsh-Marigold)
		Iris (Iris, Flag)
		Pontedaria cordata (Pickerelweed)
		Rumex (Dock)
		Sagittaria (Arrowhead)
		Sparganium (Bur-Reed)
		Typha (Cat-Tail)

Additional/Unknown Forbs		

Pres	CC	FORBS (1, 5, 6, 7)
Emergent Forbs from a Distinct Stem		
		Asclepias incarnata (Swamp-Milkweed)
		Aster (Aster)
		Bidens (Beggar-Ticks)
		Campanula aparinoides (Marsh-Bellflower)
		Cicuta (Water-Hemlock)
		Cirsium (Thistle)
		Epilobium (Willow-Herb)
		Eupatorium (Joe-Pye Weed, Boneset)
		Euthamia (Grass-Leaved Goldenrod)
		Galium (Bedstraw)
		Hypericum (St. John's-Wort)
		Impatiens (Jewelweed)
		Lathyrus (Wild Pea)
		Lycopus (Bugle Weed)
		Lysimachia (Loosestrife)
		Lythrum (Loosestrife)
		Mentha arvensis (Field-Mint)
		Pilea (Clearweed)
		Polygonum (Smartweed)
		Potentilla palustris (Marsh-Cinquefoil)
		Scutellaria (Skullcap)
		Sium suave (Water-Parsnip)
		Solanum dulcamara (Nightshade)
		Solidago (Goldenrod)
		Stachys (Hedge-Nettle
		Triadenum fraseri (Marsh St. John's-Wort)
		Urtica dioica (Stinging Nettle)
		Verbena hastata (Blue Vervain)

Additional Comments:

Metric Scoring

Before an IBI can be calculated for a wetland the individual metrics need to be scored. There are two reasons for this:

- All of the metrics need to be on the same scale. Some metrics are based on counts and others are based on percentages and cannot be combined before they are properly scaled.

- All of the metrics need to relate to human disturbance in the same way. Some of the metrics increase with increased disturbance and some decrease.

Metric scoring solves both of these problems. As an example, consider both the Vascular Genera and Persistent Litter metrics. The Vascular Genera metric is a count and ranges from 0 to over 20. The Persistent Litter metric is a percentage, so it really ranges from 0 to 1. If we were to add these two metrics together the Vascular Genera metric would "count" for much more of the total just because the scale is so different. In addition, the Vascular Genera metric tends to decrease with increased disturbance and the Persistent Litter metric tends to increase with disturbance. Again, if these two metrics were added together before being scored, they would have a tendency to cancel each other out in the IBI.

The most common IBI scoring convention is to assign a numerical rating to a raw metric value. The scoring criteria, or the "ratings", are derived by what a biologist would expect the raw metric value to be at minimally disturbed sites (5), moderately disturbed sites (3), and very disturbed or degraded sites (1). For example, the Vascular Genera metric has the following scoring criteria:

Plot Tally	Score
≥20	5
9 - 19	3
0 - 8	1

If 22 different genera were found in a sample plot, that value would be considered indicative of a minimally disturbed wetland and the metric score would be 5. Once all of the metric values are reduced to a score they can be added together to compute the IBI.

Metric scoring sheets are provided on pp. 16-19. There are specific instructions and scoring criteria for each metric on the scoring sheets. A metric scoring example is included in Appendix 2. As with the field data sheets, the scoring sheets should be used as templates. Please photocopy these and use the copies to score metrics.

MN WHEP VEGETATION SURVEY METRIC SCORING SHEET

Site Name:_____ Date Sampled:_____
Team Leader/Observer:_____ Date Scored:_____
Team Name:_____ County:_____
Local Sponsor:

1) Vascular Genera

-Count the number of different genera of low vascular plants (Ferns & Horsetails), woody plants, grasslikes, & forbs observed within the sample plot. Be careful not to count the same genus twice.

a. Number of **Low Vasculars**: _____

b. Number of **Woody Plants**: _____

c. Number of **Grasslikes**: _____

d. Number of **Forbs**: _____

e. **Plot Tally** (sum of a - d): _____

f. **Metric #1 Score**: _____

Scoring criteria for Vascular Genera

Plot Tally	Score
≥ 20	5
9 - 19	3
0 - 8	1

Comments:

2) Nonvascular Taxa

-Count the number of different kinds of nonvascular taxa observed within the sample plot. Do not count slimy filamentous algae, but note in the comments section.

a. **Plot Tally**: _____

b. **Metric #2 Score**: _____

Comments:

Scoring criteria for Nonvascular Taxa

Plot Tally	Score
≥ 2	5
1	3
0	1

MN WHEP VEGETATION SURVEY METRIC SCORING SHEET

Site Name:_____ Team Name:_____ Date Sampled:_____

3) Grasslike Genera

-Count the number of different kinds of grasslike genera observed within the sample plot (refer to metric #1, part c).

a. Plot Tally: _____

b. Metric #3 Score: _____

Comments:

Scoring criteria for Grasslike Genera

Plot Tally	Score
≥ 5	5
2 - 4	3
0 - 1	1

4) *Carex* Cover

-Estimate the percent cover of *Carex* within the sample plot.

a. *Carex* Cover Class Value: _____

b. Metric #4 Score: _____

Comments:

Scoring criteria for *Carex* Cover

CC Value	Percent	Score
3 - 6	≥ 5%	5
2	1 - 5%	3
0 - 1	0 - 1%	1

5) *Utricularia* Presence

a. Was *Utricularia* present in the plot? **Yes No**

b. Metric #5 Score: _____

Comments:

Scoring criteria for *Utricularia* Presence

Presence/Absence	Score
Present	5
Absent	1

6) Aquatic Guild

-Count the number of different Aquatic Guild genera. This includes the submergent aquatic forbs and floating leaved aquatic forbs listed on the releve data sheet ***and*** *Chara, Riccia fluitans,* and *Ricciocarpus natans*

a. Plot Tally: _____

b. Metric #6 Score: _____

Comments:

Scoring criteria for Aquatic Guild

Plot Tally	Score
≥ 6	5
3 - 5	3
0 - 2	1

MN WHEP VEGETATION SURVEY METRIC SCORING SHEET

Site Name:_____ Team Name:_____ Date Sampled:_____

7) Persistent Litter

-Record the cover class (CC) of each plant taxa listed below that was found in your plot. Determine the midpoint % cover and sum all of the values to score this metric. The midpoint % cover is the middle percentage of the range that a CC represents. Data must be converted from CC to midpoint % before being added together, because the ranges that CC's represent are not equal.

a. Sum of midpoint percent cover:

Plant	CC	Midpoint %
Typha (Cat Tail)	____	_____
Sparganium (Bur-Reed)	____	_____
Lythrum (Loosestrife)	____	_____
Phragmites australis (Giant Reed)	____	_____
Scirpus (Bulrush)	____	_____
Polygonum (Smartweed)	____	_____

Total Midpoint %: _____ (%)

CC	Midpoint %
6	87
5	63
4	38
3	15
2	3
1	0.5

b. Metric #7 Score: _____

Scoring criteria for Persistent Litter

Total Midpoint %	Score
≤ 27%	5
28 - 54%	3
≥ 54%	1

Comments:

IBI Summary

-Tally your results from the seven metrics and add them together to arrive at a wetland vegetation IBI score and condition assessment for the site.

Metric	Score
1) **Vascular Genera**	_____
2) **Nonvascular Taxa**	_____
3) **Grasslike Genera**	_____
4) ***Carex* Cover**	_____
5) ***Utricularia* Presence**	_____
6) **Aquatic Guild**	_____
7) **Persistent Litter**	_____
Total:	_____

Site Score Interpretation

IBI Score	Wetland assessment
26 - 35	Excellent
16 -25	Moderate
7 - 15	Poor

Wetland Condition Assessment:_____

MN WHEP VEGETATION SURVEY METRIC SCORING SHEET

Site Name: _____ Team Name: _____ Date Sampled:_____

Additional Site Remarks

-Please provide any additional information about this site and/or the vegetation survey. Do you think the methods for evaluating the vegetation are adequate for this site? Does the assessment reflect your impressions of the site? Are there any potential threats to the site (e.g. new developments, stormwater inputs, roads, etc)?

IBI Interpretation

An IBI score can be interpreted as a wetland condition assessment according to the IBI assessment guidelines provided in the summary section on the scoring sheets (p. 18). These guidelines are based on the same principles used to score the individual metrics. Meaning that at minimally disturbed, or reference, wetlands we would expect most of the metrics, and therefore, the IBI to score high and vice versa at severely disturbed sites.

The vegetation IBI has been developed to be a reliable indicator of wetland condition; however, ecological condition can be defined in different ways and people can make mistakes that can lead to interpretation inconsistencies. Keeping this in mind, take a moment to evaluate your IBI assessment and comment on it in the additional site remarks space on the last page of the scoring sheets (p. 19). You should ask yourself if the IBI was applied under the correct wetland type, geographic setting, and season. You should also ask if the releve sample accurately characterized the vegetation in the wetland. If, for example, a wetland was a mosaic of Cat-Tail (*Typha*) patches and aquatic communities and the sample plot was located only on a *Typha* patch, the IBI score for the wetland would be artificially low because the entire plant community was not represented adequately in the releve. These are the types of errors you should pay particular attention to. In addition, sometimes a native wetland plant community can be low in diversity but have an "excellent" condition. An example of this are Wild Rice (*Zizania*) ponds which can be relatively low in diversity but known to have a high condition because *Zizania* is very sensitive to hydrologic changes and sedimentation. The important thing to account for is if the IBI assesses the site accurately and why.

WETLAND PLANT IDENTIFICATION GUIDE

This portion of the citizen guide provides the plant identification resources necessary to complete the citizen vegetation IBI. At the heart of this plant guide is an identification key that will allow you to identify most of the plants you will likely encounter. The plant guide also includes: a table of contents for the key, brief descriptions of the plants, a glossary and plant morphology diagrams to help explain technical language used in the key, scientific and common name indexes, and a one page "key at-a-glance" included in Appendix 3.

The guide, as with the IBI, is intended for use in depressional wetlands in Central Minnesota; therefore, the accuracy of the key decreases if used in different wetland types and in different geographic regions.

Typically, plants are identified to the genus level with two general exceptions. The first is the use of higher, or more general, taxonomic divisions for the nonvascular plants (Mosses and Lichens), because identification of these plants to genus is too difficult for this guide. The second is the use of full species names for some selected plants. This was done when there is only one species in that particular genus that occurs in depressional wetlands in Central Minnesota. This was also done for a special case where the species *Polygonum amphibium* (Water-Smartweed) was keyed separately from the

rest of the genus, because *P. amphibium* is counted in the Aquatic Guild metric and the other members of the genus are not.

The plant guide primarily uses Latin scientific plant names as opposed to common names (though common names are given in parentheses). This is because plants can often have several common names, or a common name can refer to several different plants. Scientific names, on the other hand, are more precise and in general more stable.

How to Use the Plant Key

Botanists use what are called dichotomous keys to identify plants. Dichotomous keys consist of a series of pairs, or "couplets", of descriptions which are pathways for identifying an unknown plant. A plant is identified by choosing the description in a couplet that best applies to the plant and then the user proceeds to the next couplet indicated. This is repeated until ultimately the plant is identified.

The key provided in this guide relies on similar principles. Plants are identified by following a series of descriptions. To identify a plant, first start at the top of the first page of the key (p. 27) and follow the arrows down to the first series of descriptions. Each set of arrows identifies a set of descriptions that need to be weighed against each other simultaneously. Choose the description that best fits the plant in question and go to the corresponding page given. Once at that page, start at the top and repeat the same process until you have identified the plant. The additional information given in the detailed plant descriptions (pp. 60-69) will also be useful for identification.

Key Points

While the process of using this key is relatively straightforward, there are a few points that you should be aware of.

- Always *read the entire set of description*s before moving to the next step in the key or deciding what the final identification is. Keep in mind that the descriptions at any step of the key are *context specific*, meaning that they are only reliable within the context of the key as a whole. Line drawings, or in some cases photographs, of the most common or representative members of the genera are given to aid identification; however, it is the *written description* associated with these figures that should be used to make a final identification. A picture may "tell a thousand words" but it is still only a one-time depiction of a genus that may contain many different species.

- Be aware that you can easily be misled by skipping steps in the key. A key is like a many forked road and if you skip ahead and miss a critical turn you can easily get lost. If you are proceeding and it is obvious that something is wrong; don't try to force it, go back to the beginning and try again. Only after you have become familiar with *both* wetland plants and the key can you confidently skip ahead to specific sections.

- Upon looking through the key you will find that some of the same genera can be identified by a couple of different pathways. The main reason for this is that in general plants are taxonomically classified based on flower morphology and this key almost exclusively relies on growth and vegetative (leaf and stem) characteristics to identify plants. Species can have vastly different growth and vegetative characteristics but have very similar flowers and thus classified in the same genus. For example, some members of the genus *Scirpus* (Bulrush) have triangular stems and some have round stems. In this key the shape of the stem is used as a characteristic to split two broad groups within the grasslike plants and *Scirpus* ends up being keyed to in two different places.

- The first step in the key is a three-way split between three major groups of plants: the nonvascular, low-vascular, and vascular plants (p. 27). These groups differ in the complexity of their vascular tissue (cells that are joined into tubes to transport water and nutrients throughout the plant body). The nonvascular plants lack true vascular tissue, while the vascular plants have advanced organization that allow for efficient fluid transport, and the low-vascular plants have intermediate vascular organization. The problem with this step in the key, particularly for the beginner, is that it is not obvious how these groups differ from one another. Because of this, the key has been designed to allow for the nonvascular plants that are not obviously nonvascular to be identified along the vascular pathway. A tip for getting through this first step is to use a process of elimination. If your specimen is not a Moss or Lichen (the two obvious nonvasculars); and not a Fern or Horsetail (the only low-vasculars) proceed down the vascular plant pathway, and you should be able to identify the plant.

- All of the plants in the key are listed on the releve data sheet (p. 13) for recording data in the field. The lists are organized alphabetically in growth-form groupings. The groupings on the releve data sheet are broader than the groupings in the key. This was done to reduce the number of duplicate genera listings, which could give rise to recording errors. Going back to the *Scirpus* example, there is only one place to list *Scirpus* on the releve data sheet, even though the genus can be keyed to by two different ways. So, if both the round and triangular stemmed *Scirpus* were present in a plot, the *Scirpus* box should be checked *once* and it should all be lumped together for the cover estimation.

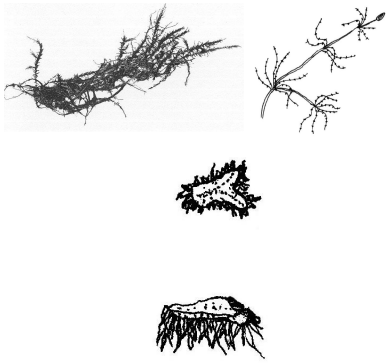
- There will be times when you encounter a plant that you cannot identify using this key. This could be caused by many things: the plant is not included in the key, the plant may not be mature enough, or the plant may be damaged. This is OK. Record the data as an "unknown" and try to incorporate it into the IBI if appropriate (i.e. if you are confident that the plant is from a different genus than the other plants in the plot). The important thing to remember is that your plant identification skills will improve with experience, and that over time you may be able to identify "marginal" specimens.

- You may want to also consult one or more of the many plant identification guides that are available. These guides range from very technical plant taxonomy treatments to less complex guides suitable for beginners. A list of recommended guides is provided in Appendix 1 (p. 77) and a complete listing of the sources used to make this guide is provided in the bibliography (p. 75).

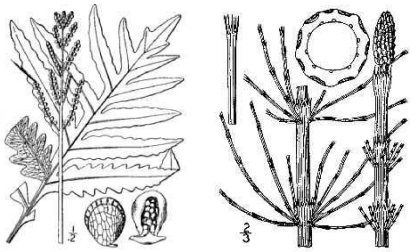
Contents for the Plant Key

General Key to Wetland Plants: Begin here and follow the arrows. Numbers in parentheses refer to the detailed plant description.

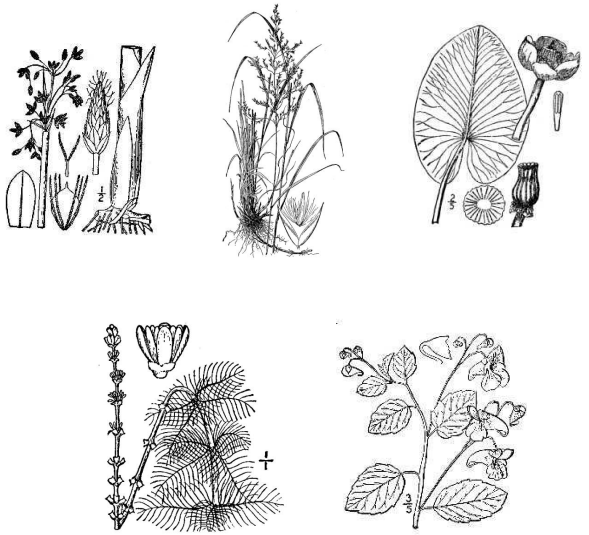
Plants often lacking recognizable leaves and stems, having a fibrous or amorphous leathery structure, or if submerged with regular whorled branches.
NONVASCULAR PLANTS (MOSSES, MUSKGRASSES, ETC): PAGE 28



Plants without flowers, reproducing via spores. Leaves (fronds) emerging from the ground with deeply cut leaf edges or plants with a distinct round vertically grooved stem with (occasionally without) whorls of scale-like leaves.
LOW-VASCULAR PLANTS (FERNS & HORSETAILS): PAGE 30



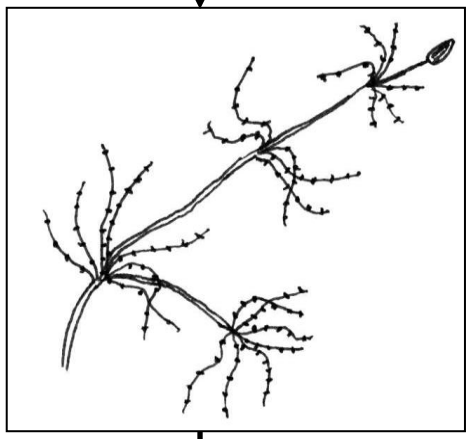
Plants with flowers, herbaceous or woody stems, and leaves, or small (< 3 x 3 cm) floating leaved plants that lack stems.
VASCULAR PLANTS (FORBS, GRASSES, SHRUBS, ETC): PAGE 31



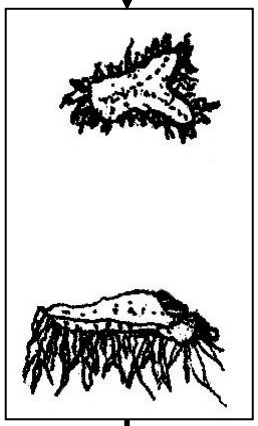
NONVASCULAR PLANTS: Plants lacking recognizable leaves and stems, having a fibrous or amorphous structure or if submerged with regular whorled branches.

Plants aquatic, either submersed or floating on waters surface

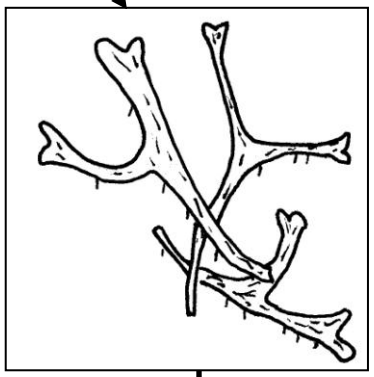
Plants terrestrial, at most growing on saturated soil, commonly growing on surface of other plants and rocks: **MOSSES & LICHENS PAGE 29**



CHARA (Muskgrass)
-Submergent, regular whorls of branches, often has a "musky" odor when crushed (61)

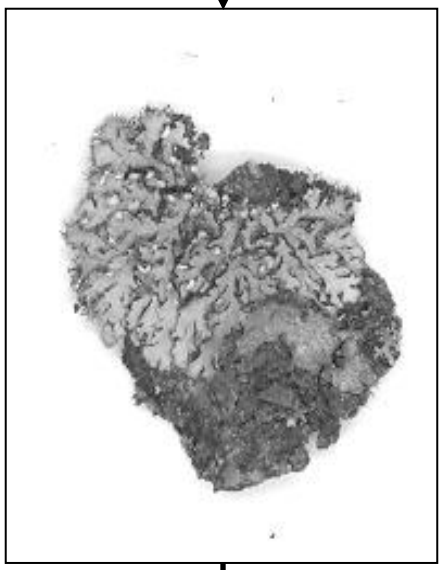


RICCIOCARPUS natans
(Purple-Fringed Riccia)
-Small floating aquatic, many rhizoids, 6 x 15mm (66)

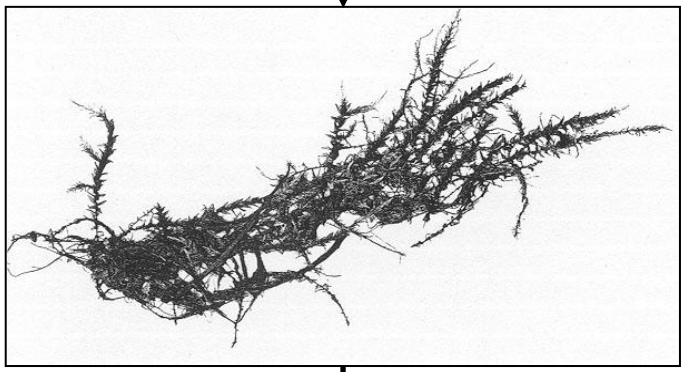


RICCIA fluitans
(Slender Riccia)
-Small floating aquatic, resembles reindeer antlers (66)

MOSSES & LICHENS: Nonvascular plants growing on various surfaces



LICHEN
-Grows on rocks and trees, often leathery or brittle



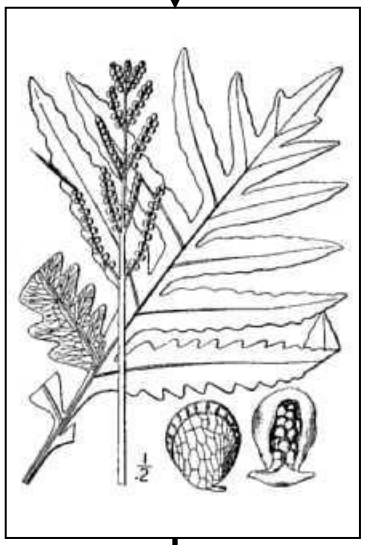
MOSS
-Leaves reduced to scales, grows on various surfaces

Mosses should be noted as a single nonvascular taxon unless certain of distinct moss taxa

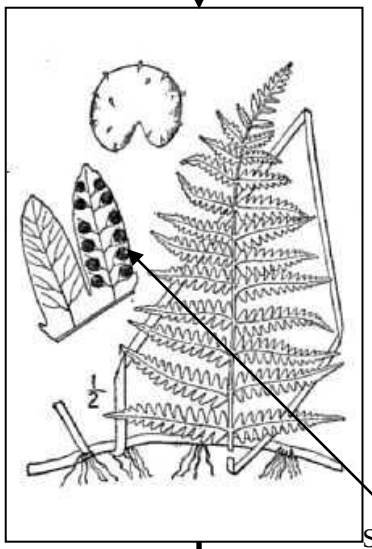
LOW VASCULAR PLANTS (Ferns and Horsetails)

Emergent leaves (fronds) arising in groups from underground stems, leaf edges sculpted or deeply cut: **Ferns**

Plants with stiff, round, and vertically grooved stems that often have whorls of scale like leaves: **Horsetails**

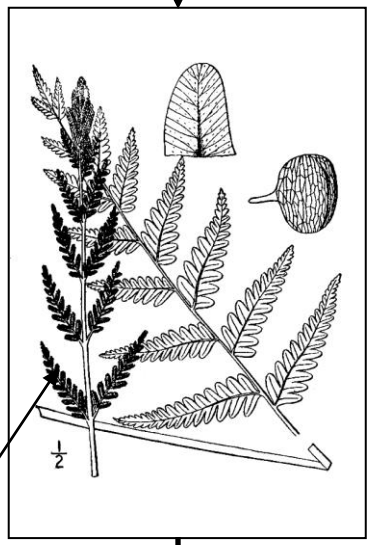


ONOCLEA sensibilis (Sensitive Fern)
-Pinnae shallowly lobed (65)

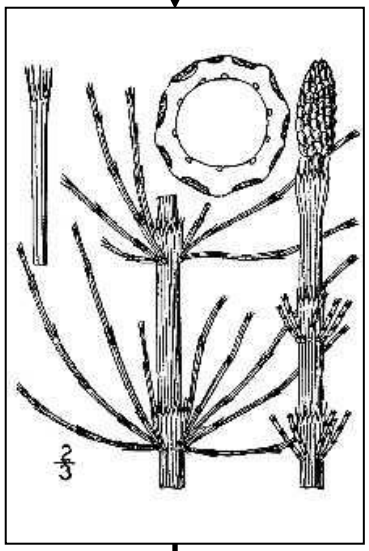


THELYPTERIS palustris (Marsh-Fern)
-Pinnae deeply lobed, frond up to 60cm tall, sori located on backside of pinnae (68)

SORI



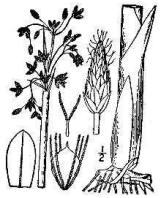
OSMUNDA (Osmunda)
-Pinnae deeply lobed or compound, frond up to 1m tall, sori emerging below pinnae or on a separate stalk (65)



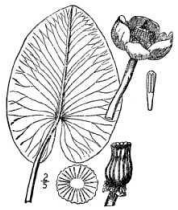
EQUISETUM (Horsetail)
-Stems can be easily pulled apart at the nodes, spores produced in terminal cone-like structures (62)

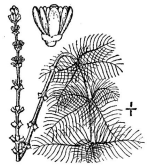
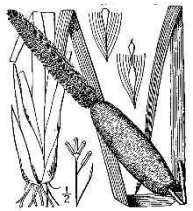
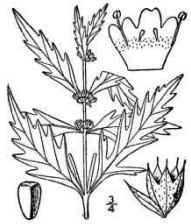
VASCULAR PLANTS

Plants with flat linear leaves arising from distinct stems or basal, or leaves round and like the stem in appearance, or plants appearing only to have a central stem with an apical inflorescence
GRASSLIKE PLANTS (Grasses, Sedges, Rushes, etc): PAGE 32


Herbaceous submergent, floating-leaved, or emergent plants with broad or linear leaves that are not grasslike.
FORBS: PAGE 37



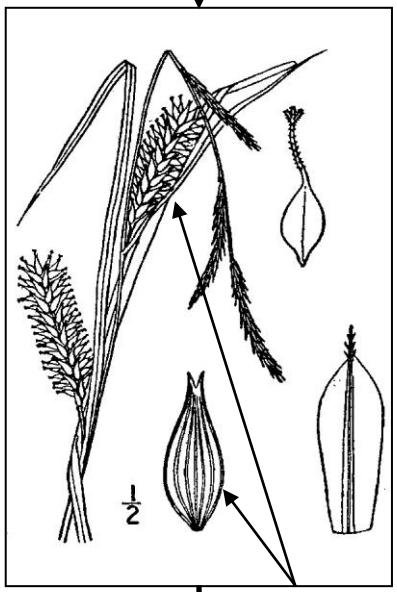





Plants with woody stems.
WOODY PLANTS (Shrubs, Vines, & Trees): PAGE 54


GRASSLIKE PLANTS (Grasses, Sedges, Rushes, etc)

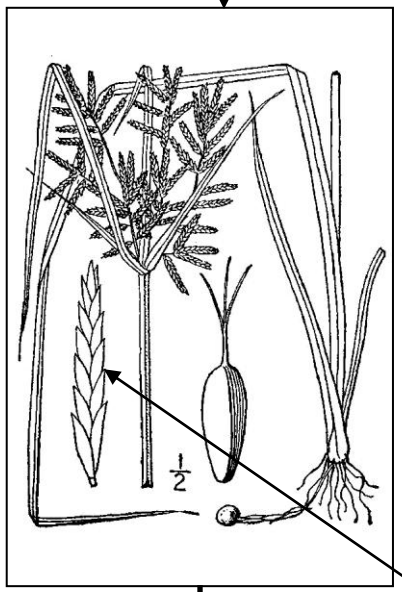
Stem triangular, leaves three-ranked, or apparently leafless

Stem round, leaves two-ranked or apparently leafless: **PAGE 33**



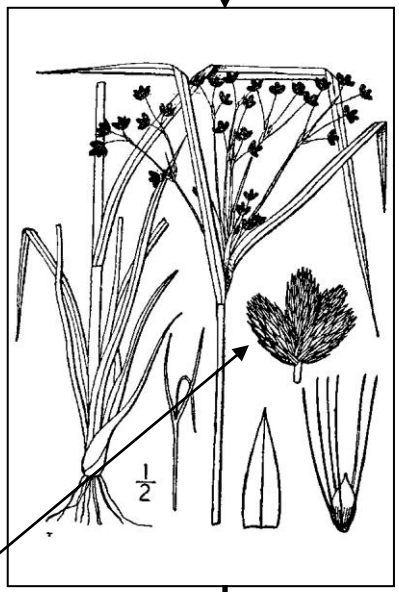
PERIGYNIUM

CAREX (Sedge)
-Flrs enclosed by perigynium, genus includes many species (61)

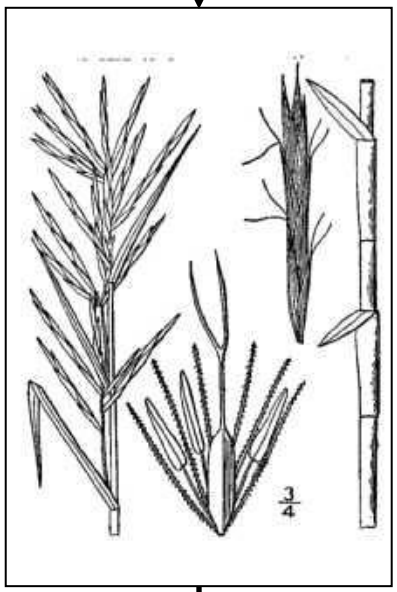


SPIKELET

CYPERUS (Flatsedge)
-Flrs behind scales, spikelets relatively long and flattened (62)



SCIRPUS (Bulrush)
-Flrs behind scales, spikelets relatively ovoid, some species lack leaves (67)

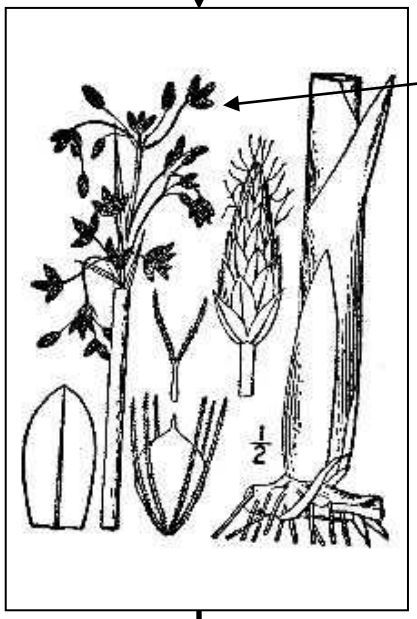


DULICHIUM arundinaceum (Three-Way Sedge)
-Leaves strongly 3-ranked (62)

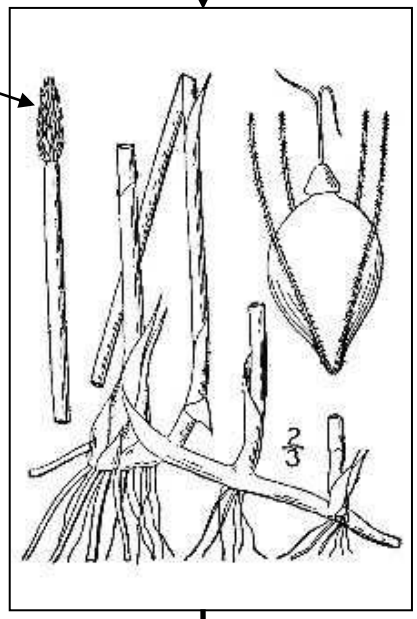
GRASSLIKE PLANTS WITH ROUND STEMS

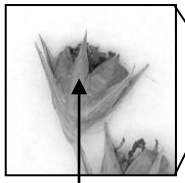
Grasslike plants **without obvious leaves** or the **leaves round** in cross section and similar to the stem

Grasslike plants **with obvious leaves** (leaves **flat** and **distinctly different from stem**), hollow stems
GRASSES PAGE 34

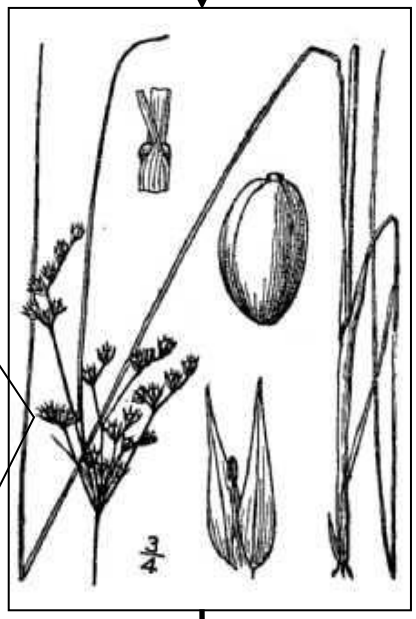


SPIKELET





TEPAL



SCIRPUS (Bulrush)
-No apparent leaves, flrs arranged in spikelets (67)

ELEOCHARIS (Spike-Rush)
-No apparent leaves, majority of stems tipped with a single spikelet (62)

JUNCUS (Rush)
-No apparent leaves or when leaves present round in cross section, flrs subtended by 6 scale-like tepals (63)

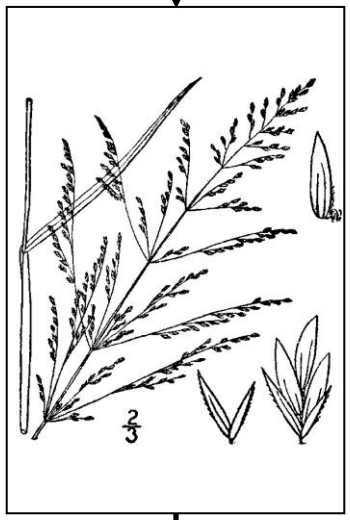
GRASSES

Grasses with **ligules < 2 mm long** and **leaves < 10 mm wide**

Grasses with a **prominent (> 2 mm long) ligule** and a panicle flower arrangement, leaf widths various: **PAGE 35**

Grasses with **leaves > 10 mm wide** and **ligules < 2 mm long** (or absent): **PAGE 36**

AGROSTIS (Bent Grass)
-Delicate grasses usually growing in groups or tufts (60) ****ligule occasionally ≥ 2mm**

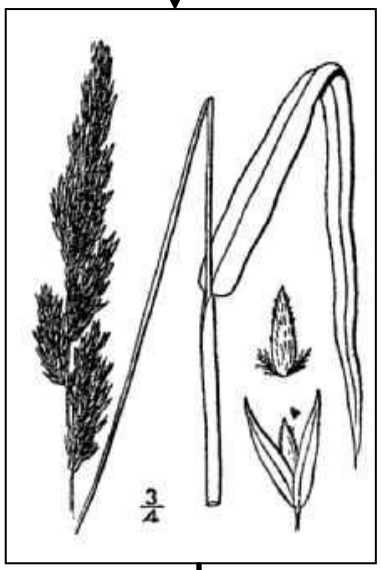


POA (Blue Grass)
-Leaves narrow and delicate ending with a boat keel shaped tip, flrs in an open panicle (65)

SPARTINA pectinata (Prairie Cord-Grass)
-Stout tall grass with long wiry leaves (67)

ALOPECURUS (Foxtail)
-Sprawling grass with flrs in a vertical spike (60)

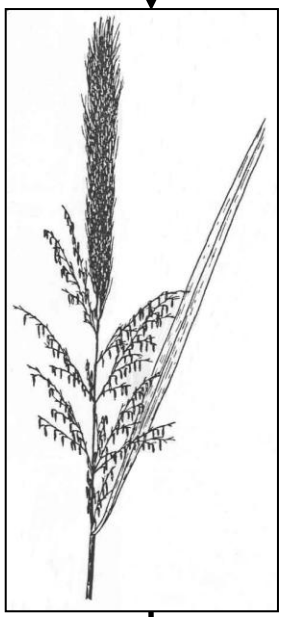
Grasses with a prominent ligule (>2mm)



PHALARIS arundinacea
(Reed Canary-Grass)
-Leaf sheathes opening near top, largest leaves > 10 mm wide (65)

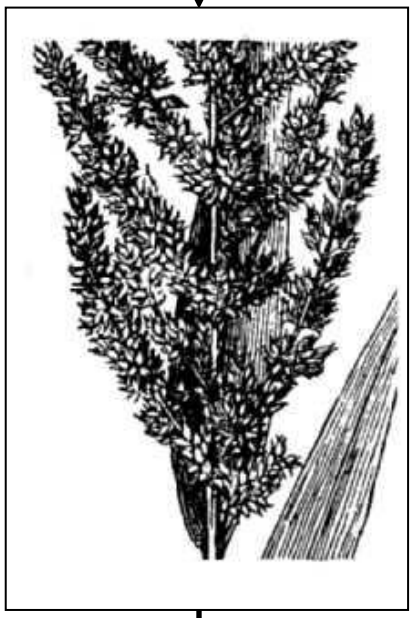
GLYCERIA
(Manna-Grass)
-Leaf sheathes completely closed, leaves strongly 2-ranked (63)

CALAMAGROSTIS
(Reed Grass)
-Leaf sheaths opening near top, largest leaves < 10 mm wide (61)

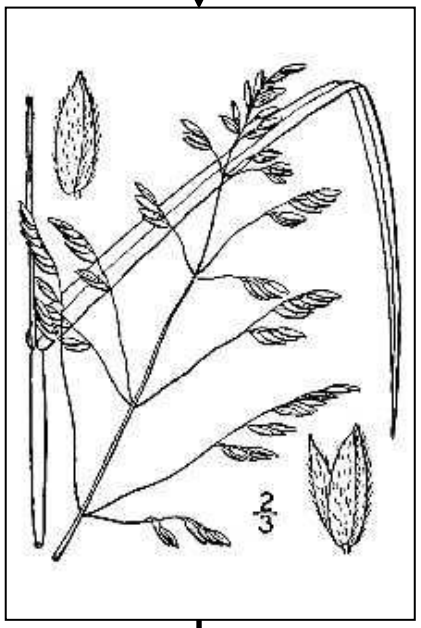


ZIZANIA aquatica
(Wild Rice)
-Almost always found in standing water, female (above) and male (below) flrs separate on same plant (69)

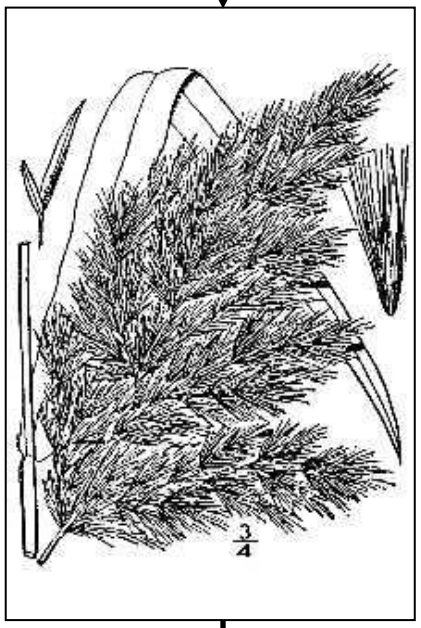
Grasses with leaves > 10 mm wide with ligules < 2 mm long (or absent)



ECHINOCHLOA (Barnyard-Grass)
-Stems strong, ligule absent (62)



LEERSIA (Cut Grass)
-Stems weak and often sprawling, ligule membranous, leaves very rough hairy (64)



PHRAGMITES australis (Giant Reed)
-Stems very stout, usually > 1 m tall, ligule white, 1 mm long (65)

FORBS: Herbaceous submergent, floating-leaved, or emergent plants with broad or linear leaves that are not grasslike

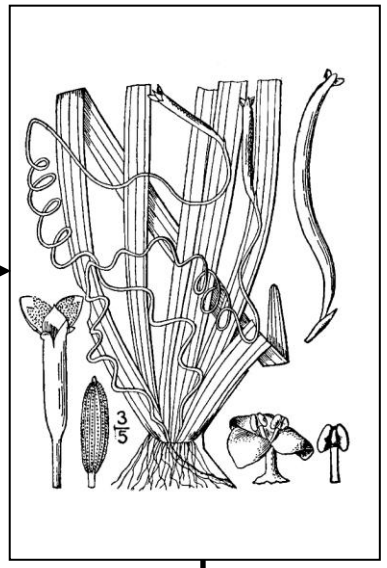
Aquatic forbs, either floating on top of or submersed below the water surface

Emergent forbs, growing on saturated soil or clearly growing above the water surface: **PAGE 43**

Submergent forbs

Floating leaved forbs: **PAGE 41**

Leaves **basal** and linear



Leaves from a distinct stem, **opposite or whorled**: **PAGE 38**

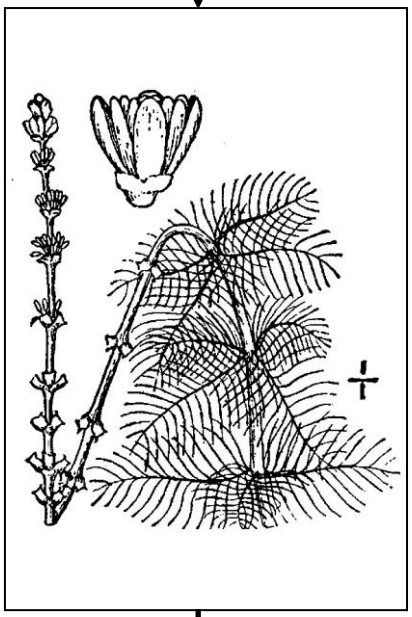
Leaves from a distinct stem, **alternate**: **PAGE 40**

VALLISNERIA americana (Water-Celery)
-Leaves long and ribbon like with a distinct light band down the middle (68)

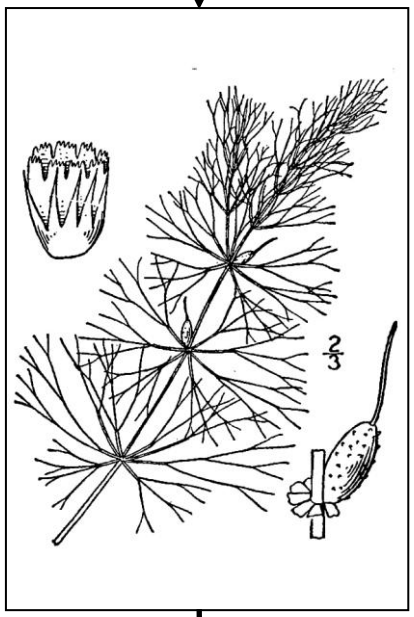
Aquatic submergent forbs with opposite or whorled leaves

Leaves are **compound**

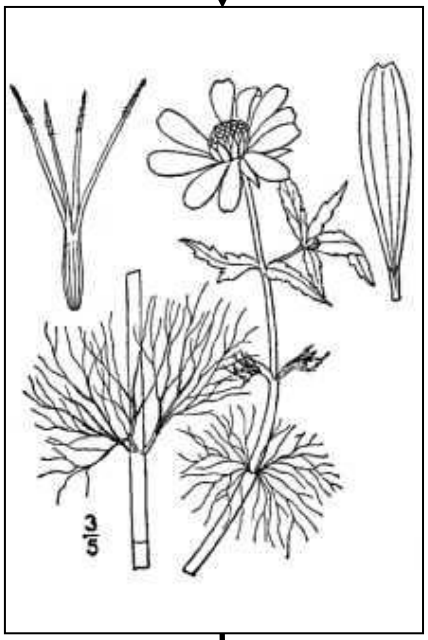
Leaves are **simple: PAGE 39**



MYRIOPHYLLUM (Water-Milfoil)
-Leaves whorled, pinnately compound (64)



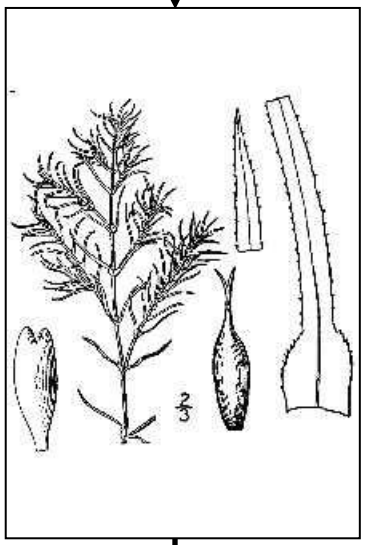
CERATOPHYLLUM (Coontail)
-Leaves whorled and branching, whorls crowded at ends of stems, leaves relatively stiff (61)



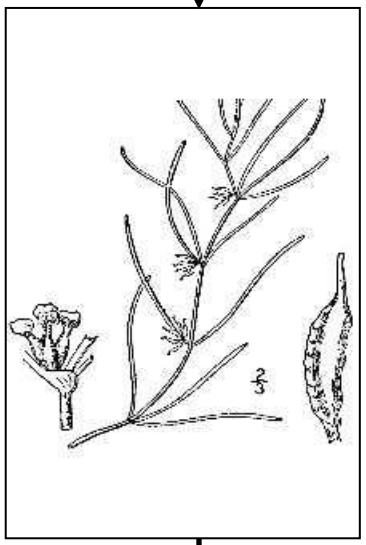
MEGALODONTA beckii
(Water-Beggar-Ticks)
-Leaves opposite or whorled and branching, relatively weak, has broad above water leaves associated with flr (64)

Aquatic submergent forbs with simple opposite or whorled leaves

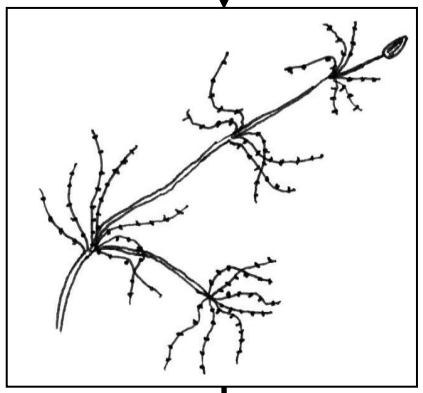
ELODEA (Waterweed)
-Leaves opposite or whorled, 1-2 mm wide, more or less regularly spaced along the stem (62)



NAJAS (Water-Nymph)
-Leaves 0.2-2 mm wide and crowding towards the end of the stem (64)

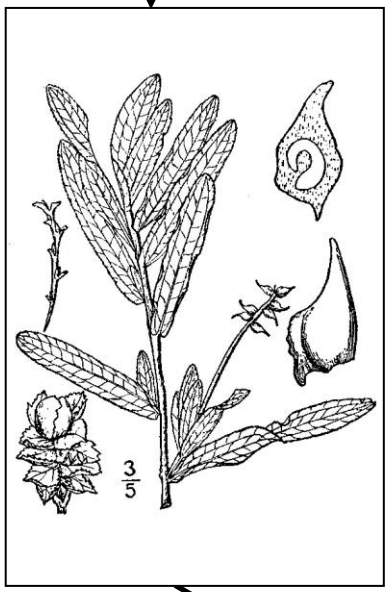


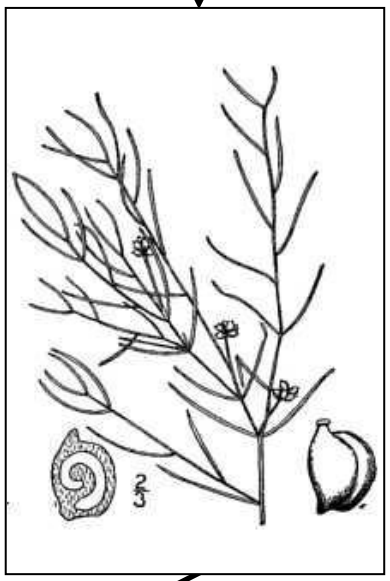
ZANNICHELLIA palustris
(Horned Pondweed)
-Leaves long (2-8 cm) and threadlike (68)



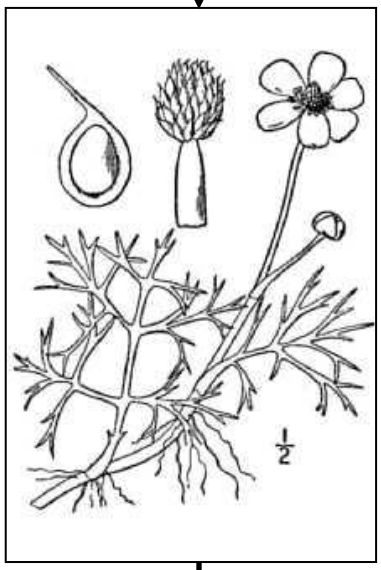
CHARA (Muskgrass)
-Regular whorls of branches, often has a "musky" odor when crushed (31)
** **NONVASCULAR** See p. 28**

Aquatic submergent forbs with alternate leaves

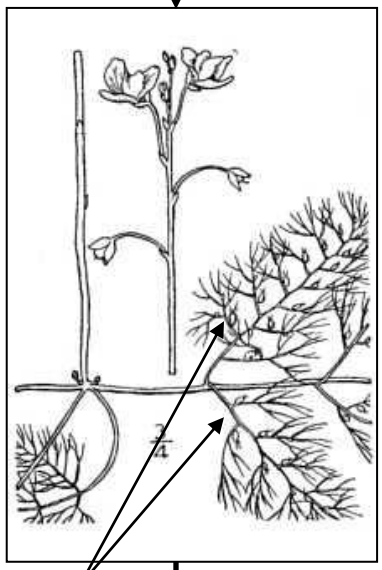




POTAMOGETON (Pondweed)
-Leaves simple, narrow linear to broad, a large genus with many species (66)



RANUNCULUS
(Water-Crowfoot)
-Leaves branching, flrs regular, white or yellow (66)



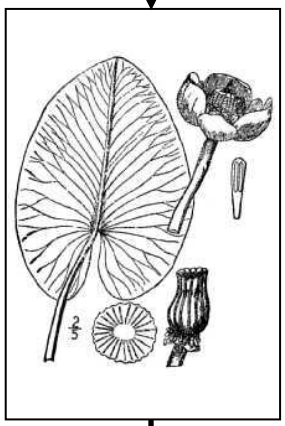
BLADDERS

UTRICULARIA
(Bladderwort)
-Leaves branching with attached sac-like bladders, flrs irregular (68)

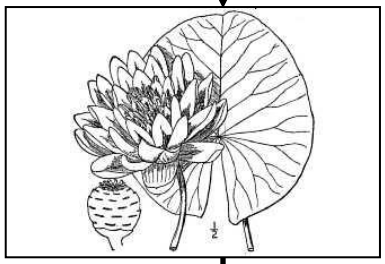
Aquatic forbs with floating leaves

Leaves larger than 3 x 3 cm

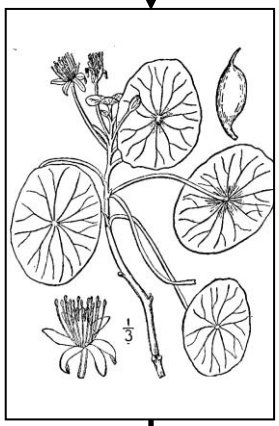
Leaves smaller than 3 x 3 cm: **PAGE 42**



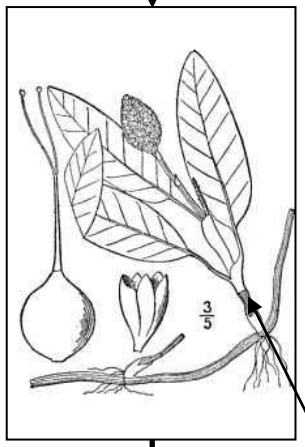
NUPHAR (Yellow Water-Lily)
-Leaves oval with a notch, flrs yellow (64)



NYMPHAEA (White Water-Lily)
-Leaves round with a notch, flrs white (64)

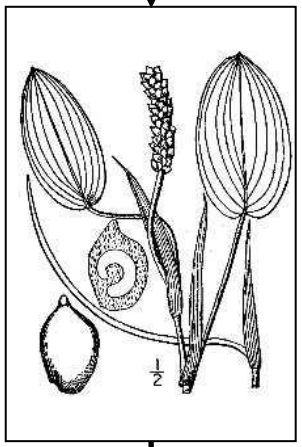


BRASENIA schreberi (Water-Shield)
-Leaves oval without a notch, petiole joins leaf in center (61)



OCREA

POLYGONUM amphibium (Water-Smartweed)
-All leaves ovate, has distinct sheath surrounding leaf nodes (ocrea) (65)

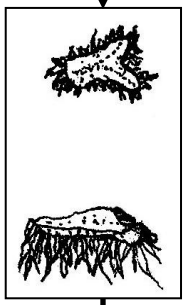


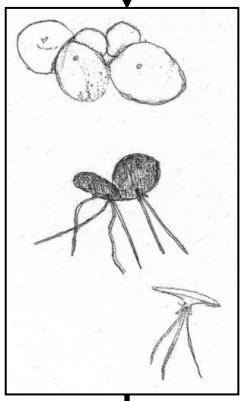
POTAMOGETON (Pondweed)
-Surface leaves ovate-elliptic, underwater leaves otherwise (66)

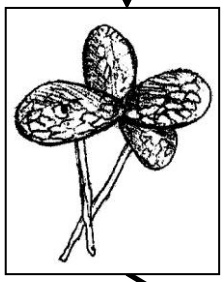
Aquatic forbs with small floating leaves (< 3 x 3 cm)

Has one or more obvious **roots or rhizoids**

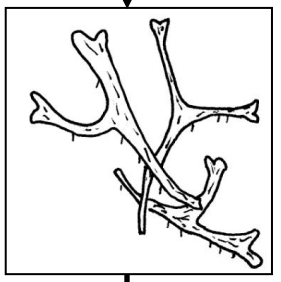
Does not have obvious **roots or rhizoids**







Occasionally with roots



LEMNA (Duckweed)
-1 root per frond, green above and below (64)

WOLFIA
(Water-Meal)
-Very small < 1.5 mm long (68)

SPIRODELA polyrhiza
(Greater Duckweed)
-2 or more roots per frond, green above reddish purple below (67)

RICCIA fluitans
(Slender Riccia)
-Resembles reindeer antlers (66)
****NONVASCULAR** See p. 28 **

RICCIOCARPUS natans (Purple-Fringed Riccia)
-More than 12 rhizoids per individual (66) ****NONVASCULAR** See p. 28 **

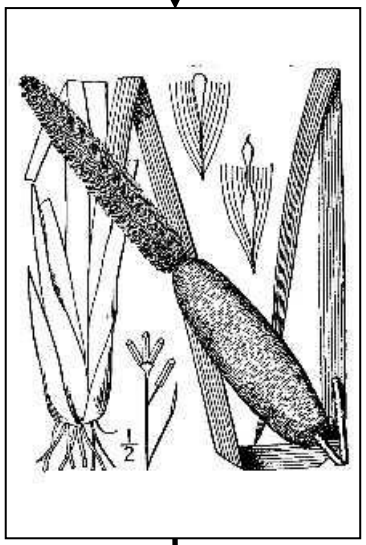
Emergent forbs

Leaves **basal**

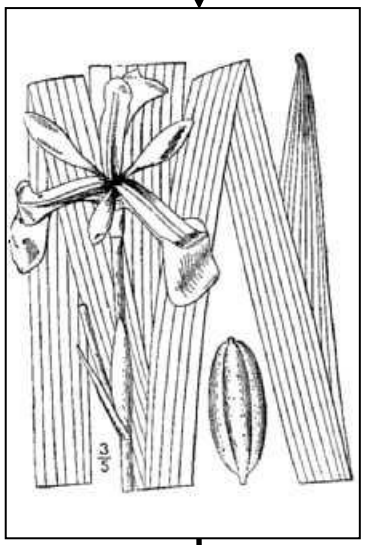
Leaves from a **distinct stem**, though stem may trailing: **PAGE 46**

Leaves **linear**, sword-like

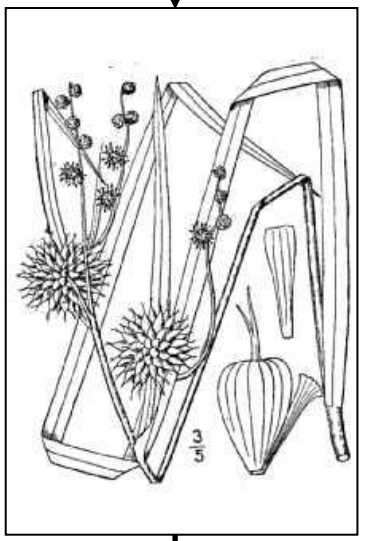
Leaves broad: **PAGE 44-45**



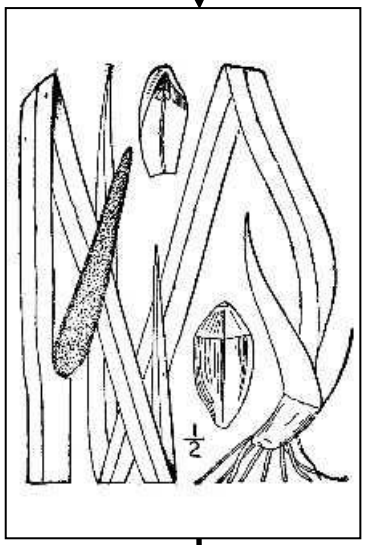
TYPHA (Cat-Tail)
-Leaves flat or crescent shaped in cross section, base of plant round (68)



IRIS (Iris, Flag)
-Leaves flat in cross section, base of plant flattened giving the plant a fan-like appearance (63)

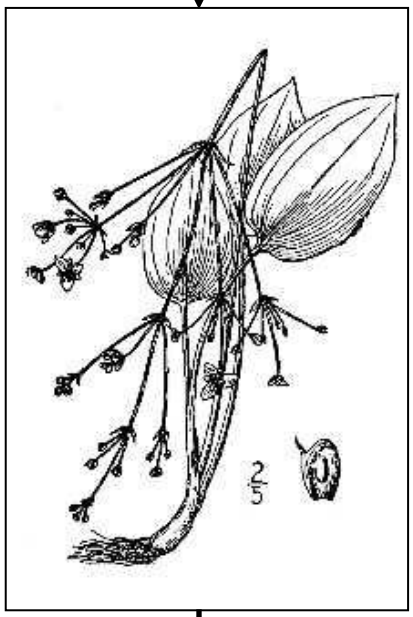


SPARGANIUM (Bur-Reed)
-Leaves triangular in cross section or with a triangular raised midrib on one side (67)

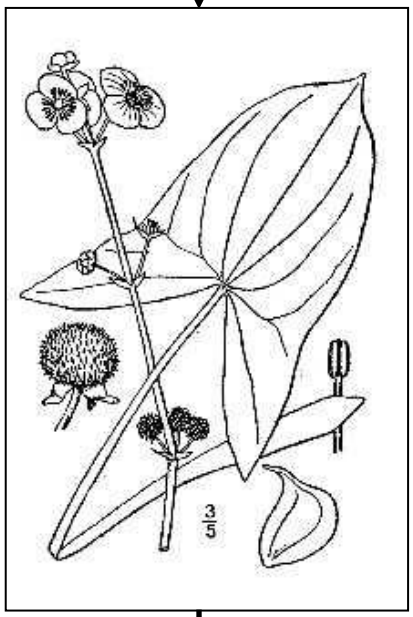


ACORUS (Sweet Flag)
-Leaves with distinct raised midrib on both sides, sweetly aromatic when crushed (60)

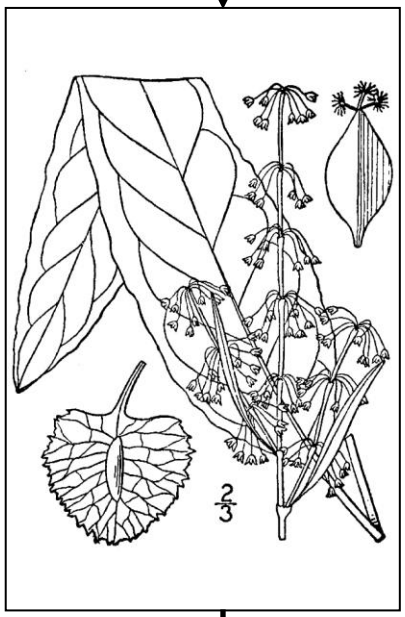
Emergent forbs with broad basal leaves



ALISMA (Water-Plantain)
-Leaves elliptic, never arrow shaped, flrs in a panicle arrangement (60)



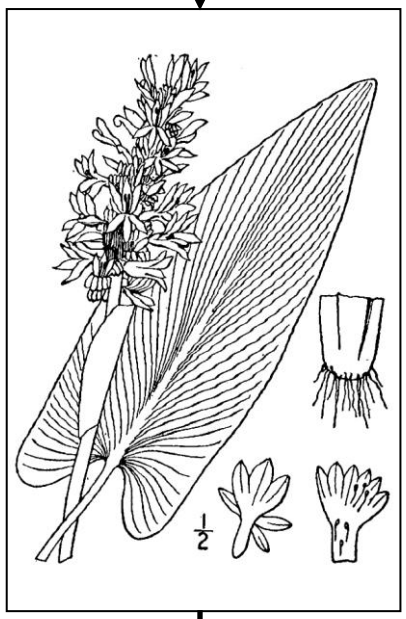
SAGITTARIA (Arrowhead)
-Leaves often arrow shaped (sometimes elliptic like *Alisma*), flrs whorled around the stem (66)



RUMEX (Dock)
-Basal leaves lanceolate-ovate and large 10-60 cm long, distinct flowering stalk stout (up to 2 m tall) (66)

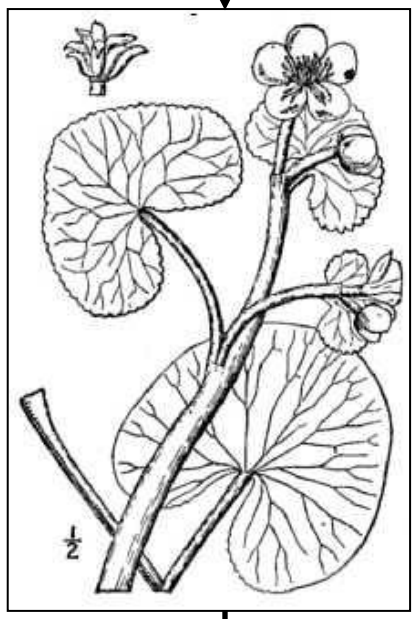
Continued on P. 45

Emergent forbs with broad basal leaves (Continued from P. 44)



PONTEDARIA cordata
(Pickerelweed)
-Leaves cordate with entire margins, flrs blue-purple (65)

CALLA palustris
(Water-Arum)
-Leaves cordate with entire margins, inflorescence creamy white (61)



CALTHA palustris
(Marsh-Marigold)
-Leaves cordate-kidney shaped, margins serrated (61)

Emergent forbs with leaves from a distinct stem

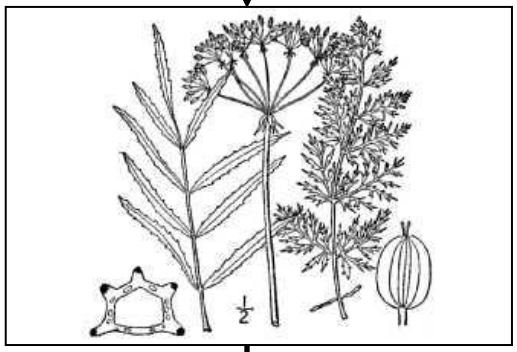
Plants **erect**

Plants **sprawling or twining** amongst other plants: **PAGE 47**

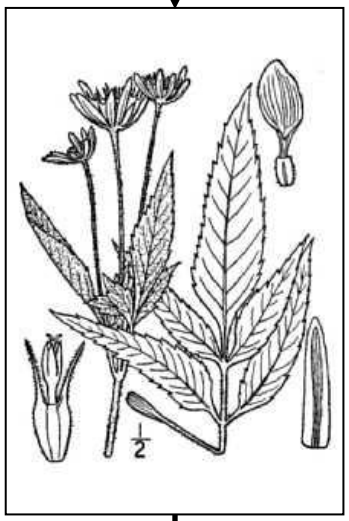
Leaves **compound**

Leaves **simple: PAGE 48**

CICUTA (Water-Hemlock)
-Leaves alternate, twice compound, leaflets 1-35mm wide (62)



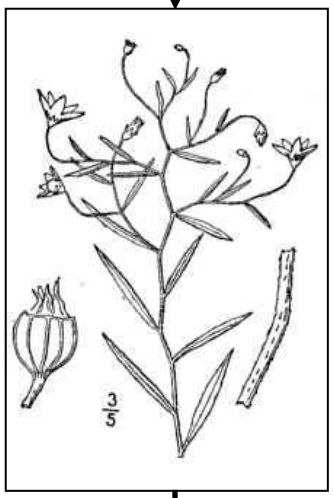
SIUM suave
(Water-Parsnip)
-Leaves alternate, 3-15 wide, with fine sharply pointed teeth (67)



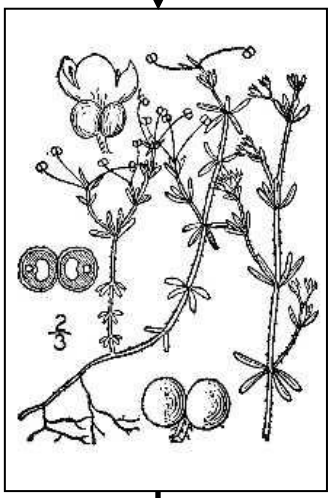
BIDENS
(Beggar-Ticks)
-Leaves opposite, 3-5 leaflets (61)

POTENTILLA palustris
(Marsh-Cinquefoil)
-Leaves alternate, 5-7 leaflets, stem sprawling, petioles upright (66)

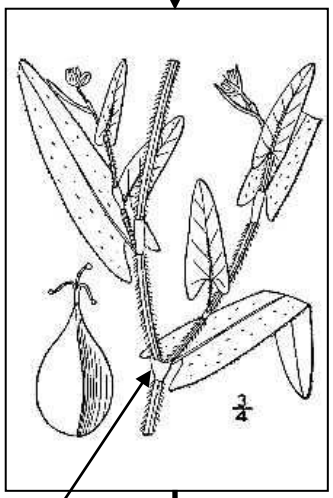
Emergent sprawling and/or twining forbs



CAMPANULA aparinoides
(Marsh-Bellflower)
-Leaves alternate, stems rough hairy, flrs white (61)

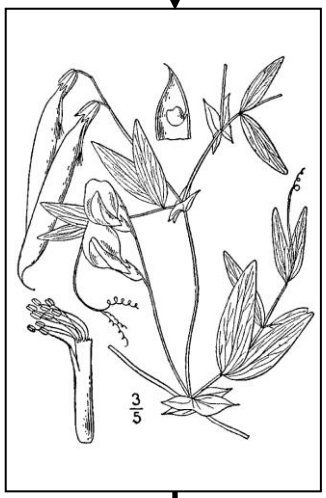


GALIUM
(Bedstraw)
-Leaves whorled, stems rough hairy, flrs white (63)

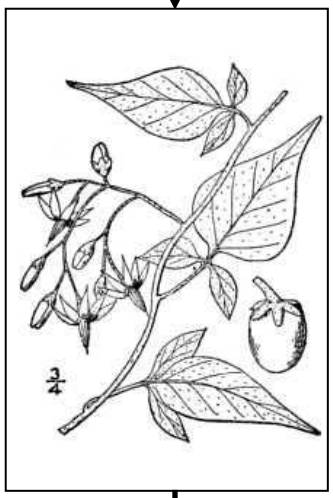


OCREA

POLYGONUM
(Smartweed)
-Has distinct sheath surrounding leaf nodes (ocrea), leaves alternate (65)



LATHYRUS
(Wild Pea)
-Leaves pinnately compound, leaflets linear-lanceolate (64)



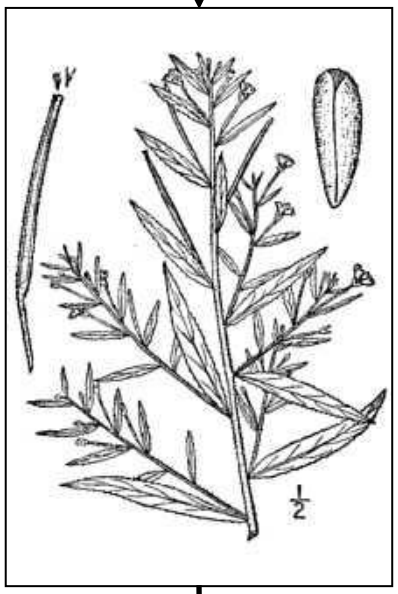
SOLANUM dulcamara
(Nightshade)
-Leaves compound and/or deeply lobed, leaflets ovate (67)

Emergent erect forbs with simple leaves from a distinct stem

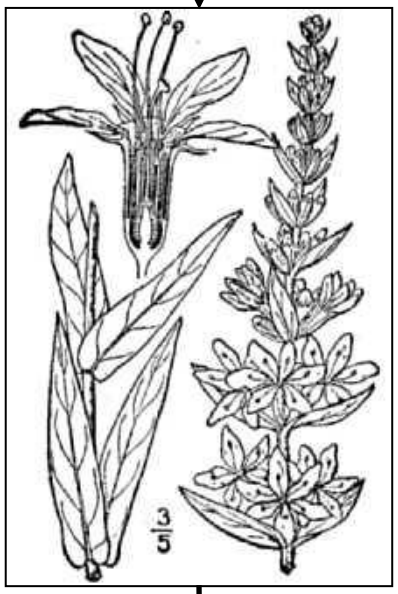
Plants with **alternate and opposite or whorled** leaves on the same individual

Leaves **alternate: PAGE 49-50**

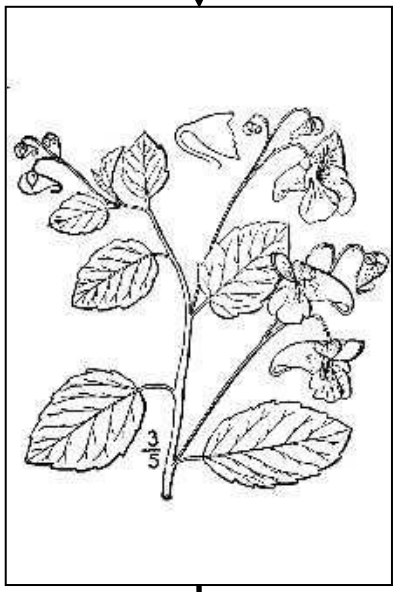
Leaves **opposite or whorled: PAGE 51**



EPILOBIUM (Willow-Herb)
-Stem round, leaf margins serrate or entire, flrs white-pink (62)



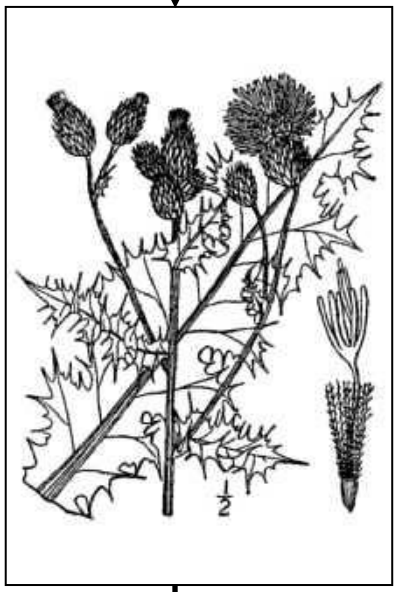
LYTHRUM (Loosestrife)
-Stem sharply angled, leaf margins entire, flrs magenta-pink (64)



IMPATIENS (Jewelweed)
-Stem round, almost transparent, and watery, leaves with poorly defined teeth, flrs orange-yellow (63)

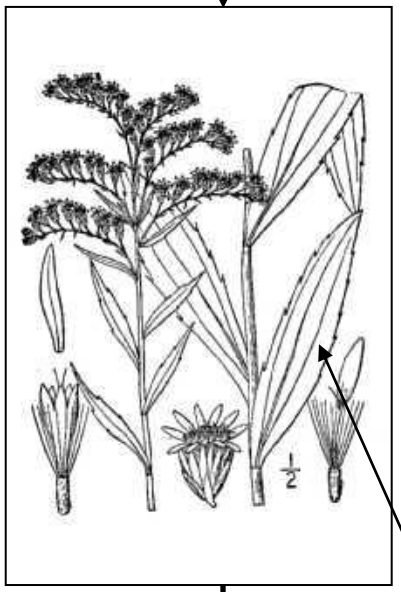
Emergent erect forbs with alternate simple leaves

Continued on P. 50



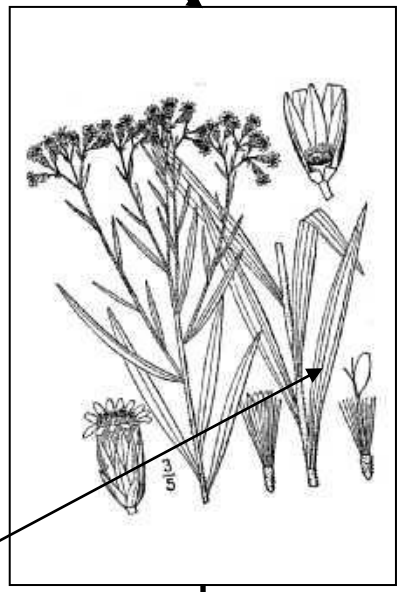
CIRSIUM (Thistle)
-Leaf margins with very sharp spines (one species without), flrs purple, leaves of immature individuals may be all basal (62)

ASTER (Aster)
-Leaves often clasping to stem, flowers with distinct (>0.5 cm long) white or blue-purple rays (60)



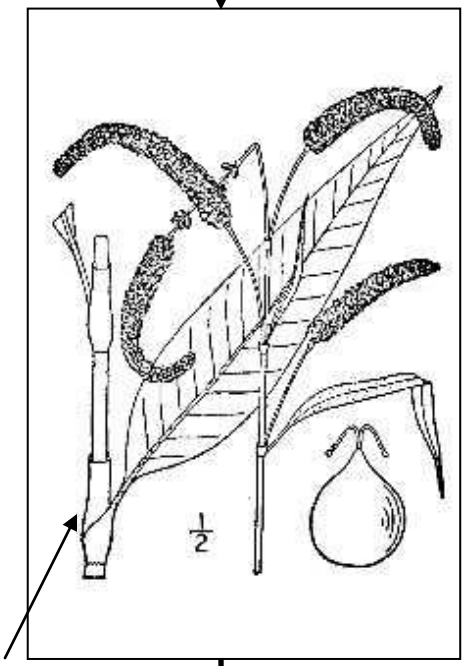
SOLIDAGO (Goldenrod)
-Leaves of common species in this genus with three distinct parallel veins, leaves wider than *Euthamia*, flrs yellow (67)

PARALLEL VEINS



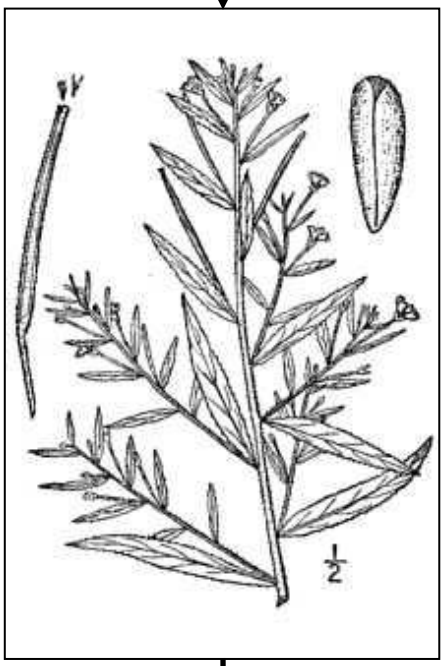
EUTHAMIA (Grass-Leaved Goldenrod)
-Leaves with three distinct parallel veins, no greater than 10 mm wide, flrs yellow (63)

Emergent erect forbs with alternate simple leaves (Continued from P. 49)

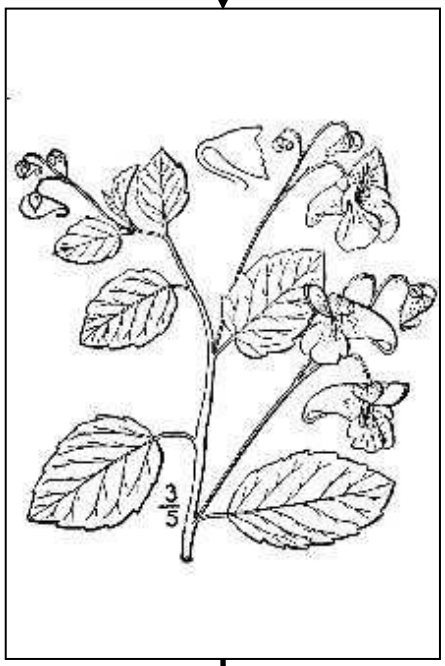


OCREA

POLYGONUM (Smartweed)
-Has distinct sheath surrounding leaf nodes (ocrea) (65)



EPILOBIUM (Willow-Herb)
-Stem round, leaf margins serrate or entire, flrs white-pink, individuals often have some opposite leaves (62)



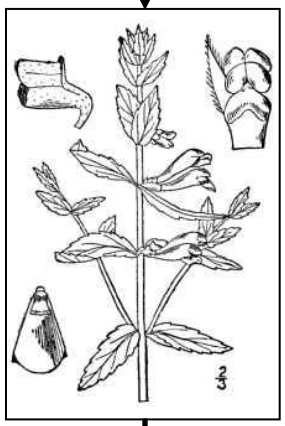
IMPATIENS (Jewelweed)
-Stem round, almost transparent, and watery, leaves with poorly defined teeth, flrs orange-yellow, individuals often have some opposite leaves (63)

Emergent erect forbs with opposite or whorled simple leaves

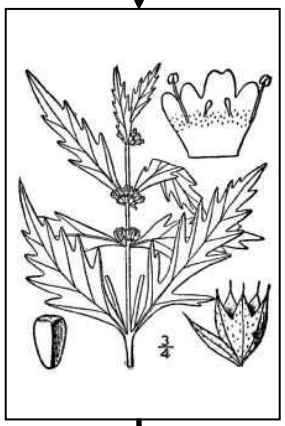
Stem is **square or sharp angled**

Stem is **round: PAGE 52**

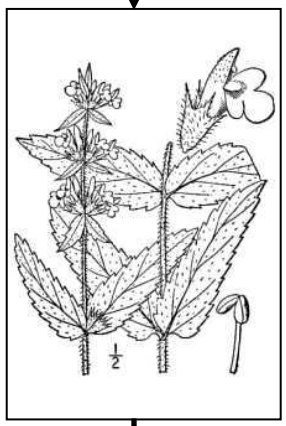
MENTHA arvensis
(Field-Mint)
-Leaves strongly mint scented when crushed, flrs axillary, small, white-light pink (64)



SCUTELLARIA
(Skullcap)
-Leaves regularly toothed, flrs axillary, relatively large, blue-purple (67)



LYCOPUS
(Bugle-Weed)
-Leaves with large teeth, flrs axillary small, white (64)



STACHYS
(Hedge-Nettle)
-Leaves regularly toothed, leaves and stems hairy, flrs lavender-pink (67)

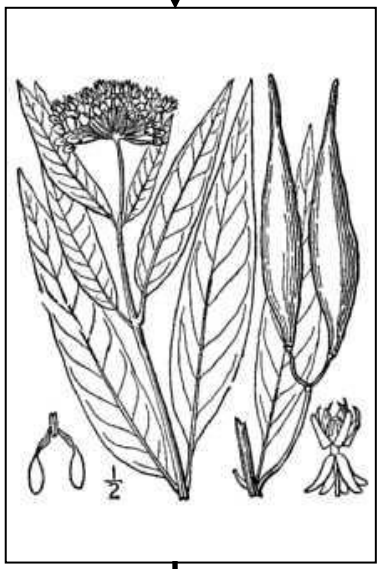
VERBENA hastata
(Blue Vervain)
-Leaves regularly toothed sometimes 3-lobed, flrs blue in long narrow spikes at the end of stems (68)

LYTHRUM
(Loosestrife)
-Stem sharply angled, leaf margins entire, flrs magenta-pink, individuals may also have alternate leaves (64)

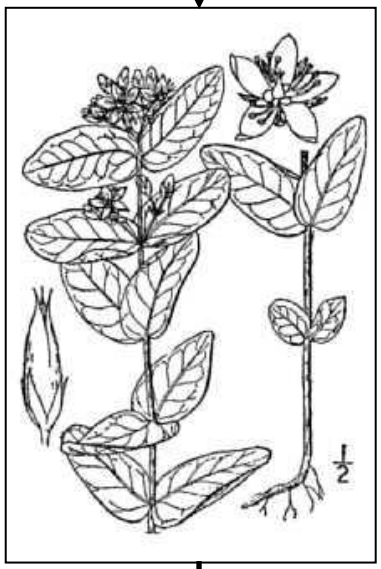
Emergent erect forbs with opposite or whorled leaves and round stems

Leaf **margins entire**

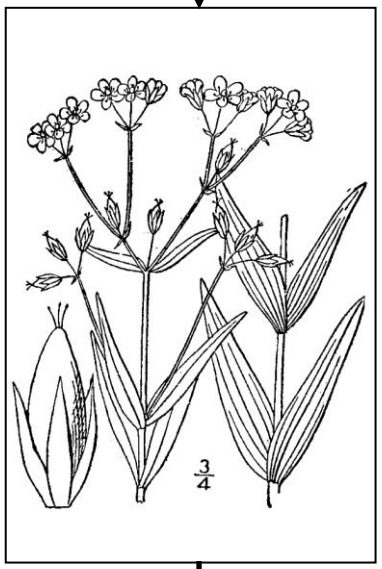
Leaf **margins serrated: PAGE 53**



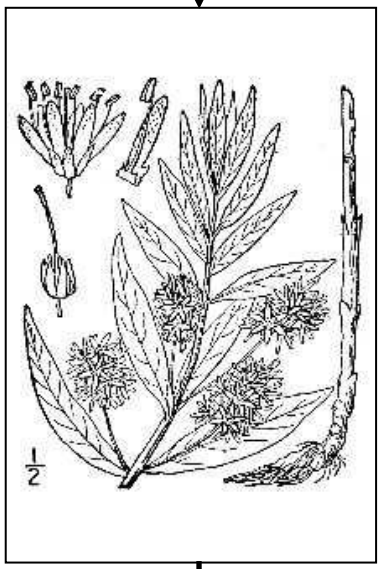
ASCLEPIAS incarnata
(Swamp-Milkweed)
-Leaves and stems with milky juice, flrs pink-purple red (60)



TRIADENUM fraseri
(Marsh St. John's-Wort)
-Flrs deep red (68)

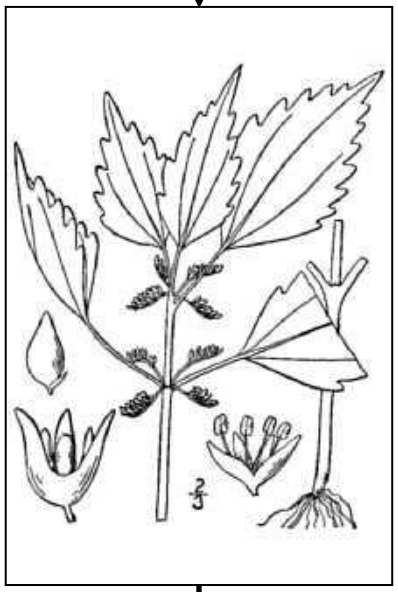


HYPERICUM
(St. John's-Wort)
-Flrs yellow-cream colored (63)



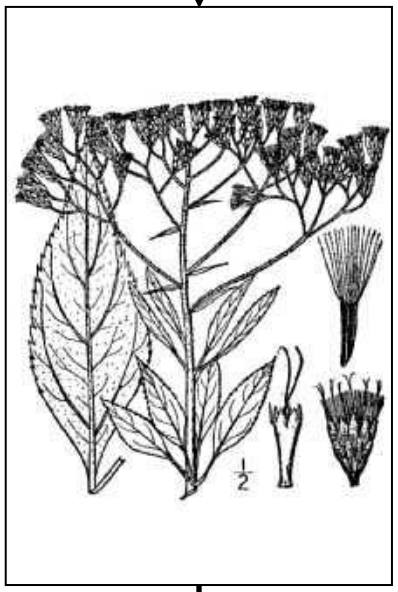
LYSIMACHIA
(Loosestrife)
-Leaves lanceolate, flrs yellow (64)

Emergent erect forbs with opposite or whorled leaves, round stems, and serrated leaf margins

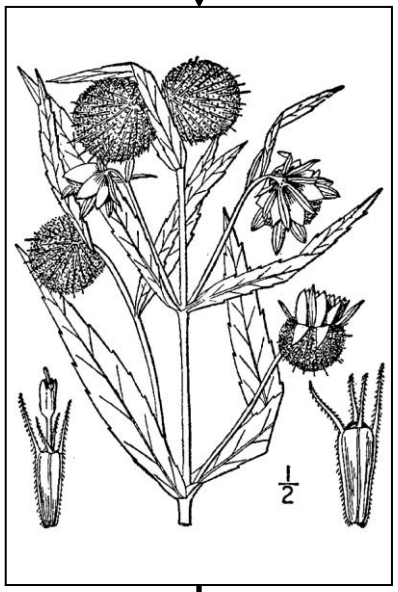


PILEA (Clearweed)
-Translucent stem and leaves (65)

URTICA dioica
(Stinging Nettle)
-Coarse leaves and stems with stinging hairs, can get to 1.5 m tall (68)



EUPATORIUM
(Joe-Pye Weed, Boneset)
-Leaves whorled, or if opposite leaf pairs joined together to form what looks like a single leaf surrounding the stem (63)



BIDENS
(Beggar-Ticks)
-Flrs with distinct yellow rays (61)

WOODY PLANTS

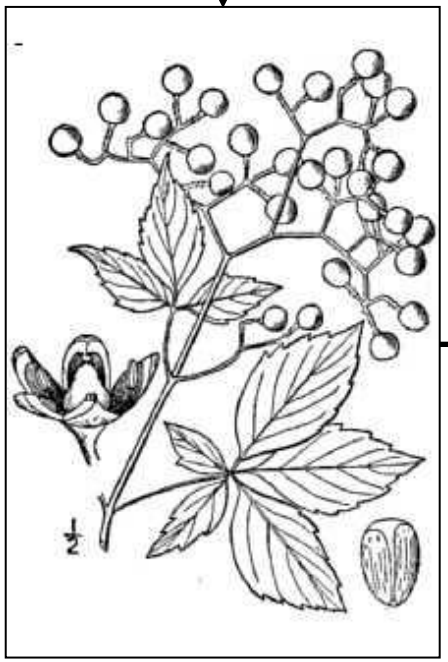
Vines

Shrubs or trees

Leaves **opposite:**
PAGE 55

Leaves **alternate:**
PAGE 57

VITIS riparia
(Grape)
-Leaves simple (68)

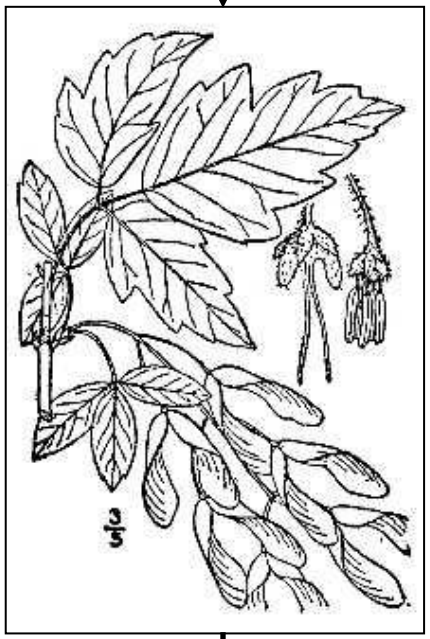


PARTHENOCISSUS
(Virginia Creeper)
-Leaves compound (64)

Shrubs or Trees with opposite leaves

Leaves **compound**

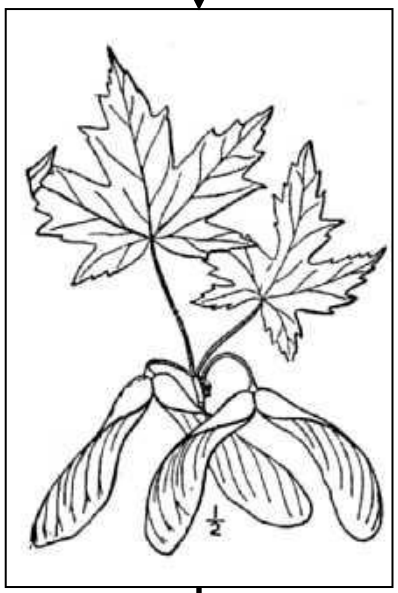
Leaves **simple: PAGE 56**



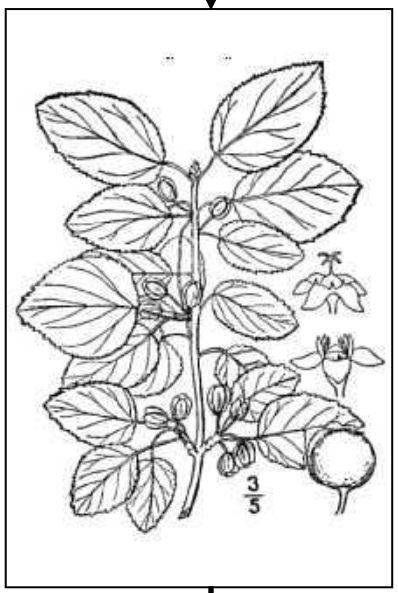
ACER negundo (Box Elder)
-3 leaflets (60)

FRAXINUS (Ash)
-7-11 leaflets (63)

Shrubs or trees with opposite simple leaves



ACER (Maple)
-Leaf margins deeply cut (60)



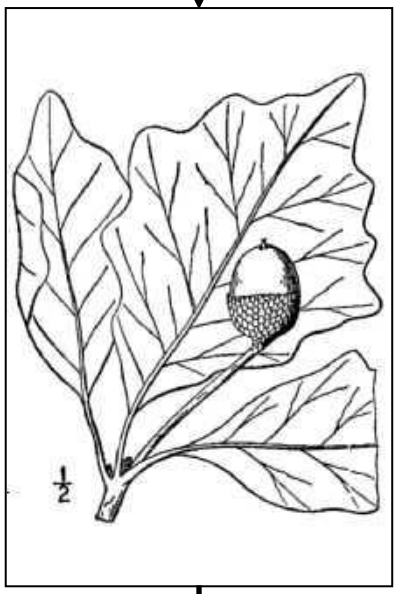
RHAMNUS cathartica (Common Buckthorn)
-Leaf margins finely serrated, individuals often also have alternate leaves, tips of twigs armed with a sharp thorn (66)

CORNUS (Dogwood)
-Leaf margins entire (62)

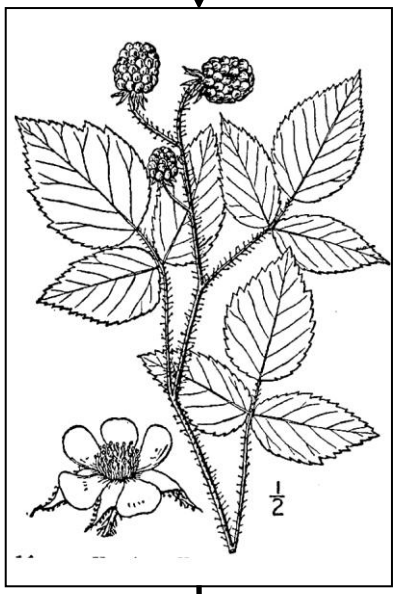
Shrubs or trees with alternate leaves

Leaves **compound** or with **coarse** rounded or pointed **teeth**

Leaves **simple**, margins entire or with **small teeth**: **PAGE 58-59**



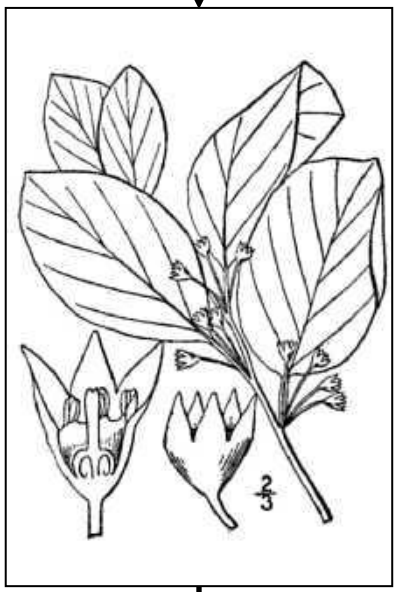
QUERCUS (Oak)
-Coarse rounded or pointed teeth (66)



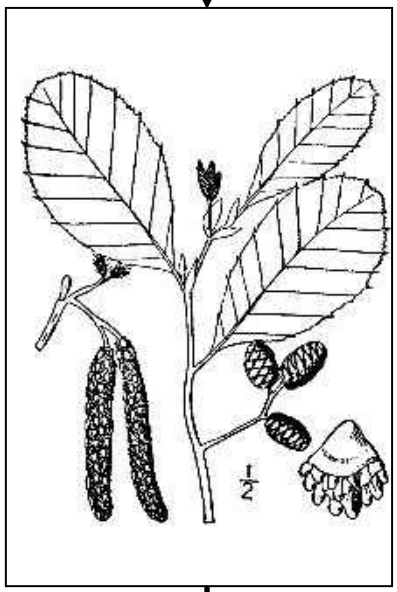
RUBUS (Raspberry, Dewberry, Blackberry)
-Leaves compound with 3-5 leaflets (66)

Shrubs or Trees with simple alternate leaves

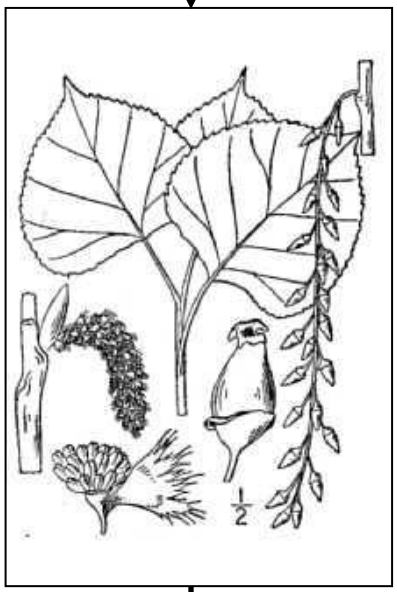
Continued on P. 59



FRANGULA alnus (Alder-Buckthorn)
-Flrs/frt axillary, margins entire (63)



ALNUS (Alder)
-Leaf margins double serrate with smaller teeth imbedded in larger teeth, frt a cone-like structure (60)



POPULUS (Aspen, Cottonwood)
-Petiole flattened, leaves roughly triangular in shape (66)

ULMUS (Elm)
-Leaf surface rough hairy (68)

Shrubs or trees with alternate simple leaves (Continued from P. 58)

CATKINS

SALIX (Willow)
-A large and variable genus, leaves linear-lanceolate, margins serrate or entire, trees or shrubs, flrs in catkins (67)

SPIRAEA alba-(Meadowsweet)
-Leaf margins serrate, flrs white in a terminal panicle, shrub of open wet-meadows (67)

Plant Descriptions

Acer (Maple)
-Small to large trees with opposite simple or compound leaves that have deeply cut margins. Seeds have a prominent wing. There are two common wetland species in this genus in our area: *Acer saccharinum* (Silver Maple) and *Acer negundo* (Box-Elder). Overall there are seven species of *Acer* in MN, one is introduced.

Acer negundo (Box-Elder)
-The only species in *Acer* with compound leaves. Has 3 or occasionally 5 leaflets. This tree is common in disturbed places throughout the state, particularly in lowland margins that periodically flood.

Acorus (Sweet Flag)
-A stout, emergent perennial forb reaching heights > 1 m. The erect sword-like leaves have a distinctly raised midrib (Figure 7) and are sweetly aromatic when crushed. The inflorescence emerges midway down the leaf and is a finger-like spike. Native Americans and early European settlers historically used the roots to make candy and for medicinal purposes. Two species occur in MN, one is introduced.

Agrostis (Bent Grass)
-Delicate annual or perennial midsize grasses, often with a tufted growth form. Usually growing in moist soils and occasionally shallow water. Leaves short, 2-8 mm wide, usually flat, occasionally inrolled. Inflorescence expanded to contracted, flrs/frt small and single per spikelet. Four species occur in MN, two are introduced.

Alisma (Water-Plantain)
-Emergent perennial forbs with broad elliptical leaves, originating from a tufted base, with prominent parallel veins. Flrs with 3 small white petals, arranged in open panicles. Typically grows in shallow water. May be easily confused with some species of *Sagittaria*, particularly when the latter is immature. When leaves are similar, these two genera can be differentiated by the flr arrangement. Three species occur in MN.

Alnus (Alder)
-Medium sized shrubs found along stream, lake, and wetland edges. Leaves simple with double serrate margins (the species in our area) or finely serrate (a second species found in Northeastern MN). Stems usually with conspicuous lenticels (pores in the bark). Frt in a persistent cone-like structure. Two species occur in MN.

Alopecurus (Foxtail)
-Short annual grasses with narrow leaves (< 0.5 cm wide), membranous ligules, and smooth leaf margins. The inflorescence is a compact vertical spike. Stems often sprawl before turning erect. Grows in shallow water or saturated soils. Three species occur in MN, one is introduced.

Asclepias incarnata (Swamp-Milkweed)
-Emergent perennial forb with linear-lanceolate leaves and entire leaf margins. Leaves and stems with milky juice. Showy pink-purple-red flrs bloom in July. This is the only species of *Asclepias* commonly found in MN wetlands.

Aster (Aster)
-Emergent forbs with compound flrs (many small "florets" organized into a central head with surrounding petals, or rays, similar to a daisy). The conspicuous rays of the common wetland Asters in our area are usually white or blue-purple. Leaves alternate, the base of the leaves clasping to the stem or lanceolate shaped. This is a large and variable genus and the entire taxonomy is currently being reviewed and revised by botanists.

Bidens (Beggar-Ticks)
-Emergent annual forbs (one species in the state is perennial) up to 0.5 m tall. Leaves opposite, variously serrated or lobed, simple or compound. Flrs yellow, with or without conspicuous rays, appearing mid-late summer. Typically grows on recently exposed saturated soils. Eight species occur in MN.

Brasenia schreberi (Water-Shield)

-Floating leaved aquatic perennial, leaves oval, 4-12 cm long and half as wide. Elongated petiole joins leaf at the center and is often coated with a clear mucilaginous gel. Flrs dull purple. Grows in quiet water up to 2 m deep.

Calamagrostis (Reed-Grass)
-Erect perennial grasses up to 1.5 m tall. Largest leaves about 1 cm wide and nearly flat, has prominent ligules. Nodes smooth and may have a bluish cast to them. The most common species, *Calamagrostis canadensis* (Bluejoint), was once the dominant grass of wet-meadow wetland types in our area but has now often been displaced by the aggressive Reed Canary-Grass (*Phalaris arundinacea*). Five species of *Calamagrostis* occur in MN, three are special concern species.

Calla palustris (Water-Arum)
-Emergent perennial forb with cordate shaped leaves. The inflorescence consists of a spike arrangement of flrs (spadix) and a modified cream colored leaf (spathe). Stems spreading in shallow water or along the soil surface, petioles and leaves erect.

Caltha palustris (Marsh-Marigold)
-Emergent perennial forb, leaves basal, cordate-kidney shaped with serrated margins. Flowers golden yellow with 5 waxy petals. One of the first wildflowers to bloom in the spring, large patches can often be found in Ash and Alder swamps before the trees have "leafed-out". *Caltha palustris* can be an indicator of groundwater discharge. Another species of *Caltha* occurs in the state but it has only been found in Northeastern MN.

Campanula aparinoides (Marsh-Bellflower)
-A thin stemmed perennial forb that typically sprawls amongst neighboring plants. Stems are rough hairy. Flrs bell-shaped and white. There are five *Campanula* species in MN but only *C. aparinoides* is typically found in wetlands.

Carex (Sedge)
- A very large and diverse genus. Many species have basal leaves or stems that are very short giving the appearance of basal leaves. Stems triangular (Figure 7) and leaves are three-ranked. The distinguishing feature of this genus is the sac-like structure called the perigynium that encloses the female (pistilate) flrs. *Carex* is the only genus with perigynia. Flrs are arranged in spikelets, often with the male (staminate) flrs in separate spikelets from the pistilate spikelets. The common rhyme "sedges have edges" refers to the triangular stem which can usually be felt when one rolls the stem in their fingers. There are species in other genera (*Cyperus, Dulichium,* and *Scirpus*) that are related to *Carex* and also have triangular stems, making this rhyme not entirely true. 143 *Carex* species occur in MN and 108 of these are typically found in wetlands.

Ceratophyllum (Coontail)
-Submergent aquatic forbs with finely branching leaves. Leaves are relatively stiff, whorled, and become crowded near the end of the stem to maximize light collection. Small white flowers bloom above water in late July. Two species occur in MN.

Chara (Muskgrass)
-A macroscopic algae. Can form uniform submergent "lime green" colored carpets in open water wetlands. Typically grows in hard waters (waters high in calcium and/or magnesium salts). The most common species in this genus, *Chara vulgaris*, gives off a strong "musky" odor when crushed.

Cicuta (Water-Hemlock)
-Emergent perennial forb up to 1.5 m tall. Leaves alternate and twice compound. Flrs white, arranged in an umbel. Two species occur in MN. One has narrow (< 5 mm, *C. bulbifera*, pictured in the guide) and the other wider (> 5 mm, *C. maculata*) leaflets. Plants in this genus are extremely poisonous.

Cirsium (Thistle)
-Emergent perennial or biennial forbs. All except one species in this genus have very sharp spines along leaf margins and stems. Flrs lavender-purple. First year leaves of the biennial species consist of a rosette of basal leaves growing close to the ground. Most often found in disturbed plant communities.

Cornus (Dogwood)
-Shrubs up to 3 m tall. Leaves opposite (one species in state has alternate leaves but does not commonly grow in wetlands); margins entire, the conspicuous veins run parallel from the midvein to leaf margin. Six species occur in MN.

Cyperus (Flatsedge)
-Annual or perennial grasslike plants. Stems triangular, leaves three-ranked. Differentiated from other related taxa (*Carex* and *Scirpus*) by the inflorescence. Flrs are arranged in relatively long and flattened spikelets. Often found on recently exposed soils. Thirteen species occur in MN, two are introduced.

Dulichium arundinaceum (Three-Way Sedge)
-Erect perennial up to 1 m tall. Stems are roughly triangular in cross section (the corners are rounded) and hollow. Leaves growing more or less perpendicular from the stem and are strongly three-ranked. Flrs arranged in spikelets emerging from leaf axils.

Echinochloa (Barnyard-Grass)
-Coarse annual grasses having shallow fibrous roots. Up to 1 m tall. Leaves are ribbon-like, typically 1 x 20 cm. Flrs/frts arranged in panicles, appearing as many short spikes off a central stem. Flrs/frts and base of stems are often red-purple tinged. Stems, particularly in young plants, are somewhat flattened at the base. Overall plant is without hairs, though the ligule may be a tuft of hairs and the ends of individual flrs may be tipped with a single coarse hair-like structure called an awn. Three species occur in MN, one is introduced.

Eleocharis (Spike-Rush)
-Fine (< 10 cm tall, hair-like) to robust (0.5 m tall) perennial grasslikes appearing as a leafless stem (leaves reduced to clasping bracts around the base of the stem) tipped with a cone-like spikelet. Often grows as many distinct single stems. Typically grows in shallow water or as part of a floating mat.

Elodea (Waterweed)
- Submergent perennials with short leaves up to 4 mm wide and < 30 mm long, arranged in whorls of 3-4 from an often branched stem. The simple leaves have entire margins. White flrs reach the surface via long thin filaments. Two species occur in MN.

Epilobium (Willow-Herb)
-Emergent perennial forbs. Leaves linear to lanceolate, may be opposite and alternate on the same individual. Flrs regular with four white-pink petals. Frts consist of elongated capsules containing many seeds. Seven species occur in MN.

Equisetum (Horsetail)
-Low vascular plants with distinct round, hollow, and vertically grooved stems that are regularly jointed. Stems can easily be pulled apart at the joints. Some species have whorls of scale-like leaves. Spores borne in terminal brown cones. Nine species occur in MN.

Eupatorium (Joe-Pye Weed, Boneset)
-There are two distinct species that are commonly found in wetlands in our area. *E. maculatum* (Joe-Pye Weed) is a tall (up to 1.5 m) emergent forb that has whorled leaves and pale-pink flrs (pictured in the guide). *E. perfoliatum* (Boneset) is also a tall emergent forb but has opposite leaves with the pairs of leaves joined together and completely surrounding the stem and white flrs. Both bloom in late July and August and grow on saturated soils.

Euthamia (Grass-Leaved Goldenrod)
-Emergent forbs with alternate leaves. Leaves have three distinct veins that run parallel up the length of the leaf. Leaves of some *Solidago* also have this pattern; however, leaves of Euthamia are not as wide (2-4 mm). Flrs golden-yellow. Grows on saturated soils. Two species occur in MN.

Frangula alnus (Alder-Buckthorn)
-Medium to large shrub. Leaves alternate, margins entire, oval shaped and tapered to a tip. Flrs/frts axillary. Frt a purple-black berry. An aggressive invasive species of shrub swamps.

Fraxinus (Ash)
-Medium to large trees with compound opposite leaves with 7-11 leaflets. Leaf edges are serrated, at least above the middle. Seeds have a prominent wing. Bark is dark gray with shallow ridge-like furrows. Three species occur in MN.

Galium (Bedstraw)
-Sprawling or twining emergent forbs. Leaves whorled, linear-narrowly oval, usually with a prominent midvein. Stems, and sometimes the leaves, are often rough-hairy. Flrs are small and white. Twelve species occur in MN, two are introduced.

Glyceria (Manna-Grass)
-Erect perennial grasses with prominent ligules. Leaf sheaths closed up to the point where the leaf diverges from the stem. The distinct feature of these grasses is the strongly two-ranked leaves. Inflorescence large open panicles. Four species occur in MN.

Hypericum (St. John's-Wort)
-Emergent forbs, 10 cm to 1.5 m tall, with opposite entire leaves. Leaves of some species covered with brown glands (use hand-lens). Flrs regular, with 4-5 yellow-cream colored petals. Most often found on saturated soils in our area. Six species occur in MN, one is introduced.

Impatiens (Jewelweed)
-Emergent annual forbs with round, almost transparent, watery stems. Individuals will often have both alternate and opposite leaves. Flrs irregular, orange-yellow usually with reddish-brown spots. Juice of stem found to sooth minor skin irritants (such as the sting from *Urtica*, Stinging Nettle). Grows on saturated soil. Two species occur in MN.

Iris (Iris, Flag)
-Emergent perennial forbs reaching 50-80 cm. Leaves more or less flat in cross section (Figure 7), growing in clumps with the clumps flattened at the base giving the plant a fan-like appearance. Flrs regular, showy, either blue or yellow. Typically grows on saturated soils. Three species occur in MN, one (the yellow flowered *I. pseudacorus*) is introduced.

Juncus (Rush)
-Grasslike perennials with round stems. Leaves are either reduced to sheaths along the stem (giving the appearance that the plant lacks leaves, similar to some members of *Scirpus*), or strongly inrolled, or completely round in cross section. The distinctive feature of *Juncus* is the regular 6 scale-like tepals that subtend the flr/frt (use hand-lens), as opposed to flrs/frts being located behind scales such as in *Scirpus* or *Cyperus*. Often grows on recently exposed soils. Twenty two species occur in MN.

Lathyrus (Wild Pea)
-Sprawling or twining emergent forbs. Leaves are pinnately compound with linear-lanceolate leaflets with entire margins. Flrs irregular, white-purple. Six species occur in MN.

Leersia (Cut Grass)
-Sprawling perennial grasses. Leaves are extremely rough hairy, nodes are ringed with short stiff hairs. Ligule is short and membranous. Flrs emerge late in the season. Typically grows in shallow water or recently exposed soils. Three species occur in MN, *L. lenticularis* is on the State Special Concern list.

Lemna (Duckweed)
-Small (plants up to 3 cm wide) free-floating aquatic forbs. Individual fronds usually have a single root (*L. trisulca*, Star-Duckweed, often lacks roots). May form a continuous "green carpet" on the water surface of wetlands. Two species occur in MN.

Lycopus (Bugle-Weed)
-Emergent forbs up to 0.5 m tall with square stems. Leaves are opposite and have relatively coarse teeth. Small white bugle-like flrs are clustered tightly in the leaf axils. Four species occur in MN.

Lysimachia (Loosestrife)
-Emergent forbs up to 0.5 m tall with round stems. Leaves opposite or sometimes whorled, margins entire. In the two common wetland species the flrs are regular with 5 yellow petals and are either terminal or axillary (pictured in guide). Seven species occur in MN, one is introduced.

Lythrum (Loosestrife)
-Emergent forbs up to 1.5 m tall. The stem is winged or sharp angled. Leaves opposite or whorled and may become alternate as the leaves spiral towards the tops of stem. Leaves lanceolate and often clasping the stem. Flrs regular, pink-purple, showy. This genus includes the invasive Purple Loosestrife (*L. salicaria*) which is an exotic aggressive plant that can outcompete and crowd-out native plants.

Megalodonta beckii (Water-Beggar-Ticks)
-Submergent aquatic forb with opposite or whorled branching leaves. Has an above water inflorescence that includes broad opposite leaves. Flrs compound with 6-10 gold-yellow rays.

Mentha arvensis (Field-Mint)
-Emergent forb with a square stem and opposite leaves. Leaves and stems are noticeable hairy with white or pink irregular flrs grouped in bunches either in the leaf axils or terminal. Stems and leaves are strongly mint scented when crushed. Three other *Mentha* species occur in MN; however, they are introduced species that do not commonly grow in wetlands.

Myriophyllum (Water-Milfoil)
-Submergent aquatic forbs with whorled pinnately compound leaves and often a reddish stem. Inflorescences often emergent with small axillary flrs. This genus includes the invasive Eurasian Water-Milfoil (*M. spicatum*) which can be identified by having more than 12 leaflets on one side of a leaf (check several leaves). Six species occur in MN; one has alternate leaves but does not occur in our area.

Najas (Water-Nymph)
-Submergent aquatic forbs with opposite ribbon-like leaves. The leaves becoming crowded near the end of stems. Leaves enlarged or "winged" near the base. Four species occur in MN.

Nuphar (Yellow Water-Lily)
-Floating leaved aquatic perennials. Leaves large, 10-25 cm long, two-thirds as wide, oval in outline with a deep notch or cleft. Flrs yellow, showy.

Nymphaea (White Water-Lily)
-Floating leaved aquatic perennials. Leaves large, 10-30 cm long, round in outline with a notch or cleft. Flrs white, showy, many petaled, fragrant.
Onoclea sensibilis (Sensitive Fern)
-Fern with shallowly cut pinnae. Reproductive frond growing from a separate stalk that is unlike the green photosynthetic frond.

Osmunda (Osmunda)
-Ferns with deeply cut or compound (in one species, *O. regalis*) pinnae. Fronds are large when mature, up to 1 m tall. Sori borne on modified pinnae located below photosynthetic pinnae or on a separate stalk. The early spring immature fronds, or "fiddleheads", of *O. claytoniana* (Interrupted Fern) are sought after as a wild vegetable similar to Asparagus. Three species occur in MN.

Parthenocissus (Virginia Creeper)
-Sprawling vine appearing to be mostly herbaceous but has a woody base. Compound leaves have five coarsely toothed leaflets. Flrs/frts axillary. Frt a blue-black berry. Two species occur in MN.

Phalaris arundinacea (Reed Canary-Grass)
-A stout erect perennial grass. Leaves are often wider than 1 cm. Ligule is prominent. Inflorescence is a closed to loosely open panicle that appears somewhat like a spike when flrs are immature and after the grass has dropped its seed. Usually grows on saturated soil but can grow in standing water up to 0.5 m. *P. arundinacea* is a very aggressive plant that often forms dense stands crowding out other native plants.

Phragmites australis (Giant Reed)
-A stout perennial grass that can grow to be 2-4 m tall. The leaves are flat, 1-4 cm wide. Ligule consists of a tuft of short hairs. The inflorescence is somewhat feather-like. This is our tallest wetland grass and often grows in dense colonies. This grass is also potentially invasive. There is a native strain and a strain introduced from Europe which is aggressive and can outcompete native plants.

Pilea (Clearweed)
-Annual emergent forbs, up to 50 cm tall. Leaves opposite, coarsely serrated. Similar in general appearance to *Urtica dioica* but is usually smaller, lacks stinging hairs, and has a clear or translucent stem (similar to *Impatiens*). Often found growing on woody debris in marshes. Two species occur in MN.

Poa (Blue Grass)
-Perennial or annual grasses. Leaves are narrow, < 3 mm wide, ending with a boat keel shaped tip (meaning that when looking at the tip of the leaf blade, head on, it looks like the bow of a boat). Ligule short and membranous. Inflorescence an open panicle, 2-several individual flrs per spikelet, each spikelet fringed at the base with short cob-web-like hairs (use hand-lens). Seventeen species occur in MN, six are introduced, one (*P. wolfii*) is on the state Special Concern List.

Polygonum (Smartweed)
-A very diverse genus. Erect emergent forbs, or sprawling and twining emergent forbs, or floating leaved aquatic forbs (see *Polygonum amphibium*). Leaves lanceolate-cordate. The distinguishing feature of this genus is a sheath that surrounds the stem at each leaf node (ocrea). Flrs white-pink. Thirty species occur in MN, nine are introduced.

Polygonum amphibium (Water-Smartweed)
-The only species of *Polygonum* that is a floating leaved aquatic forb. Can be differentiated from floating leaved *Potamogeton* species by the ocrea and the veins on the leaves branch out from a central midvein as opposed to all of the veins running parallel up and down the leaf. Flrs red-bright pink, arranged in terminal spikes. Two forms of this species occur, a true aquatic form and an erect emergent form.

Pontedaria cordata (Pickerelweed)
-Emergent perennial forb. Stems creeping in the soil or shallow water, petioles and leaves are erect. Leaves cordate, margins entire. Flrs blue-purple arranged in a spike. Usually found in shallow water.

Populus (Aspen, Cottonwood)
-Medium to large trees. Leaves alternate, roughly triangular in shape. Petioles are flattened which can be felt when you try to roll the petiole in your fingers. Newer bark is smooth white-green-light brown. Older bark becomes furrowed and grey. Five species occur in MN, one is introduced.

Potamogeton (Pondweed)
-A very large and variable genus. There are two general types in this genus: submergent aquatic forbs and floating leaved aquatic forbs. The difference between the two types is that the floating leaved forbs have dissimilar floating and below water leaves and the submergent type leaves are all the same. All species have alternate leaves. Below water leaves range from narrowly linear-lanceolate-ovate, floating leaves are ovate-elliptic with parallel venation (leaf veins run parallel to each other from the base to the tip of the leaf). Twenty four species occur in MN, one of these is an aggressive introduced species (*P. crispus*, Curly Pondweed).

Potentilla palustris (Marsh-Cinquefoil)

-Emergent perennial forb. Stems creep along the soil or in shallow water often rooting at the nodes. Petioles and leaves erect. Leaves alternate, compound with 5-7 leaflets. Flrs dark red.

Quercus (Oak)
-Large trees up to 50 m. Leaves simple, alternate, and have large coarse teeth. "White" oaks have rounded teeth and "Red" oaks have sharply pointed teeth. Bark becomes deeply furrowed in older trees. Usually found in uplands, one species found in wetlands in our area (*Q. bicolor*, Swamp-White Oak).

Ranunculus (Water-Crowfoot)
-Perennial submergent aquatic forbs. Leaves alternate and finely branching. Flrs above the water surface, consisting of regular yellow or white petals. Eighteen species of *Ranunculus* occur in MN, only the submergent aquatics are covered in this guide.

Rhamnus cathartica (Common Buckthorn)
-Medium sized-tall shrubs often with alternate and opposite leaves. Leaves margins serrated. Twigs often end with stout thorns. An aggressive invasive species of forests and some wetlands.

Riccia fluitans (Slender Riccia)
-A free-floating thallose liverwort. Main body is a slender branched frond somewhat resembling reindeer antlers. Length is usually < 3 cm. Often found in tangled masses on or just below the water surface.

Ricciocarpus natans (Purple-Fringed Riccia)
-A free-floating thallose liverwort, usually about 1 cm wide. Main body is flat with a central furrow and is lobed at one end. Upper surface is green and lower surface purple with numerous rhizoids (roots).

Rubus (Raspberry, Dewberry, Blackberry)
-A large genus of low lying to medium sized shrubs (some species herbaceous). Leaves alternate and compound with 3-5 leaflets. Stems often thorny. Twenty one species occur in MN.

Rumex (Dock)
-Emergent perennial forbs. The common wetland species have large (10-60 cm long) basal leaves that are arching from the base, lanceolate-ovate, often with wrinkled or wavy margins. Flowering stalks are distinctly taller (up to 2 m) than the basal leaves.

Sagittaria (Arrowhead)
-Emergent perennial forbs with arrow shaped (sometimes elliptic like *Alisma*) basal leaves. Floating leaved forms do occur. Leaves originate from the base of the plant in a tufted clump. Flrs regular with three white petals, whorled around the flowering stem on short stalks (as opposed to *Alisma* which has a panicle flr arrangement). Typically grows in shallow water. Six species occur in MN.

Salix (Willow)
-A large and variable genus. Willows range from small shrubs to medium sized (20 m) trees. Most Willow species grow in wetlands, preferring wet soils. Leaves alternate, margins serrated or entire, range in shape from linear-ovate but most often are lanceolate. Flrs arranged in catkins, blooming May-June. Nineteen species occur in MN, three are introduced.

Scirpus (Bulrush)
-A large and variable genus. All *Scirpus* species have flrs arranged in ovoid spikelets. There are two general forms in this genus: *Scirpus* without leaves and *Scirpus* with grasslike leaves. Some of the without leaf species have round stems and some have triangular stems. All with leaf species have triangular stems. Twenty one species occur in MN.

Scutellaria (Skullcap)
-Emergent perennial forbs with square stems. Leaves opposite. Flrs irregular with an arched lip extending over the other petals, blue-purple. Five species occur in MN.

Sium suave (Water-Parsnip)
-Emergent perennial forb. Stems hollow, low and trailing when not in bloom, stout and erect (up to 1 m tall) when in bloom. Leaves pinnately compound, may be finely dissected if under water. Flrs small, white.

Solanum dulcamara (Nightshade)
-A sprawling or twining forb. May be somewhat woody at the base of the plant but is generally considered herbaceous. Leaves compound and/or lobed at the base. Leaflets ovate. Flrs purple with petals bent back exposing yellow anthers in the center.

Solidago (Goldenrod)
-Emergent perennial forbs with alternate leaves. The common wetland species in this genus have three distinct parallel veins that run the length of the leaf. This is similar to *Euthamia*; however, leaves are wider in *Solidago* (1-4 cm). Flrs yellow. Fifteen species occur in MN.

Sparganium (Bur-Reed)
-Emergent perennial forbs. Leaves long and linear, distinctly triangular in cross section or at least with a triangular raised midrib on one side (Figure 7). Floating ribbon-like aquatic leaves may be present when immature. Also some *Sparganium* species have mature ribbon-like aquatic leaves, but they are not common in our area. Flrs/frts occur as dense heads along zigzagging branches. The female flr/frt heads appearing as a spike covered ball. Usually grows in shallow water. Eight species occur in MN.

Spartina pectinata (Prairie Cord-Grass)
-Stout perennial grass with thin wiry leaves, 10 mm wide and up to 80 cm long. Ligule is short and membranous often fringed with short hairs. Flrs are arranged into one sided spikelets.

Spiraea alba (Meadowsweet)
-A medium sized shrub up to 2 m tall. Leaves alternate, finely serrated. Flrs arranged in terminal panicles. Flrs have five regular white petals, blooming July-August.

Spirodela polyrhiza (Greater Duckweed)
-A small free-floating forb. Fronds with two or more roots, green on upper surface and reddish purple below. Often mixed in with floating carpets of *Lemna*.

Stachys (Hedge-Nettle)
-Emergent forb, up to 1 m tall, with square stems and opposite leaves. Leaves and stems are hairy. Flrs irregular, occurring in clusters in the axils of the upper leaves, lavender-pink. Leaves and stems not aromatic when crushed.

Thelypteris palustris (Marsh-Fern)
-Fern with deeply cut pinnae. Sori located on the backside or underside of pinnae. Similar in general appearance to members of *Osmunda* but much smaller (< 60 cm tall). Commonly found on floating mats and saturated soils.

Triadenum fraseri (Marsh St. John's-Wort)
-Emergent forb with a round stem and opposite leaves. Leaves with dark-transparent glands on the underside (use hand-lens) and entire margins. Flrs deep red. Most often found on floating mats.

Typha (Cat-Tail)
-Emergent perennial forbs with linear basal leaves up to 2.5 m tall. Leaves are flat or crescent shaped in cross section (Figure 7), 0.5-3 cm wide. Inflorescence a dense spike with male flowers above female. Two species occur in MN, one is considered native (*T. latifolia*) and the other (*T. angustifolia*) introduced. *T. latifolia* has wide (1-3 cm) leaves and no gap between the male and female flrs and *T. angustifolia* has narrow (0.5-1 cm) leaves and a gap (usually > 2 cm) between male and female flrs. These two species readily hybridize to produce a Cat-Tail with characteristics in between (*T.* x *glauca*). Both *T. angustifolia* and *T.* x *glauca* are aggressive invasive species.

Ulmus (Elm)

-Medium to large trees. Leaves alternate, coarsely serrated, and the upper surface is often rough hairy. Grows in floodplains, moist woods, and uplands. Four species occur in MN, one is exotic.

Urtica dioica (Stinging Nettle)
-Emergent forb with opposite leaves. Leaves and stems are covered with stinging hairs which can leave irritating welts. Flrs in the upper leaf axils. Can grow up to 2 m tall. *U. dioica* is an introduced species.

Utricularia (Bladderwort)
-Submergent aquatic forbs with finely branching alternate leaves. The characteristic feature of this genus is the sac-like bladders attached to the leaves (or in some species on a separate stem that lacks leaves). These bladders trap zooplankton (very small free swimming animals) and then slowly digest their prey with enzymes to acquire a portion of their nutrients, making these plants carnivorous. Flrs irregular, emerging out of the water, yellow or purple. Six species occur in MN.

Vallisneria americana (Water-Celery)
-Submergent aquatic forb with long ribbon-like leaves. Leaves basal and have a distinct light shaded band running down the middle. Immature specimens of *Sagittaria* and *Sparganium* have similar leaves; however, they lack the vertical banding.

Verbena hastata (Blue Vervain)
-Emergent forb with opposite leaves. Leaves sometimes 3-lobed. Flrs small, blue, arranged in long narrow spikes at the top of stems. Five species occur in MN, but only *V. hastata* is found in wetlands.

Vitis riparia (Grape)
-Woody vines typically climbing into trees or shrubs. Leaves alternate and simple with sharp teeth mostly forward pointing. Tendrils opposite of most leaves. Grows along margins of wetlands and other water bodies.

Wolfia (Water Meal)
-Very small (not more than 1.5 mm long) tear-drop shaped free-floating aquatic forbs. Often flat on one side and domed on the other. Lacks roots. Often found with other Duckweeds. Three species occur in MN.

Zannichellia palustris (Horned Pondweed)
-Submergent aquatic forb with simple opposite leaves. Stem is many branched like *Najas* but the leaves do not crowd near the tip. Leaves are very slender and thread-like (0.5 mm wide). Flrs/frts axillary, 2-3 mm long, appearing like small bean pods with hooks at the ends.

Zizania aquatica (Wild Rice)
-A stout annual grass that can reach heights of 3 m. Almost always found in shallow water. Leaves are broad (1-4 cm) and flat with a long membranous ligule. The female or grain-producing flrs (above) and male (below) flrs separate on the same plant. Wild Rice was a traditional food source of Native Americans and is still widely harvested today. Wild Rice is also an important food for migrating water fowl.

Plant diagrams

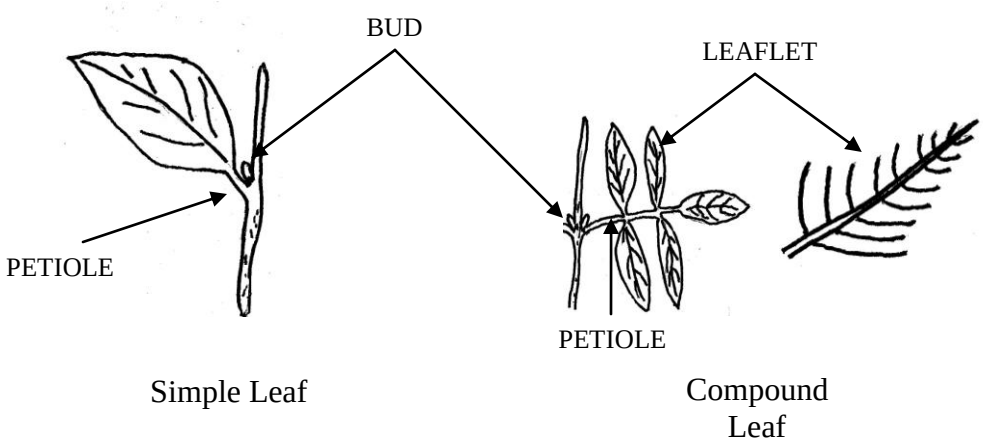


Figure 5. Leaf morphology.

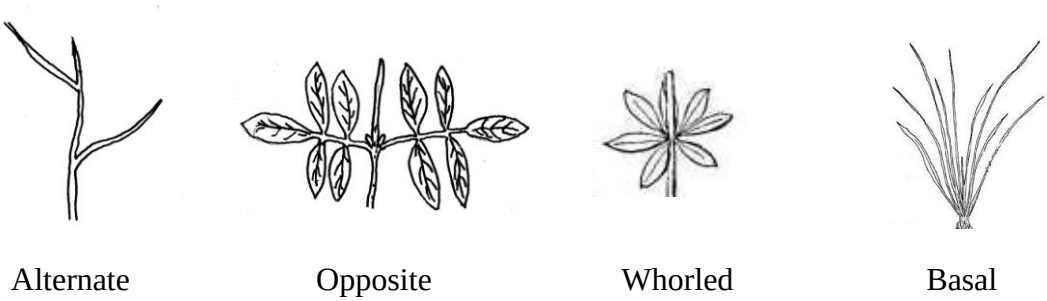


Figure 6. Leaf arrangement.

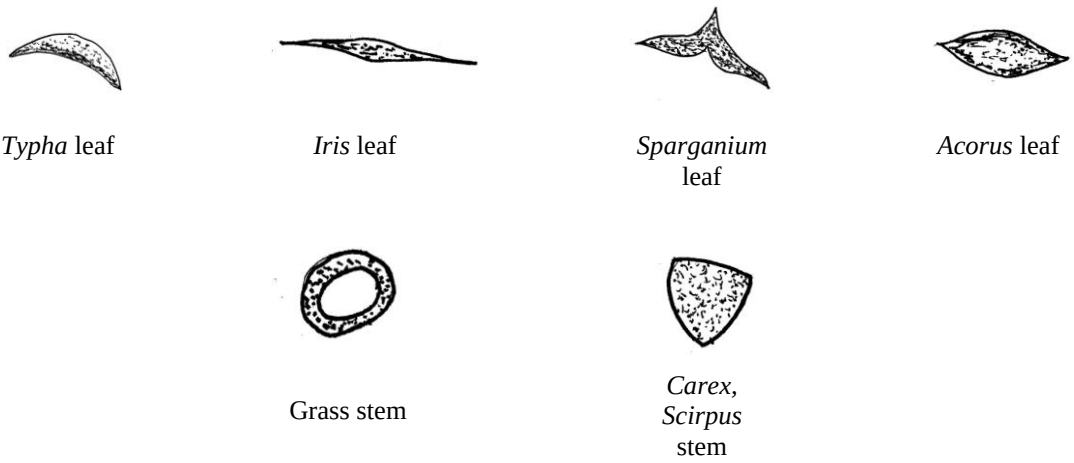


Figure 7. Cross sections of selected leaves and stems (Adapted from Eggers and Reed 1997).

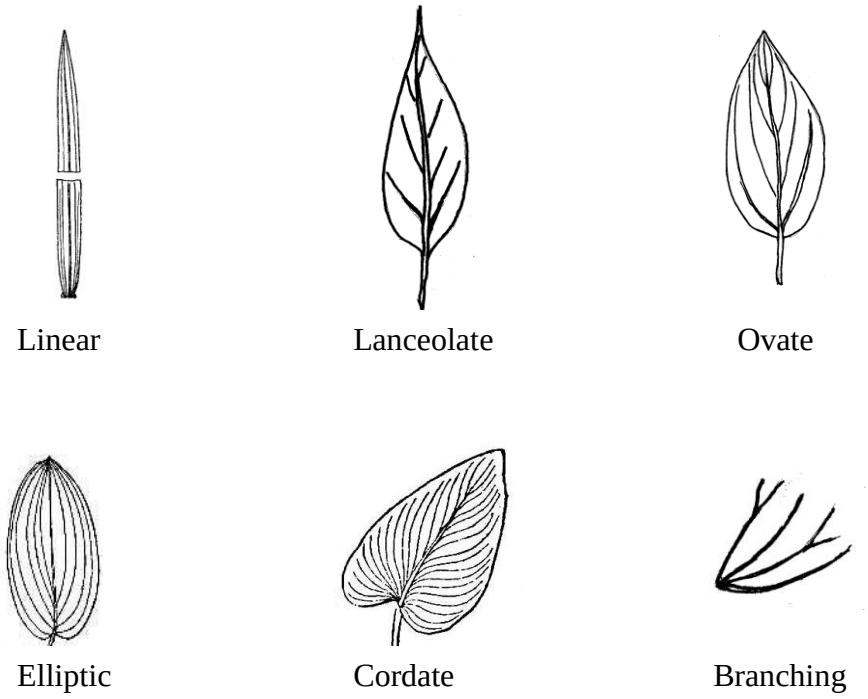
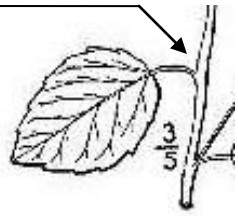


Figure 8. Leaf shape.

Glossary of Plant Terms

Alternate leaf arrangement. Leaves emerge from alternating sides of the stem (Figure 6).

Aquatic. Plants growing entirely in the water either submersed or with leaves floating on the surface (may be above surface during low water periods).



Axil. The angle where the petiole emerges from the stem.

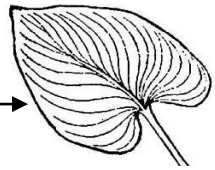
Axillary. Originating from the leaf axil.

Basal leaf arrangement. Leaves apparently emerging from the soil surface, plants without above ground stems or stems very short (Figure 6).

Branching leaf shape. Compound leaves with fine thread-like leaflets that repeatedly fork, not originating from a central axis (Figure 8).

Catkin. Lax or erect spike-like inflorescence of some trees and shrubs bearing small, usually unisexual flowers.

Compound leaf. Leaf with two or more distinct leaflets growing beyond the bud (Figure 5).



Cordate leaf shape. Base of the leaf is distinctly lobed (Figure 8).

Double serrate margin. Leaf margin with smaller teeth imbedded in larger teeth**.**

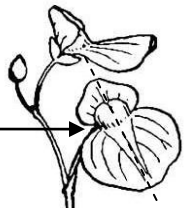
Elliptic leaf shape. Leaf oval in outline (Figure 8).

Emergent. Plants growing above the water surface**.**

Entire leaf margin. Leaf margin without teeth.

Flr. Abbreviation for flower.

Forb. An herbaceous vascular plant (generally with broad leaves) that is not a Grass, Rush, or Sedge.



Frond. The leaf of a fern or duckweed where leaves and stems are not differentiated.

Frt. Abbreviation for fruit.

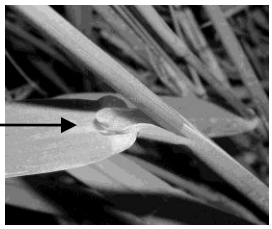
Genus. The second finest taxonomic classification division for biological organisms.

Herbaceous. A plant without a persistent woody stem.

Inflorescence. The flower arrangement of a plant.

Irregular flower. A flower with dissimilar petals that can be cut into two equal parts in only one plane (bilaterally symmetrical)**.**

Lanceolate leaf shape. Lance or spear-head shaped, much longer than wide (Figure 8).

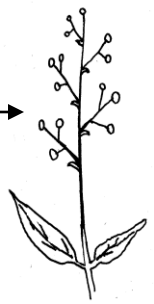


Leaflet. The leaf-like division of a compound leaf (Figure 5).

Ligule. A small projection or tuft of hairs at the juncture of the leaf blade and stem present in some grasses.

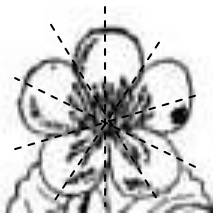
Linear leaf shape. Leaf that is very long and narrow (Figure 8).

Margin. The edge of the leaf.
Mid-rib. The main or central vein of a leaf.
Node. The point on a stem where a leaf originates.
Ocrea. A sheath that surrounds the leaf node in the genus *Polygonum*.
Opposite leaf arrangement. Leaves emerge from stems in pairs that are arranged side by side (Figure 6).
Ovate leaf shape. Wider than lanceolate (Figure 8).
Ovoid. Shaped like an egg.
Panicle. A flower arrangement which is branched more than once beyond the main flowering axis.



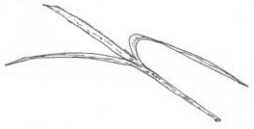
Perigynium. A sac-like structure that encloses the female flower in the genus *Carex*.
Petiole. The stalk of a leaf (Figure 5).
Pinnae. The leaflets from the main axis of a fern.
Pinnately compound leaves. Leaflets are arranged along both sides of an elongate leaf axis (Figure 5).

Ray. Flower petals in the family Asteraceae (Asters, Sunflowers, Daisies, etc).
Regular flower. A flower with petals that are all similar in size, shape, and orientation and can be cut into equal parts along more than one plane (radialy symmetrical).
Rhizoid. A simple root-like structure that lacks true vascular tissue.
Serrate leaf margin. Leaf margin with teeth.
Sheath. A collar-like part of a leaf that wraps around the stem.
Simple leaf. A leaf with the blade all in one piece (Figure 5).



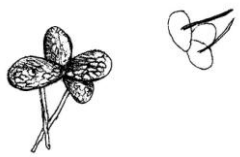
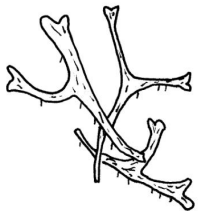
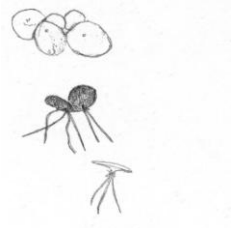
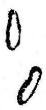
Sori. Reproductive (spore bearing) structures of ferns.
Spike. An elongated unbranched inflorescence with many small flowers.
Spikelet. A small spike, found in many Grasses, Sedges, Rushes, etc.
Submergent. Plants growing below the water surface, or if floating, submerged and floating leafs all alike.
Tepal. Sepals and petals of flowers that cannot be differentiated.
Terrestrial. Growing on land, not aquatic
Three-ranked. Leaves emerge from stems in three distinct directions when looking straight down from the top of the plant.

Two-ranked. Leaves emerge from stems in two distinct directions when looking straight down from the top of the plant.

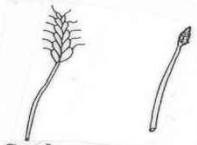
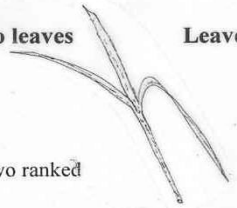
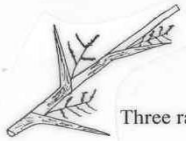
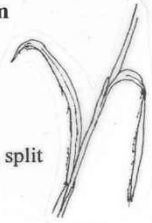
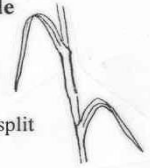


Whorled leaf arrangement. Leaves emerge from stems in groups of three or more per node (Figure 6).

Small floating wetland plants

Genera	Shape of the plant body (thallus)	Rhizoids (roots)	Color underneath	Size	General plant group
Lemma minor		Usually one, longer than the thallus body	Green to white, rarely reddish	2 – 6 mm	Forb
Lemna trisulca		none	Light green	5 – 18 mm	Forb
Riccia		None or very obscure	Light green	0.1 – 0.3 X 5.0 30 mm	Nonvascular
Ricciocarpus		Many, shorter or equal to the length of the thallus body	Dark brown to black; occasionally hints of dark red	6.0– 15.0 mm	Nonvascular
Spirodela	Round –multi-lobed 	Two or more, about as long as the thallus body	Dark red	3.0 – 5.0 X 8.0 – 10.0 mm	Forb
Wolffia	Round to rod-shaped 	none	Light green	0.2 -1.4 X 0.3 –1.0 mm	Forb

"Grasslike" Plants

Name	Grass	Spike Rush	Three-way Sedge	True Rush	Nut Sedge	Sedge	Bullrush
Taxon	**(Various)**	***Eleocharis***	***Dulichium***	***Juncus***	***Cyperus***	***Carex***	***Scirpus***
Bracts below flower/fruit --	**No leaflike bract under the flwr/frt**	**No leaflike bract under the flwr/frt**  bracts absent	**No leaflike bract under the flwr/frt**	**One or more leaflike bracts below the flwr/frt**	**One or more leaflike bracts below the flwr/frt**  leaflike bracts	**Often with a leaflike bract under the flwr/frt**	**One or more leaflike bracts below the flwr/frt**
Seed/fruit arrangement --	**Seeds enclosed within two or more scalelike leaves**  seed bract	**Seeds are attached to scalelike bracts**	**Seeds are attached to scalelike bracts which are arranged in two vertical rows**  seed bract	**Many tiny seeds within a capsule**  capsule with seeds	**Seeds are attached to scalelike bracts which are arranged in two vertical rows**  Two rows	**Each seed within a saclike bract called the "Perigynium"**  Perigynium	**Seeds are attached to scalelike bracts which are arranged in a spiral**  Spiral
Stems --	**Stems flat or round and hollow except at joint**	**Stems round and hollow**	**Stems round and hollow**	**Stem usually round often hollow**	**Stem is angled often appearing triangular, usually solid**	**Stem triangular or round and usually solid**	**Stem triangular or round and usually solid**
Leaf arrangement --	**Leaves 2-ranked**	**No leaves**  Two ranked	**Leaves 3-ranked**	**Leaves two ranked**  Three ranked	**Leaves 3-ranked**	**Leaves 3-ranked**	**Leaves 3-ranked or absent**
Leaf Sheath -- (open /closed)	**Leaf sheath split down one side**	**No leaves, green stem**  Leaf sheath open, split	**Leaf sheath not split (closed) down side**	**Leaf sheath not split (closed) down side**	**Leaf sheath not split (closed) down side**	**Leaf sheath not split (closed) down side**  Leaf sheath closed, not split	**Leaf sheath not split (closed) down side**

Scientific name index

Boldface numbers refer to the identification key. Page numbers with regular font refer to the detailed plant description.

Common name index

Boldface numbers refer to the identification key. Page numbers with regular font refer to the detailed plant description.

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Appendix 1. Equipment List.

- Chest waders
- Clipboard
- Site information data sheet
- Releve data sheet
- GPS unit (if available)
- Compass
- Pencils
- 50 m tape measure
- 4 tall garden stakes/dowels
- Hand-lens or magnifying glass
- Additional plant identification guides (if available)
  Recommended:
  - *Wetland Plants and Plant Communities of Minnesota and Wisconsin* (Eggers and Reed)
  - *A Great Lakes Wetland Flora* (Chadde)
  - *Through the Looking Glass-A Field Guide to Aquatic Plants* (Borman et. al)
  - *A Guide to Aquatic Plants-Identification and Management* (Fink)
- Gallon size plastic bags for collecting unknown plants
- Permanent marker for labeling bags

MN WHEP VEGETATION SURVEY FIELD SHEET: SITE INFORMATION

Site Name: Brick Pond
Date/Time: 7/16/04 5:00
Team Leader/Observer: Robert Orleans
Team Name: Eagan
Local Sponsor: Dakota Co.
County: Dakota

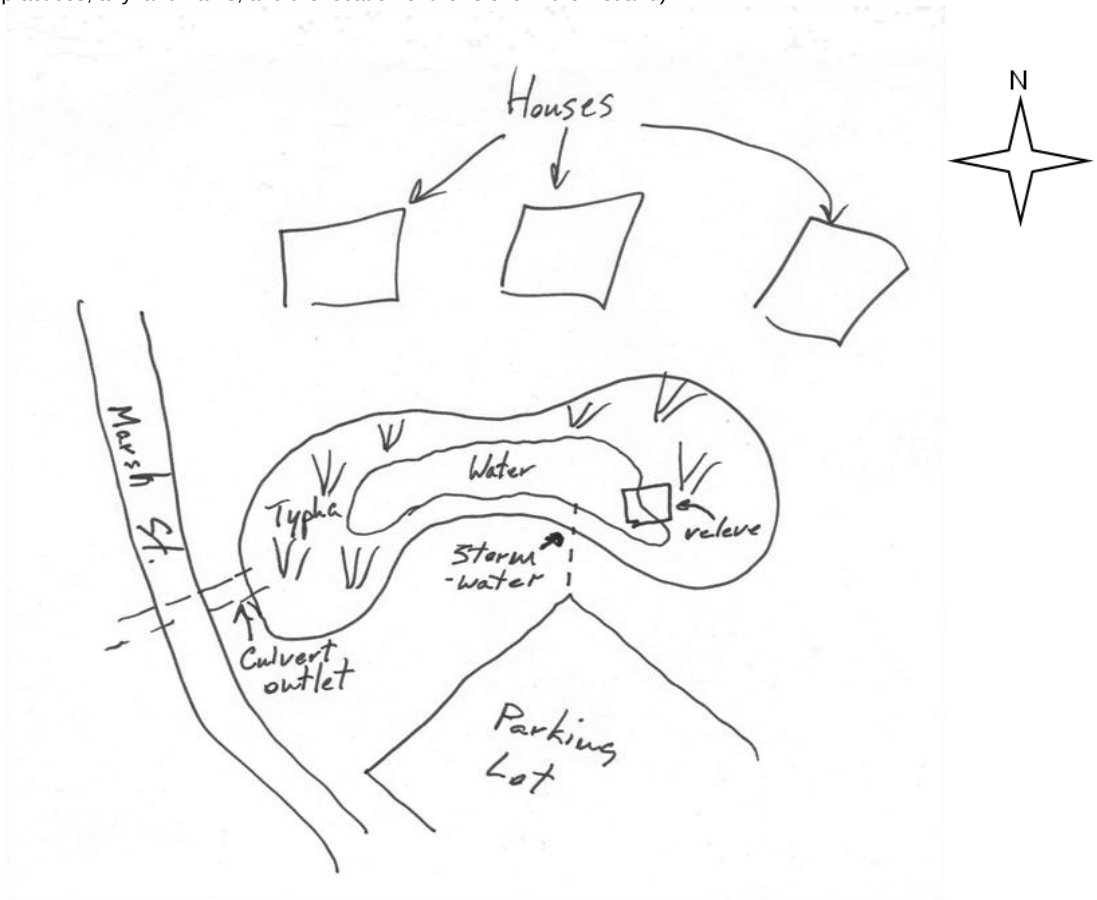
Location Information (UTM coordinates from GPS unit, Township Range Section coordinates, or street directions):

497232.8614 (x) 4982563.69786 (y) Datum: NAD 83

Site Description (include vegetation, water pathway, and immediate land use descriptions. Note any unique plants or plant communities within the wetland but occurring outside of the releve. Did you observe any wildlife while at this site?

- Relatively small (< 1 acre) wetland with cat-tail dominated emergent veg, lily pads in the middle
- Wetland drains west into Brick Lake
- Houses to the north have well groomed lawns (they probably spray) mowed to wetland edge, eastern margin bordered by an old field, stormwater is coming from the parking lot to the south

Site Sketch (Include vegetation zones, water inlets and outlets, point source pollution inputs such as stormwater pipes, immediate land use practices, any landmarks, and the location of the releve in the wetland):



MN WHEP VEGETATION SURVEY FIELD SHEET: RELEVE DATA

Site Name: Brick Pond Date/Time: 7/16/04 5:00
Team Leader/Observer: [redacted] Team Name: [redacted]
Local Sponsor: 0 County: 1

Releve Shape (circle one): **10 m x 10 m** or **5 m x 20 m** = 100 m^2
Is the releve typical of the wetland plant community ? (circle one): **Yes** or **No** (explain below)
Water depth in the plot (meters): Shallowest: [redacted] m Deepest: [redacted] m
Substrate/bottom description: [redacted]

Comments:
- Water column is clear
- Many toads and a pair of mallards present

Note: *Numbers in ( ) refer to the metrics where the data are used*

Pres		NONVASCULAR (2, 6)
		Chara (Muskgrass)
		Lichen
		Moss
	2	*Riccia fluitans* (Slender Riccia)
✓		*Ricciocarpus natans* (Purple-Fringed Riccia)

Pres	CC	LOW VASCULAR (1)
		Equisetum (Horsetail)
		Onoclea sensibilis (Sensitive Fern)
		Osmunda (Osmunda)
		Thelypteris palustris (Marsh-Fern)

Pres	CC	WOODY (1)
		Vines
		Parthenocissus (Virginia Creeper)
		Vitis riparia (Grape)
		Shrubs or Trees with Opposite Leaves
		Acer (Maple, Box Elder)
		Cornus (Dogwood)
		Fraxinus (Ash)
		Rhamnus cathartica (Common Buckthorn)
		Shrubs or Trees with Alternate Leaves
		Alnus (Alder)
		Frangula alnus (Alder-Buckthorn)
		Populus (Aspen, Cottonwood)
		Quercus (Oak)
	1	*Rubus* (Raspberry, Dewberry, Blackberry)
✓		*Salix* (Willow)
		Spiraea alba (Meadowsweet)
		Ulmus (Elm)

Pres	CC	GRASSLIKE (1, 3, 4, 7)
		Sedges, Bulrushes, Rushes
	2	*Carex* (Sedge)
		Cyperus (Flatsedge)
		Dulichium arundinaceum (Three-Way Sedge)
✓	2	*Eleocharis* (Spike-Rush)
		Juncus (Rush)
		Scirpus (Bulrush)
		True Grasses
		Agrostis (Bent Grass)
		Alopecurus (Foxtail)
		Calamagrostis (Reed Grass)
		Echinochloa (Barnyard-Grass)
✓	1	*Glyceria* (Manna-Grass)
		Leersia (Cut Grass)
✓	3	*Phalaris arundinacea* (Reed Canary-Grass)
		Phragmites australis (Giant Reed)
		Poa (Blue Grass)
		Spartina pectinata (Prairie Cord-Grass)
		Zizania aquatica (Wild Rice)

Cover Class (CC)	Cover Class (CC) Estimate
6	75-100%
5	50-75%
4	25-50%
3	5-25%
2	1-5%
1	0-1%

Appendix 3. Wetland Vegetation Key At-a-Glance

Pres	CC	FORBS (1, 5, 6, 7)
Submergent Aquatic Forbs		
✓	4	*Ceratophyllum* (Coontail)
		Elodea (Waterweed)
		Megalodonta beckii (Water Beggar-Ticks)
		Myriophyllum (Water-Milfoil)
		Najas (Water-Nymph)
✓	2	*Potamogeton* (Pondweed)
		Ranunculus (Water Crowfoot)
		Utricularia (Bladderwort)
		Vallisneria americana (Water Celery)
		Zannichellia palustris (Horned Pondweed)
Floating Leaved Aquatic Forbs		
		Brasenia schreberi (Water-Shield)
✓	4	*Lemna* (Duckweed)
✓	3	*Nuphar* (Yellow Water-Lily)
		Nymphaea (White Water-Lily)
✓	2	*Polygonum amphibium* (Water Smartweed)
✓	2	*Potamogeton* (Pondweed)
		Spirodela polyrhiza (Greater Duckweed)
		Wolfia (Water-Meal)
Emergent Forbs with Basal Leaves		
		Acorus (Sweet Flag)
		Alisma (Water-Plantain)
		Calla palustris (Water-Arum)
		Caltha palustris (Marsh-Marigold)
		Iris (Iris, Flag)
		Pontedaria cordata (Pickerelweed)
		Rumex (Dock)
		Sagittaria (Arrowhead)
		Sparganium (Bur-Reed)
✓	5	*Typha* (Cat-Tail)

Pres	CC	FORBS (1, 5, 6, 7)
Emergent Forbs from a Distinct Stem		
		Asclepias incarnata (Swamp-Milkweed)
		Aster (Aster)
✓	1	*Bidens* (Beggar-Ticks)
		Campanula aparinoides (Marsh-Bellflower)
		Cicuta (Water-Hemlock)
✓	1	*Cirsium* (Thistle)
		Epilobium (Willow-Herb)
		Eupatorium (Joe-Pye Weed, Boneset)
		Euthamia (Grass-Leaved Goldenrod)
		Galium (Bedstraw)
		Hypericum (St. John's-Wort)
		Impatiens (Jewelweed)
		Lathyrus (Wild Pea)
✓	1	*Lycopus* (Bugle Weed)
		Lysimachia (Loosestrife)
		Lythrum (Loosestrife)
		Mentha arvensis (Field-Mint)
		Pilea (Clearweed)
✓	1	*Polygonum* (Smartweed)
		Potentilla palustris (Marsh-Cinquefoil)
		Scutellaria (Skullcap)
		Sium suave (Water-Parsnip)
		Solanum dulcamara (Nightshade)
		Solidago (Goldenrod)
		Stachys (Hedge-Nettle
		Triadenum fraseri (Marsh St. John's-Wort)
		Urtica dioica (Stinging Nettle)
		Verbena hastata (Blue Vervain)

		Additional/Unknown Forbs
✓	1	**Unknown Forb #1**

Additional Comments:

-There are 2 Potamogetons in the plot, 1 floating leaved and 1 submergent
-Total Potamogeton CC = 3

-There are 2 Polygonums
-Total Polygonum CC = 2

MN WHEP VEGETATION SURVEY METRIC SCORING SHEET

Site Name: Brick Pond Date Sampled: 7/16/04
Team Leader/Observer: Robert Orleans Date Scored: 7/22/04
Team Name: Eagan County: Dakota
Local Sponsor: Dakota Co.

1) Vascular Genera

-Count the number of different genera of low vascular plants (Ferns & Horsetails), woody plants, grasslikes, & forbs observed within the sample plot. Be careful not to count the same genus twice.

a. Number of **Low Vasculars**: 0

b. Number of **Woody Plants**: 1

c. Number of **Grasslikes**: 4

d. Number of **Forbs**: 10

e. **Plot Tally** (sum of a - d): 15

f. **Metric #1 Score**: 3

Comments:

Scoring criteria for Vascular Genera

Plot Tally	Score
? 20	5
9 - 19	3
0 - 8	1

2) Nonvascular Taxa

-Count the number of different kinds of nonvascular taxa observed within the sample plot. Do not count algae, but note in the comments section.

a. **Plot Tally**: 1

b. **Metric #2 Score**: 3

Comments:

Scoring criteria for Nonvascular Taxa

Plot Tally	Score
? 2	5
1	3
0	1

MN WHEP VEGETATION SURVEY METRIC SCORING SHEET

Site Name: Brick Pond Team Name: Eagan Date Sampled: 7/16/04

3) Grasslike Genera

-Count the number of different kinds of grasslike genera observed within the sample plot (refer to metric #1, part c).

a. Plot Tally: 4

b. Metric #3 Score: 3

Comments:

Scoring criteria for Grasslike Genera

Plot Tally	Score
? 5	5
2 - 4	3
0 - 1	1

4) *Carex* Cover

-Estimate the percent cover of *Carex* within the sample plot.

a. *Carex* Cover Class Value: 2

b. Metric #4 Score: 3

Comments:

Scoring criteria for *Carex* Cover

CC Value	Percent	Score
3 - 6	? 5%	5
2	1 - 5%	3
0 - 1	0 - 1%	1

5) *Utricularia* Presence

a. Was *Utricularia* present in the plot? Yes (No)

b. Metric #5 Score: 1

Comments:

Scoring criteria for *Utricularia* Presence

Presence/Absence	Score
Present	5
Absent	1

6) Aquatic Guild

-Count the number of different Aquatic Guild genera. This includes the submergent aquatic forbs and floating leaved aquatic forbs listed on the releve data sheet ***and*** *Chara, Riccia fluitans,* and *Ricciocarpus natans*

a. Plot Tally: 6

b. Metric #6 Score: 5

Comments:

Scoring criteria for Aquatic Guild

Plot Tally	Score
? 6	5
3 - 5	3
0 - 2	1

MN WHEP VEGETATION SURVEY METRIC SCORING SHEET

Site Name: **Brick Pond** Team Name: **Eagan** Date Sampled: **7/16/04**

7) Persistent Litter

-Record the cover class (CC) of each plant taxa listed below that was found in your plot. Determine the midpoint % cover and sum all of the values to score this metric. The midpoint % cover is the middle percentage of the range that a CC represents. Data must be converted from CC to midpoint % before being added together, because the ranges that CC's represent are not equal.

a. Sum of midpoint percent cover:

Plant	CC	Midpoint %
Typha (Cat Tail)	5	63
Sparganium (Bur-Reed)		
Lythrum (Loosestrife)		
Phragmites australis (Giant Reed)		
Scirpus (Bulrush)		
Polygonum (Smartweed)	2	3

Total Midpoint %: **66** (%)

CC	Percent Cover Range	Midpoint %
6	75-100	87
5	50-75	63
4	25-50	38
3	5-25	15
2	1-5	3
1	0-1	0.5

b. Metric #7 Score: **1**

Comments:

Scoring criteria for Persistent Litter

Total Midpoint %	Score
? 27%	5
28 - 54%	3
? 54%	1

IBI Summary

-Tally your results from the seven metrics and add them together to arrive at a wetland vegetation IBI score and condition assessment for the site.

Metric	Score
1) Vascular Genera	3
2) Nonvascular Taxa	3
3) Grasslike Genera	3
4) *Carex* Cover	3
5) *Utricularia* Presence	1
6) Aquatic Guild	5
7) Persistent Litter	1
Total:	19

Site Score Interpretation

IBI Score	Wetland assessment
26 - 35	Excellent
16 -25	Moderate
7 - 15	Poor

Wetland Condition Assessment: **Moderate**

MN WHEP VEGETATION SURVEY METRIC SCORING SHEET

Site Name: **Brick Pond** Team Name: **Eagan** Date Sampled: **7/16/04**

Additional Site Remarks

-Please provide any additional information about this site and/or the vegetation survey. Do you think the methods for evaluating the vegetation are adequate for this site? Does the condition assessment reflect your impressions of the site? Are there any potential threats to the site (e.g. new developments, stormwater inputs, roads, etc)?

-The vegetation is pretty homogenous at this site, so we're pretty confident that our releve accurately characterized the wetland

-We agree with the assessment. The aquatic community looks ok but the emergent community is being overrun with cat tails giving an overall moderate assessment.

Appendix 3. Wetland Vegetation Key At-a-Glance