Managing Iowa Habitats

Fen Wetlands

Introduction

Fens are the rarest of Iowa's wetland communities and of great scientific interest. While their geology varies, they all are the products of the seepage of groundwater to the surface. Because the water is rich in calcium and other minerals, only a select group of plants is able to grow there. As a result, fens contain many plant species considered endangered or threatened in Iowa.

A few of the oldest fens contain plant remains that date back 10,000 years, though most Iowa fens are less than 5,000 years old. A few of these "younger" fens may have existed 10,000 years ago, but because of dramatic climate changes, they may have dried up and lost the plant remains (by burning or erosion) that could prove their age. When the climate grew wetter again about 5,000 years ago, these fens may have reappeared. Most Iowa fens, however, are thought to be of rather recent origin, geologically speaking. It is likely they were formed in the last 5,000 years and are related to the changes in geology brought by the receding of the last glaciers from Iowa.

Why should I be concerned?

Fens are an important and unique wetland type. Not only are the fens themselves rare, but they shelter over 200 plant species, 20 of which are Iowa endangered and threatened species. Many of the plant species have been in these areas for thousands of years. The fen's vegetation, in turn, shelters wildlife by providing valuable habitat.

Fens are valuable to humans as well. They are important as sites of groundwater discharge — good indicators of shallow aquifers. Vegetation in all wetlands plays an important role in recycling nutrients, trapping eroding soil, and filtering out polluting chemicals such as nitrates. However, the rarity of fens and their relatively small size makes it important to protect them from overloading by these materials. Too many nutrients or other chemicals can irreparably damage fens. As miners watched their canaries for signs of poisoned air, it is wise for humans to watch closely the health of plant and animal life in ecosystems such as fens, which are good indicators of environmental quality. The condition of plants and animals in fens can help us mon- itor the quality of groundwater resources.

Fringed gentian

IOWA STATE UNIVERSITY
Extension and Outreach

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What are fen wetlands?

The name *fen* is not as commonly used in the United States as in Europe where these wetlands are not as rare. In Iowa, fens have been called marshes, seeps, side-hill seeps, mound springs, wet prairies, sedge meadows, and sloughs. They also have been mistakenly called bogs, hanging bogs, and hillside bogs. Fens are typically found on hillsides, though occasionally in low areas between hills.

Fens differ substantially from other wetlands.

There are many different kinds of wetlands. Certain characteristics make fens unique. Typically, the water in fens is neutral to alkaline (the pH is 7 or greater) and rich in nutrients. The water comes from groundwater that saturates the fens' organic soils — layers of partially decomposed plant material called peat. In certain areas this peat is so saturated with water it sometimes is called "quaking soil" because the ground trembles when walked on. Sometimes the water that saturatesthis soil carries enough dissolved calcium carbonate to form a grayish-white, lime-rich substance called *marl* or *tufa* when it comes to the surface. Because of this calcium deposit, these wetlands are sometimes referred to as *calcareous*.

Because of the dissolved calcium and other minerals in the water, fen plants are very distinctive. The most common plants in the fen are sedges that often hide some rare and beautiful wild flowers. Other plants that live in the fen include grasses, *forbs* (broad-leaved plants), and a few shrubs and trees.

Fen characteristics

Fens differ substantially from other wetlands. Some of these differences cannot be directly observed because they are deep below the soil surface.

Geological settings - underground structure

Fens can form where a groundwater source rich in minerals is exposed to the surface. Depending on a fen's location in the state, its foundation was laid either during a glacial period hundreds of thousands of years ago (and since eroded), or during the most recent glacial period — about 10,000 years ago. In either case, the geology provided an ideal setting for the development of a fen. There are basically two settings:

- The most common setting is one in which **the groundwater source is a buried sand and gravel deposit** located in debris left behind by glaciers (see Figure 1). Over time, erosion exposed portions of this sand and gravel resulting in a seep area — a place where the groundwater is near the surface. Peat soil is characteristic of fens formed over the seep area.
- A less common setting is one in which **the groundwater source is in sand and gravel that was deposited on the surface** by flowing water from the melting glaciers.

These geological settings of fens are important because they relate to the likelihood of contamination by chemicals and other pollutants. Fens with groundwater sources near the surface (second setting) can be contaminated by surface-derived pollutants much more easily than fens whose source of groundwater is buried (first setting). However, the glacial deposits surrounding the buried groundwater sources of eastern Iowa fens are old and weathered. This makes them more fractured, allowing pollutants moving through the ground to enter the fen easily and rapidly. Thus eastern Iowa fens are more likely to be contaminated by surface pollutants that move into and through the fractures than similar western Iowa fens, whose geologic setting is younger and not as weathered.

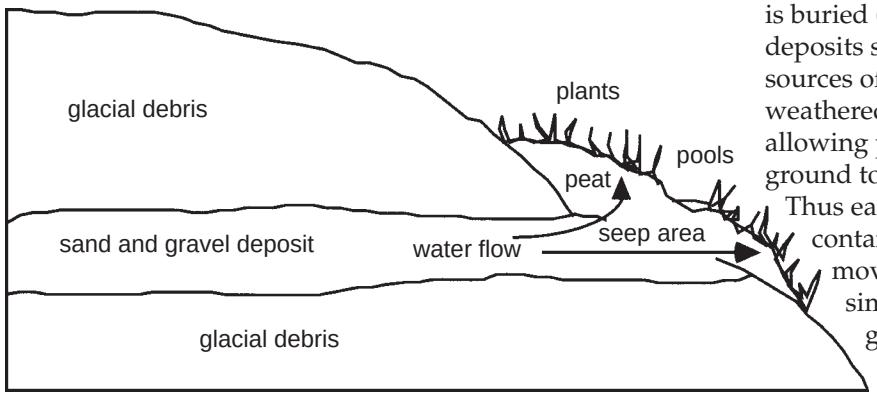


Figure 1. Generalized cross-section diagram of an Iowa fen.

Soils

Fen soil contains a large quantity of decomposing plant and animal material called humus. Soils with a high humus content are called organic soils. Fen organic soil is saturated with water, and the humus is so rotted that it is difficult to discern any bits of plant or animal material. Such organic soil is called muck. In contrast, the true peat soils of bogs show recognizable bits of plant stems and other material. Two soil series are typical of Iowa fens: *Palms muck* and *Houghton muck*. However, some exceptions exist; these soil series do not always have fens, and some fens are found on other soil series.

Water — pH

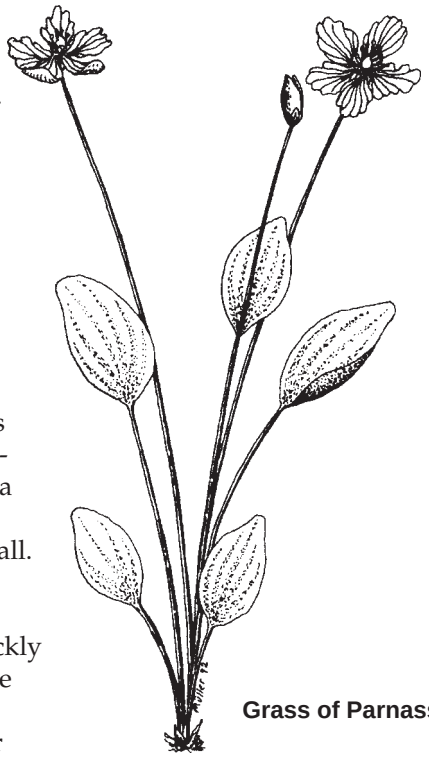
A particular water chemistry also characterizes a fen. For example, its pH is alkaline, neutral, or only slightly acidic, whereas a bog is very acidic. Fen soils are saturated with water coming directly from groundwater sources. This groundwater supplies most of the nutrients needed by fen plants. Classification of Iowa fens is based on the quantity of available nutrients and the water pH. There are three distinct types:

- *nutrient-poor* (slightly acidic),
- *nutrient-rich* (neutral), and
- *very nutrient-rich* (alkaline).

Only two nutrient-poor fens are known to exist in Iowa. One of these is located in Pilot Knob State Park. Nutrient-rich fens are located chiefly in the types of geological settings typical of eastern Iowa. Most of the very nutrient-rich fens are found in northwestern Iowa. Very nutrient-rich fens also may be characterized by calcium carbonate (limestone) deposits of marl or tufa.

Water — hardness

The hardness of water is largely defined by the quantity of dissolved calcium and magnesium ions in the water. The more dissolved ions present, the harder the water. Hard water tends to be more alkaline. As a result, slightly alkaline, very nutrient-rich fen have higher concentrations of dissolved calcium carbonate, sulfate and silica than neutral, nutrient-rich fens. The different water chemistry among fens was first thought to reflect an east-west gradient across the state. Currently, researchers feel it is more likely due to differences in the nature of the geology of the sites.



Grass of Parnassus

Water-response to rainfall.

A fens's response to rainfall is related to its geological setting. Moisture levels in eastern Iowa fens tend to reflect the current quantity of rainfall. Most eastern fens are drier during drought periods and recover quickly after wet periods because the geological materials around the groundwater sources allow water to move rapidly through to the fens after a rainfall. At the same time, these materials do not hold water well enough and the groundwater storage volume is not large enough to maintain moisture levels during droughts.

Some western Iowa fens have geological materials surrounding them that cause water to move through more slowly. These materials hold water better and the groundwater sources can store more water. These conditions can help maintain a more constant moisture level and cause a more delayed response to changes in rainfall patterns.

Plant life

Certain species of plants, such as beak-rush, Grass of Parnassus, and brook lobelia, can be used as indicators of fens. (See page 8 for scientific names of plants.) Of those plant species peculiar to fens, 80 percent occur in both eastern Iowa and western Iowa fens. These include upright sedge, inland sedge, bull sedge, purple-stemmed aster, flat-topped white aster, Muhly, and Grass of Parnassus. Most fens in Iowa are dominated by upright sedge.

Iowa fens shelter more than 200 species of wildflowers, some of which only live in fens.

However, some well-developed western fens contain a variety of dominant sedges that include water and beaked sedge. Beak-rush also is frequent in western fens, but not in eastern fens. There are a number of forbs found in eastern fens that are rare or absent in western fens. These include marsh-marigold or cowslip, swamp saxifrage, sensitive fern, and marsh fern. Eastern fens have twenty-two species of trees and shrubs while western fens contain only two.

It is likely that the differences in plant populations found in eastern and western fens are due chiefly to differences in climate and moisture, though variations in geology and water chemistry may also play a part. In some individual cases, plant population characteristics may reflect land use, such as loss of plant species due to grazing.

Iowa fens shelter more than 200 species of wildflowers, some of which only live in fens. This encompasses approximately 13 percent of the state's native wildflowers. Recent searches of fens have discovered over 20 species of plants that are considered rare in Iowa. Three of the species had previously been listed as extirpated (gone from the state completely). *State endangered* plants (species in danger of being extirpated) found in fens include bog bedstraw and bogbean. The seven *state threatened* plants (species becoming very rare in the state) found in fens are bog birch, yellow monkey flower, beak-rush, narrow-leaved fringed gentian, bog willow, small arrow grass, and large arrow grass. *State special concern* plant species found in fens are valerian, brook lobelia, tall cottongrass, and sage or hoary willow. These plants are listed so that they will be more closely studied and monitored in the state.

Zonation of plants is an unusual phenomenon found in fen plant communities. Plants in fens can be grouped into three distinct zones: the *discharge zone*, the *sedge mat zone*, and the *border zone* (see Figure 2). Much like the concentric growth rings in a tree trunk, the first zone forms around the groundwater seepage area, the second zone forms around the first, and the third around the second. Actual presence af all three zones, as well as how distinctly they are defined, varies among fens. In Iowa, only a few large, well-developed fens such as Silver Lake and Excelsior fens in the northwest, fully demonstrate this phenomenon. Some other western Iowa fens have three zones, but the sedge mat zone is narrow and not as well defined. Zonation becomes less distinct in fens from west to east across the state. Eastern Iowa fens are primarily made up of border zone with small discharge zones, if any. Most do not have sedge mat zones.

Animal Life

All wetland types are important habitat for a large number of wildlife species. Many birds, such as the sora rail, yellow-headed blackbird, marsh wren, and common snipe depend on fens and other wetlands. Fens have been found to shelter a great variety of butterflies. This includes the rare Baltimore checkerspot butterfly. Unique communities of microscopic border zone plants and animals, such as diatoms, also have been found in fens.

Where are Iowa's fens?

Formerly, fens were thought to occur only in northwest Iowa. However, fens in Iowa include some peaty wetlands found in the northeastern part of the state. A statewide fen inventory found 200 fens in 37 Iowa counties. The search identified many other possible fen sites that had been destroyed by cultivation, grazing, mining, or impoundments.

Of the 200 existing fens, about 25 are considered high quality — those that have suffered little or no damage, and exhibit a large number

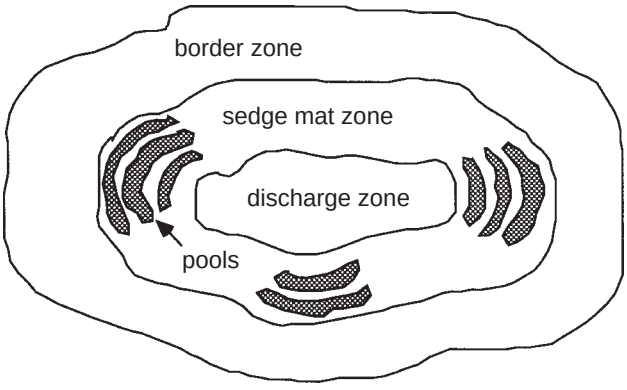


Figure 2. Aerial view of zonation in a large, well-developed fen.

and wide variety of plant species characteristic of fens. Ranging in size from less than $^1/_2$ acre to 25 acres, most of these fens are located in privately-owned pastures surrounded by cropland.

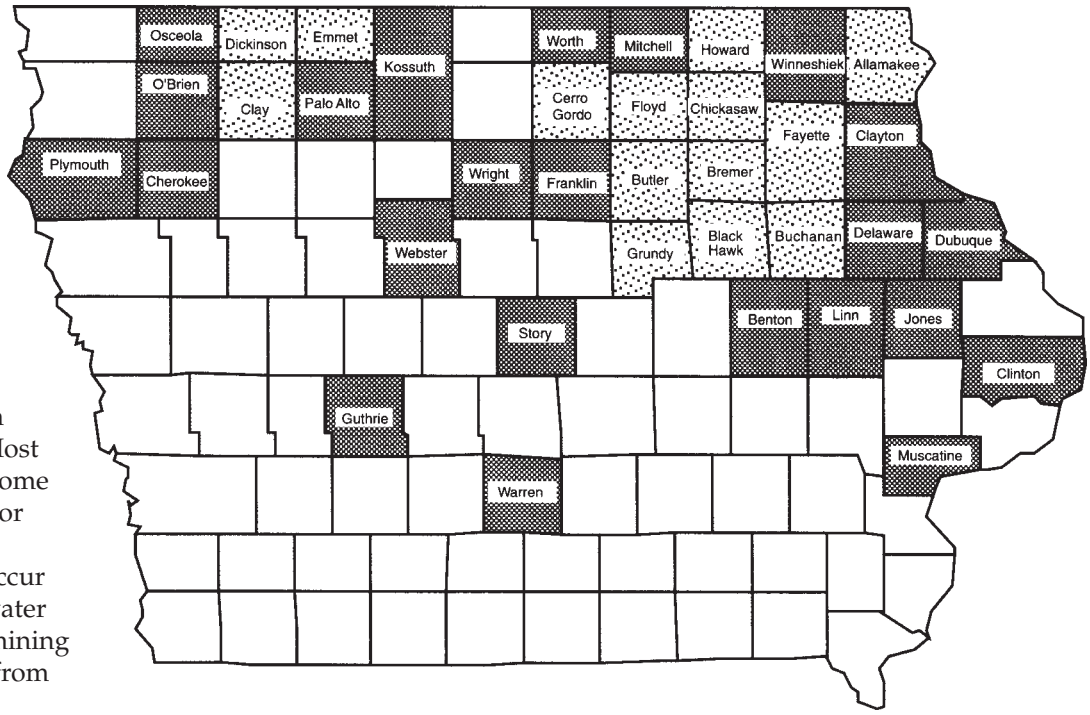


Figure 3. Counties in Iowa that contain at least one identified fen.

This location has been detrimental to fens. Most have been altered in some way through grazing or drainage for farming. Damage to fens can occur from direct use as a water source for livestock, mining for peat or gravel, or from runoff and drift of pesticides and fertilizers from surrounding fields. These are major threats to Iowa's remaining fens unless something is done soon.

The future of this rare wetland type is entrusted to your hands — the landowner.

What assistance is available for landowners for maintaining fens?

Financial assistance

Some landowners are in a financial position that allows them to set this land aside or sell the fen property. And there are various programs that provide cost assistance for doing so.

Acquisition of property such as fens is a high priority for some agencies and organizations. The Iowa Department of Natural Resources is active in acquiring fens for the state from willing sellers. Private organizations such as The Nature Conservancy, the Iowa Natural Heritage Foundation, and Pheasants Forever also work toward buying fens. Rather than managing the fens themselves, these organizations sometimes turn them over to the local County Conservation Board.

However, the landowner may not wish to sell. When a fen is located, for example, in the middle of pasture or cropland, it is not convenient to sell a small parcel. When the landowner does not wish to sell, but does want to maintain the fen in its native state, there are options that provide tax credits for the landowner. These include *conservation easements* that allow the landowner to retain ownership and the right to use the property in ways agreed upon with the agency providing the easement payment. The landowner may use the land for recreation such as bird watching, but may not farm, drain, or fill the fen. In return, the landowner benefits by retaining ownership of the property, gaining tax benefits, and controlling access. The easement is usually permanent to ensure that the land is maintained as a natural area.

Reserved life estates are another way of setting aside property. The landowner gives the deed to the land to a qualifying organization, but reserves lifetime use of the property. Again this use must not destroy the natural state of the property. Reserved life estates also provide the landowner with tax benefits. For more options,

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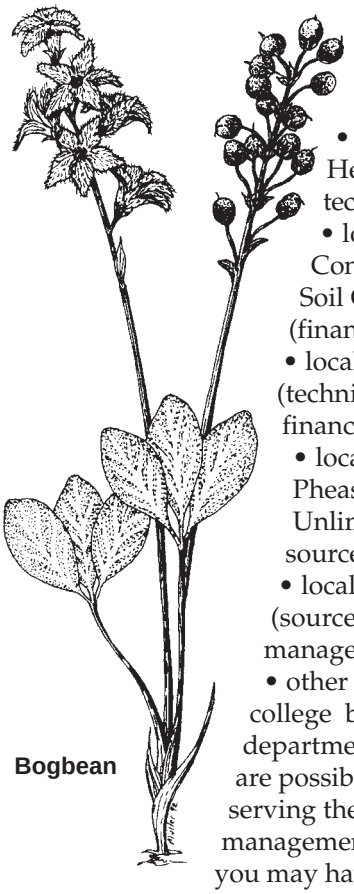
see the booklet: *The Landowner's Options: a guide to the voluntary protection of land in Iowa*, available from the Iowa Natural Heritage Foundation, Des Moines, Iowa 50319, (515) 288-1846.

Technical assistance

For help in managing fens or in identifying plants, there is a wide range of assistance available. The primary source is the **Bureau of Preserves and Ecological Services**, Iowa Department of Natural Resources, Wallace State Office Building, Des Moines, IA 50319, (515) 281-3891 (technical assistance, fen inventory, initial management plans). Other sources include:

- Environmental Protection Agency, Wetlands Protection Section (technical assistance);
- Geological Survey Bureau, Iowa Department of Natural Resources (technical assistance);
- U.S. Fish and Wildlife Service, Private Lands Office, Walnut Creek National Wildlife Refuge (technical assistance);
- Iowa Prairie Network (source of volunteers for implementing management plans such as prescribed burns and weed control);
- Iowa State University Extension (technical assistance);
- The Nature Conservancy (financial and technical assistance);
- Wetlands for Iowa, Iowa Natural Heritage Foundation (financial and technical assistance);
- local Agricultural Stabilization and Conservation Service (ASCS) and Soil Conservation Service (SCS) (financial and technical assistance);
- local County Conservation Board (technical assistance, possible source of financial assistance and volunteers);
- local hunting groups such as Pheasants Forever and Ducks Unlimited (financial assistance and source of volunteers);
- local Master Gardener groups (sources of volunteers for implementing management plans); and
- other conservation groups. Local college botany, biology, or animal ecology departments and even local Scout troops are possible sources of assistance in preserving these rare, natural areas. For some management practices, such as weed control, you may have to find groups with individuals who have Pesticide Applicator Training and who are willing to sign liability release forms.



Bogbean

How should fens be managed?

One of the primary techniques in fen management is avoiding land-use practices that are damaging to fens, such as grazing, draining, or tilling the fen. Also avoid farming practices outside the fen that allow excessive soil and chemical runoff and pesticide drift.

Attempts at draining fens for farming can cause irreversible damage, as well as often being illegal. The real tragedy is that after spending a large quantity of money tiling a fen to drain it, the land often remains wet. The land is still untillable and the fen is lost. Therefore, it is important to avoid trying to crop these areas.

Livestock grazing and watering also can damage fens. Many fens are located in pastures that are grazed by cattle. Some landowners allow cattle access to fens. In wet years, cattle do not venture far into the fen because of the wet, unstable ground. However, during dry years, cattle trampling can cause uneven surfaces and trails that allow undesirable exotic weeds to invade the fen. It is best to fence off the fen and devise an alternative water source.

Protect water quality

In a recent study of 20 Iowa fens, it was found that some of the most important techniques in managing fens were those that managed the land around the fen. In particular, land management practices that safeguard water quality help maintain quality fens. Because many fens have row crops upslope from them, it is critical to protect fens from the runoff or drift of agricultural chemicals. Of 20 fens studied, 10 contained pesticides and 14 exhibited high levels of nitrates. These chemicals can be harmful to the wildlife and plants of the fen. Excess nitrogen and herbicide runoff, with resultant changes in pH, can weaken and kill sensitive plant species, making room for the invasion of less desirable species. Pesticides can affect wildlife in many ways. For more information see the ISU Extension brochure: *Agricultural Pesticides and Wildlife: A Balancing Act* .

Buffer strips of grass at least 20 feet wide

(preferably 66-99 feet wide), can help reduce the quantity of chemicals carried into fens from nearby farming areas. Buffer strips are most effective when used in conjunction with other farming practices that help reduce runoff. These practices include conservation tillage, strip cropping, and terracing. Because fens get their water directly from the groundwater, farming practices that reduce the quantity of fertilizer and pesticides entering groundwater sources will reduce the quantity that enters fens. Crop rotations and use of Integrated Pest Management (IPM) are among these practices.

Control weeds and woody vegetation

We are still learning about the best way to maintain fen plant communities. Researchers are experimenting with careful burning once every four or five years to remove invading woody vegetation. Burning must be done only during wet periods so that the organic soils (the peat) is not burned. Effects of burning on rare insect populations is a concern that needs further study.

Burning for weed control is not always the best option. Each fen must be considered on an individual basis. Some fens seem to benefit most from careful spot spraying or the mowing of undesirable plants. Woody vegetation can sometimes be controlled by cutting or girdling. Herbicides should only be used when burning, mowing, cutting, and girdling are not effective options.

The timing of control attempts is important to combat certain weed species effectively. For example, Canada thistle is best controlled by late spring burns-between May and June. Early spring burns can actually increase sprouting and reproduction. Annual burns may be necessary during the first three years of control efforts. Hand-cutting of individual plants can be an effective control if done at least three times each year-in June, August, and September. Careful spot-spraying of the amine formulation of 2,4-D can be used in heavy infestations. Use all herbicides according to label directions.

There is wide agreement that maintaining steady water levels, fencing out livestock, and protecting the fen from runoff and contaminated groundwater are all critical to maintaining high quality fens. With your help, Iowans will have this important resource for many generations to come.

For more information

Wetland Plants and Plant Communities of Minnesota and Wisconsin is a guide to fen plants, including those in Iowa fens. It can be obtained for $6.50 from Dept. of the Army, St. Paul District, Corps of Engineers, ATTN: CENCS-LM/SALES AGENT, U.S. Post Office and Custom House, St. Paul, MN 55101-1479

Vegetation ManagementManual and Guidelines for 25 aggressive woody and herbaceous species can be obtained from the Illinois Nature Preserves Commission, 524 So. Second St., Lincoln Tower Plaza, Springfield, IL 62701-1787, (217) 785-8686.

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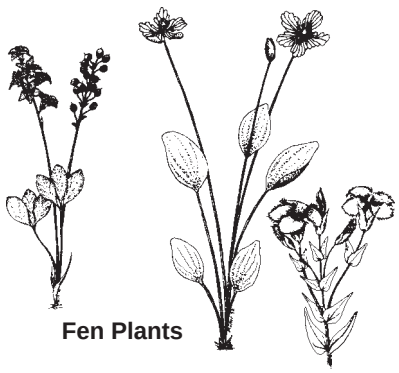

Fen Plants

Sora rail among fen plants

Scientific names* for Iowa fen plants listed in text

Common name	Scientific name
beak-rush	*Rhynchospora capillacea*
beaked sedge	*Carex rostrata*
bog bedstraw	*Galium labradoricum*
bog birch	*Betula pumila*
bog willow	*Salix pedicellaris*
bogbean	*Menyanthes trifoliata*
brook lobelia	*Lobelia kalmii*
bull sedge	*Carex lanuginosa*
bulrush	*Scirpus spp.*
cattails	*Typha spp.*
common boneset	*Eupatorim perfoliatum*
flat-topped white aster	*Aster umbellatus*
fringed gentian	*Gentianopsis crinata*
Grass of Parnassus	*Parnassia glauca*
inland sedge	*Carex interior*
large arrow grass	*Triglochin maritimum*
marsh fern	*Thelypteris thelypteroides*
marsh-marigold or cowslip	*Caltha palustris*
Muhly or barnyard grass	*Muhlenbergia glomerata*
narrow-leaved fringed gentian	*Gentianopsis procera*
northern bog violet	*Viola nephrophylla*
Olney's bulrush	*Scirpus americanus*
purple-stemmed aster	*Aster puniceus*
reedgrass (common reed)	*Phragmites australis*
sage or hoary willow	*Salix candida*
sensitive fern	*Onoclea sensibilis*
small arrow grass	*Triglochin palustre*
spotted Joe-Pye-Weed	*Eupatoriadelphus maculatus*
swamp saxifrage	*Saxifraga pensylvanica*
tall cottongrass	*Eriophorum angustifolium*
upright sedge	*Carex stricta*
valerian	*Valeriana edulis*
water sedge	*Carex aquatilis*
yellow monkey flower	*Mimulus glabratus*

* Nomenclature follows: Reed, Jr., P. J. 1988. National list of plant species that occur in wetlands: Iowa. U. S. Fish and Wildlife Service Biological Report NERC-88/18. 15. A copy can be viewed at your local U.S. Soil Conservation Service office.

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File: Wildlife