

A Floristic Survey of Acid Seep Springs in Martin and Dubois Counties, Indiana

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Introduction

A seep spring natural community is an area with a soil or peat substrate saturated by a continuous, diffuse flow of groundwater (18). Those where the substrate and the water flowing through them are acid are termed acid seep springs. Although described in surrounding states (16,11), acid seep springs have not previously been recognized in Indiana (8,12). In this state they are apparently restricted to the unglaciated region where three examples are known. One site in Monroe County which I am classifying as an acid seep spring community was known historically as a bog (13), and another acid seep springs site in Dubois County was termed a swamp and marshy woods (2). A third site was discovered in Martin County in 1982 by the author and Tom Post.

A floristic inventory was conducted at the Martin County and Dubois County acid seep spring sites in 1982 and 1983. Several species infrequently found in southern Indiana were discovered, including two currently known in the state only from the Dubois County site. The two species, *Poa paludigena* and *Carex atlantica* subsp. *capillacea*, are listed as endangered in Indiana (1).

Methods

The sites were visited at various intervals during the growing seasons of 1982 and 1983. Plant species seen were noted at the sites, although some were collected for further study and documentation. Specimens will be deposited in the Deam Herbarium at Indiana University in Bloomington. The *Carex atlantica* subsp. *capillacea* was deposited at the University of Michigan Herbarium. Nomenclature follows Gleason (4), with the exception of *Platanthera*, which follows Luer (9) and *Carex atlantica* subsp. *capillacea*, which follows Reznicek (15).

On October 13, 1983 water samples from the seep springs were tested at the sites with a portable pH meter. The samples tested were taken from a small rivulet flowing through the seep and from water collected in a ten centimeter deep depression made in the peat. Samples were also tested for total dissolved solids at a laboratory of the Indiana Geological Survey in Bloomington.

The Study Area

I am aware of three acid seep spring sites in the state. All are in unglaciated landscapes and each in a separate physiographic region of the Interior Low Plateaus Province (10,14). The Wening-Sherritt Seep Springs in Dubois County occur on the Ohio River Hills and Lowlands subsection (Wabash Lowland), the Plaster Creek Seep Springs in Martin County occur on the Mammoth Cave Plateau Subsection (Crawford Upland), and Baxter's Bog in Monroe County (now under water of Monroe Reservoir) occurred on the Norman Upland Subsection.

Baxter's Bog was studied and described in detail by Potzger (13). It occurred on an old river terrace presumably formed during the Pleistocene Epoch. He states that sediment washed from nearby uplands eventually filled small stream courses on

the terrace, thereby ponding precipitation runoff to form the bog. However, he also states, "In addition to the normal rainfall and stream-water accumulation, seepage from the old river terraces enter at several places like springs". That statement and the reported acidity (pH 5.8) and unique flora indicate the occurrence of acid seep springs, and not a bog as currently defined. It occurred in the SW $\frac{1}{4}$, Section 31, T8N, R1E.

Seepage emanates at or near the base of massive Mansfield sandstone cliffs to form the Plaster Creek Seep Springs (Figure 1). The community is mostly forested, but a portion is a wet meadow, with only a few scattered trees and shrubs. The seeps, with water having a pH range of 5.6 to 5.9, occur as a discontinuous linear strip along the lower slope and valley floor, approximately 400 meters long and ten meters wide. They occur predominantly in the SW $\frac{1}{4}$, Section 11, T2N, R4W.

The Wening-Sherritt Seep Springs occur on Negley silt loam and Bonnie silt loam in a small forested valley slightly entrenched in Pleistocene lacustrine deposits (6, 19). The seeps form a discontinuous 300 meter long, five to ten meter wide strip between the base of upland slopes and an alluvial plain. In appearance they look like small linear bogs, even to the point of quaking slightly when disturbed. Water tested yielded a pH range of 5.8 to 5.9. The seeps are located in the SW $\frac{1}{4}$, Section 3, T1S, R5W.

Plant Communities

The vegetation of acid seep springs consists of an unique assemblage of plants; at least in southern Indiana. The most conspicuous and characteristic plants are the *Osmunda* ferns, particularly *O. cinnamomea* and *O. regalis*. These ferns often dominate the seep community by forming a distinct sub-canopy. The hummocks formed from the base of these ferns provide the only stable substrate for many species, especially mosses and liverworts. *Poa paludigena*, *P. autumnalis*, and several *Carex* species are found almost exclusively on these hummocks at the Wening-Sherritt site. *Sphagnum* sp. is scattered throughout the seeps, though seldom forming a large continuous mat. A variety of sedges are found, the most characteristic being *Carex bromoides*, *C. crinita*, and *C. lurida*. *Carex debilis* and *C. atlantica* subsp. *capillacea* are common at the Wening-Sherritt site, but absent from Plaster Creek. The typical grasses are *Panicum microcarpon*, *Leersia oryzoides*, *Cinna arundinacea*, and *Glyceria striata*. Other herbs characteristic of the seep springs are *Solidago patula*, *S. rugosa*, *Aster puniceus*, *Impatiens biflora*, *Polygonum arifolium*, *Oxypolis rigidor*, and *Platanthera clavellata*.

Woody shrubs characteristic of the seeps include *Ilex verticillata*, *Aronia melanocarpa*, *Lindera benzoin*, and *Viburnum dentatum*. *Rhus vernix* and *Alnus serrulata* are common mid-canopy species of the Wening-Sherritt site. The few tree species encountered usually occur on the border and on larger hummocks of the seep springs. These include *Nyssa sylvatica*, *Liriodendron tulipifera*, *Acer rubrum*, *Populus heterophylla*, *Fraxinus pennsylvanica*, *Quercus bicolor*, *Q. michauxii*, and *Liquidambar styraciflua*.

Many fallen trees are found throughout the seeps, most probably uprooted by strong winds. Large trees are apparently too heavy to be supported by the mucky substrate and therefore uproot during a windstorm. The broken upper canopy has resulted in a relatively sunny environment in the mid and lower canopy zones, producing a lush and occasionally rank vegetative growth in places. In the wet meadow portion of Plaster Creek, dense growths of *Amphicarpa bracteata*, *Polygonum arifolium*, and *Leersia oryzoides* cover all but the tallest herbs by summer's end.

Results and Discussion

Although acid seep springs are quite rare in Indiana, the landforms where they occur are not (5). Given that fact, one would expect to find several examples of acid



FIGURE 1. Photo of Plaster Creek acid seep springs showing *Osmunda*, *Saururus*, and *Sphagnum*.

seep springs, but nowhere have they been found except for the three cited examples. Studies of the hydrology and geology of the known seeps may identify a common feature responsible for their rarity.

The cause of the acidity of the seep springs' water is not well understood. A test for dissolved solids yielded low readings (135 ppm and 65 ppm for the Wening-Sherritt and Plaster Creek sites respectively), implying that sulfates or other inorganic agents are not contributing significantly to the acidity of the water (7). Organic acids leaching from the peat, or the absence of buffering agents in the soil to neutralize precipitation, e.g. carbonates, could account for the acidity.

Ninety-three taxa were found at the Wening-Sherritt Seep Springs and one hundred and six taxa at the Plaster Creek Seep Springs (see Table 1). Many of these species are characteristic of acid seep spring communities in surrounding states, notably Illinois, Kentucky, and Missouri (11,16). Some of the species common to all or most of the seeps in the states include *Osmunda cinnamomea*, *O. regalis*, *Platanthera clavellata*, *Polygonum arifolium*, *P. sagittatum*, *Aronia melanocarpa*, *Solidago patula*, *S. rugosa*, *Panicum microcarpon*, *Carex lurida*, *C. crinita*, *C. bromoides*, *Eupatorium fistulosum*, *Boehmeria cylindrica*, and *Sphagnum* sp.

TABLE 1. *Vascular Flora of Two Indiana Acid Seep Springs and Environs*

Taxa	Wening-Sherritt Seep Springs	Plaster Creek Seep Springs
Aceraceae		
<i>Acer rubrum</i> L.	X	X
<i>Acer saccharum</i> Marsh.	X	
Alismaceae		
<i>Alisma subcordatum</i> Raf.		X
Anacardiaceae		
<i>Rhus radicans</i> L.	X	X
<i>Rhus vernix</i> L.	X	
Annonaceae		
<i>Asimina triloba</i> (L.) Dunal	X	
Aquifoliaceae		
<i>Ilex verticillata</i> (L.) Gray	X	X
Araceae		
<i>Arisaema triphyllum</i> (L.) Schott.		X
Balsaminaceae		
<i>Impatiens biflora</i> Willd.	X	X
Berberidaceae		
<i>Podophyllum peltatum</i>	X	
Betulaceae		
<i>Alnus serrulata</i> (Ait.) Willd.	X	
<i>Betula nigra</i> L.	X	X
<i>Carpinus caroliniana</i> Walt.		X
<i>Corylus americana</i> Walt.		X
Caprifoliaceae		
<i>Lonicera japonica</i> Thumb.	X	
<i>Sambucus canadensis</i> L.	X	
<i>Viburnum acerifolium</i> L.		X
<i>Viburnum dentatum</i> L.	X	X
<i>Viburnum prunifolium</i> L.	X	
Caryophyllaceae		
<i>Stellaria longifolia</i> Muhl.	X	
Celastraceae		
<i>Euonymus americanus</i> L.	X	X
<i>Euonymus atropurpureus</i> Jacq.	X	

TABLE 1.—Continued

Taxa	Wening-Sherritt Seep Springs	Plaster Creek Seep Springs
Compositae		
<i>Aster lateriflorus</i> (L.) Britt.	X	
<i>Aster puniceus</i> L.	X	X
<i>Aster umbellatus</i> Mill.		X
<i>Bidens coronata</i> (L.) Britt.		X
<i>Eupatorium fistulosum</i> Barratt	X	X
<i>Eupatorium perfoliatum</i> L.		X
<i>Senecio aureus</i> L.	X	X
<i>Solidago patula</i> Muhl.	X	X
<i>Solidago rugosa</i> Mill.	X	
Convolvulaceae		
<i>Cuscuta compacta</i> Juss.		X
<i>Cuscuta gronovii</i> Willd.	X	
Cornaceae		
<i>Cornus florida</i> L.		X
<i>Cornus racemosa</i> Lam.	X	
<i>Nyssa sylvatica</i> Marsh.	X	X
Crassulaceae		
<i>Penthorum sedoides</i> L.		X
Cruciferae		
<i>Cardamine bulbosa</i> (Schreb.) BSP.	X	
Cyperaceae		
<i>Carex atlantica</i> subsp. <i>cappillacea</i> (L. H. Bailey) Reznicek	X	
<i>Carex bromoides</i> Schk.	X	X
<i>Carex crinita</i> Lam.	X	X
<i>Carex cristatella</i> Britt.		X
<i>Carex debilis</i> Michx.	X	
<i>Carex gracillma</i> Schw.	X	X
<i>Carex grayii</i> Carey		X
<i>Carex lacustris</i> willd.	X	
<i>Carex laevivaginata</i> (Kukenth) Mackenzie	X	
<i>Carex lupulina</i> Muhl.		X
<i>Carex lurida</i> Wahl.	X	X
<i>Carex prasina</i> Wahl.	X	X
<i>Carex rosea</i> Schk.		X
<i>Carex squarrosa</i> L.		X
<i>Carex tribuloides</i> Wahl.		X
<i>Carex typhina</i> Michx.		X
<i>Carex vulpinoidea</i> Michx.		X
<i>Cyperus strigosus</i> L.	X	
<i>Dulichium arundinaceum</i> (L.) Britt.	X	
<i>Scirpus polyphyllus</i> Vahl.	X	X
Dioscoreaceae		
<i>Dioscorea villosa</i> L.		X
Ebenaceae		
<i>Diospyros virginiana</i> L.	X	
Fagaceae		
<i>Fagus grandifolia</i> Ehrh.	X	X
<i>Quercus alba</i> L.		X
<i>Quercus bicolor</i> Willd.		X
<i>Quercus michauxii</i> Nutt.	X	
<i>Quercus palustris</i> Muenchh.	X	X
<i>Quercus prinus</i> L.		X
<i>Quercus rubra</i> L.	X	X
Gentianaceae		
<i>Bartonia virginica</i> (L.)	X	

TABLE 1.—Continued

Taxa	Wening-Sherritt Seep Springs	Plaster Creek Seep Springs
Gramineae		
<i>Cinna arundinacea</i> L.	X	X
<i>Glyceria striata</i> (Lam.) Hitchc.	X	X
<i>Leersia oryzoides</i> (L.) Sw.	X	X
<i>Leersia virginica</i> Willd.	X	
<i>Panicum clandestinum</i> L.		X
<i>Panicum microcarpon</i> Muhl.	X	X
<i>Poa autumnalis</i> Muhl.	X	
<i>Poa paludigena</i> Fern. & Wieg.	X	
Hamamelidaceae		
<i>Liquidambar styraciflua</i> L.		X
Iridaceae		
<i>Iris virginica</i> L.	X	X
Juncaceae		
<i>Juncus acuminatus</i> Michx.		X
<i>Juncus effusus</i> L.	X	X
<i>Juncus tenuis</i> Willd.		X
Labiatae		
<i>Prunella vulgaris</i> L.		X
Lauraceae		
<i>Lindera benzoin</i> (L.)	X	X
<i>Sassafras albidum</i> (Nutt.) Nees.		X
Leguminosae		
<i>Amphicarpa bracteata</i> (L.)		X
<i>Apios americana</i> Medic.	X	X
<i>Desmodium nudiflorum</i> (L.) DC.		X
Liliaceae		
<i>Medeola virginiana</i> L.		X
<i>Smilax glauca</i> Walt.		X
<i>Smilax rotundifolia</i> L.		X
Lobeliaceae		
<i>Lobelia cardinalis</i> L.	X	X
Lycopodiaceae		
<i>Lycopodium porophyllum</i> Lloyd & Underw.		X
Magnoliaceae		
<i>Liriodendron tulipifera</i> L.	X	X
Oleaceae		
<i>Fraxinus pennsylvanica</i> Marsh.	X	X
Onagraceae		
<i>Epilobium coloratum</i> Biehler	X	X
<i>Ludwigia alternifolia</i> L.		X
Ophioglossaceae		
<i>Botrychium virginianum</i> (L.) Sw.	X	
Orchidaceae		
<i>Platanthera clavellata</i> (Michx.) Luer	X	X
<i>Platanthera lacera</i> (Michx.) G. Don	x	
<i>Tipularia discolor</i> (Pursh) Nutt.		X
Orobanchaceae		
<i>Conopholis americana</i> (L.) Wallr.		X
<i>Epifagus virginiana</i> (L.) Bart.		X
Osmundaceae		
<i>Osmunda cinnamomea</i> L.	X	X
<i>Osmunda claytoniana</i> L.		X
<i>Osmunda regalis</i> L.	X	X
Polemoniaceae		
<i>Phlox glaberrima</i> L.	X	X

TABLE 1.—Continued

Taxa	Wening-Sherritt Seep Springs	Plaster Creek Seep Springs
Polygonaceae		
<i>Polygonum arifolium</i> L.	X	X
<i>Polygonum sagittatum</i> L.		X
<i>Polygonum virginianum</i> L.	X	X
Polypodiaceae		
<i>Athyrium filix-femina</i> (L.) Roth	X	X
<i>Dryopteris cristata</i> (L.) Gray	X	X
<i>Onoclea sensibilis</i> L.		X
<i>Thelypteris noveboracensis</i> (L.) Niewl.	X	X
<i>Thelypteris palustris</i> Schott.		X
Primulaceae		
<i>Lysimachia nummularia</i> L.	X	
Ranunculaceae		
<i>Caltha palustris</i> L.	X	
<i>Ranunculus recurvatus</i> Poir	X	
<i>Ranunculus hispidus</i> Michx.		X
Rosaceae		
<i>Agrimonia parviflora</i> Ait		X
<i>Aronia melanocarpa</i> (Michx.) Ell.	X	X
<i>Prunus serotina</i> Ehrh.	X	X
<i>Rosa multiflora</i> Thumb.	X	
<i>Rosa palustris</i> marsh.	X	X
<i>Spiraea alba</i> Du Roi	X	
Rubiaceae		
<i>Cephalanthus occidentalis</i> L.	X	X
<i>Galium tinctorium</i> L.		X
<i>Mitchella repens</i> L.	X	X
Salicaceae		
<i>Populus deltoides</i> Marsh.	X	
<i>Populus heterophylla</i> L.		X
<i>Populus grandidentata</i> Michx.		X
<i>Salix sericea</i> Marsh.		X
Saururaceae		
<i>Saururus cernuus</i> L.	X	X
Saxifragaceae		
<i>Heuchera americana</i> L.		X
<i>Hydrangea arborescens</i> L.		X
<i>Itea virginica</i> L.	X	
<i>Saxifraga pennsylvanica</i> L.	X	
Scrophulariaceae		
<i>Chelone glabra</i> L.	X	X
<i>Mimulus alatus</i> Ait.		X
<i>Scrophularia marilandica</i> L.		X
Typhaceae		
<i>Typha latifolia</i> L.	X	X
Ulmaceae		
<i>Ulmus americana</i> L.	X	
Umbelliferae		
<i>Cicuta maculata</i> L.	X	X
<i>Oxypolis rigidior</i> (L.) C. & R.	X	X
Urticaceae		
<i>Boehmeria cylindrica</i> (L.) Sw.	X	X
<i>Pilea pumila</i> (L.) Gray		X
Violaceae		
<i>Viola missouriensis</i> Greene	X	
Vitaceae		
<i>Parthenocissus quinquefolia</i> (L.) Planch.	X	X

Plants of widely different geographic affinities can be found in Indiana acid seep springs. For instance, there are very few other areas, if any, where one can find northern species such as *Dryopteris cristata*, *Poa paludigena*, and *Saxifraga pennsylvanica* growing with the southern species *Itea virginica*, *Quercus michauxii*, and *Liquidambar styraciflua*. Generally though, most of the species are of widespread midwestern and eastern distribution.

The rarest plant occurring in the seep springs is *Poa paludigena*. Personal communication with botanists in all states of its range reveal only four known populations collected from or seen in the past fifteen years. Collected at the Wening-Sherritt Seep Springs on June 4, 1929 by Charles Deam, this species was rediscovered there in 1982 by Cloyce Hedge, Lee Casebere, and the author.

A plant common to the Wening-Sherritt Seep Springs is *Carex atlantica* subsp. *capillacea*. Known formerly as *C. howei*, this species was previously collected only once in Indiana, in Porter County on June 17, 1923 (3). *Carex howei* has been grouped with *C. mohriana*, *C. atlantica*, and *C. incompta* (the latter is a plant common to southern Illinois acid seep springs) to form the *C. atlantica* complex as defined by Reznicek (15).

Although the two seep spring sites are relatively undisturbed and efforts are underway to protect them, they are not without potential threats. The hydrologic system is the critical feature of the seeps and any alteration of it could have adverse consequences. Other threats include herbicide drift from nearby agricultural activities and utility line right-of-way vegetation control, groundwater contamination, drainage changes, and siltation from run-off of nearby cultivated fields. A few exotic species are present, notably *Lonicera japonica* and *Rosa multiflora*. Currently they are infrequent and not a serious problem. A dense stand of *Typha latifolia* occurs under a utility line right-of-way, but has not spread into the adjacent seeps.

Attempts are being made by the Indiana Division of Nature Preserves to locate more seep spring communities. Recent efforts have been unsuccessful, due primarily to the apparent rarity of the community and difficulty in systematically identifying potential sites from aerial photos, maps, and other materials.

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