

Chapter Ten

VASCULAR PLANT COMMUNITIES IN WETLANDS OF PENNSYLVANIA

ROBERT P. BROOKS¹ and RALPH W. TINER, JR.²

¹School of Forest Resources
Forest Resources Laboratory
Pennsylvania State University
University Park, PA 16802

and

²U.S. Fish and Wildlife Service
Northeast Region
Newton Corner, MA 02158

INTRODUCTION

Patterns of wetland vegetation develop as a result of both internal (autogenic) and external (allogenic) changes that occur within environments (Niering, Chapter 9). The effects of both ecological and anthropogenic changes on a wetland's hydrologic regime and substrate determine the composition and arrangement of the plant species that are found. In Pennsylvania, the effects of regional precipitation and previous glacial activity on the landscape have led to the recognition of rather distinct physiographic regions across the state (Fig. 1, Chapter 4; Cunningham et al. 1977, Keener and Park 1986). The wetlands within these regions sometimes support different associations of vascular plants. In this chapter, we present an overview of the vascular plant communities found in wetlands from representative locations throughout the state based on the literature and the authors' field experience. Further information on species distributions in Pennsylvania can be obtained in Wherry et al. (1979) and Keener and Park (1986). For information on rare and endangered wetland plants in the state see Wiegman (1986) and Chapter 12 of this book. Common names are used throughout the chapter, see Table 1 for scientific names.

TABLE I
Common names, scientific names and indicator status of selected wetlands
plants found in Pennsylvania.*

Common Name	Scientific Name	Indicator Status*
TREES and SHRUBS		
alder, speckled	<i>Alnus rugosa</i>	FACW
arrowwood, northern	<i>Viburnum recognitum</i>	FACW
ash,		
black	<i>Fraxinus nigra</i>	FACW
green	<i>Fraxinus pennsylvanica</i>	FACW
white	<i>Fraxinus americana</i>	FACU
azalea, swamp	<i>Rhododendron viscosum</i>	FACW
beechnut, American	<i>Fagus grandifolia</i>	FACU
birch,		
black	<i>Betula lenta</i>	FACU
river	<i>Betula nigra</i>	FACW
yellow	<i>Betula alleghaniensis</i>	FAC
blueberry, highbush	<i>Vaccinium corymbosum</i>	FACW
buttonbush	<i>Cephalanthus occidentalis</i>	OBL
cherry, black	<i>Prunus serotina</i>	FACU
chokeberry,		
black	<i>Aronia melanocarpa</i>	FACW
purple	<i>Aronia prunifolia</i>	FACW
dogwood,		
red-panicked	<i>Cornus foemina</i> spp. <i>racemosa</i>	FAC
red-osier	<i>Cornus stolonifera</i>	FACW
silky	<i>Cornus amomum</i>	FACW
elderberry, common	<i>Sambucus canadensis</i>	FACW
elm, American	<i>Ulmus americana</i>	FACW
gum, black	<i>Nyssa sylvatica</i>	FAC
hawthorns	<i>Crataegus</i> spp.	FACU
hemlock, eastern	<i>Tsuga canadensis</i>	FACU
hickory, bitternut	<i>Carya cordiformis</i>	FAC
holly,		
mountain	<i>Nemopanthus mucronatus</i>	OBL
common winterberry	<i>Ilex verticillata</i>	FAC
ironwood (hornbeam)	<i>Carpinus caroliniana</i>	FAC
laurel, sheep	<i>Kalmia angustifolia</i>	FAC
larch, American	<i>Larix laricina</i>	FACW
leatherleaf	<i>Chamedaphne calyculata</i>	OBL
maple,		
box elder	<i>Acer negundo</i>	FAC
red	<i>Acer rubrum</i>	FAC
silver	<i>Acer saccharinum</i>	FACW
meadowsweet,		
broad-leaved	<i>Spiraea latifolia</i>	FACW
narrow-leaved	<i>Spiraea alba</i>	OBL
nannyberry	<i>Viburnum lentago</i>	FAC
northern wild raisin	<i>Viburnum cassinoides</i>	FACW
oak,		
pin	<i>Quercus palustris</i>	FACW
swamp white	<i>Quercus bicolor</i>	FACW
pine, eastern white	<i>Pinus strobus</i>	FACU

TABLE 1 (continued)

Common names, scientific names and indicator status of selected wetlands plants found in Pennsylvania.*

Common Name	Scientific Name	Indicator Status*
poison ivy	<i>Toxicodendron radicans</i>	FAC
rhododendron, rosebay	<i>Rhododendron maximum</i>	FAC
rose, swamp	<i>Rosa palustris</i>	OBL
spicebush, northern	<i>Lindera benzoin</i>	FACW
spruce,		
black	<i>Picea mariana</i>	FACW
red	<i>Picea rubens</i>	FACU
steep-le-bush	<i>Spiraea tomentosa</i>	FACW
sumac, poison	<i>Toxicodendron vernix</i>	OBL
sweet gale	<i>Myrica gale</i>	FAC
sycamore	<i>Platanus occidentalis</i>	FACW
tulip tree	<i>Liriodendron tulipifera</i>	FACU
walnut, black	<i>Juglans nigra</i>	FACU
willow, black	<i>Salix nigra</i>	FACW
silky	<i>Salix sericea</i>	OBL
HERBACEOUS SPECIES		
arrow arum	<i>Peltandra virginica</i>	OBL
arrowhead,		
awl-leaf	<i>Sagittaria subulata</i>	OBL
broad-leaved	<i>Sagittaria latifolia</i>	OBL
hooded	<i>Sagittaria calycina</i>	OBL
aster,		
swamp	<i>Aster spp.</i>	variable
swamp	<i>Aster puniceus</i>	OBL
beakrush, white	<i>Rhynchospora alba</i>	OBL
bedstraw, stiff marsh	<i>Galium tinctorium</i>	OBL
beggar-ticks,		
smooth	<i>Bidens laevis</i>	OBL
swamp	<i>Bidens bidentoides</i>	FACW
bladderwort,		
horned	<i>Utricularia spp.</i>	OBL
horned	<i>Utricularia cornuta</i>	OBL
blue vervain	<i>Verbena hastata</i>	FACW
boneset, common	<i>Eupatorium perfoliatum</i>	FACW
bugleweed,		
American	<i>Lycopus americanus</i>	OBL
northern	<i>Lycopus uniflorus</i>	OBL
bulrush,		
green	<i>Scirpus atrovirens</i>	OBL
river	<i>Scirpus fluviatilis</i>	OBL
Smith's	<i>Scirpus smithii</i>	OBL
soft-stemmed	<i>Scirpus validus</i>	OBL
bur-reed,		
eastern	<i>Sparganium americanum</i>	OBL
giant	<i>Sparganium eurycarpum</i>	OBL
buttercup, northern swamp	<i>Ranunculus septentrionalis</i>	OBL
cardinal flower	<i>Lobelia cardinalis</i>	FACW
cattail, broad-leaved	<i>Typha latifolia</i>	OBL
common reed	<i>Phragmites australis</i>	FACW

TABLE 1 (continued)
 Common names, scientific names and indicator status of selected wetlands
 plants found in Pennsylvania.*

Common Name	Scientific Name	Indicator Status ^a
cotton-grass, few-nerve	<i>Eriophorum tenellum</i>	OBL
Virginia	<i>Eriophorum virginicum</i>	OBL
dewberry, swamp	<i>Rubus hispidus</i>	FACW
dock, swamp	<i>Rumex verticillatus</i>	OBL
fern,		
cinnamon	<i>Osmunda cinnamomea</i>	FACW
crested	<i>Dryopteris cristata</i>	FACW
royal	<i>Osmunda regalis</i>	OBL
sensitive	<i>Onoclea sensibilis</i>	FACW
globeflower, spreading	<i>Trollius laxus</i>	OBL
golden club	<i>Orontium aquaticum</i>	OBL
goldenrod,	<i>Solidago</i> spp.	variable
giant	<i>Solidago gigantea</i>	FACW
rough-stemmed	<i>Solidago rugosa</i>	FAC
goldthread	<i>Coptis trifolia</i>	FACW
grass,		
bluejoint	<i>Calamagrostis canadensis</i>	OBL
deer-tongue	<i>Dichanthelium clandestinum</i>	FAC
fowl manna	<i>Glyceria striata</i>	OBL
manna	<i>Glyceria canadensis</i>	OBL
northern yellow-eyed	<i>Xyris montana</i>	OBL
reed canary	<i>Phalaris arundinacea</i>	FACW
rice cut-	<i>Leersia oryzoides</i>	OBL
Virginia rye	<i>Elymus virginicus</i>	FACW
Walter's barnyard	<i>Echinochloa walteri</i>	FACW
wool	<i>Scirpus cyperinus</i>	FACW
hemp, tidewater	<i>Amaranthus cannabinus</i>	OBL
iris, blue flag	<i>Iris versicolor</i>	OBL
jack-in-the-pulpit	<i>Arisaema triphyllum</i>	FACW
jewelweed, spotted	<i>Impatiens capensis</i>	FACW
Joe-Pye-weed, spotted	<i>Eupatorium maculatus</i>	FACW
laurel, pale	<i>Kalmia polifolia</i>	OBL
lily,		
yellow pond	<i>Nuphar luteum</i>	OBL
white water	<i>Nymphaea odorata</i>	OBL
loosestrife,		
swamp	<i>Decodon verticillatus</i>	OBL
purple	<i>Lythrum salicaria</i>	FACW
marsh marigold	<i>Caltha palustris</i>	OBL
meadow-rue, tall	<i>Thalictrum pubescens</i>	FACW
monkey-flower, square-stemmed	<i>Mimulus ringens</i>	OBL
nettle, false	<i>Boehmeria cylindrica</i>	FACW
nightshade, bitter sweet	<i>Solanum dulcamara</i>	FAC
pickerelweed	<i>Pontederia cordata</i>	OBL
pitcher plant, northern	<i>Sarracenia purpurea</i>	OBL
pondweeds	<i>Potamogeton</i> spp.	OBL
quillwort, shore	<i>Isoetes riparia</i>	OBL

TABLE 1 (continued)
 Common names, scientific names and indicator status of selected wetlands
 plants found in Pennsylvania.*

Common Name	Scientific Name	Indicator Status*
rush,		
Baltic	<i>Juncus balticus</i>	OBL
Canada	<i>Juncus canadensis</i>	OBL
soft	<i>Juncus effusus</i>	FACW
sedge,		
beaked	<i>Carex rostrata</i>	OBL
blunt broom	<i>Carex tribuloides</i>	FACW
cypress-like	<i>Carex pseudocyperus</i>	OBL
false hop	<i>Carex lupuliformis</i>	FACW
few-flower	<i>Carex pauciflora</i>	OBL
fringed	<i>Carex crinita</i>	OBL
lakebank	<i>Carex lacustris</i>	OBL
Long's	<i>Carex lonchocarpa</i>	OBL
northeastern	<i>Carex cryptolepis</i>	OBL
prairie	<i>Carex prairea</i>	FACW
rigid	<i>Carex tetanica</i>	FACW
Schweinitz's	<i>Carex schweinitzii</i>	OBL
shallow	<i>Carex lurida</i>	OBL
straw-colored	<i>Cyperus strigosus</i>	FACW
three-seed	<i>Carex trisperma</i>	OBL
three-way	<i>Dulichium arundinaceum</i>	OBL
tussock	<i>Carex stricta</i>	OBL
wooly	<i>Carex lanuginosa</i>	OBL
yellow	<i>Carex flava</i>	OBL
seedbox, marsh	<i>Ludwigia palustris</i>	OBL
skullcap,		
blue	<i>Scutellaria lateriflora</i>	FACW
hyssop	<i>Scutellaria integrifolia</i>	FACW
skunk cabbage	<i>Symplocarpus foetidus</i>	OBL
smartweed,	<i>Polygonum</i> spp.	variable
arrow-leaved tearthumb	<i>Polygonum sagittatum</i>	OBL
mild water pepper	<i>Polygonum hydropiperoides</i>	OBL
smartweed	<i>Polygonum pennsylvanicum</i>	FACW
speedwell, American	<i>Veronica americana</i>	OBL
Sphagnum moss	<i>Sphagnum magellanicum</i>	OBL
	<i>Sphagnum recurvum</i>	OBL
spikerush,		
blunt	<i>Eleocharis obtusa</i>	OBL
bright-green	<i>Eleocharis olivacea</i>	OBL
small	<i>Eleocharis parvula</i>	OBL
St. John's wort, slender	<i>Hypericum mutilum</i>	FACW
sundews	<i>Drosera</i> spp.	OBL
sweet flag	<i>Acorus calamus</i>	OBL
trillium, nodding	<i>Trillium cernuum</i>	FACW
violets	<i>Viola</i> spp.	variable
water-crowfoot, white	<i>Ranunculus trichophyllus</i>	OBL
water lobelia	<i>Lobelia dortmanna</i>	OBL
water parsnip	<i>Sium suave</i>	OBL
water purslane	<i>Ludwigia palustris</i>	OBL
water shield	<i>Brasenia schreberi</i>	OBL

TABLE 1 (continued)
 Common names, scientific names and indicator status of selected wetlands
 plants found in Pennsylvania.*

Common Name	Scientific Name	Indicator Status*
water willow, common	<i>Justicia americana</i>	OBL
water buttons	<i>Eriocaulon septangulare</i>	OBL
wild calla	<i>Calla palustris</i>	OBL
wild rice	<i>Zizania aquatica</i>	OBL
willow-herb, purple-leaved	<i>Epilobium coloratum</i>	OBL
yellow-cress, creeping	<i>Rorippa sylvestris</i>	FACW
marsh	<i>Rorippa palustris</i>	OBL

*Names generally follow Reed (1988) and Tiner (1988).

*Degree of wetland dependence according to Reed (1988) and Tiner (1988);

OBL = obligate (>99% occurrence in wetlands), FACW = facultative wet (67-99%), FAC = facultative (34-66%), FACU = facultative upland (1-33%).

GLACIATED NORTHEASTERN REGION

In the northeastern corner of the state, glaciers modified the dissected plateaus and river valleys to produce a mosaic of shallow depressions, many of which support wetland vegetation characteristic of more northern ecoregions. About 40% of Pennsylvania's wetlands are located in the Low Plateaus and Pocono Plateau areas (Tiner and Finn 1986, see Chapter 30 of this book). Most of these wetlands are classified as palustrine types, although in recent years, man-made impoundments have increased the occurrence of fringing, lacustrine wetlands along the shores of lakes and reservoirs.

Palustrine forested wetlands dominate the northeastern section of the state. Red spruce, American larch, and red maple were the dominant tree species found in six wetlands studies by Brooks et al. (1987), including English Swamp (Lackawanna Co.) and Smith's Swamp (Pike Co.). Other dominant wetland trees in this area include eastern hemlock, black spruce, eastern white pine, yellow birch, and silver maple (along floodplains).

Scrub-shrub wetlands contain associations of ericaceous shrubs with leatherleaf being the most common. Deciduous shrubs such as high-bush blueberry, buttonbush, common winterberry, broad-leaved meadowsweet, swamp rose, and mountain holly are common. Sweet gale, sheep laurel, and swamp azalea are less common. *Sphagnum* mosses dominate the ground cover in bog-like wetlands. *S. recurvum* and *S. magellanicum* are the most abundant species, but numerous other species of *Sphagnum* and other mosses can be found (Brooks et al. 1987; see Chapter 11 of this book). In areas disturbed by beaver (*Castor canadensis*) or man, sedges and steple-bush are common.

Abundant herbaceous plants in the bog-like wetlands included three-seed

sedge, white beakrush, Virginia cotton-grass, pitcher plant, and sundews. Keener and Park (1986) found that distributions of the following species of obligate wetland plants were restricted to the glaciated northeastern region of the state: bright-green spikerush, white buttons, few-nerve cotton-grass, pale laurel, water lobelia, horned bladderwort, and northern yellow-eyed grass. Emergent wetlands in this region may be characterized by eastern bur-reed, soft rush and other rushes, spike rushes, wool grass, rice cutgrass, beaked sedge, bluejoint, smartweeds, tussock sedge, and others.

GLACIATED NORTHWESTERN REGION

Wetlands comprise about 20% of the land area in the glaciated regions of the northwestern corner of the state (Tiner and Finn 1986). The relatively large wetland complexes of this area such as Hartstown Bog/Pymatuning Reservoir and Conneaut Marsh/Lake (Crawford Co.) support a tremendous diversity of plants (Decker 1955). Wetland tree species that are commonly found in these areas include American elm, red maple, green ash, black ash, and swamp white oak. Another common association in this region includes red maple, yellow birch, and black cherry. Eastern hemlock is the principal conifer found in these wetlands. Silver maple dominates many floodplain wetlands. Black willow also may be common.

Shrubs found in the understory of forested wetlands include high-bush blueberry, spicebush, common winterberry, northern arrowwood, nannyberry, and the occasional poison sumac. The ground cover of forested wetlands supports ferns (sensitive, cinnamon, royal, and crested), sedges (fringed, shallow, and tussock), skunk cabbage, jack-in-the-pulpit, mild water pepper, and spotted jewelweed.

Scrub-shrub wetlands that are seasonally or temporarily flooded are dominated by dogwoods (red-osier, red-panicked, and silky), speckled alder, willows, common elderberry, swamp loosestrife, meadowsweet, and steeplebush. Large stands of speckled alder and buttonbush usually occupy the wetter and sometimes permanently flooded areas along river channels. Leatherleaf bogs also are found in northwestern Pennsylvania.

Emergent wetland communities are highly variable. They may contain eastern bur-reed, giant bur-reed, yellow pond lily, wild calla, broad-leaved cattail, big-leaved arrowhead, arrow-leaved tearthumb, reed canary grass, soft rush, swamp loosestrife, umbrella sedge, small spikerush, and rice cutgrass. Scattered patches and individual stems of bulrushes (green, soft-stemmed), asters, common boneset, marsh seedbox, false nettle, water parsnip, water purslane, blue vervain, marsh yellow cress, swamp dock, golden club, and bittersweet nightshade may be found. Typical sedges include shallow sedge, northeastern sedge, yellow sedge, few-flower sedge, and cypress-like sedge (Keener and Park 1986). Other emergent wetlands contain smartweeds, spotted jewelweed, swamp dewberry,

swamp rose, swamp beggar-ticks, and rough-stemmed goldenrod. Homogeneous stands of broad-leaved cattail, wool grass, soft rush, common reed, and purple loosestrife often appear in disturbed areas (Brooks et al. 1988).

UNGLACIATED REGION

The majority of Pennsylvania's landscape is unglaciated, and wetlands are found typically in association with the state's 7,000 streams. Forested wetlands of the Ridge and Valley Province, and the Allegheny Mountains and Plateaus support red maple, American elm, green ash, black ash, swamp white oak, yellow birch, black gum, and eastern hemlock. Rosebay rhododendron is a common understory species, especially along mountain streams. American beech, black cherry, ironwood, white ash, black walnut, tulip tree, and bitternut hickory are generally less common. In these unglaciated regions of Pennsylvania, so called "relic bogs" contain similar bog-like plant communities such as found in Bear Meadows (Centre Co.) and Rosecrans Bog (Clinton Co.).

Riparian areas and floodplains of the larger rivers (e.g., Allegheny, Delaware, Juniata, Susquehanna) are frequently lined with silver maple, sycamore, black willow, river birch, pin oak, ashes, hawthorns, and box-elder. The shrubs found on these floodplains include speckled alder, red-osier dogwood, northern wild raisin, northern arrowwood, spicebush, highbush blueberry, purple and black chokeberry, and poison ivy. Other shrub wetlands are dominated by meadowsweet, steeple-bush, and silky dogwood. Shrub swamps dominated by buttonbush are common throughout the unglaciated region.

Seasonally-flooded, emergent wetlands may contain reed canary grass, manna grass, rice cutgrass, deer-tongue grass, wool grass, arrow-leaved tearthumb, soft rush, tussock sedge, three-way sedge, bluejoint, common boneset, spotted Joe-Pye-weed, blue vervain, mild water pepper and other smartweeds, purple-leaved willow-herb, swamp aster, beggar-ticks, sensitive fern, broad-leaved arrowhead, and creeping yellow cress. Keener and Park (1986) reported that occurrences of woolly sedge, white water crowfoot, hyssop skullcap, and nodding trillium were restricted to the Allegheny Front. Under wetter conditions, the following species could occur: pondweeds, white water lily, water shield, small spikerush, eastern bur-reed, yellow pond lily, three-way sedge, broad-leaved arrowhead, sweet flag, and broad-leaved cattail. Gravel flats along the Juniata and Susquehanna Rivers are dominated by rice cut-grass, water willow, and smartweeds, with tussock sedge, purple loosestrife, and silky willow also present among others.

Herbaceous plants found under a wooded overstory of forested wetlands included ferns (cinnamon and sensitive), cardinal flower, blunt broom sedge, false hop sedge, fringed sedge, Long's sedge, shallow sedge, false nettle, northern bugleweed, Virginia rye grass, skunk cabbage, violets, blue flag iris, false nettle, marsh marigold, tall meadow-rue, goldthread, and giant goldenrod.

The development of calcareous wetlands parallels the distribution of limestone and dolomite in the unglaciated regions, and to a lesser extent the calcareous glacial drift in the northwestern region. Keener and Park (1986) report the occurrence of at least four common sedges; lakebank, prairie, Schweinitzii's, and rigid. Baltic rush also is found. These unique wetland types support an array of rare species, including the endangered spreading (American) globeflower.

Plant communities of the Piedmont and coastal regions of southeastern Pennsylvania are more typical of the freshwater inland and tidal wetlands of New Jersey, Maryland, Delaware, and Virginia. The freshwater tidal marshes of the Delaware estuary commonly contain yellow pond lily, wild rice, arrow arum, Walter's barnyard grass, pickerelweed, common reed, river bulrush, Smith's bulrush, hooded arrowhead, awl-leaf arrowhead, smooth beggar-ticks, swamp beggarticks, shore quillwort, and tidewater hemp (McCormick 1970, Schuyler 1986, Tiner 1985, 1987).

Some plants are found throughout the state regardless of the variable conditions found in the physiographic regions. Keener and Park (1986) included the following wetland plants in a list of common species found throughout Pennsylvania: red maple, black willow, silky willow, common elderberry, common water willow, broad-leaved arrowhead, shallow sedge, blunt spikerush, common boneset, stiff marsh bedstraw, fowl manna grass, slender St. John's-wort, spotted jewelweed, American bugleweed, square-stemmed monkey-flower, sensitive fern, cinnamon fern, Pennsylvania smartweed, arrow-leaved tearthumb, northern swamp buttercup, blue skullcap, blue vervain, and American speedwell. Members of the family Lemnaceae (duckweed) are common in all regions except the Allegheny Plateaus. Other common plants that occur throughout much of the Commonwealth include: speckled alder, high-bush blueberry, button-bush, steeple-bush, meadowsweet, broad-leaved cattail, soft rush, reed canary grass, wool grass, eastern bur-reed, yellow pond lily, and smartweeds.

This chapter provides an overview of the common, vascular plants found within the various ecoregions of Pennsylvania. The associations presented are not meant to be all-encompassing, but rather to introduce the reader to the diversity of hydrophytes that occupy the wetland habitats of the Commonwealth. Emphasis was given to obligate and facultative-wetland species rather than those that can be found equally well in drier sites. Additional details on the distribution, habits, and status of wetland plants can be obtained in Wherry et al. (1979), Reed (1988), and Tiner (1987, 1988).

LITERATURE CITED

- Brooks, R.P., D.E. Arnold and E.D. Bellis. 1987. Wildlife and plant communities of selected wetlands in the Pocono region of Pennsylvania. U.S. Fish Wildl. Serv. NWRC Open File Rep. 87-02, Washington, D.C. 41 pp.
- Brooks, R.P., J.P. Hepp, and J.B. Hill. 1988. Wetland creation opportunities

- on coal mined lands. Pages 181-184 in: J. Zelazny and J.S. Feierabend (eds.). *Increasing Our Wetland Resources*. National Wildl. Fed., Washington, D.C. 363 pp.
- Cunningham, R.L., E.J. Ciolkosz, G.W. Petersen, R.P. Matelski, R. Pennock, Jr., R.F. Shipp, A.H. Kuhl, I.W. Ratcliff, Jr., G.H. Lipscomb, W.N. Peechatka and A. Schadel. 1977. Soils of Pennsylvania. Pennsylvania State University, Agric. Exp. Stn. Rep. No. 365. 24 pp + map.
- Decker, E. 1955. The Conneaut marsh—marsh and waterfowl investigations. M.S. Thesis. Pennsylvania State University, University Park. 108 pp.
- Keener, C.S. and M.M. Park. 1986. An overview of the vascular plant geography of Pennsylvania. Pages 111-144 in: S.K. Majumdar, F.J. Brenner, and A.F. Rhoads (eds.). *Endangered and Threatened Species Programs in Pennsylvania and Other States: Causes, Issues, and Management*. Pennsylvania Acad. Sci. xix + 519 pp.
- McCormick, J. 1970. The natural features of Tinicum Marsh, with particular emphasis on the vegetation. In: Two studies of Tinicum Marsh. The Conservation Foundation, Washington, D.C. 104 pp.
- Reed, P.B., Jr. 1988. National list of plant species that occur in wetlands: 1988 Pennsylvania. U.S. Fish Wildl. Serv., National Wetlands Inventory NERC-88/18.38, St. Petersburg, FL.
- Schuyler, A.E. 1986. Rare plants of the Delaware estuary. Pages 156-162 in: S.K. Majumdar, F.J. Brenner, and A.F. Rhoads (eds.). *Endangered and Threatened Species Programs in Pennsylvania and Other States: Causes, Issues, and Management*. Pennsylvania Acad. Sci. xix + 519 pp.
- Tiner, R.W., Jr. 1985. Wetlands of New Jersey. U.S. Fish Wildl. Serv., Newton Corner, MA. 117 pp.
- Tiner, R.W., Jr. 1987. A Field Guide to Coastal Plants of the Northeastern United States. Univ. Massachusetts Press, Amherst, MA. 296 pp.
- Tiner, R.W., Jr. 1988. Field guide to nontidal wetland identification. Maryland Dep. Nat. Resour., Annapolis and U.S. Fish Wildl. Serv., Newton Corner, MA. Coop. publ. 283 pp. + plates.
- Tiner, R.W., Jr. and J.T. Finn. 1986. Status and recent trends of wetlands in five mid-Atlantic states: Delaware, Maryland, Pennsylvania, Virginia, and West Virginia. U.S. Fish Wildl. Serv., Region 5, National Wetlands Inventory Project, Newton Corner, MA, and U.S. Environ. Prot. Agency, Region III, Philadelphia, PA. Coop. publ. 40 pp.
- Wherry, E.T., J.M. Fogg, Jr. and H.A. Wahl. 1979. Atlas of the flora of Pennsylvania. Morris Arboretum, Univ. Pennsylvania, Philadelphia.
- Wiegman, P.G. 1986. Endangered plants in Pennsylvania: present status and future protection. Pages 86-102 in: S.K. Majumdar, F.J. Brenner, and A.F. Rhoads (eds.). *Endangered and Threatened Species Programs in Pennsylvania and Other States: Causes, Issues, and Management*. Pennsylvania Acad. Sci. xix + 519 pp.