



Natural Heritage &
Endangered Species
Program

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**Natural Community Fact Sheet:
Bogs and Fens – Non-Forested Acidic Peatlands**

Community description

Peatlands, commonly called “bogs” or “fens,” are wetland communities with accumulations of incompletely decomposed organic material, or peat. Acidic peatlands form on poorly drained sites in areas with cool moist summers, where precipitation exceeds evapotranspiration. The combination of cool temperatures and low amounts of dissolved oxygen and nutrients in the water limits the decomposition of organic matter by microorganisms. Consequently, dead vegetation builds up, forming a layer of peat. The peat layer locks up essential nutrients making them unavailable to plants, and if the peat is sufficiently thick, it cuts off plants’ access to nutrient-rich groundwater below. The amount of nutrient availability in peatland communities depends on the degree of isolation from the water table and the amount of stream flow through the system. Ombrotrophic (or “rain-nourished” peatlands, called bogs) are the most isolated, highly acidic, and nutrient-poor, while minerotrophic (or “mineral-nourished” peatlands, called fens) typically have nutrient-rich stream and /or groundwater inputs. Acidic fens are intermediate between the two extremes of nutrient-rich and nutrient-poor. This fact sheet deals with the acidic end of the spectrum of peatland communities (that is, bogs and acidic fens). Calcareous fens, which also occur in Massachusetts, are described separately.



Acidic peatland around a pond, with leatherleaf, highbush blueberry (red fall colors) and larch in foreground. Photo: P. Swain, NHESP.

The Massachusetts Natural Heritage & Endangered Species Program (NHESP) inventoried the state’s acidic peatlands in order to classify the range of vegetation associations, to assess community quality, and to establish land protection priorities. Based on that work, four acidic peatland communities are currently recognized in the *Classification of Natural Communities of Massachusetts* – Level Bogs, Kettlehole Level Bogs, Acidic Shrub Fens, and Acidic Graminoid Fens (Table 1). The word “level” is used to differentiate Massachusetts’ bogs from the raised or domed bogs of more northern latitudes. In raised bogs, the peat becomes so thick that the surface of the bog is actually domed, and the only way nutrients enter the system is through precipitation. The climate of Massachusetts is not cold enough to support development of raised bogs.

Table 1. Non-forested Acidic Peatland Community Types in Massachusetts

Community Name	Abundance rank	NHESP High Quality Sites	Examples
Level Bog	S3	34	Ponkapoag Bog, Canton; Poutwater Pond Bog, Holden
Kettlehole Level Bog	S2	22	Arcadia Bog, Belchertown; Gale Rd. Bogs, Warwick
Acidic Shrub Fen	S3	16	Turner Pond Bog, New Bedford; Long Pond, Royalston
Acidic Graminoid Fen	S3	22	Grassy Pond, Acton; East Brimfield Lake Bog, Brimfield
TOTAL		94	

Good examples of acidic peatland communities are limited in Massachusetts, in part because Massachusetts is at the southern limit of their geographic range and climatic conditions are marginal. The sites that do occur are threatened by wetland alterations (including dock building, small-scale peat mining operations, and conversion to commercial cranberry bogs), encroaching development, changes in hydrology, and nutrient enrichment from leach fields, road salt run-off, and siltation. Due to their limited occurrence and their distinct assemblages of plant and animal species, the four types of acidic peatland communities in Table 1. have been designated **Priority Natural Communities** for protection within the Commonwealth by the Massachusetts Natural Heritage & Endangered Species Program (MNHESP) due to their unique vegetation and limited distribution. High-quality examples of these wetland communities are tracked by MNHESP.

Environment

Level Bog communities receive little or no streamflow and they are isolated from the water table, making them the most acidic and nutrient-poor of peatland communities. The pH of Level Bogs is in the range of 3 to 4. Level bogs develop along pond margins, at the headwaters of streams, or in isolated valley bottoms without inlet or outlet streams. **Kettlehole Level Bogs** are a subset of Level Bogs that occur in iceblock depressions (commonly called kettleholes) in sandy glacial outwash. They are typically small (<3 acres), round, and they lack inlets and outlets. Acidic fens are less acidic and nutrient-poor than Level Bogs because they tend to have more surface water inflow, and they have some groundwater connectivity. **Acidic Shrub Fens** and **Acidic Graminoid Fens** most often occur along pond margins, slow-moving streams, and along the outlet streams of stream headwater peatlands. More information is needed to identify the physical, geochemical, or hydrological differences between Acidic Shrub Fens and Acidic Graminoid Fens.

Characteristic plant species in Massachusetts

A variety of species of Sphagnum moss (*Sphagnum* spp.) are the most common plants in all acidic peatlands. As with vascular plants, particular species depending on acidity and nutrient availability. **Level Bogs** and **Kettlehole Level Bogs**, the most acidic and nutrient-poor of peatland communities, are characterized by a mixture of tall and short shrubs that are predominantly ericaceous (members of the Heath family, the Ericaceae). Leatherleaf (*Chamaedaphne calyculata*) is dominant. Other typical ericaceous shrubs include rhodora (*Rhododendron canadense*), sheep laurel (*Kalmia angustifolia*), bog laurel (*K. polifolia*), bog rosemary (*Andromeda polifolia* var. *glaucophylla*), Labrador tea (*Ledum groenlandicum*), and low-growing large and small cranberry (*Vaccinium macrocarpon* and *V. oxycoccus*). Scattered stunted coniferous trees (primarily tamarack (*Larix laricina*) and black spruce (*Picea mariana*)) occur throughout. A mixture of specialized bog plants grow on the hummocky sphagnum surface, including carnivorous pitcher plants (*Sarracenia purpurea*) and sundews (*Drosera rotundifolia* and *D. intermedia*).

Acidic Shrub Fens are composed primarily of interwoven shrubs with sphagnum moss growing at the shrub bases. Typical species include leatherleaf, high-bush blueberry (*Vaccinium corymbosum*), swamp azalea (*Rhododendron viscosum*), and fetterbush (*Leucothoe racemosa*). Scattered red maples (*Acer rubrum*) also occur, sometimes with alder (*Alnus* spp.) and sweet-pepperbush (*Clethra alnifolia*). There is a limited number of herbaceous species, including St. John's-wort (*Hypericum* spp.) and arrowhead (*Sagittaria* spp.). **Acidic Graminoid Fens** are the most species-rich of the acidic peatland communities. They have many similar species to

Acidic Shrub Fens, but graminoid (grass-like) and herbaceous species are dominant. Typical graminoids include cotton-grasses (*Eriophorum* spp.) and other sedges such as beaked sedge (*Carex utriculata*), slender woolly-fruited sedge (*C. lasiocarpa* var. *americana*), white-beaked sedge (*Rhynchospora alba*), and twig-sedge (*Cladium mariscoides*). Threeway sedge (*Dulichium arundinaceum*) is characteristic of wet, nutrient enriched edges of Acidic Graminoid Fens. Associated herbaceous species are St. John's-wort, pickerel weed (*Peltandra virginica*), and rose pogonia (*Pogonia ophioglossoides*). Large cranberry can also be abundant.



Sphagnum magellanicum, a common sphagnum moss in Massachusetts acidic peatlands. From: Damman, A.W.H. & T.W. French. 1987. The ecology of peat bogs of the glaciated northeastern United States: a Community Profile. U.S. Fish Wildl. Serv. Biol. Rep. 85(7.16).

Rare plant species in Massachusetts

Five of Massachusetts’ rare plant species – pod-grass (*Scheuchzeria palustris*; E), dwarf mistletoe (*Arceuthobium pusillum*; SC), mud sedge (*Carex limosa*; WL), three-leaved Solomon’s Seal (*Maianthemum trifolium*; WL), and northern yellow-eyed grass (*Xyris montana*; WL) – occur almost exclusively in acidic peatlands. Two of those species (pod-grass and dwarf mistletoe) are protected under the Massachusetts Endangered Species Act. Pod-grass, mud sedge, and northern yellow-eyed grass occur most commonly in open sphagnum lawns of Level Bog communities where they are not shaded by woody shrubs. Three-leaved Solomon’s seal is usually found on the dry, stable sphagnum hummocks of northern kettlehole bogs where it grows with leatherleaf and bog laurel. Dwarf-mistletoe is a parasitic plant that grows on the branches of black spruce trees; it is limited to northern Level Bogs where black spruce occurs. Several other rare plant species can occur in acidic peatland habitats in Massachusetts, but they are also found in other community types. They are golden-club (*Orontium aquaticum*; E), arethusa (*Arethusa bulbosa* T), bog-sedge (*Carex exilis*; WL), bog-willow (*Salix pedicellaris*; WL), and rough aster (*Eurybia (wasAster) radula*; WL).

E=State Endangered, T=Threatened, SC=State Special Concern, WL=state Watch List (not regulated).

Characteristic animal species in Massachusetts

Due to the extended periods of saturation, lack of nutrients, and the high acidity and low oxygen content of the water, acidic peatlands are inhospitable to many animal species. Winged animals and large terrestrial animals can use peatlands as part of their habitat and then move on when conditions are unfavorable. Moose and white-tailed deer use acidic peatlands for browsing and grazing, and their trails are often evident across the peat mat. Bears are attracted to the cranberries and blueberries in season. Many bird species use peatlands for part of the year as nesting or foraging habitat. Massachusetts’ birds that can be found in acidic peatlands include Swamp and White-tailed Sparrows, Common Yellowthroat, Olive-sided and Alder Flycatchers, Red-winged Blackbirds, and Gray Catbirds. Many species of dragonflies and damselflies inhabit acidic peatlands, especially where there is adjacent open water. The acidity and low oxygen content of Level Bogs make them poor habitat for most amphibians and reptiles, although some species can breed in the shallow pools that form among the sphagnum hummocks.

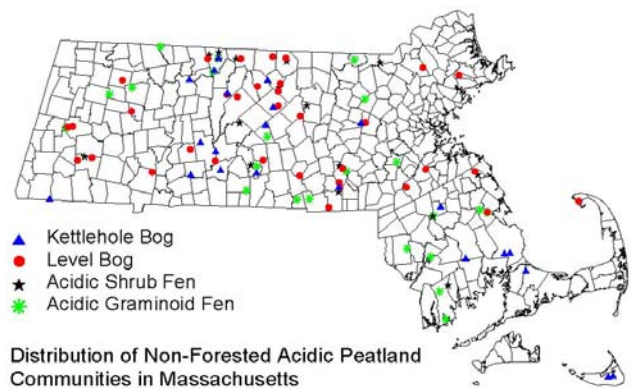
Rare animal species

The Southern Bog Lemming (*Synaptomys cooperi*; SC) and three state-protected rare dragonfly species—the Ringed Boghaunter Dragonfly (*Williamsonia lintneri*; E) and Ebony Boghaunter (*W. fletcheri*; E), and the Kennedy’s Emerald (*Somatochlora kennedyi*; E)—are limited to acidic peatlands in Massachusetts. Several other state-protected rare animal species use acidic peatlands as an important component of their habitat. Four-toed Salamanders (*Hemidactylum scutatum*; SC) breed in nests in Sphagnum moss. Spotted turtles (*Clemmys guttata*; delisted in 2006, but protected on state lands) occupy a variety of wetland habitats in Massachusetts, including acidic peatlands. Larvae of the Pitcher Plant Borer moth (*Papaipema appassionata*; T) feed on the stems and roots of pitcher plants, and larvae of the Chain Fern Borer (*P. stenocelis*; T) feed on the rhizomes of Virginia Chain Fern. They are limited to sites where those plant species occur. Hessel’s Hairstreak (*Callophrys hesseli*; SC) is found in acid bogs with Atlantic White Cedar.

SC=State Special Concern, T=State Threatened, E=State Endangered

Range of Acidic Peatlands & Distribution in Massachusetts

In North America, bogs and acidic fens are northern community types that are distributed across Canada and northern sections of the United States. Massachusetts is at the southern limit of the geographic range of acidic peatlands, meaning that climatic conditions are marginal and occurrences are patchy. Level Bogs occur throughout the state, but most occur in north-central Massachusetts on the Worcester Plateau. Kettlehole Level Bogs are most abundant in parts of the state with large deposits of



glacial outwash sediments, i.e., the Connecticut Valley, southern Plymouth County, and Cape Cod. Acidic fens are more broadly distributed, but most of the best occurrences are in the eastern half of the state. At present, over 300 non-forested acidic peatlands are known to occur in the state, with about 100 of the four types high enough quality to be in the NHESP database. Due to their limited acreage, acidic peatlands warrant active land protection efforts.

Threats and Management Recommendations

Although land acquisition and conservation restrictions are important ways to protect the remaining examples of non-forested acidic peatlands in Massachusetts, land protection alone will not maintain these sites as high-quality, natural communities. Alterations of hydrology and surface and peat water chemistry impact species composition and community quality. For example, cat-tails (*Typha* spp.), although native to Massachusetts, do not normally occur in Level Bog or Acidic Fen communities; their occurrence in peat areas is indicative of alteration to the natural hydrology and chemistry of peatland systems. Cat-tails are associated with high concentrations of calcium, other nutrients, and high alkalinity. Cat tails in bogs are usually associated with episodic water runoff across roads, railbeds, and other sources of introduced nutrients. Road salt runoff has been linked to the occurrences of the highly invasive Common Reed grass, *Phragmites australis*, and to overall changes in plant species composition in some peatlands.

Acidic Shrub and Graminoid Fens, which are naturally more nutrient-enriched than Level Bogs, appear to be more susceptible to invasions by non-native species. However, when the normal hydrologic and geochemical conditions of Level bogs are altered (such as through road construction or nutrient loading from lawns, railroad track fill, and road salt runoff), invasive species can establish and expand. Although more work on the geochemical and hydrological parameters of both natural and “impacted” peatlands is needed in order to understand the underlying causes of non-native species invasions and factors influencing species composition, available data indicate that all efforts should be made to limit nutrient-loading and run-off into these naturally acidic community types.

While hydrology and geochemistry appear to have the greatest effect on species composition, trampling has the greatest impact on peat mat integrity and quality. Trampling by humans flattens the natural hummock-hollow topography of peatlands, wears permanent trails into the mat, and kills plants. All efforts must be made to limit trampling, particularly at sites that are frequently visited by researchers and students. Whenever possible, site visits should only be made to those publicly owned peatlands with established boardwalks. There are many in the state, including: Ponkapoag Bog in Canton, Ward Bog in Andover, Black Pond Bog in Norwell, Poutwater Pond Bog in Holden, and Hawley Bog in Hawley.

JBK-Originated: 1999
Species ranks and maps updated: 2007

Partially Funded by a grant from the U.S. Environmental Protection Agency