

APPENDICES

Appendix A. General Description of Maryland's Coastal Plain Wetlands. (Source: Tiner and Burke 1995)

Vegetation and Plant Communities of Maryland's Wetlands

Introduction

Most of Maryland's wetlands are colonized by plants adapted to existing hydrologic, water chemistry, and soil conditions, while certain wetland types (e.g., tidal mud flats) or parts of wetlands (e.g., salt flats of estuarine marshes) are devoid of macrophytic plants. Most wetland definitions have traditionally relied heavily, oftentimes solely, on characteristic vegetation for identification and classification purposes. The presence of "hydrophytes" or "hydrophytic vegetation" is one of the three key attributes of the Service's wetland definition (Cowardin *et al.* 1979) and for identifying a Federal jurisdictional wetland (Environmental Laboratory 1987; Federal Interagency Committee for Wetland Delineation 1989). Vegetation is usually the most conspicuous feature of wetlands and one that may be often readily identified in the field. In this chapter, after briefly discussing the concept of "hydrophyte," major plant communities of Maryland's wetlands will be described.

Hydrophyte Definition and Concept

Wetland plants are technically referred to as "hydrophytes" or "hydrophytic vegetation." The Service defines a "hydrophyte" as "any plant growing in water or on a substrate that is at least periodically deficient in oxygen as a result of excessive water content" (Cowardin *et al.* 1979). Thus, hydrophytes are not restricted to true aquatic plants growing in water (e.g., ponds, lakes, rivers, and estuaries), but also include plants morphologically and/or physiologically adapted to periodic flooding or prolonged saturated soil conditions typical of marshes, swamps, bogs, and many bottomland forests. The concept of hydrophyte applies to individual plants and not simply to species of plants, although certain genera and species may be represented entirely by hydrophytes, such as arrowheads (*Sagittaria* spp.), pondweeds (*Potamogeton* spp.), smooth cordgrass (*Spartina alterniflora*), and broad-leaved cattail (*Typha latifolia*) (Tiner 1991). Certain individuals of species common on uplands, such as American holly (*Ilex opaca*), white oak (*Quercus alba*), pitch pine (*Pinus rigida*), and tulip poplar (*Liriodendron tulipifera*), are considered hydrophytes when they grow in hydric soils having a seasonal high water table near the surface or subject to frequent

inundation. Wetland ecotypes of many plant species undoubtedly exist and these ecotypes are typically adapted for a wetland existence (Tiner 1991). All plants growing in wetlands have adapted in one way or another for life in periodically flooded or saturated, anaerobic soils. Consequently, these individuals are considered hydrophytes.

The Service, with support from other Federal agencies, has prepared a comprehensive list of plant species found in the Nation's wetlands to help clarify its wetland definition (Reed 1988). A list of plant species that occur in Maryland's wetlands has been extracted from the national list and is presented in the Appendices. This list contains 1,644 species of plants that may occur in Maryland's wetlands, including 80 species of aquatics, 65 species of ferns and fern allies, 170 species of grasses, 202 species of sedges, 33 species of rushes, 809 species of forbs (other herbaceous plants), 115 species of shrubs, 121 species of trees, and 49 species of vines. In the near future, a supplement to the 1988 regional list will be issued. This list will update the indicator status for certain species based on new information. In addition, the Northeast region will be separated into a few subregions (e.g., Coastal Plain) where some key plant species have different affinities for wetlands than they do in the rest of the region. The Service recognizes four types of indicator plants that occur in wetlands: (1) obligate wetland (OBL), (2) facultative wetland (FACW), (3) facultative (FAC), and (4) facultative upland (FACU). Obligate hydrophytes are those plants which nearly always (more than 99 percent of the time) occur in wetlands under natural conditions. The facultative types can be found in both wetlands and uplands to varying degrees. Facultative wetland (FACW) plants usually occur in wetlands (from 67 to 99 percent of the time), while purely facultative plants (FAC) show no affinity to wetlands or uplands (equally likely to occur in both habitats) and are found in wetlands with a frequency of occurrence between 34-66 percent. By contrast, facultative upland (FACU) species usually occur in uplands, but are present in wetlands between 1-33 percent of the time. When present, they are often in drier wetlands including wetlands with sandier soils where they may dominate, or at higher elevations (e.g., hummocks) in wetter areas. Table 6-1 shows the number of plant species in each wetland indicator status category. OBL species represent 29 percent of the

Maryland wetland plant list, FACW species 23 percent, FAC species 19 percent, and FACU species 26 percent. Examples of these four major types of wetland plants for Maryland are presented in Table 6-2. Field guides for identifying Maryland's wetland plants are available (Tiner 1987, 1988b, 1993).

Wetland Plant Communities

Many factors influence wetland vegetation and community structure, including climate, hydrology, water chemistry, soils, and human activities. Penfound (1952) identified five site-specific physical factors as most important: (1) location of the water table, (2) fluctuation of water levels, (3) soil type, (4) acidity, and (5) salinity. He also recognized the role of biotic factors, i.e., plant competition, animal actions (e.g., herbivory or grazing), and human activities. Man probably exhibits the greatest impact on current vegetation patterns in both wetlands and nonwetlands in Maryland, while rising sea level is very important along the coast, especially on the Eastern Shore from Dorchester County south. Many construction projects alter the hydrology of wetlands through channelization, drainage, and groundwater withdrawals or by changing surface water runoff patterns, especially in urban areas, or by impounding water. These activities often have a profound effect on plant composition. In coastal marshes, mosquito ditching has increased the abundance of high-tide bush (*Iva frutescens*), and groundsel-bush (*Baccharis halimifolia*) especially on spoil mounds adjacent to ditches. Restriction of tidal flow often leads to replacement of typical salt marsh species by common reed (*Phragmites australis*). Repeated timber cutting, mowing, heavy grazing, and severe fires also have profound effects on wetland communities. Controlled burning is a common wildlife management technique for brackish marshes. Its use is particularly widespread on the lower Eastern Shore.

Maryland's wetlands fall within five ecological systems inventoried by the NWI: Marine, Estuarine, Riverine, Lacustrine and Palustrine. In coastal areas, the estuarine marshes (including salt and brackish marshes and tidal mud flats) are most abundant along Chesapeake, Chincoteague, and Assawoman Bays, with marine wetlands limited to intertidal beaches along the Atlantic Ocean from Ocean City south. Palustrine wetlands encompass the overwhelming majority of freshwater marshes, swamps, and ponds. Wetlands within the riverine and lacustrine systems are largely restricted to nonpersistent emergent wetlands, aquatic beds, and nonvegetated flats. Overall, palustrine wetlands predominate by a somewhat small margin, representing about 57 percent of the state's wetlands, whereas estuarine wetlands represent

42 percent. The high percentage of the latter wetlands reflects the significance of Chesapeake Bay with its tidal tributaries to Maryland.

The following sections address major wetland types in each ecological system. Descriptions are primarily based on NWI field observations and a review of scientific literature. While this chapter is not an exhaustive treatment of all the potential wetland plant communities that exist in Maryland, the chapter is fairly comprehensive in discussing plant composition of the major wetland types found throughout the state by giving many specific examples of wetland plant communities observed during the survey and by others. (*Note: Tables 6-5 through 6-35 summarize wetland community data; they are presented at the end of the chapter due to the number and length of these tables.*)

Marine Wetlands

The Marine System is represented by the open ocean overlying the continental shelf and the associated high-energy coastline. Deepwater habitats predominate this system, with wetlands generally limited to sandy intertidal beaches along the Atlantic Ocean. Most of Maryland's marine intertidal beaches are located on Assateague Island. Vegetation is sparse and scattered along the upper zones of beaches. Vascular plants, such as sea rocket (*Cakile edentula*), seaside broomspurge (*Euphorbia polygonifolia*), saltwort (*Salsola kali*),

Table 6-1. Number of Maryland plant species in each wetland indicator status according to the 1988 wetland plant list. (Reed 1988) The asterisk (*) denotes tentative assignments.

Indicator Status	Number of Species
OBL	482
OBL*	1
FACW*	107
FACW	231
FACW*	1
FACW-	34
FAC*	41
FAC	271
FAC*	1
FAC-	46
FACU*	20
FACU	277
FACU*	8
FACU-	125
	<u>1,644</u>

Table 6-2. Examples of Maryland plants in each wetland indicator status category.

Hydrophyte Type	Plant Common Name	Scientific Name
Obligate	Royal Fern	<i>Osmunda regalis</i>
	White Water Lily	<i>Nymphaea odorata</i>
	Smooth Cordgrass	<i>Spartina alterniflora</i>
	Black Needlerush	<i>Juncus roemerianus</i>
	Bluejoint	<i>Calamagrostis canadensis</i>
	Sweet Flag	<i>Acorus calamus</i>
	Lizard's Tail	<i>Saururus cernuus</i>
	Three-way Sedge	<i>Dulichium arundinaceum</i>
	Broad-leaved Cattail	<i>Typha latifolia</i>
	Water Willow	<i>Decodon verticillatus</i>
	Swamp Rose	<i>Rosa palustris</i>
	Southern Wild Raisin	<i>Viburnum nudum</i>
	Virginia Sweet-spires	<i>Itea virginica</i>
	Buttonbush	<i>Cephalanthus occidentalis</i>
	Bald Cypress	<i>Taxodium distichum</i>
Atlantic White Cedar	<i>Chamaecyparis thyoides</i>	
Facultative Wetland	Cinnamon Fern	<i>Osmunda cinnamomea</i>
	Salt Hay Grass	<i>Spartina patens</i>
	Common Reed	<i>Phragmites australis</i>
	False Nettle	<i>Boehmeria cylindrica</i>
	Boneset	<i>Eupatorium perfoliatum</i>
	Reed Canary Grass	<i>Phalaris arundinaceum</i>
	High-tide Bush	<i>Iva frutescens</i>
	Speckled Alder	<i>Alnus rugosa</i>
	Highbush Blueberry	<i>Vaccinium corymbosum</i>
	Common Elderberry	<i>Sambucus canadensis</i>
	Steeplebush	<i>Spiraea tomentosa</i>
	Sweet Bay	<i>Magnolia virginiana</i>
	Drummond Red Maple	<i>Acer rubrum ssp. drummondii</i>
	Green Ash	<i>Fraxinus pennsylvanica</i>
	Cherrybark Oak	<i>Quercus falcata var. pagodifolia</i>
American Elm	<i>Ulmus americana</i>	
Rosebay Rhododendron	<i>Rhododendron maximum</i>	
Facultative	Foxtail Grass	<i>Setaria geniculata</i>
	Rough-stemmed Goldenrod	<i>Solidago rugosa</i>
	Purple Joe-Pye-weed	<i>Eupatoriadelphus purpureus</i>
	Jumpseed	<i>Polygonum virginianum</i>
	Poison Ivy	<i>Toxicodendron radicans</i>
	Sweet Pepperbush	<i>Clethra alnifolia</i>
	Southern Arrowwood	<i>Viburnum dentatum</i>
	Japanese Honeysuckle	<i>Lonicera japonica</i>
	Red Maple	<i>Acer rubrum</i>
	Sweet Gum	<i>Liquidambar styraciflua</i>
	Loblolly Pine	<i>Pinus taeda</i>
	Ironwood	<i>Carpinus caroliniana</i>
Facultative Upland	Ground-pine	<i>Lycopodium obscurum</i>
	Partridgeberry	<i>Mitchella repens</i>
	Flowering Dogwood	<i>Cornus florida</i>
	Black Huckleberry	<i>Gaylussacia baccata</i>
	Multiflora Rose	<i>Rosa multiflora</i>
	Black Haw	<i>Viburnum prunifolium</i>
	American Holly	<i>Ilex opaca</i>
	White Oak	<i>Quercus alba</i>
	Tulip Poplar	<i>Liriodendron tulipifera</i>
	Red Spruce	<i>Picea rubens</i>
Hemlock	<i>Tsuga canadensis</i>	

beach grass (*Ammophila breviligulata*), seabeach orach (*Atriplex arenaria*), sea purslane (*Sesuvium maritimum*), and beach bean (*Strophostyles helvola*) may occur in these areas (Silberhorn 1982; Higgins *et al.* 1971). The first three species are also typical of estuarine beaches along Chesapeake Bay (Chrysler 1910).

Estuarine Wetlands

The Estuarine System consists of salt and brackish tidal waters and contiguous wetlands where ocean water is at least occasionally diluted by freshwater runoff from the land. It extends upstream in tidal rivers to freshwater where no measurable ocean-derived salts (less than 0.5 parts per thousand) can be detected during average annual low flows (Cowardin *et al.* 1979).

From a salinity standpoint, Maryland estuaries can be divided into three distinct reaches: (1) polyhaline—strongly saline areas (18-30 parts per thousand salinity), (2) mesohaline (5-18 ppt), and (3) oligohaline—slightly brackish areas (0.5-5 ppt). Chincoteague, Sinepuxent, and Assawoman Bays are examples of polyhaline estuaries. Chesapeake Bay and its tidal tributaries become increasingly fresher upstream from their mouths as saltwater is more diluted by freshwater runoff. These areas range from polyhaline to oligohaline waters and eventually to freshwater. The Maryland portion of Chesapeake

Bay falls within the mesohaline, oligohaline, and freshwater zones (Figure 6-1).

Vegetation patterns are greatly affected by salinity levels and by differences in the duration and frequency of tidal flooding. Major estuarine wetland types in Maryland include: (1) intertidal flats, (2) emergent wetlands, (3) scrub-shrub wetlands, (4) forested wetlands, and (5) aquatic beds.

Estuarine Intertidal Flats

Intertidal flats of mud and/or sand (technically called unconsolidated shores) are a common feature in estuaries, particularly between salt marshes and coastal waters. Estuarine tidal flats are typically flooded by tides and exposed to air twice daily or are exposed less often by low “spring” tides. These flats are typically devoid of macrophytes. While tidal flats are characteristically nonvegetated by vascular plants, some plants do colonize these sites, although their occurrence is usually rare. Smooth cordgrass (*Spartina alterniflora*) may occur in isolated clumps on mud flats in polyhaline and mesohaline waters. Sea lettuce (*Ulva lactuca*) and other macroscopic algae may be present in considerable amounts. Microscopic plants, especially diatoms, euglenoids, dinoflagellates and blue green algae, are often extremely abundant, yet inconspicuous (Whitlatch 1982). On occasion, sea grass beds of widgeongrass (*Ruppia maritima*), Eurasian

Table 6-3. Some tidal marsh species listed in approximate descending order (left column, then right) of their salt tolerance, based on observations by Chrysler (1910) for the Western Shore and the senior author’s experiences in the Northeast.

Common Name	Scientific Name	Common Name	Scientific Name
Common Glasswort	<i>Salicornia europaea</i>	Switchgrass	<i>Panicum virgatum</i>
Sea Lavender	<i>Limonium carolinanum</i>	Mock Bishop-weed	<i>Prilimnium capillaceum</i>
Smooth Cordgrass	<i>Spartina alterniflora</i>	Lance-leaf Frog-fruit	<i>Phyla lanceolata</i>
Salt Hay Grass	<i>Spartina patens</i>	Water Pepper	<i>Polygonum hydropiper</i>
Salt Grass	<i>Distichlis spicata</i>	Walter Millet	<i>Echinochloa walteri</i>
Salt Marsh Aster	<i>Aster tenuifolius</i>	Seashore Mallow	<i>Kosteletzkya virginica</i>
Marsh Orach	<i>Atriplex patula</i>	Rose Mallow	<i>Hibiscus moscheutos</i>
High-tide Bush	<i>Iva frutescens</i>	Narrow-leaved Cattail	<i>Typha angustifolia</i>
Seaside Goldenrod	<i>Solidago sempervirens</i>	Wax Myrtle	<i>Myrica cerifera</i>
Salt Marsh Bulrush	<i>Scirpus robustus</i>	Pickerelweed	<i>Pontederia cordata</i>
Salt Marsh Fleabane	<i>Pluchea purpurascens</i>	Swamp Milkweed	<i>Asclepias incarnata</i>
Salt Marsh Pink	<i>Sabatia stellaris</i>	Wild Rice	<i>Zizania aquatica</i>
Black Needlerush	<i>Juncus roemerianus</i>	Cardinal Flower	<i>Lobelia cardinalis</i>
Olney Three-square	<i>Scirpus americanus</i>	Mistflower	<i>Conoclinium coelestinum</i>
Salt Marsh Loosestrife	<i>Lythrum lineare</i>	Smooth Alder	<i>Alnus serrulata</i>
Big Cordgrass	<i>Spartina cynosuroides</i>	Swamp Rose	<i>Rosa palustris</i>
Groundsel-bush	<i>Baccharis halimifolia</i>	Big-leaved Arrowhead	<i>Sagittaria latifolia</i>
Water Hemp	<i>Amaranthus cannabinus</i>	Lizard’s Tail	<i>Saururus cernuus</i>
Purple Gerardia	<i>Agalinis purpurea</i>	Beck’s Water-marigold	<i>Megalodonta beckii</i>

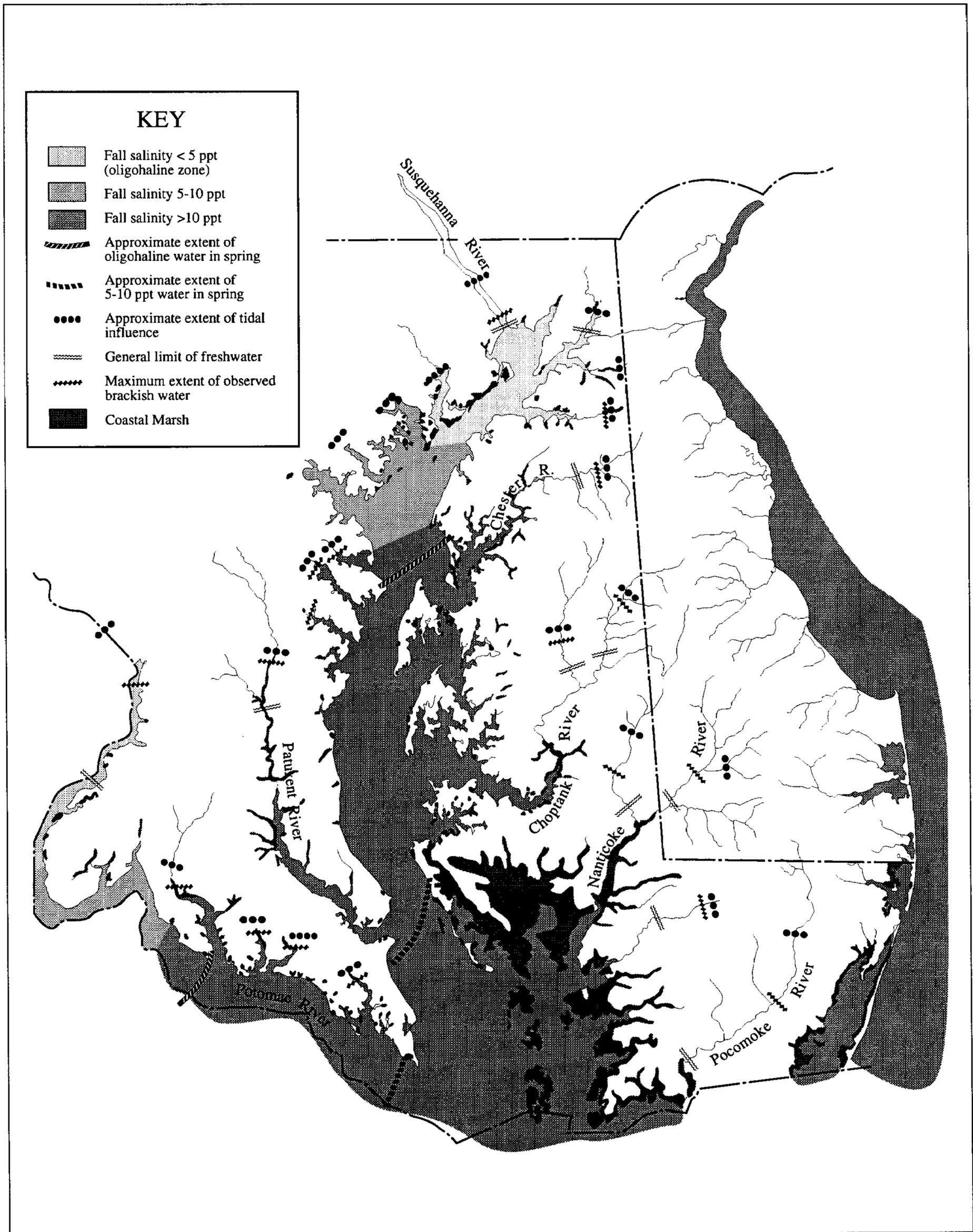


Figure 6-1. General distribution of Maryland's estuarine and tidal fresh marshes and spring and fall salinity zones in Chesapeake Bay and its major tributaries. (Compiled from Tiner 1987, Webb and Heidel 1970, and White 1990)

water milfoil (*Myriophyllum spicatum*), and eelgrass (*Zostera marina*) may be exposed during extreme low tides. Tidal flats and shores in slightly brackish areas may be colonized by pygmy-weed (*Crassula aquatica*, formerly *Tillaea aquatica*), kidney-leaf mud plantain (*Heteranthera reniformis*), American waterwort (*Elatine americana*), water purslane (*Ludwigia palustris*), mudwort (*Limosella subulata*), and mudflower (*Hemianthus micranthemum*, formerly *Micranthemum micranthemoides*) (Thompson 1974). Many of these species are regarded as rare plants and some are now believed to be extirpated from Maryland. Pygmy-weed, American waterwort, water purslane, mudwort, and mudflower also occur in tidal freshwater areas, where they may be more characteristic. Shreve (1910) found least spike-rush (*Eleocharis acicularis*) and eastern lilaopsis (*Lilaeopsis chinensis*) common on tidal fresh mudflats, with other species much less common: awl-leaf arrowhead (*Sagittaria subulata*), grass-leaved arrowhead (*S. graminea*) and quillwort (*Isoetes saccharata*).

Estuarine Emergent Wetlands

Differences in salinity and tidal flooding within estuaries have a profound and visible effect on the distribution of emergent vegetation. Plant composition changes markedly from the more saline regions to the brackish areas further inland. Table 6-3 lists some major plant species of tidal marshes in order of their tolerance to salt water. Even within areas of similar salinity, vegetation differs largely due to the frequency

and duration of tidal flooding and, locally, due to freshwater runoff or groundwater seepage. Table 6-4 outlines different types of estuarine wetlands. Much of the following discussion is based on observations during NWI field trips plus the work of McCormick and Somes (1982) which presented existing information on Maryland's coastal wetlands, and of Thompson (1974). Sipple (1982) also summarized information on coastal wetlands, with emphasis on the Eastern Shore. The Botany Department of the University of Maryland compiled a list of plant species found within estuarine wetlands of Chesapeake Bay and its tributaries (Krauss *et al.* 1971). Tables 6-5 and 6-6 present examples of estuarine wetland communities observed during the survey. Plates 7, 8 and 9 illustrate typical estuarine wetlands in Maryland. Figure 6-2 shows the general location of salt, brackish and other tidal wetlands within the coastal zone.

Salt Marshes

Salt marshes are the most seaward of Maryland's estuarine emergent wetlands. They have formed on the intertidal shores of tidal waters in areas of high salinity (polyhaline). They occur along Chincoteague, Assawoman, and Sinepuxent Bays in Worcester County (Figure 6-3). Adjacent to the mainland, salt marshes may gradually grade into tidal fresh marshes and then into palustrine forested wetlands or may simply end abruptly beside the upland.

Table 6-4. General estuarine wetland types of Maryland with major species listed.

Wetland Type	Predominant Species*
Low Salt Marsh	Smooth Cordgrass-tall form
High Salt Marsh	Salt Hay Grass, Salt Grass, and Smooth Cordgrass-short form
High Salt Marsh Panne	Glassworts
High Salt Marsh Border	Black Needlerush, Switchgrass, and Salt Marsh Fimbristylis
Salt Shrub Swamp	High-tide Bush and Groundsel-bush with Salt Hay Grass
Low Brackish Marsh	Smooth Cordgrass-tall form and Water Hemp
High Brackish Marsh	Salt Hay Grass, Salt Grass, Black Needlerush, Smooth Cordgrass-short form, Olney Three-square, Switchgrass, Common Three-square, Narrow-leaved Cattail, Rose Mallow, Big Cordgrass, Salt Marsh Bulrush, Common Reed, and Seaside Goldenrod
Brackish Shrub Swamp	High-tide Bush and Groundsel-bush, with Salt Hay Grass and Rose Mallow
Brackish Evergreen Forested Wetland	Loblolly Pine
Low Oligohaline Marsh	Arrow Arum, Pickerelweed, Spatterdock, Wild Rice, Soft-stemmed Bulrush, Narrow-leaved Cattail, Water Hemp, and Common Three-square
High Oligohaline Marsh	Big Cordgrass, Common Reed, Narrow-leaved Cattail, Wild Rice, Broad-leaved Cattail, and Sweet Flag

*Pure or mixed stands of these species may occur.

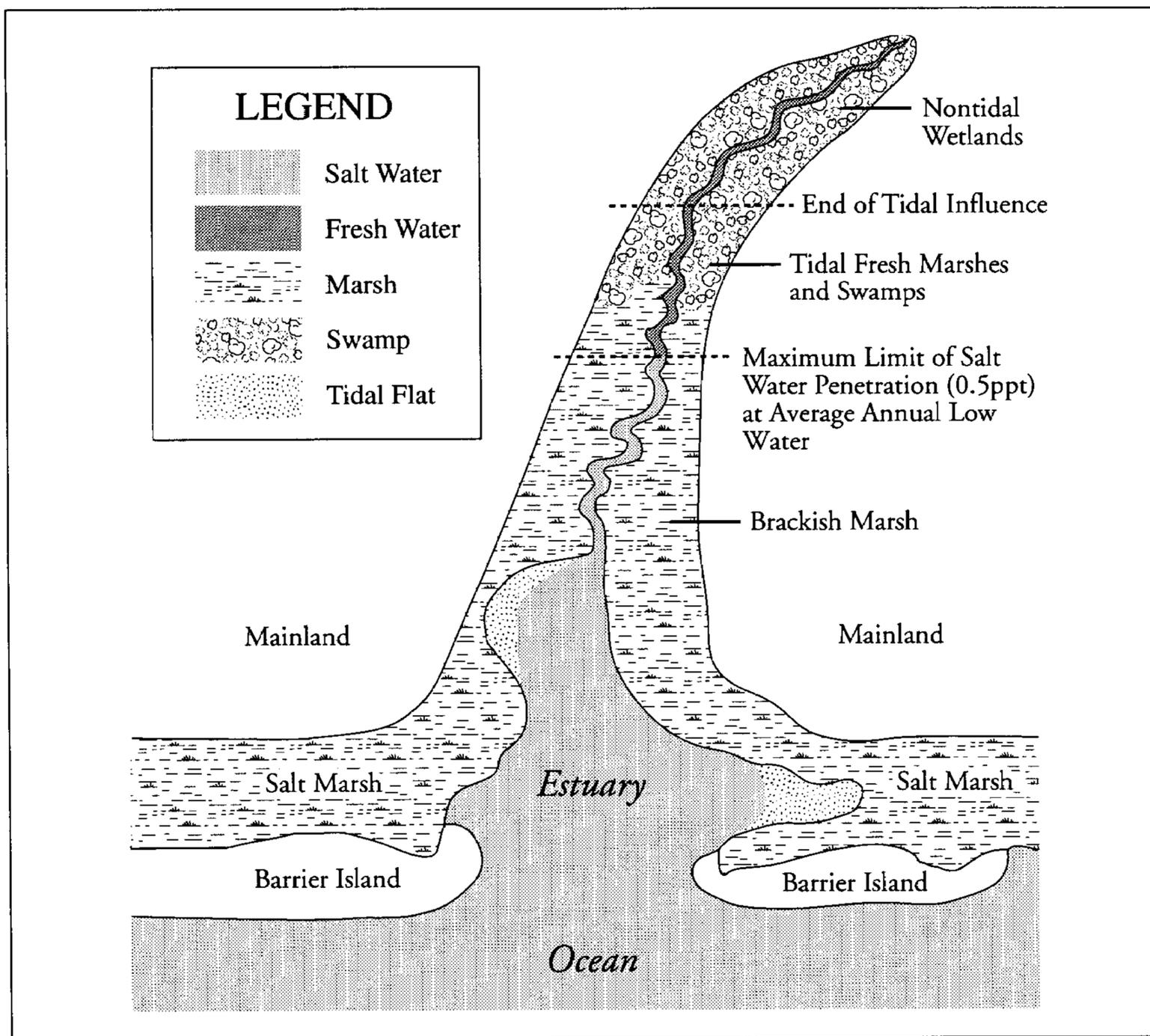


Figure 6-2. General location of different types of tidal wetlands in the estuary. (Redrawn from Tiner 1993)

Differences in tidal flooding regimes have created two general vegetative zones within salt marshes: (1) regularly flooded low marsh and (2) irregularly flooded high marsh. The vegetation within each zone is different due largely to flooding frequency and duration. The low marsh is flooded usually twice a day by the tides, while the high marsh is flooded less often than daily. Overall, plant diversity is low in salt marshes and only along the upland border where the effects of salt water are minimized does diversity increase substantially. Of the 50 taxa reported in salt marshes by McCormick and Somes (1982), only about a dozen may be considered abundant species.

A single plant—the tall form (approximately 3-6 feet high or more) of smooth cordgrass (*Spartina alterniflora*)—typically dominates the low marsh forming monotypic stands from approximately mean sea level to the mean high water mark. The low marsh is generally limited to creekbanks and upper borders of tidal flats. Annual glasswort (*Salicornia europaea*)

may also occur in low numbers intermixed with smooth cordgrass in this zone. A study in Connecticut found that the tall form of smooth cordgrass was an accurate indicator of the landward extent of mean high tide (Kennard *et al.* 1983).

The high marsh is often a complex mosaic of vegetation types rather than a distinct zonation of species. Plant diversity generally rises with increasing elevation in the high marsh. Among the more abundant or typical species are a short form of smooth cordgrass (generally less than 1 1/2 feet tall), salt hay grass (*Spartina patens*), spike or salt grass (*Distichlis spicata*), glassworts (*Salicornia bigelovii*, *S. europaea*, and *S. virginica*), marsh orach (*Atriplex patula*), sea lavender (*Limonium carolinianum* and *L. nashii*), perennial salt marsh aster (*Aster tenuifolius*), and black needlerush (*Juncus roemerianus*). Pools and tidal creeks within the salt marshes may be vegetated with widgeongrass and sea lettuce or other algae.



Figure 6-3. Salt marsh behind Assateague Island (Worcester County). (Ralph Tiner photo)

The short form of smooth cordgrass forms extensive stands just above the low marsh. This community occurs in the most frequently flooded zone of the high marsh. Glassworts and sea lavender may be observed in these stands.

Above the short cordgrass marsh in areas subject to less frequent tidal flooding, two grasses and one rush predominate: salt hay grass, spike grass, and black needlerush. Salt hay grass often forms nearly pure stands, but it is frequently intermixed with spike grass. Spike grass usually forms pure or nearly pure stands in the more poorly drained high marsh areas where surface water is present for extended periods. An intermediate form of smooth cordgrass (from 1 1/2 to 3 feet tall) frequently occurs in this middle high marsh zone and is often intermixed with salt hay grass. Black needlerush is found in abundance at slightly higher elevations. Other typical high marsh plants include salt marsh bulrush (*Scirpus robustus*), black grass (*Juncus gerardii*), sea lavender, marsh orach, perennial salt marsh aster, seaside goldenrod (*Solidago sempervirens*), and high-tide bush (*Iva frutescens*). Among the less common associates are sea-blites (*Suaeda linearis* and *S. americana*), smooth heath aster (*Aster pilosus*), salt marsh pink (*Sabatia*

stellaris), purple gerardia (*Agalinis purpurea*), foxtail grass (*Setaria geniculata*), and spike-rushes (*Eleocharis parvula* and *E. palustris*) (Higgins *et al.* 1971). Many of these species are characteristic of the marsh-upland border. Creeks and ditches throughout the high marsh are often immediately bordered by a tall or intermediate form of smooth cordgrass, while old spoil mounds adjacent to these mosquito ditches may be colonized by high-tide bush or groundsel-bush.

At the upland edge of salt marshes within reach of the highest spring tides and storm tides, plant diversity is relatively high at least by salt marsh standards. These occasionally flooded, yet nearly permanently saturated soils are colonized by many species, including black needlerush, switchgrass (*Panicum virgatum*), big cordgrass (*Spartina cynosuroides*), common reed (*Phragmites australis*), groundsel-bush (*Baccharis halimifolia*), high-tide bush, rose mallow (*Hibiscus moscheutos*), seaside goldenrod, grass-leaved goldenrod (*Euthamia graminifolia*), northern bayberry (*Myrica pensylvanica*), wax myrtle (*Myrica cerifera*) and red cedar (*Juniperus virginiana*). Black needlerush often forms a marginal band along the upper marsh. Other plants present in border areas include poison

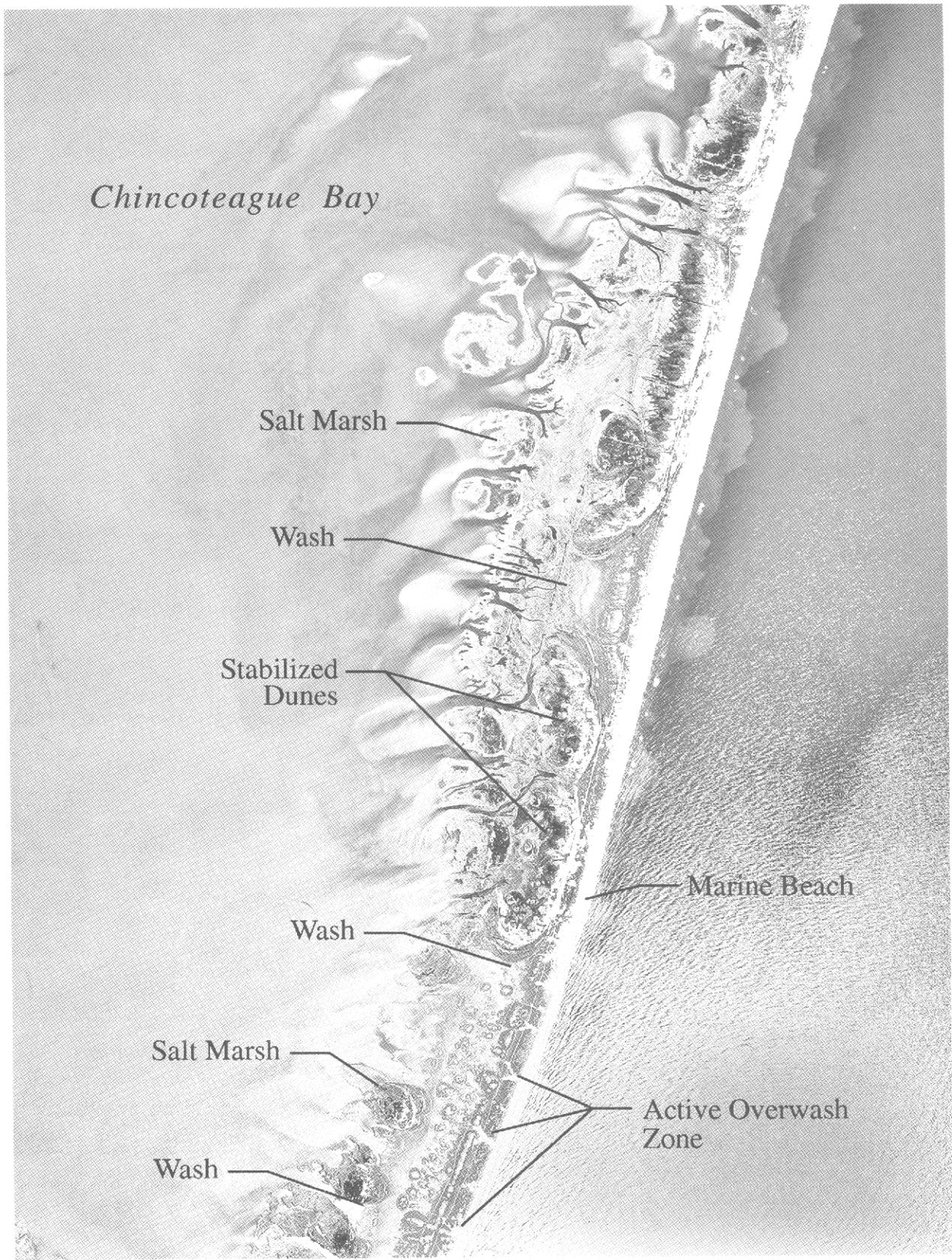


Figure 6-4. Washes lie on the bayside of Assateague Island and form a complex mosaic with salt marshes and sand dunes.

ivy (*Toxicodendron radicans*), American germander (*Teucrium canadense*), salt marsh fimbriatilis (*Fimbristylis castanea*), lowland broom-sedge (*Andropogon glomeratus*), black grass, and salt marsh pink.

Where freshwater influence from the upland is strong, narrow-leaved cattail (*Typha angustifolia*), three-squares (*Scirpus americanus* and *S. pungens*), marsh fern (*Thelypteris thelypteroides*), rose mallow, spike-rushes (*Eleocharis* spp.), and other species may characterize the marsh-upland border. These areas resemble brackish marshes which are more extensive upstream along tidal rivers.

Within the high marsh are low depressions called "salt pans" where salt water collects at "spring" tides and similar high tides. As the water evaporates in these pans, the salts are left behind where they accumulate in the soil. These pans are subjected to extreme temperatures and salinity, with salinities ranging from above 40 parts per thousand in summer (Martin 1959) to fresh after heavy rains. These areas are the most salt-stressed environments in the estuarine marshes; in places, they are devoid of plantlife. Blue-green algae often form surface encrustations in these pans.

"Washes" are similarly salt-stressed habitats on Assateague Island that lie between the Atlantic Ocean and estuarine embayments. These sandy flats are flooded only by the most extreme high tides and subject to periodic overwash (Figure 6-4).

Vegetative cover of pans and washes may be sparse or abundant varying widely over time. Plant species are restricted to the most salt-tolerant of the halophytes, including common glasswort (*Salicornia europaea*), Bigelow's glasswort (*S. bigelovii*), saltwort (*Salsola kali*), sea purslane, seabeach knotweed (*Polygonum glaucum*), sea rocket, seabeach orach, and salt marsh sand spurrey (*Spergularia marina*). Associated species along the less salt-stressed edges include hairy smotherweed (*Bassia hirsuta*), witchgrass (*Panicum capillare*), switchgrass, rabbit-foot grass (*Polypogon monspeliensis*), smooth cordgrass-short form, spike grass, salt hay grass, Nuttall's cyperus (*Cyperus filicinis*), slender flatsedge (*Cyperus filiculmis*), toad-rush (*Juncus bufonius*), spring ladies-tresses (*Spiranthes vernalis*), stiff yellow flax (*Linum medium*), Virginia meadow-beauty (*Rhexia virginica*), water-hyssop (*Bacopa monnieri*), purple gerardia, seaside gerardia (*Agalinis maritima*), perennial salt marsh aster, annual salt marsh aster (*Aster subulatus*), and stinking fleabane (*Pluchea foetida*) (Higgins *et al.* 1971).

Two Fish and Wildlife Service reports on New England salt marshes (Nixon 1982; Teal 1986) and one for the

southeastern coastal marshes (Wiegert and Freeman 1990) serve as useful regional references on the ecology of salt marshes. Plants characteristic of these and other tidal wetlands are described in Tiner (1987, 1993). The distribution of these plants in Maryland has been reported by Thompson (1974) and Sipple (1978a). McCormick and Somes (1981) provides an excellent review of the vegetation of Maryland's coastal marshes and their values. A bibliography of pre-1978 publications discussing Maryland's tidal wetlands (Sipple 1978b) is also available from the Maryland Department of Natural Resources.

Brackish Marshes

Brackish marshes are the predominant estuarine wetland type in Maryland. They are found along the shores of Chesapeake Bay, mostly on the Eastern Shore and for considerable distances upstream in coastal rivers where the salinity ranges from about 25 parts per thousand (ppt) to about 0.5 ppt at low river flow (Plates 7 through 9). There is a wide zone of marked transition within the brackish marshes from the more seaward brackish marshes with many representatives of salt marsh species to the more inland marshes with considerable representation by typical freshwater species. Consequently, plant diversity is usually higher than that of the salt marshes. Along the Patuxent River, Anderson and others (1968) recorded an increase in diversity from 14 species in the strongly brackish marshes to 56 species in tidal fresh marshes upstream. Sipple (1990) also described this inverse relationship between salinity and species richness in estuarine wetlands. Tables 6-4 and 6-5 present some examples of wetland plant communities observed in Maryland's estuaries.

The more seaward brackish marshes are characterized by salt marsh species. For example, smooth cordgrass-intermediate form dominates regularly flooded creekbanks (low marsh), while its short form, salt hay grass, and spike grass are major components of the irregularly flooded high marsh. Other dominant species in this zone include Olney three-square (*Scirpus americanus*, formerly *S. olneyi*), black needlerush, salt marsh bulrush, switchgrass, seaside goldenrod, common reed, and high-tide bush. Plants of common occurrence are salt marsh loosestrife (*Lythrum lineare*), seashore mallow (*Kosteletzkya virginica*), spike-rushes, groundsel-bush, perennial salt marsh aster, marsh orach, salt marsh fleabane (*Pluchea purpurascens*), and salt marsh pink. Other species include salt marsh fimbriatilis, foxtail grass, black grass, umbrella sedge (*Cyperus strigosus*), sedges (*Carex* spp.), annual glasswort, mock bishop-weed (*Ptilimnium capillaceum*), water pimpernel (*Samolus parviflorus*), mild water-pepper



Figure 6-5. Mosaic vegetation pattern of brackish marshes along Chesapeake Bay on the lower Eastern Shore (Somerset County). (Ralph Tiner photo)

(*Polygonum hydropiperoides*), camphorweed (*Pluchea camphorata*), seaside gerardia, annual salt marsh aster, and sea lavender (McCormick and Somes 1982; personal observations). Flowers (1978) and Philipp and Brown (1965) discussed marsh plant zonation in a tributary of the Patuxent River (Calvert County) and the South River (Anne Arundel County), respectively.

Black needlerush dominates extensive areas of brackish marshes on the Eastern Shore. It forms nearly pure stands that are intermixed with stands of salt hay grass, spike grass, three-squares, and smooth cordgrass forming a mosaic pattern (Figure 6-5). Seaside goldenrod, salt marsh fleabane, perennial salt marsh aster, black grass, foxtail grass, salt marsh fimbriatylis, and salt marsh bulrush may also occur in substantial amounts. Seashore mallow and marsh orach may also be present (McCormick and Somes 1982). Smooth cordgrass typically dominates the regularly flooded creekbanks. Stands of black needlerush-salt hay grass marshes are most abundant in Dorchester and Somerset Counties, while they also occur in Queen Annes, Talbot, and Wicomico Counties and to a lesser extent in St. Marys County (Sipple 1982, Chrysler 1910).

Further upstream or along the upland edges of the more brackish marshes, the following species may be abundant: Olney three-square, common reed, narrow-leaved cattail, switchgrass, big cordgrass, salt marsh bulrush, seaside goldenrod, and rose mallow. The first five species typically form nearly pure stands. Black grass and salt marsh fimbriatylis may form part of the upper border. The uppermost boundary, however, is often represented by a shrubby zone of high-tide bush and groundsel-bush mixed with wax myrtle and several herbs. Olney three-square occupies the more seaward of these marshes, along with the following species: rose mallow, spike grass, salt marsh bulrush, smooth cordgrass, salt hay grass, seashore mallow, salt marsh loosestrife, salt marsh fleabane, umbrella sedge, black needlerush, high-tide bush, water hemp (*Amaranthus cannabinus*), and seaside goldenrod. Swamp milkweed (*Asclepias incarnata*) has been observed with common reed and rose mallow along the Choptico River in St. Marys County (Chrysler 1910). Salt hay grass often assumes a tussocked appearance (habit) in the more upstream brackish marshes. Rose mallow and narrow-leaved cattail are frequent co-dominants in other brackish marshes further upstream. Co-existing with these two species are spike grass, Olney three-square, common three-square, switchgrass, big cordgrass, and giant foxtail (*Setaria magna*). Where switchgrass

or big cordgrass predominate, a host of other species may occur, including mock bishop-weed, arrow-leaved tearthumb (*Polygonum sagittatum*), arrow arum (*Peltandra virginica*), swamp milkweed, and ground-nut (*Apios americana*).

Oligohaline Marshes

The uppermost of the estuarine marshes have been called oligohaline, slightly brackish, intermediate, or transitional marshes (Plate 9; Tiner 1993). They occur in a predominantly fresh water zone that is subject to periodic salt water intrusion (especially in late summer and early fall during low river flows). Consequently these marshes have representatives of both fresh water and brackish marshes with the majority of species having fresh water affinities (Tables 6-4, 6-6, and 6-7). They are found along the upper reaches of tidal rivers, being abundant in the Choptank, Nanticoke, and Wicomico Rivers, and in tidal tributaries feeding into the upper part of Chesapeake Bay (Sipple 1982).

Common plants in the regularly flooded zone or low marsh include narrow-leaved cattail, big-leaved arrowhead, bull-tongue (*Sagittaria falcata*), soft-stemmed bulrush, water hemp, arrow arum, common reed, pickerelweed, sedge (*Carex alata*), sweet flag (*Acorus calamus*), greater bur-reed (*Sparganium eurycarpum*), swamp dock (*Rumex verticillatus*), rice cutgrass (*Leersia oryzoides*), and spatterdock (*Nuphar luteum*). Smooth cordgrass also occurs along the water's edge in some places, but is gradually replaced by the other species listed above.

Big cordgrass often forms pure stands on the natural levees and is also a common high marsh plant. Other prominent high marsh species include narrow-leaved cattail, common reed, common three-square, switchgrass, spike-rushes, dotted smartweed (*Polygonum punctatum*), rose mallow, swamp milkweed, American germander, Virginia bugleweed (*Lycopus virginicus*), and swamp rose. Other herbaceous species observed along the Nanticoke River near Vienna are also characteristic of these wetlands, including Walter millet (*Echinochloa walteri*), salt marsh fleabane, seashore mallow, arrow-leaved tearthumb, water parsnip (*Sium suave*), mock bishop-weed, boneset (*Eupatorium perfoliatum*), salt marsh loosestrife, marsh fern, twig rush (*Cladium mariscoides*), umbrella sedge, salt marsh bulrush, climbing hempweed (*Mikania scandens*), rice cutgrass, fall panic grass (*Panicum dichotomiflorum*), tussock sedge (*Carex stricta*), fireweed or pilewort (*Erechtites hieracifolia*), large fruit beggar-ticks (*Bidens coronata*), foxtail grass, elongated lobelia (*Lobelia elongata*), jewelweed (*Impatiens capensis*), halberd-leaved tearthumb (*Polygonum arifolium*), and New York ironweed (*Vernonia*

noveboracensis). Woody shrubs and vines may be scattered in these marshes and they may include groundsel-bush, wax myrtle, poison ivy, and Virginia creeper (*Parthenocissus quinquefolia*). An occasional bald cypress (*Taxodium distichum*) may rarely occur in these marshes (Thompson 1974), providing evidence of minimal salt tolerance of this species. Anderson and others (1968) and Sipple (1990) described the distribution of plants from brackish to fresh waters in the upper Patuxent River.

Estuarine Scrub-Shrub Wetlands

Estuarine shrub swamps are common along the Maryland coastal zone. They are usually dominated by two species: high-tide bush and/or groundsel-bush, which are common along the upper edges of salt marshes and in the more saline brackish marshes. High-tide bush may form relatively large stands in brackish and slightly brackish marshes around Chesapeake Bay (Bill Sipple, pers. comm.). Red cedar, wax myrtle, and poison ivy are commonly associated woody species. Shining sumac (*Rhus copallina*) may also occur at higher levels (McCormick and Somes 1982). Salt hay grass, spike grass, smooth cordgrass-short form, black grass, switchgrass, foxtail grass, lowland broom-sedge, Olney three-square, seaside goldenrod, rose mallow, and other "high marsh" species are often present with these shrubs. Purple gerardia, salt marsh pink, and pink wild bean (*Strophostyles umbellata*) have also been reported in more open shrubby areas (Chrysler 1910; personal observations). Two vines—climbing hempweed and dodder (*Cuscuta* sp.)—may be observed on the shrubs (Chrysler 1910). Along the slightly brackish to freshwater reaches of tidal rivers, wax myrtle may form a dense shrub thicket. Poison ivy is often present in these thickets. Some examples of estuarine shrub communities are given in Tables 6-4, 6-6, and 6-8.

Estuarine Forested Wetlands

The apparent effects of rising sea level and coastal subsidence on the Delmarva Peninsula may be readily observed along the borders of the more saline estuarine marshes where low-lying pine flatwoods dominated by loblolly pine (*Pinus taeda*) are now subject to frequent tidal flooding with salt water. The now salty soils favor the growth of halophytes, so the salt marshes are advancing into these areas. This is not a recent phenomena, since similar observations were reported in the early 1900s (Shreve 1910a). This situation is especially evident in Dorchester and Somerset Counties (see enclosed state wetland map). It is also occurring at Point Lookout on the Western Shore (Plate 7).

Many of these estuarine forested wetlands are in designated wildlife management areas subject to frequent controlled marsh burning. Such activities probably accelerate the effects of sea level rise and coastal subsidence by burning off the upper peats that would otherwise naturally form and raise the surface of the wetland, perhaps sufficiently to keep pace with the rising water levels. Chrysler (1910) warned against using controlled burning, since it destroys the organic layer of the soil. Whatever the cause, it is plain to see that pines are dying and/or severely stressed (chlorotic) due to salt water intrusion as standing dead trunks characterize the seaward margins of these areas. Some of the estuarine pine forests have salt hay grass, spike grass, switchgrass, common reed, or black needlerush as common herbaceous species or even as co-dominants in more open forests. High-tide bush, groundsel-bush, and wax myrtle are typical shrubs in these wetlands. Other plants that may be present include salt marsh aster, swamp rose, poison ivy, American holly (*Ilex opaca*), grass-leaved goldenrod, salt marsh bulrush, rose mallow, spike-rushes, persimmon (*Diospyros virginiana*), sweet gum, and common greenbrier (McCormick and Somes 1982; personal observations).

Estuarine Aquatic Beds

The shallow water zones of Maryland's estuaries, especially Chesapeake Bay and its tributaries, often contain considerable amounts of aquatic beds. Most of these beds are comprised of "submerged aquatic vegetation" ("SAV"). In more saline waters such as Chincoteague and Assawoman Bays and the lower part of the Chesapeake Bay, eelgrass and widgeongrass are the typical aquatic bed species. Widgeongrass is most common in salt marsh pools and ditches (Thompson 1974). As salinity decreases toward the head of Chesapeake Bay or in tidal rivers, widgeongrass remains important, but eelgrass is replaced by other species, including redhead-grass (*Potamogeton perfoliatum*), sago pondweed (*Potamogeton pectinatus*), and horned pondweed (*Zannichellia palustris*). Further upstream in slightly brackish waters, species diversity of aquatic beds increases with the addition of the following species: wild celery (*Vallisneria americana*), Eurasian water milfoil (*Myriophyllum spicatum*), naiads or bushy pondweeds (*Najas guadalupensis* and *N. flexilis*), coontail (*Ceratophyllum demersum*), pondweeds (*Potamogeton amplifolius*, *P. crispus*, *P. epiphydrus*, *P. nodosus*, *P. pulcher*, *P. pusillus*, *P. richardsonii*, and *P. robbinsii*), waterweeds (*Elodea canadensis* and *E. nuttallii*), hydrilla (*Hydrilla verticillata*), water star-grass (*Zosterella dubia*, formerly *Heteranthera dubia*), pygmy-weed, muskgrass (*Nitella flexilis*), awl-leaf arrowhead, eastern bur-reed (*Sparganium americanum*), and water chestnut (*Trapa natans*). Floating-leaved plants may also form aquatic beds in slightly brackish

waters. Common species are spatterdock and white water lily (*Nymphaea odorata*). Table 6-9 shows the relationship between tidal aquatic species and salinity.

Much recent scientific study has been devoted to assessing the distribution and trends in submerged aquatic vegetation in Chesapeake Bay (Anderson 1972; Orth *et al.* 1985, 1986, 1987, 1993, 1994) and in the Potomac River (Carter *et al.* 1983, 1985a, 1987b; Carter and Rybicki 1987; Haramis and Carter 1983; Paschal *et al.* 1982; Rybicki *et al.* 1986, 1987). An annotated bibliography of Chesapeake Bay submerged aquatic vegetation has been published (Chesapeake Research Consortium, Inc. 1978).

Palustrine Wetlands

Maryland's palustrine wetlands are represented by fresh water marshes and swamps, including tidal and nontidal wetlands. Structurally, palustrine wetland communities can be divided into four major types based on predominant vegetation: (1) forested wetlands, (2) scrub-shrub wetlands, (3) emergent wetlands, and (4) aquatic beds. Forested wetlands are characterized by the dominance of woody vegetation 20 feet (6 m) or taller, while scrub-shrub wetlands are dominated by woody plants less than 20 feet (6 m) in height. In contrast, emergent wetlands are represented by erect, herbaceous (non-woody) vegetation and aquatic beds by various floating-leaved, free-floating or submerged plants.

The following discussion emphasizes major palustrine wetland communities in Maryland based primarily on NWI field observations and a review of available literature. It must be recognized that individual wetland communities vary from site to site due to local conditions and that this discussion attempts to characterize the major types and in doing so, makes necessary generalizations. Community descriptions are arranged according to physiographic region, except for aquatic bed communities which are discussed at the end of this section. Figure 6-6 shows the general location of these physiographic regions.

Coastal Plain Wetlands

Forested Wetlands

Forested wetlands are the most abundant and widely distributed palustrine wetland type on the Coastal Plain (Plates 10 through 13). These wetlands are found on floodplains along the freshwater tidal and nontidal portions of rivers and streams, in upland depressions, and in broad flats between drainage streams (i.e., interstream divides). Four general types of forested wetlands can be identified based on differences in

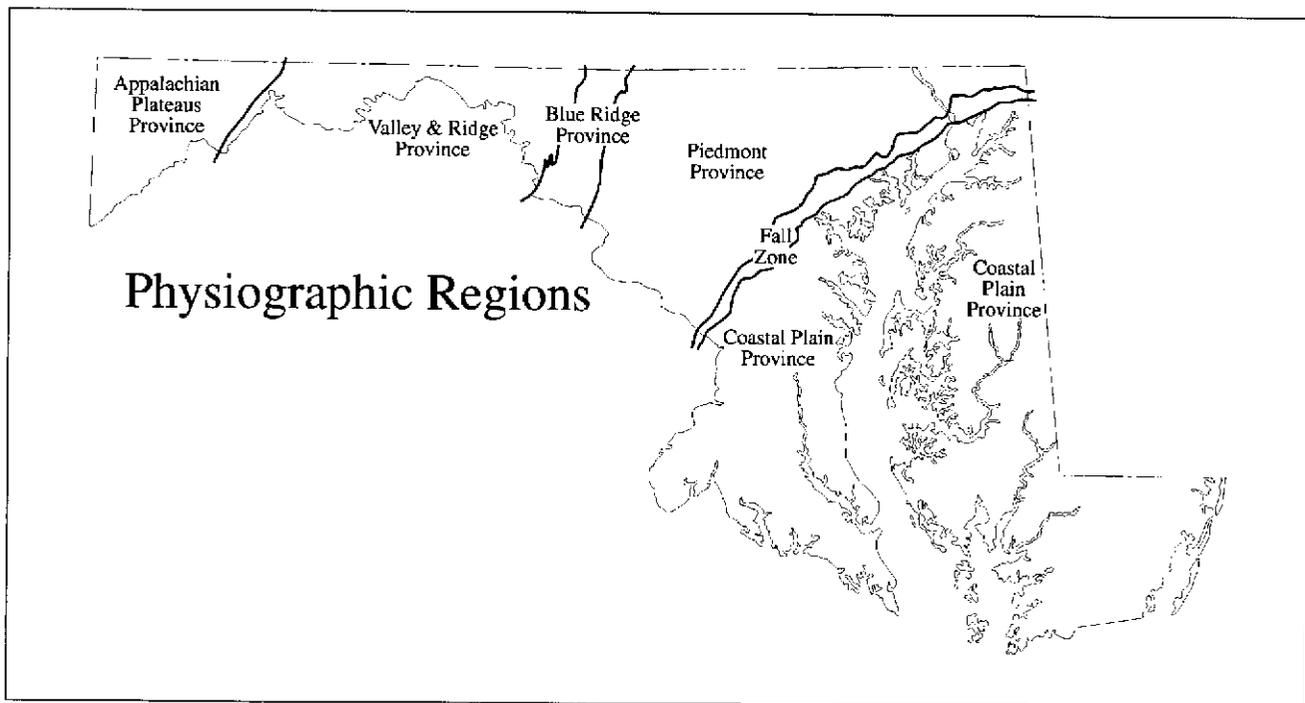


Figure 6-6. Physiographic regions of Maryland.

flooding characteristics: (1) tidally flooded (freshwater), (2) semipermanently flooded, (3) seasonally flooded, and (4) temporarily flooded. The first type is flooded periodically by tides, while the rest are nontidal wetlands. The second type is flooded throughout the growing season in most years and the wetland surface is only infrequently exposed to air. The latter two types are flooded for varying periods: the seasonally flooded type has standing surface water for extended periods (usually more than two weeks) during the growing season, while the temporarily flooded type is inundated only briefly (perhaps a week or so), usually in winter and early spring. The temporarily flooded type sometimes called "winter wet woods" or "wet flatwoods" is the most common forested wetland type on the Coastal Plain. This type also includes seasonally saturated wetlands which are maintained by seasonal high water tables from late winter to late spring, with surface water rarely present. Coastal Plain forested wetlands may be dominated by deciduous and/or evergreen tree species.

At the turn of the century, Forrest Shreve (1910a) described eight general types of forested wetlands for the Eastern Shore: (1) clay upland swamps of the Talbot Terrace, (2) sandy loam upland swamps, (3) wetter floodplain forests, (4) drier floodplain forests, (5) sandy floodplains, (6) upland

swamps of the Wicomico Terrace, (7) river swamps, and (8) stream swamps. Table 6-10 summarizes characteristic vegetation of each type. These descriptions provide an interesting historical perspective on Eastern Shore wetlands. Shreve felt that low topographic position was the important factor determining the vegetation of the river swamps, while soil texture was more important for other types, especially various upland swamps. The upland swamps typically occupied broad flats between drainage streams (interstream divides). Yet despite being separated from streams, their vegetation was essentially identical to swamps that occurred behind various tidal marshes. Shreve also commented that the poor drainage of the Talbot Terrace caused considerable seasonal fluctuations in soil moisture of the upland swamps due to rainfall. Interestingly, he noticed that the vegetation of the upland swamps on lighter soils was more distinct from "the Upland" than that of the clay soils¹. Clay upland swamps occupied Elkton clays and similar soils, covering much of Dorchester County. Their vegetation was very similar to that of the "clay upland forest" with the notable difference being the absence of certain species. The sandy loam upland swamps were found mainly south of the Nanticoke River, occurring in the interstream divides or contiguous with the tidal marshes. Loblolly pine often predominated, while several deciduous

¹Readers interested in wetland delineation should read chapters in *The Plant Life of Maryland* (Shreve et al. 1910), particularly Shreve's chapter on the Eastern Shore which aptly shows that some of the earliest plant geographers considered much of the Eastern Shore, especially Dorchester County, to be some type of wetland. After reading this book, one might likely conclude that the concept of wetland in the 1989 Federal interagency wetland delineation manual is remarkably similar to that described in 1910.

species made up 10-40 percent of the tree stratum in the wet pine flatwoods. Deciduous trees also dominated many sandy loam upland swamps. Upland swamps of the Wicomico Terrace were most abundant in the northeastern part of Queen Annes County. They resembled the clay upland swamps of Dorchester County, except for the conspicuous absence of loblolly pine. River swamps bordered the Pocomoke River, Dividing Creek, and Nassawango Creek. Bald cypress characterized the outer zone of these swamps, while the inner zone resembled the sandy loam upland swamps. River swamps were diverse in plant composition, with often thick undergrowth. Stream swamps bordered the Nanticoke and Choptank Rivers and all small streams of the Talbot Formation. These swamps were characterized by a mix of rather short deciduous trees mixed with many shrubs and herbs.

Tidal Swamp Forests

Tidal freshwater swamps occur along coastal rivers in areas subject to tidal influence, but beyond the maximum penetration of salt water. These forested wetlands are usually dominated by red maple (*Acer rubrum*) and/or green ash (*Fraxinus pensylvanica* var. *subintegerrima*), but black willow (*Salix nigra*) and black gum (*Nyssa sylvatica*) may also co-dominate (Tables 6-11 and 6-12). Black gum appears to be more prevalent at higher elevations in tidal swamps. Swamp black gum (*N. sylvatica* var. *biflora*) may characterize the wetter areas along with bald cypress (*Taxodium distichum*) as noted by Beaven and Oosting (1939) along the Pocomoke River. The latter species is also common in the tidal portion of Battle Creek Cypress Swamp in Calvert County on the Western Shore. Other trees that may occur in tidal swamps include Atlantic white cedar (*Chamaecyparis thyoides*), sweet gum (*Liquidambar styraciflua*), American elm, and loblolly pine. The latter three species may predominate at higher elevations subject to infrequent tidal inundation—temporarily flooded-tidal swamps. Large areas of tidal pine swamp occur on the lower Eastern Shore in Dorchester and Somerset Counties (Bill Sipple, pers. comm.). Pin oak (*Quercus palustris*) co-dominated a couple of stands of tidal swamps in Harford County on the upper Western Shore, while sweet gum was the other dominant species. Swamp cottonwood (*Populus heterophylla*) may also exist in small numbers as observed along the Pocomoke River (Beaven and Oosting 1939).

Shrubs characteristic of the wettest tidal swamps are buttonbush (*Cephalanthus occidentalis*), swamp rose, and smooth alder (*Alnus serrulata*). Other common shrubs are southern arrowwood (*Viburnum dentatum*), silky dogwood (*Cornus amomum*), highbush blueberry (*Vaccinium*

corymbosum), fetterbush (*Leucothoe racemosa*), sweet pepperbush (*Clethra alnifolia*), swamp azalea (*Rhododendron viscosum*), wax myrtle, winterberry (*Ilex verticillata*), and saplings of common tree species. Seaside alder (*Alnus maritima*) was observed along the edge of tidal freshwater swamps and marshes bordering Marshyhope Creek and Nassawango Creek. In the eastern U.S., this species is restricted to wetland habitats on the Delmarva Peninsula. Spicebush (*Lindera benzoin*), black haw (*Viburnum prunifolium*), red chokeberry (*Aronia arbutifolia*), common elderberry (*Sambucus canadensis*), and maleberry (*Lyonia ligustrina*) are less common. Pawpaw (*Asimina triloba*) may occur on drier sites, especially on the Western Shore.

Herbs characteristic of wetter swamps include lizard's tail (*Saururus cernuus*), royal fern (*Osmunda regalis*), cinnamon fern (*O. cinnamomea*), stiff-leaved cowbane (*Oxypolis rigidior*), jewelweed, sensitive fern, halberd-leaved tearthumb (*Polygonum arifolium*), and tussock sedge (*Carex stricta*) (Sipple 1978a, McCormick and Somes 1982; personal observations). Less common plants may include wood reed (*Cinna arundinacea*), marsh horsetail (*Equisetum fluviatile*), arrow-leaved tearthumb, and manna grass (*Glyceria striata*). In more open locations, such as along channels, water-willow or swamp loosestrife (*Decodon verticillatus*), blue flag (*Iris versicolor*), dotted and other smartweeds, spatterdock, arrow arum, and rose mallow may occur. Drier tidal swamps may have false nettle (*Boehmeria cylindrica*) present.

Vines such as common greenbrier (*Smilax rotundifolia*), poison ivy, Virginia creeper (*Parthenocissus quinquefolia*), and Japanese honeysuckle (*Lonicera japonica*) may be present, especially in temporarily flooded-tidal swamps or high levels in wetter swamps. Cross vine (*Bignonia capreolata*), a southern vine at its northern limits in Maryland, is common along the Pocomoke River, often in tidal swamps with some bald cypress. Laurel-leaved greenbrier (*Smilax laurifolia*) and American mistletoe (*Phoradendron flavescens*), an epiphyte, may also be observed on deciduous trees in wetter tidal swamps.

Semipermanently Flooded Swamp Forests

Semipermanently flooded forested wetlands are uncommon in Maryland, although they are more abundant in eastern Virginia and further south. These wetlands may be found along Battle Creek on the Western Shore and along the Pocomoke River on the lower Eastern Shore. Bald cypress dominates these wetlands. Associated trees at higher elevations are red maple, swamp black gum, black gum, sweet bay, ironwood, fringe tree, and swamp cottonwood. The shrub

layer is usually quite diverse, including southern wild raisin (*Viburnum nudum*), highbush blueberry, buttonbush, smooth alder, swamp azalea, and Virginia sweet-spires, among others (Bill Sipple, pers. comm.). Emergent vegetation associated with these wetlands include sedges (including *C. stricta*, *C. intumescens*, *C. lupuliformis*), wood reed, manna grasses (*Glyceria* spp.), lizard's tail, arrow arum, and beggar-ticks. Typical vines include those found in tidal swamps, plus trumpet creeper (*Campsis radicans*). Cross vine may occur in these wetlands along the Pocomoke River (Bill Sipple, pers. comm.).

Seasonally Flooded Swamp Forests

Seasonally flooded forested wetlands are usually dominated by one or more of the following species: red maple, sweet gum, willow oak (*Quercus phellos*), basket or swamp chestnut oak (*Quercus michauxii*), pin oak, loblolly pine, and less commonly by bald cypress, swamp black gum, and Atlantic white cedar (Plates 10 and 11). Other trees common in seasonally flooded swamps are green ash, black gum, American elm, and sweet bay (*Magnolia virginiana*). Less common trees include overcup oak (*Quercus lyrata*), swamp cottonwood, white oak (*Quercus alba*), American holly (*Ilex opaca*), pond pine (*Pinus serotina*), and persimmon which may be common in forested "pothole" wetlands in the Millington-Goldsboro-Sudlersville area (see Figure 4-2; Plate 12; Sipple and Klockner 1984). Seasonally flooded forested wetlands include red maple swamps, bottomland hardwood swamps, loblolly pine flatwoods, mixed pine-hardwood flatwoods, Atlantic white cedar swamps, and bald cypress swamps. Examples of typical communities of these wetlands are shown in Tables 6-13 through 6-17.

Shrubs often form a dense understory thicket in seasonally flooded swamps. Dominant shrubs include southern arrowwood, highbush blueberry, smooth alder, fetterbush, sweet pepperbush, and swamp azalea. Other shrubs present in variable amounts may be spicebush, common elderberry, Virginia sweet-spires (*Itea virginica*), silky dogwood, common winterberry, smooth winterberry (*I. laevigata*), and dangleberry (*Gaylussacia frondosa*). Grapes (*Vitis* spp.) and poison ivy vines may be common, with other vines usually less common, including common greenbrier, Virginia creeper, trumpet creeper, and Japanese honeysuckle. Swamp dewberry (*Rubus hispida*), a trailing shrub, may form some of the groundcover in these swamps.

Herbaceous vegetation may be abundant or sparse in seasonally flooded swamps depending on local conditions. Common emergents (herbs) include wood reed, manna grasses

(*Glyceria* spp., especially *G. striata*), tussock sedge, other sedges, cardinal flower (*Lobelia cardinalis*), royal fern, cinnamon fern, marsh fern (*Thelypteris thelypteroides*), sensitive fern, net-veined chain fern (*Woodwardia areolata*), skunk cabbage (*Symplocarpus foetidus*), violets (*Viola* spp.), false nettle, lizard's tail, three-way sedge (*Dulichium arundinaceum*), and jewelweed (*Impatiens capensis*). In many seasonally flooded swamps, peat mosses (*Sphagnum* spp.) are common in wet depressions, while bog moss (*Aulacomnium palustre*) also occurs in these swamps.

Bald cypress swamps occur in the Pocomoke River drainage on the Eastern Shore (e.g., Atkins Pond in Wicomico County and along Nassawango Creek) and along Battle Creek in Calvert County on the Western Shore. Bald cypress has also been reported in scattered locations elsewhere on the Western Shore by Mansueti (1955). Stands where bald cypress is dominant or co-dominant have been mapped by the current survey in Calvert, Somerset, Wicomico, and Worcester Counties. A rather detailed floristic study of the Pocomoke Swamp has been performed by Beaven and Oosting (1939).

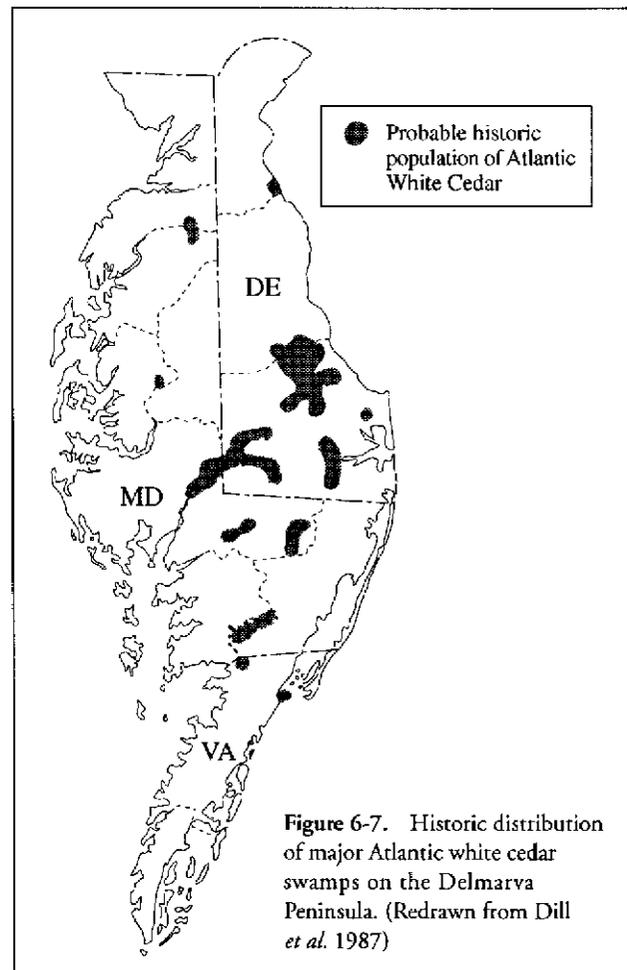


Figure 6-7. Historic distribution of major Atlantic white cedar swamps on the Delmarva Peninsula. (Redrawn from Dill et al. 1987)

Table 6-18 lists plant species associated with this cypress swamp.

Atlantic white cedar swamps were more abundant in Maryland than they are today. Figure 6-7 shows the probable historic range of Atlantic white cedar on the Delmarva Peninsula. The Pocomoke and Nanticoke River systems had the most cedar swamps in Maryland. Most of the swamps have been cut over in the past and now are hardwood swamps. Dill and others (1987) described the historical and current distribution of cedar swamps on the Delmarva Peninsula. Seventeen of the 58 reported Delmarva sites occur in Maryland: 9 in Wicomico County (5-Nanticoke River, 3-Wicomico River, 1-Pocomoke River), 3 in Worcester County (Pocomoke River), 2 in Dorchester County (Nanticoke River), 1 in Talbot County (Choptank River), 1 in Queen Annes County (Chester River), and 1 in Kent County (Chester River). Table 6-19 lists species of Atlantic white cedar swamps on the Delmarva Peninsula and includes representatives of 117 taxa. Many rare or endangered plants may be found in cedar swamps, including dragon's mouth (*Arethusa bulbosa*), swamp pink (*Helonias bullata*), Collins' sedge (*Carex collinsii*), slender blue flag (*Iris prismatica*), and northern pitcher plant (*Sarracenia purpurea*) (Dill *et al.* 1987). Beaven and Oosting (1939) found significant and nearly pure stands of Atlantic white cedar bordering the upland in nontidal portions of the Pocomoke River. Shreve (1910) reported cedar swamps along the Nanticoke River from Marshyhope Creek upstream into Delaware. Seaside alder was a common associate.

While more common on the Eastern Shore, Sipple and Klockner (1980, 1984) found two small cedar swamps in Anne Arundel County. Associated species were highbush blueberry, royal fern, cinnamon fern, and peat mosses. In part of one of the swamps, red maple was the dominant tree, with sweet bay, black gum, sweet pepperbush, swamp azalea, cinnamon fern, and peat mosses also present. In total, plants from 39 taxa were found in the Cypress Creek cedar swamp (Sipple and Klockner 1980). Hull and Whigham (1987) also described vegetation of this wetland in addition to some other wetlands in the vicinity of Annapolis.

Temporarily Flooded Swamp Forests²

Temporarily flooded forested wetlands occur on floodplains, in isolated depressions surrounded by uplands, or in interstream divides (Plate 13). The latter two types have been commonly referred to as "winter wet woods" because

they are wettest in winter and are relatively dry during the late spring, summer and early fall, except after heavy rains. Since many of these wetlands occur in broad flats between drainage streams (i.e., interstream divides), they may also be called "wet flatwoods." Shreve (1910) called these types of wetlands "upland swamps" and noted their abundance on the Talbot Terrace which represents most of Maryland's Eastern Shore, particularly Worcester, Wicomico, Somerset, Dorchester and Talbot Counties. He also commented on the similarity of their vegetation with swamps bordering extensive marshes on the Eastern Shore. Interestingly, he also noticed the subtle differences in plant composition versus the adjacent upland and that the absence of species was more notable than the presence of species in separating the swamp from the upland. Many tree species may dominate the canopy of temporarily flooded forested wetlands: red maple, sweet gum, black gum, basket oak, willow oak, water oak (*Quercus nigra*), southern red oak (*Quercus falcata*), swamp white oak (*Quercus bicolor*), sycamore (*Platanus occidentalis*), black willow, sweet bay, American holly, and loblolly pine.

Loblolly pine dominates many temporarily flooded swamps, especially flatwoods on the lower Eastern Shore in Somerset, Dorchester, and Wicomico Counties. These wetlands are the northern extension of the wet pine flatwoods that dominate much of the Coastal Plain in the Southeast. Shreve (1901) reported loblolly pine as the dominant tree of "sandy loam upland swamps" which are found mostly south of the Nanticoke. Deciduous trees made up 10-40 percent of these swamp forests earlier in this century. Willow oak, basket oak, American holly, sweet bay, and white oak (*Quercus alba*) were chief associates and may still be common in areas not actively managed for pines. Shrubs, including sweet pepperbush, highbush blueberry, and wax myrtle may be present in variable amounts. Herbs are usually sparse and may include slender spikegrass (*Chasmanthium laxum*) and partridgeberry (*Mitchella repens*). Many of these wetlands are periodically cut over to produce timber products. In attempting to collect data on the plant composition of these wetlands for this state wetland report, the senior author encountered many harvested areas (Figure 6-8). Cutover pine swamp forests and mixed pine-hardwood swamp forests may be recolonized by lowland broom-sedge (*Andropogon glomeratus*), wool grass (*Scirpus cyperinus*), soft rush, other rushes, slender spike-grass, deer-tongue (*Dicanthelium clandestinum*), sedges, umbrella sedges, beak-rushes, purple gerardia, seedbox, meadow-beauty, asters, grass-leaved and

²Palustrine forests with brief periods of surface water ponding (in depressions) and seasonal high water tables were mapped as temporarily flooded forested wetlands. Many of these wetlands are perhaps better defined as seasonally saturated, since surface water is absent in most areas and the presence of seasonal high water tables creates conditions favoring wetland establishment.



Figure 6-8. Former palustrine forest recently harvested, now colonized mainly by wool grass (*Scirpus cyperinus*). (Ralph Tiner photo)

other goldenrods, various other grasses, swamp dewberry, sweet pepperbush, highbush blueberry, brambles (*Rubus* sp.), and wax myrtle. Pokeweed (*Phytolacca americana*) and fireweed are disturbance species that may become established soon after timber harvest. Seedlings of tree species from surrounding forests, e.g., sweet bay, loblolly pine, red maple, sweet gum, black gum, and various oaks, usually become established and eventually bring the return of forested wetlands to these sites. Tables 6-20 and 6-21 include a few examples of wet pine flatwoods in Maryland.

Many temporarily flooded forested wetlands are dominated by two or more tree species, as shown in Tables 6-20 through 6-24. White oak, beech (*Fagus grandifolia*), and tulip poplar (*Liriodendron tulipifera*) may be present and even dominant or co-dominant in some wetlands or the upper portions of other wetlands. Bitternut hickory (*Carya cordiformis*) and fringe-tree (*Chionanthus virginiana*) may occur in low numbers. Box elder (*Acer negundo*) and pawpaw are more important on the Western Shore, with the latter characteristic of natural levees along floodplains. Brush and others (1980) reported that the river birch-sycamore association was absent from most floodplains of the lower Eastern Shore. The shrub understory usually consists of sweet pepperbush, highbush blueberry, southern arrowwood, spicebush, and elderberry. Wax myrtle and smooth alder may also occur and partridgeberry frequently grows in patches on the forest floor. Vines are common, especially common

greenbrier, poison ivy, Japanese honeysuckle, grapes, and trumpet creeper. Although present in seasonally flooded swamps, these vines are usually more abundant in drier swamps. Wintergreen (*Gaultheria procumbens*) may infrequently occur on the ground. Herbs are usually few in number and scattered throughout these wetlands. Among those that may be present are net-veined chain fern, cinnamon fern, royal fern, clearweed (*Pilea pumila*), false nettle, sedges, and grasses. Virginia knotweed (*Polygonum virginicum*) is a typical floodplain species of common occurrence on the Western Shore. Lizard's tail, skunk cabbage, and bugleweed may be found in wetter spots in temporarily flooded swamps.

Scrub-Shrub Wetlands

Shrub swamps are not particularly abundant on the Eastern Shore, but where present, they are dominated by true shrubs of buttonbush (*Cephalanthus occidentalis*), silky dogwood, southern arrowwood, and smooth alder, and/or by saplings of deciduous trees, such as red maple, black gum, green ash, and black willow (Table 6-25). Less common shrubs include winterberries, chokeberries (*Aronia* spp.), and inkberry (*Ilex glabra*). Buttonbush is most abundant in semipermanently flooded and the wetter seasonally flooded shrub swamps, such as Eastern Shore potholes (see Figure 6-9; Sipple and Klockner 1981; personal observations). The other species are more characteristic of other seasonally flooded wetlands and temporarily flooded swamps. Water-willow,



Figure 6-9. Buttonbush swamps occupy many potholes on the upper Eastern Shore (Kent County). (Ralph Tiner photo)

arrow arum, spatterdock, broad-leaved cattail (*Typha latifolia*), and persimmon may be associated with buttonbush swamps. Emergent plants commonly intermixed with seasonally flooded shrubs and include broad-leaved cattail, rice cutgrass, wool grass, green bulrush (*Scirpus atrovirens*), red-tinged bulrush (*S. microcarpus*, formerly *S. rubrotinctus*), river bulrush (*S. fluviatilis*), dotted smartweed, other smartweeds (*Polygonum* spp.), water hemlock (*Cicuta maculata*), skunk cabbage, jewelweed, dodder (*Cuscuta* sp.), sedges, soft rush (*Juncus effusus*), sensitive fern, and various mosses. Some pothole shrub swamps on the Eastern Shore have abundant emergent growth by smartweeds and rice cutgrass in summer when surface water is absent (Sipple and Klockner 1981). Other plants, such as autumn sedge or slender fimbry (*Fimbristylis autumnalis*) and long-beak baldrush (*Psilocarya scirpoides*), may also be present at such times.

Bogs are rare wetlands on Maryland's Coastal Plain. Sipple and Klockner (1984) identified six on the Western Shore: Round Bay Bog, Eagle Hill Bog, Angel's Bog, South Gray's Bog, Suitland Bog, and Muirkirk Bog (Figure 6-10). The first four are in Anne Arundel County and the latter two (called "magnolia bogs") in Prince Georges County. Dominant shrubs in these bogs include big cranberry (*Vaccinium macrocarpon*) and leatherleaf (*Chamaedaphne calyculata*). Water-willow (*swamp loosestrife*), a shrublike herb, is also a dominant in some bogs. Associated species include white beak-rush (*Rhynchospora alba*), three-way sedge, pine barren rush (*Juncus abortivus*), Virginia meadow-beauty (*Rhexia virginica*), round-

leaved sundew (*Drosera rotundifolia*), spatulate-leaved sundew (*D. intermedia*), Virginia chain fern (*Woodwardia virginica*), rose pogonia (*Pogonia ophioglossoides*), red maple, long-tubercle spikerush (*Eleocharis tuberculosa*), manna grass (*Glyceria obtusa*), among others. Hull and Whigham (1987) provided a quantitative assessment of the vegetation in these bogs. Only peat mosses (*Sphagnum* spp.) and marsh St. John's-wort (*Triadenum virginicum*) were present in all six bogs, but five other species were found in five bogs including white water lily, white beak-rush, pine barren rush, fibrous bladderwort (*Utricularia fibrosa*), and spatulate-leaved sundew. Surprisingly, giant cane (*Arundinaria gigantea*), a plant more typical of swamps and wet thickets from Virginia south, occurred in two bogs (South Gray's and Eagle Hill). Table 6-26 lists some of the more abundant species recorded in these bogs. Chrysler (1910) also reported the existence of a bog in Anne Arundel County and listed characteristic species including many of those referenced above, plus purple pitcher-plant (*Sarracenia purpurea*), Carolina yellow-eyed grass (*Xyris caroliniana*), bog clubmoss (*Lycopodium inundation*), and ten-angle pipewort (*Eriocaulon decangulare*).

Hitchcock and Standley (1919) and McAtee (1918) were the first to describe the magnolia bogs. These bogs were observed south of Beltsville and near Suitland. Sweet bay is one of the more common species, along with the following: peat mosses, cypress witchgrass (*Dicanthelium dichotomum*), southern bog clubmoss (*Lycopodium appressum*), Virginia cotton-grass (*Eriophorum virginicum*), white beak-rush, few-



Figure 6-10. Eagle Hill bog in Anne Arundel County. (David Burke photo)

flower nutrush (*Scleria pauciflora*), hairy umbrella-sedge (*Fuirena squarrosa*), yellow-eyed grass, ten-angle pipewort, coastal false-asphodel (*Tofieldia racemosa*), white-fringed orchid (*Platanthera blephariglottis*), bog orchid (*P. clavellata*), rose pogonia, grass-pink (*Calopogon tuberosus*), wax myrtle, sundews, black chokeberry (*Aronia melanocarpa*), downy serviceberry (*Amelanchier arborea*), cross-leaf milkwort (*Polygala cruciata*), Virginia meadow-beauty, swamp azalea, sheep laurel, zig-zag bladderwort (*Utricularia subulata*), southern wild raisin, and hairy thorough-wort (*Eupatorium pilosum*). The bogs were usually underlain by gravel and located on sloping ground, next to a stream. Magnolia bogs still occur on the Oxon Run floodplain near Suitland (R.C. Dintaman, pers. comm.).

Emergent Wetlands

Emergent wetlands on the Coastal Plain may be characterized by a wide range of plants, depending on water regime. This region probably has the highest diversity of emergent wetland communities in the state, since both tidal and nontidal freshwater marshes occur here.

Tidal Fresh Marshes

Tidal freshwater marshes are common along large coastal rivers, such as the Nanticoke, Chester, Choptank, Pocomoke,

Patuxent, and Potomac Rivers. They occur between the oligohaline (slightly brackish) marshes and the tidal freshwater swamps upstream. Tidal fresh marshes are probably maintained by two factors: the frequency and duration of tidal flooding and perhaps, we speculate, by periodic episodes of salt water intrusion. Such intrusion may favor the growth of herbaceous vegetation over woody species and prevent succession to forested wetlands at these locations. Rising sea level is perhaps accelerating this process and facilitating the replacement of forested wetlands with marshes, as is occurring along Delmarva salt and brackish marshes. Some tidal marshes may have higher levees colonized by trees bordering the streams. This situation occurs along Western Shore marshes on the Patuxent, Gunpowder, and Port Tobacco Rivers (Bill Sipple, pers. comm.).

Tidal fresh marshes may have a more diverse assemblage of plants from the oligohaline estuarine marshes just downstream. Sipple (1990, 1978) reported an increase from an average of 20 species to an average of 28 species along the Patuxent River from Cocktown Creek (fresh-brackish transition) to above Ferry Landing (tidal fresh). Common species of tidal fresh marshes may include cattails, big cordgrass, common reed, three-squares, river bulrush, switchgrass, rose mallow, wild rice (*Zizania aquatica*), fall panic grass, rice cutgrass, wood reed, Walter millet, three-way sedge (*Dulichium arundinaceum*), water-willow, climbing

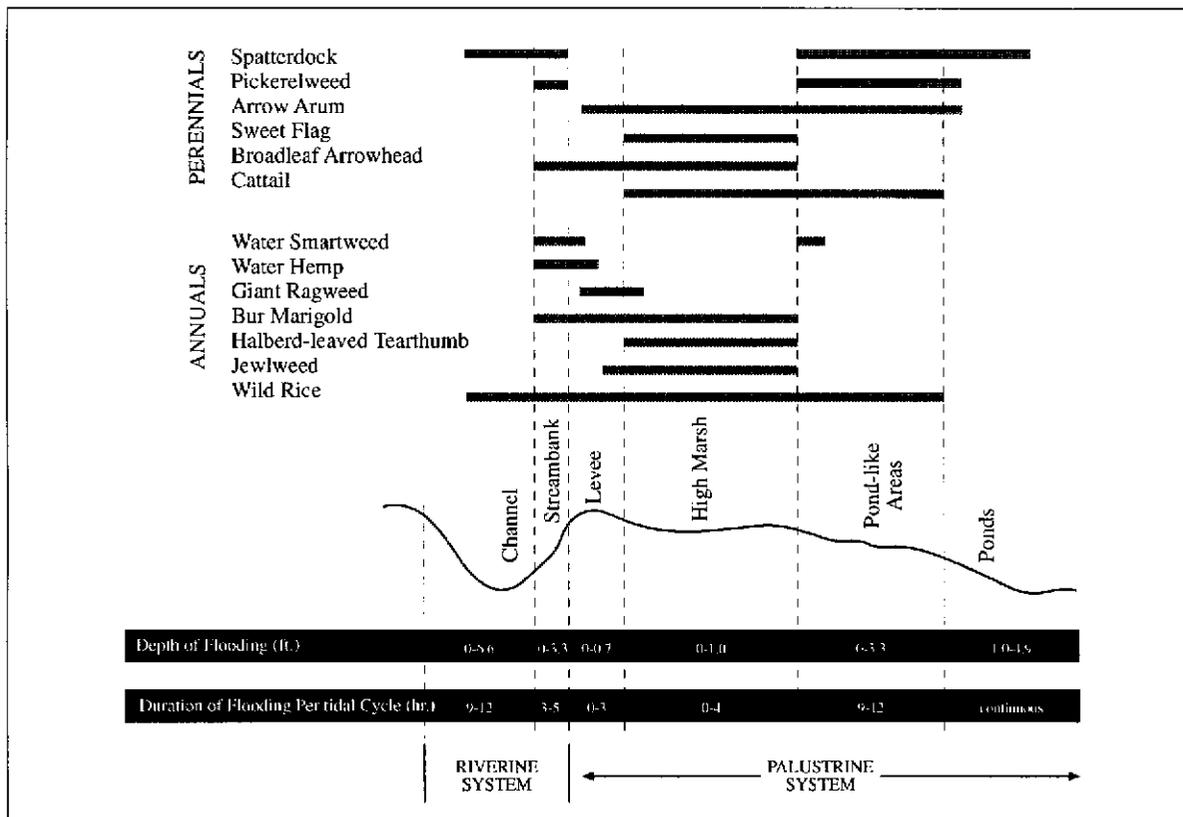


Figure 6-11. Generalized plant zonation in a freshwater tidal marsh in New Jersey, somewhat similar patterns occur in Maryland, although there undoubtedly are differences, e.g. sweet flag may also occur on streambank. (Redrawn from Simpson *et al.* 1983) Note that vegetation occurs in two systems—Riverine and Palustrine.

hempweed, water parsnip, golden club (*Orontium aquaticum*), bur-marigold (*Bidens laevis*), beggar-ticks (*Bidens cernua*, *B. coronata*, and *B. frondosa*), sneezeweed (*Helenium autumnale*), white paniced aster (*Aster lanceolatus*, formerly *A. paniculatus*), clearweed, greater bur-reed, spike-rushes, sedges, jewelweed, tearthumbs (*Polygonum arifolium* and *P. sagittatum*), and smartweeds (especially *P. punctatum*) plus low marsh plants typical of oligohaline marshes, especially spatterdock, arrow arum, pickerelweed, big arrowhead, and sweet flag. Extensive monospecific stands of spatterdock, pickerelweed, and arrow arum may exist, as reported by Sipple (1990) along the Pocomoke and Choptank Rivers. McCormick and Somes (1982) recognized numerous dominance types of tidal fresh marshes (Table 6-27). It is interesting to note that common reed was not common in Maryland in the early 1900s (Shreve 1910). Baxter (1973) and Sipple (1980) reported that common reed has replaced wild rice in many marshes along the Patuxent River due to increased sedimentation from eroded uplands in the watershed. Table 6-28 lists most, if not all, of the more significant species found in Maryland's tidal fresh marshes. Various woody plants, such as swamp rose, buttonbush, smooth alder, common elderberry, wax myrtle, and red maple (saplings), may be intermixed with the

herbaceous species. Oftentimes, tidal fresh marsh communities have high diversity and, therefore, are vital habitats for the preservation of biodiversity.

The changing vegetative appearance (e.g., seasonal dominance and aspect) of tidal fresh marshes has been reported in numerous areas along the Atlantic and Gulf coasts (McCormick and Somes 1982, Eleuterius 1972, McCormick and Ashbaugh 1972, Ecological Analysts, Inc. 1978, Shima *et al.* 1976, Sipple 1990). Seasonal changes in dominants typically occur in these wetlands. Along Piscataway Creek on the Western Shore, sweet flag predominated in the spring, died-back in summer, and was replaced in the fall by jewelweed, tearthumbs, and smartweeds (Ecological Analysts, Inc. 1978). Shima and others (1976) also noted the following as fall dominants along the Patuxent River: tearthumbs, rose mallow, jewelweed, and a sedge. Seasonal vegetation changes in tidal fresh marshes are attributed to varying species growth rates and their flowering sequence (Sipple 1990).

Tidal fresh marshes may exhibit a distinct zonation pattern (low marsh v. high marsh) due to the frequency and duration of tidal flooding. Simpson and others (1983) and Whigham

and Simpson (1975) have described this zonation for the Delaware River (Figure 6-11), while Shreve (1910) outlined the following zonation for Maryland. Spatterdock occurs at the water's edge just above mean sea level. This zone has the longest hydroperiod. The next zone is dominated by arrow arum, pickerelweed, big-leaved arrowhead, and river bulrush. Rose mallow may be locally abundant in this zone. Although not mentioned by Shreve, wild rice may be expected to be common in this zone in summer and early fall. Cattails are also expected to occur at the higher levels.

Interdunal Wet Swales

Wet swales between the dunes on Assateague Island and similar environs represent a distinctive type of palustrine emergent wetland. These swales are areas where the water table is in close contact with the land surface. As a result of this surface wetness, hydrophytic plants have colonized these sites in marked contrast to the xeric species of neighboring dunes.

Dominant plants of interdunal swales are common three-square, salt hay grass, and rabbit-foot grass (Higgins *et al.* 1971; personal observations). Associated plants may include wax myrtle, big cranberry, marsh fern, needlepod rush (*Juncus scirpoides*), turnflower rush (*J. biflorus*), Canada rush (*J. canadensis*), grass-leaved goldenrod, seaside goldenrod, beak-rushes (*Rhynchospora* spp.), foxtail grass, mock bishop-weed, dotted smartweed, straw sedge (*Carex hormathodes*), Virginia meadow-beauty, many-flower pennywort (*Hydrocotyle umbellata*), Carolina yellow-eyed grass, bugleweed (*Lycopus americanus*), and pink wild bean (*Strophostyles umbellata*). Purple gerardia, salt marsh pink, and narrow-leaved cattail may also occur in these wetlands (Bill Sipple, pers. comm.)

Semipermanently Flooded Marshes

Semipermanently flooded marshes are dominated by several species including broad-leaved and narrow-leaved cattails, spatterdock, arrow arum, water-willow, and bur-reeds (*Sparganium* spp.). Also common are duckweeds (*Spirodela polyrhiza* and *Lemna* spp.), rose mallow, big arrowhead, pickerelweed, blue flag, and various aquatic species such as white water lily (*Nymphaea odorata*). Water shield (*Brasenia schreberi*) may occur less commonly.

Seasonally Flooded Marshes

Dominant emergents in seasonally flooded marshes include rice cutgrass, broad-leaved cattail, narrow-leaved cattail, soft rush, arrow arum, switchgrass, wool grass, and sedges. Reed canary grass (*Phalaris arundinacea*) may be

dominant on the Western Shore, but is more common further inland in the Piedmont region. Common herbs are jewelweed, tearthumbs, smartweeds, willow-herbs (*Epilobium* spp.), common reed, beak-rushes, beggar-ticks, Virginia meadow-beauty, boneset (*Eupatorium perfoliatum*), big arrowhead (*Sagittaria latifolia*), spike-rushes, and Joe-Pye-weeds (*Eupatoriadelphus* spp.). Other herbs include lowland broom-sedge and skunk cabbage. An herbaceous vine—climbing hempweed—may be present. Peat mosses (*Sphagnum* spp.) may occur in some of the wettest of the seasonally flooded marshes. Various shrubs may be intermixed with the herbs, including buttonbush, swamp rose, common elderberry, southern arrowwood, southern wild raisin, silky dogwood, smooth alder, and saplings of red maple, sweet gum, black gum, and black willow.

Sipple and Klockner (1984) described a wet savanna along Cypress Creek in Anne Arundel County as one of several uncommon wetlands on Maryland's Coastal Plain. This wetland was dominated by twig-rush and white beak-rush, with scattered shrubs of Atlantic white cedar and a ground cover of peat mosses. Plants from 47 taxa were found in this savanna (Sipple and Klockner 1980). White beak-rush also characterized two other bogs in this County.

On the Eastern Shore in the vicinity of Millington and Sudlersville, isolated wetlands variously called "potholes," "Carolina bays," or "Delmarva bays" exist in somewhat circular depressions (see Figure 4-2; Sipple and Klockner 1984, Tyndall *et al.* 1990). These wetlands are most common in a five-county region on the Delmarva Peninsula: Caroline, Kent, and Queen Annes Counties in Maryland and Kent and New Castle Counties in Delaware. Similar wetlands occur along the Atlantic Coastal Plain from New Jersey to Florida, with concentrations in the Carolinas (Tyndall *et al.* 1990). Eastern Shore potholes may be dominated by trees, shrubs, or emergent vegetation in various combinations. Those characterized by the latter are called "glades." Common dominants include Walter's sedge (*Carex walteriana*), giant beardgrass (*Erianthus giganteus*), maidencane (*Panicum hemitomom*), Virginia meadow-beauty, loose-head beak-rush (*Rhynchospora charalocephala*), warty panic grass (*Panicum verrucosum*), water-willow, twig-rush, and smartweeds (Sipple and Klockner 1984, Boone *et al.* 1984, Tyndall *et al.* 1990). Peat mosses form the groundcover, while scattered buttonbush, sweet gum, red maple, and persimmon may be present. Tyndall and others (1990) described plant zonation within six Carolina bays. A fetterbush zone formed the border between the adjacent forest and the emergent wetlands. Maidencane and warty panic grass often represent the next zone. Various emergent species dominated zones within the

marsh, including Virginia meadow-beauty, Walter's sedge, netted nutrush (*Scleria reticularis*), and creeping seedbox (*Ludwigia sphaerocarpa*). Such zonation patterns with an inner community of herbs and an outer zone of trees is typical of Carolina bays (Sharitz and Gibbons 1982). Species in the herbaceous zones may vary annually due to hydrologic conditions. Table 6-29 lists characteristic plants of Eastern Shore glades.

Temporarily Flooded Wet Meadows

Temporarily flooded wet meadows may be dominated by soft rush, common reed, Walter millet, goldenrods (*Solidago* spp. and *Euthamia* spp.), Joe-Pye-weeds, New York ironweed (*Vernonia noveboracensis*), and asters, as well as many other grasses and sedges. Soft rush often dominates heavily grazed wet meadows. Many emergent wetlands are temporary successional communities being the result of recent timber harvest. Lowland broom-sedge and wool grass are common dominant species in these cutover areas (Figure 6.8). See discussion under temporary flooded swamp forests in this section for details.

Piedmont Wetlands

Forested Wetlands

Forested wetlands within the Piedmont are typically found on floodplains in stream valleys (Plate 14). The two most common types are distinguished on the basis of flooding frequency and duration: (1) seasonally flooded forested wetland and (2) temporarily flooded forested wetland. The former type is flooded more often and for longer periods (i.e., usually more than two weeks during the growing season) than the latter, which is flooded only briefly (about a week or less), usually during early spring. Forested swamps in this region are dominated by broad-leaved deciduous trees.

Seasonally Flooded Swamp Forests

Red maple is the principal dominant of seasonally flooded forested wetlands called red maple swamps. Black willow and green ash are common and may frequently be co-dominant with red maple (Table 6-30). Red maple-green ash swamps are relatively common. Other trees present, but usually less numerous, include ironwood (*Carpinus carolinianus*), tulip poplar, American elm, swamp white oak, pin oak, box elder, black gum, river birch, white ash (*Fraxinus americana*), and sycamore. Many of these trees are more abundant and typical of temporarily flooded swamps. Sweet gum and black walnut (*Juglans nigra*) are uncommon associates. A dense understory of shrubs and emergents usually characterizes seasonally

flooded swamps. Spicebush and southern arrowwood are perhaps the most frequently occurring shrub associates. Other understory shrubs include common elderberry, smooth alder, multiflora rose (*Rosa multiflora*), silky dogwood, and winterberry. Highbush blueberry, swamp azalea, and sweet pepperbush may occur near the coast in the Fall Zone, but they are not typical of the Piedmont. Poison ivy and brambles (*Rubus* spp.) are less common. Skunk cabbage is a characteristic and the predominant herb in many red maple swamps (Plate 15). Other frequently occurring and sometimes abundant herbs are tussock sedge, other sedges, lizard's tail, cardinal flower, royal fern, cinnamon fern, wood reed, false nettle, tearthumbs, smartweeds, manna grasses, beggar-ticks, and jewelweed. Asiatic tearthumb (*Polygonum perfoliatum*), an invasive exotic, may be abundant in more open areas in floodplain swamps. Less abundant emergents include three-way sedge, arrow arum, soft rush, sensitive fern, clearweed, skullcaps (*Scutellaria* spp.), blue flag, jack-in-the-pulpit (*Arisaema triphyllum*), asters, green-headed coneflower (*Rudbeckia laciniata*), white grass (*Leersia virginica*), deer-tongue, stinging nettle (*Urtica dioica*), tall meadow-rue (*Thalictrum pubescens*), and lady's thumb (*Polygonum persicaria*). The herbaceous layer is more diverse in swamps with relatively open canopies. Vines are also quite common in many areas and they include grapes, climbing hempweed (in more open areas), poison ivy, and, on occasion, common greenbrier and Japanese honeysuckle.

Temporarily Flooded Swamp Forests

Temporarily flooded forested wetlands occur on floodplains of rivers and streams throughout the Piedmont. They may be dominated by one or more of the following trees: red maple, sycamore, pin oak, silver maple (*Acer saccharinum*), green ash, tulip poplar, box elder, black walnut, and black locust (*Robinia pseudoacacia*) (Table 6-31). Brush and others (1980) reported the sycamore-green ash-box elder-silver maple association was characteristic of all floodplains in the Piedmont. On the Potomac River floodplain, eastern cottonwood (*Populus deltoides*) and silver maple may co-dominate, with sycamore and black willow also common. Ironwood is sometimes a common subcanopy species. Less common trees are bitternut hickory, shagbark hickory (*Carya ovata*), American basswood (*Tilia americana*), American elm, beech, white ash, common hackberry (*Celtis occidentalis*), black cherry (*Prunus serotina*), and choke cherry (*Prunus virginiana*). The shrub understory is usually not as dense as in seasonally flooded forests, but common species include multiflora rose, spicebush, southern arrowwood, and silky dogwood. Pawpaw may be common at higher levels in floodplain forests. Less common shrubs may include common

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Table 6-5. Examples of salt and brackish marsh communities observed in Maryland.

Dominance Type (Location)	Common Associates	Less Common Species
Black Needlerush (Dorchester County)	Salt Grass	High-tide Bush, Seaside Goldenrod, Marsh Orach
Black Needlerush (Somerset County)	None	Salt Grass, Sea Lavender, Salt Hay Grass (in openings)
Common Reed (Kent County)	Rose Mallow, Mock Bishop-weed, Salt Hay Grass, Black Grass, Olney Three-square	None
Common Reed (Long Point, Queen Annes County)	None	None
Narrow-leaved Cattail-Salt Hay Grass-Salt Grass (Dorchester County)	Rose Mallow, High-tide Bush, Salt Marsh Bulrush, Switchgrass, Black Needlerush, Olney Three-square	Broad-leaved Cattail, Spike-rush, Wax Myrtle, Black Grass
Olney Three-square (Dorchester County)	None	Switchgrass, Cattails, Salt Marsh Bulrush, Salt Grass, High-tide Bush, Wax Myrtle
Olney Three-square (Kent Island, Kent County)	Seashore Mallow, Salt Hay Grass, Salt Grass	Salt Marsh Pink, High-tide Bush, Groundsel-bush, Salt Marsh Fleabane, Salt Marsh Fimbristylis, Common Reed (edge)
Olney Three-square (Muddy Creek, Queen Annes County)	Black Needlerush, Seashore Mallow, Salt Hay Grass	Seaside Gerardia, Salt Marsh Fimbristylis, Salt Marsh Aster, Flatsedge, Salt Marsh Fleabane, Salt Marsh Loosestrife
Salt Hay Grass (Patuxent River, Charles County)	Smooth Cordgrass, Common Reed	Arrow Arum, Salt Marsh Fleabane, High-tide Bush, Big Cordgrass, Olney Three-square, Rose Mallow, Groundsel-bush
Salt Hay Grass (Kent County)	None	Salt Marsh Loosestrife, Salt Marsh Pink, High-tide Bush, Marsh Orach
Salt Hay Grass (Muddy Creek, Queen Annes County)	Salt Marsh Fimbristylis	Salt Grass, Seashore Mallow, Salt Marsh Fleabane, Salt Marsh Bulrush, Seaside Goldenrod
Salt Hay Grass-Black Needlerush-High-tide Bush (Somerset County)	Groundsel-bush, Salt Marsh Aster, Seaside Goldenrod, Salt Grass (wetter sites)	Salt Marsh Bulrush, Wax Myrtle, Foxtail Grass
Salt Hay Grass-Salt Grass (Somerset County)	Seaside Goldenrod, Groundsel-bush, High-tide Bush	Poison Ivy, Wax Myrtle, Common Reed, Salt Marsh Bulrush, Grass-leaved Goldenrod, Flatsedge
Smooth Cordgrass (Long Point, Queen Annes County)	Salt Hay Grass, Salt Grass	Salt Marsh Fleabane, Black Needlerush, Common Reed, Aster, Marsh Orach, Water Hemp, Seaside Gerardi
Smooth Cordgrass (Worcester County)	None	None
Spike-rush-Switchgrass (Caroline County)	Rose Mallow, Water Hemp, Umbrella Sedge, Mock Bishop-weed, Dwarf Spike-rush, Aster, Salt Hay Grass, Olney Three-square	Rush, Walter Millet, Flatsedge

Table 6-6. Examples of oligohaline wetland plant communities observed in Maryland. Communities marked with an asterisk (*) are scrub-shrub wetlands; the remainder are emergent types.

Dominance Type (Location)	Common Associates	Less Common Species
Big Cordgrass (Graham Creek/Patuxent River, Calvert County)	Arrow Arum, Narrow-leaved Cattail, Smooth Cordgrass, Olney Three-square	Water Parsnip, Pickerelweed, Arrow-leaved Tearthumb, Swamp Milkweed, Big Arrowhead, Rose Mallow, Walter Millet, Seashore Mallow, Hedge Bindweed
Big Cordgrass (Allens Fresh Run, Charles County)	Narrow-leaved Cattail, Rose Mallow, Seashore Mallow, Three-squares, Halberd-leaved Tearthumb, Pickerelweed, Climbing Hempweed	Wax Myrtle (edge)
Big Cordgrass-Narrow-leaved Cattail (Morgan Creek, Kent County)	Rose Mallow, Common Reed	Smooth Cordgrass, Arrow Arum
Mixed Community (Patuxent River, Charles County)	Big Cordgrass, High-tide Bush, Groundsel-bush, Salt Grass, Olney Three-square, Common Reed, Salt Hay Grass, Smooth Cordgrass, Salt Marsh Fleabane	Narrow-leaved Cattail, Arrow Arum, Seashore Mallow
Narrow-leaved Cattail (St. Marys County)	Rose Mallow, Swamp Rose, Dodder	Wool Grass, Black Willow (edges)
Narrow-leaved Cattail-Switchgrass (Chicamacomico River, Dorchester County)	Rose Mallow	Smartweed, Big Cordgrass, Wax Myrtle
Narrow-leaved Cattail-Olney Three-square (Transquaking River, Dorchester County)	Rose Mallow	Seashore Mallow, Switchgrass, Common Reed, Big Cordgrass (creekside levee)
Narrow-leaved Cattail-Rose Mallow (Manokin River, Somerset County)	Arrow Arum	Big Cordgrass, Arrow-leaved Tearthumb, Climbing Hempweed, Sedge, Swamp Rose, Aster, Smartweed, Water-willow
Switchgrass (Chicamacomico River, Dorchester County)	Olney Three-square, Narrow-leaved Cattail, Salt Hay Grass	Smartweed
*Wax Myrtle (Chicamacomico River, Dorchester County)	Rose Mallow, Salt Hay Grass, Poison Ivy, Swamp Rose	Seashore Mallow, Red Cedar, Red Maple, Loblolly Pine
*Wax Myrtle (Assateague, Worcester County)	Poison Ivy, Wool Grass, Common Reed, Climbing Hempweed, Switchgrass	False Nettle, Canada Rush, Dwarf St. John's-wort, Mock Bishop-weed, Virginia Rye Grass

Table 6-7. Plant species often occurring in oligohaline marshes (Thompson 1974 and personal observations).

Salt/Brackish Water Species	Fresh Water Species
<i>Grass or Grasslike Plants:</i>	<i>Aquatic Bed Plants:</i>
Fragrant Galingale (<i>Cyperus odoratus</i>)	Spatterdock (<i>Nuphar luteum</i>)
Creeping Spike-rush (<i>Eleocharis palustris</i>)	White Water Lily (<i>Nymphaea odorata</i>)
Dwarf Spike-rush (<i>Eleocharis parvula</i>)	<i>Grass and Grasslike Plants:</i>
Beaked Spike-rush (<i>Eleocharis rostellata</i>)	Sedges (<i>Carex</i> spp.)
Canada Rush (<i>Juncus canadensis</i>)	Wood Reed (<i>Cinna arundinacea</i>)
Switchgrass (<i>Panicum virgatum</i>)	Twig-rush (<i>Cladium mariscoides</i>)
Common Reed (<i>Phragmites australis</i>)	Umbrella Sedges (<i>Cyperus</i> spp.)
Foxtail Grass (<i>Setaria geniculata</i>)	Three-way Sedge (<i>Dulichium arundinaceum</i>)
Giant Foxtail (<i>S. magna</i>)	Walter Millet (<i>Echinochloa walteri</i>)
Olney Three-square (<i>Scirpus americanus</i>)	Soft Rush (<i>Juncus effusus</i>)
Common Three-square (<i>S. pungens</i>)	Fall Panic Grass (<i>Panicum dichotomiflorum</i>)
Salt Marsh Bulrush (<i>Scirpus robustus</i>)	Panic Grasses (<i>Panicum</i> spp.)
New England Bulrush (<i>S. cylindricus</i>)	Reed Canary Grass (<i>Phalaris arundinacea</i>)
Big Cordgrass (<i>Spartina cynosuroides</i>)	Brownish Beak-rush (<i>Rhynchospora capitellata</i>)
Salt Hay Grass (<i>S. patens</i>)	Wool Grass (<i>Scirpus cyperinus</i>)
Smooth Cordgrass (<i>S. alterniflora</i>)	River Bulrush (<i>S. fluviatilis</i>)
<i>Herbs:</i>	Soft-stemmed Bulrush (<i>S. validus</i>)
Water Hemp (<i>Amaranthus cannabinus</i>)	Wild Rice (<i>Zizania aquatica</i>)
Small-flowered Salt Marsh Aster (<i>Aster subulatus</i>)	<i>Herbs:</i>
Grass-leaved Goldenrod (<i>Euthamia graminifolia</i>)	Sweet Flag (<i>Acorus calamus</i>)
Purple Gerardia (<i>Gerardia purpurea</i>)	Swamp Milkweed (<i>Asclepias incarnata</i>)
Rose Mallow (<i>Hibiscus moscheutos</i>)	Swamp Aster (<i>Aster puniceus</i>)
Seashore Mallow (<i>Kosteletzkya virginica</i>)	Bur-marigold (<i>Bidens laevis</i>)
Eastern Lilaeopsis (<i>Lilaeopsis chinensis</i>)	Beggar-ticks (<i>Bidens</i> spp.)
Salt Marsh Fleabane (<i>Pluchea purpurascens</i>)	Partridge Pea (<i>Cassia fasciculata</i>)
Curly Dock (<i>Rumex crispus</i>)	Water Hemlock (<i>Cicuta maculata</i>)
Large Marsh Pink (<i>Sabatia dodecandra</i>)	Water-willow (<i>Decodon verticillatus</i>)
Salt Marsh Pink (<i>Sabatia stellaris</i>)	Rattlesnake Master (<i>Eryngium aquaticum</i>)
American Germander (<i>Teucrium canadense</i>)	Maryland Meadow-beauty (<i>Rhexia mariana</i>)
Narrow-leaved Cattail (<i>Typha angustifolia</i>)	Boneset (<i>Eupatorium perfoliatum</i>)
Water Pimpernel (<i>Samolus parviflorus</i>)	Bedstraws (<i>Galium</i> spp.)
<i>Shrubs:</i>	Hedge-hyssops (<i>Gratiola</i> spp.)
Groundsel-bush (<i>Baccharis halimifolia</i>)	Sneezeweed (<i>Helenium autumnale</i>)
High-tide Bush (<i>Iva frutescens</i>)	Swamp Dock (<i>Rumex verticillatus</i>)
Wax Myrtle (<i>Myrica cerifera</i>)	Water Pennywort (<i>Hydrocotyle ranunculoides</i>)
Poison Ivy (<i>Toxicodendron radicans</i>)	Marsh Pennywort (<i>H. umbellata</i>)
<i>Vines:</i>	St. John's-wort (<i>Hypericum</i> spp.)
Climbing Hempweed (<i>Mikania scandens</i>)	Jewelweed (<i>Impatiens capensis</i>)
	Yellow Flag (<i>Iris pseudacorus</i>)
	Blue Flag (<i>I. versicolor</i>)
	Seedbox (<i>Ludwigia alternifolia</i>)
	Water Horehound (<i>Lycopus americanus</i>)
	Bugleweed (<i>L. virginicus</i>)
	Purple Loosestrife (<i>Lythrum salicaria</i>)
	Golden Club (<i>Orontium aquaticum</i>)
	Royal Fern (<i>Osmunda regalis</i>)
	Arrow Arum (<i>Peltandra virginica</i>)
	Clearweed (<i>Pilea pumila</i>)
	Halberd-leaved Tearthumb (<i>Polygonum arifolium</i>)
	Cespitose Knotweed (<i>P. caespitosum</i>)
	Mild Water-pepper (<i>P. hydropiper</i>)
	Water-pepper (<i>P. hydropiperoides</i>)
	Pinkweed (<i>P. pennsylvanicum</i>)
	Lady's Thumb (<i>P. persicaria</i>)

Table 6-7. (continued)

Fresh Water Species (continued)	
<i>Herbs (continued):</i>	
Water Smartweed (<i>P. punctatum</i>)	
Arrow-leaved Tearthumb (<i>P. sagittatum</i>)	
Pickerelweed (<i>Pontederia cordata</i>)	
Mock Bishop-weed (<i>Ptilimnium capillaceum</i>)	
Bull-tongue (<i>Sagittaria falcata</i>)	
Big-leaved Arrowhead (<i>Sagittaria latifolia</i>)	
Lizard's Tail (<i>Saururus cernuus</i>)	
Water Parsnip (<i>Sium suave</i>)	
Bur-reeds (<i>Sparganium</i> spp.)	
Marsh Fern (<i>Thelypteris thelypteroides</i>)	
Marsh St. John's-wort (<i>Triadenum virginicum</i>)	
Broad-leaved Cattail (<i>Typha latifolia</i>)	
Blue Vervain (<i>Verbena hastata</i>)	
<i>Vines:</i>	
Ground-nut (<i>Apios americana</i>)	
Hedge Bindweed (<i>Calystegia sepium</i>)	
Virginia Creeper (<i>Parthenocissus quinquefolia</i>)	
Trailing Wild bean (<i>Strophostyles helvola</i>)	
<i>Shrubs:</i>	
Swamp Rose (<i>Rosa palustris</i>)	

Table 6-8. Examples of estuarine scrub-shrub and forested wetland communities observed in Maryland.

Dominance Type (Location)	Common Associates	Less Common Species
High-tide Bush-Rose Mallow (Rockhold Creek, Anne Arundel County)	Salt Hay Grass, Seaside Goldenrod	Big Cordgrass, Groundsel-bush, Salt Grass, Smooth Cordgrass, Seashore Mallow
High-tide Bush-Salt Hay Grass (Dorchester County)	Salt Grass, Black Needlerush, Switchgrass, Groundsel-bush	Olney Three-square, Smooth Cordgrass, Marsh Orach
High-tide Bush-Salt Marsh Bulrush (Church Creek, Dorchester County)	None	Salt Grass, Marsh Orach, Common Reed, Cattail, Switchgrass, Seaside Goldenrod, Water Dock
High-tide Bush-Salt Grass (St. Marys County)	None	Black Grass, Big Cordgrass, Salt Marsh Bulrush, Rose Mallow, Seaside Goldenrod, Smooth Cordgrass, Salt Hay Grass, Red Cedar
Loblolly Pine-Salt Hay Grass (Monie Bay Estuarine Sanctuary, Somerset County)	Groundsel-bush, Poison Ivy, Common Reed, Switchgrass	Wax Myrtle, Salt Marsh Aster, Swamp Rose, American Holly, High-tide Bush, Grass-leaved Goldenrod, Narrow-leaved Cattail, Spike-rush, Lowland Broom-sedge (on berm)
Loblolly Pine-Salt Hay Grass (Upper Fairmont, Somerset County)	Groundsel-bush, High-tide Bush	Salt Marsh Aster, Salt Marsh Bulrush, Poison Ivy, Wax Myrtle, Rose Mallow

Table 6-9. Salinity ranges of tidal aquatic plants. Based largely on Stewart (1962) and Anderson (1972) as reported by McCormick and Somes (1982).

	Saline	Highly Brackish	Moderately Brackish	Slightly Brackish	Fresh
Sea Lettuce (<i>Ulva lactuca</i>)	x	x	x		
Green Algae (<i>Enteromorpha</i> sp.)	x	x	x		
Eelgrass (<i>Zostera marina</i>)	x	x	x		
Widgeongrass (<i>Ruppia maritima</i>)	x	x			
Horned Pondweed (<i>Zannichellia palustris</i>)		x	x	x	x
Sago Pondweed (<i>Potamogeton pectinatus</i>)		x	x	x	x
Redhead-grass (<i>P. perfoliatus</i>)		x	x	x	x
Eurasian Water-milfoil (<i>Myriophyllum spicatum</i>)		x	x	x	x
Common Waterweed (<i>Elodea densa</i>)			x	x	x
Muskgrasses (<i>Chara</i> spp.)			x	x	x
Curly Pondweed (<i>P. crispus</i>)			x	x	x
Wild Celery (<i>Vallisneria americana</i>)				x	x
Southern Naiad (<i>Najas guadalupensis</i>)				x	x
Small Pondweed (<i>P. pusillus</i>)				x	x
Coontail (<i>Ceratophyllum demersum</i>)				x	x
Slender Naiad (<i>N. flexilis</i>)			x		x
Water Chestnut (<i>Trapa natans</i>)				x	x
Hydrilla (<i>Hydrilla verticillata</i>)				x	x
White Water Lily (<i>Nymphaea odorata</i>)				x	x
Nuttall's Waterweed (<i>Elodea nuttallii</i>)					x
Other Pondweeds: (<i>P. amplifolius</i> , <i>P. epiphydrus</i> , <i>P. foliosus</i> , <i>P. gramineus</i> , <i>P. nodosus</i> , <i>P. robbinsii</i>)					x
Cutleaf Water-milfoil (<i>M. tenellum</i>)					x
Threadlike Naiad (<i>N. gracillima</i>)					x
Water Star-grass (<i>Zosterella dubia</i>)					x

Table 6-10. Vegetation of Eastern Shore swamps and floodplains according to Shreve (1910a).

Wetland Type	Common Associates
Clay Upland Swamps	<p>Trees: Sweet Gum, White Oak, Black Gum, Willow Oak, Red Maple, Swamp White Oak, Loblolly Pine; also less commonly, American Holly, Basket Oak</p> <p>Shrubs: Sweet Pepperbush, Maleberry, Highbush Blueberry, Swamp Azalea, Fetterbush, Southern Arrowwood, Virginia Sweet-spires, Black Haw, Sweet Bay, Common Winterberry, Flowering Dogwood, Smooth Alder</p> <p>Herbs: Sedges (<i>Carex caroliniana</i>, <i>C. comosa</i>, <i>C. lupulina</i>, <i>C. hirta</i>), and Pale Manna Grass (<i>Glyceria pallida</i>)</p> <p>Others: Peat Moss</p>
Sandy-Loam Upland Swamps	<p>Trees: Loblolly Pine, Willow Oak, White Oak, Sweet Gum, Red Maple, Water Oak, Basket Oak, Black Gum, Sweet Bay, American Holly, Flowering Dogwood; also less commonly, Fringe-tree, River Birch</p> <p>Shrubs: Wax Myrtle, Southern Arrowwood, Poison Sumac, Staggerbush, Virginia Sweet-spires, Devil's Walking Stick, Red Chokeberry, American Strawberrybush</p> <p>Herbs: Not specified</p> <p>Others: Peat Moss</p>
Wetter Floodplain Forests	<p>Trees: Red Maple, Black Gum, White Ash, Sweet Bay</p> <p>Shrubs: Common Winterberry, Sweet Pepperbush, Smooth Alder, Southern Arrowwood, Buttonbush, Poison Sumac</p> <p>Herbs: Lizard's Tail, Cinnamon Fern, Sensitive Fern, Golden Saxifrage, Turtlehead, Marsh St. John's-wort, Jewelweed, Sweet White Violet, Cursed Crowfoot, Bladder Sedge, Sweet-scented Bedstraw</p>
Sandy Floodplains	<p>Trees: Loblolly Pine, Water Oak, American Holly, Black Gum, Sweet Bay, White Ash, Fringe-tree, Flowering Dogwood, Ironwood</p> <p>Shrubs: Sweet Pepperbush, Southern Arrowwood, Pink Azalea, American Strawberrybush</p> <p>Herbs: Partridgeberry, Bladder Sedge, Long Sedge, Sedge (<i>Carex laxiculmis</i>)</p> <p>Vines: Common Greenbrier, Virginia Creeper, Fox Grape, Trumpet Creeper, Wild Yam</p>
Drier Floodplain Forests	<p>Trees: Tulip Poplar, Ironwood, Sweet Gum, White Ash, Sycamore, American Elm, Willow Oak, Red Maple, Black Gum</p> <p>Shrubs: Spicebush, Southern Arrowwood, American Strawberrybush</p> <p>Herbs: Virginia Grape Fern, White Grass, Smooth Solomon's-seal, Jack-in-the-pulpit, Sweet White Violet, Swamp Aster, Wood Sorrel</p>
Upland Swamps of Wicomico Terrace	<p>Trees: Black Gum, Swamp White Oak, Red Maple, Sweet Gum, Willow Oak, White Oak; also American Holly, Beech, Sweet Bay, Swamp Cottonwood</p> <p>Shrubs: Virginia Sweet-spires, Red Chokeberry, Swamp Azalea</p> <p>Herbs: Water Smartweed, Inflated Bladderwort, Mermaid-weed</p>
River Swamps	<p>Trees: Bald Cypress (outer zone), Black Gum, Red Maple, Sweet Gum, Swamp Black Gum, Green Ash, Sweet Bay; also less commonly, Tulip Poplar, Ironwood, Swamp Cottonwood, Water Oak, Atlantic White Cedar (outer zone), Loblolly Pine, White Oak, American Holly (inner zone)</p> <p>Shrubs: Wax Myrtle, Sweet Pepperbush, Maleberry, Smooth Alder, Buttonbush, Silky Dogwood, Southern Arrowwood, Staggerbush, Water-willow (Swamp Loosestrife), Dangleberry</p> <p>Vines: Trumpet Creeper, Grapes, Common Greenbrier, Virginia Creeper, Poison Ivy, Cross Vine</p> <p>Herbs: Dwarf St. John's-wort, Jewelweed, Water Pennywort, Marsh St. John's-wort, Marsh Fern, Cardinal Flower, Three-way Sedge, Water Primrose, Mermaid-weed, Lizard's Tail, False Nettle, Ditch Stonecrop, Virginia Bugleweed, Hoplike Sedge</p>
Stream Swamps	<p>Trees (small sized): Red Maple and Green Ash; also less commonly, Loblolly Pine, Atlantic White Cedar, Black Gum, Sweet Bay, Sweet Gum, Black Willow, Swamp White Oak, River Birch</p> <p>Shrubs: Common Winterberry, Sweet Pepperbush, Buttonbush, Smooth Alder, Water-willow (Swamp Loosestrife), Silky Dogwood, Virginia Sweet-spires, Poison Sumac, Southern Arrowwood, Swamp Rose</p> <p>Herbs: Broad-leaved Cattail, Cinnamon Fern, Jewelweed, Lizard's Tail, Royal Fern, Big-leaved Arrowhead, Water Hemlock, Water Dock, Arrow Arum, Pickerelweed, New York Ironweed, Water Pepper, Blue Flag, Mermaid-weed, Tall Meadow-rue, Marsh Blue Violet, False Nettle</p>

Table 6-11. Examples of tidal swamp communities on Maryland's Eastern Shore. Communities marked with an asterisk (*) are temporarily flooded-tidal, while the rest are seasonally flooded-tidal.

Dominance Type (Location)	Common Associates	Less Common Species
Green Ash (Chicamacomico River, Dorchester County)	Winterberry, Highbush Blueberry, Fetterbush, Red Maple, Silky Dogwood, Sweet Pepperbush, Swamp Azalea, Tussock Sedge, Sweet Bay	Smooth Alder, Japanese Honeysuckle, Sweet Gum, Poison Ivy, Marsh Fern, Laurel-leaved Greenbrier, Common Greenbrier, Swamp Rose, Black Gum, Royal Fern, Wax Myrtle, Buttonbush, Rose Mallow, Mistletoe
Green Ash (Marshyhope Creek, Dorchester County)	Red Maple, Smooth Alder, Seaside Alder, Tussock Sedge	Common Winterberry, Sedge, Climbing Buckwheat, Poison Ivy, Laurel-leaved Greenbrier, Swamp Rose, Red Chokeberry, Sweet Bay, Highbush Blueberry, Sweet Pepperbush, Fetterbush, Maleberry, Swamp Azalea, Aster, Buttonbush, Climbing Hempweed, Umbrella Sedge
Green Ash (Dividing Creek, Somerset County)	Fetterbush, Swamp Azalea, Southern Arrowwood, Sedges	Bald Cypress, Winterberry, American Holly, Highbush Blueberry, Sweet Pepperbush, Cross Vine, Sweet Gum, Red Maple, Black Gum, Sweet Bay, Poison Ivy, Grape, Laurel-leaved Greenbrier, Wood Reed, Ironwood
Green Ash-Bald Cypress (Pocomoke River, Worcester County)	Common Greenbrier, Sweet Bay, Red Maple, Southern Arrowwood, Japanese Honeysuckle	Willow Oak, Poison Ivy, Serviceberry, Cross Vine, Southern Wild Raisin, Grape, Tall Meadow-rue Swamp Azalea, Sedges, Sweet Pepperbush, Fetterbush, Loblolly Pine
Green Ash-Black Gum (Wagram Creek, Worcester County)	Lizard's Tail, Sweet Gum	Cross Vine, River Birch, Red Maple, Winterberry
*Loblolly Pine-Wax Myrtle (Worcester County)	Cinnamon Fern, Royal Fern, Virginia Creeper, Poison Ivy, Sweet Gum, Grape, Common Greenbrier	Sensitive Fern, Trumpet Creeper
*Red Maple (Worcester County)	Willow Oak, Sweet Gum, Southern Arrowwood, Common Greenbrier, Virginia Creeper, Sedge, False Nettle	Sweet Bay, Elderberry, Grape, Cardinal Flower, Black Gum

Table 6-13. Examples of seasonally flooded palustrine (nontidal) forested wetland communities observed on the Lower Eastern Shore of Maryland. These communities are typical of the Lower Coastal Plain or the Gulf-Atlantic Coastal Flats of Hammond (1970).

Dominance Type (Location)	Associates
Swamp Black Gum (Wicomico County)	Trees: Red Maple, Sweet Bay, Green Ash, Sweet Gum Shrubs: Sweet Pepperbush, Fetterbush, Southern Wild Raisin Herbs: Bladder Sedge, False Nettle, Net-veined Chain Fern, Manna Grass, Devil's Beggar-ticks, Bugleweed, Long Sedge, Wood Reed, Lizard's Tail, Joe-Pye-weed Vines: Common Greenbrier
Loblolly Pine (Kings Creek, Somerset County)	Trees: Red Maple, Sweet Gum Shrubs: Wax Myrtle, Common Winterberry Herbs: Royal Fern, Sedge, Pennywort
Red Maple (Kentuck Swamp, Dorchester County)	Trees: Black Gum, Swamp Black Gum, Loblolly Pine, Willow Oak, Sweet Gum, Swamp White Oak, Southern Red Oak, Basket Oak Shrubs: Sweet Pepperbush, Common Winterberry, Highbush Blueberry, American Holly, Fetterbush Herbs: Slender Spike-grass, Bladder Sedge, Unidentified Grass, Sedges, White Grass, Panic Grass Others: Common Greenbrier, Grape, Japanese Honeysuckle, Partridgeberry, Poison Ivy
Red Maple (Somerset County)	Trees: Loblolly Pine, Sweet Bay, American Holly, Sweet Gum, Cherrybark Oak Shrubs: Southern Arrowwood, Silky Dogwood, Common Winterberry, Common Elderberry Herbs: Wood Reed, Cinnamon Fern, Net-veined Chain Fern, Sedge, False Nettle Others: Japanese Honeysuckle, Swamp Dewberry, Grape, Common Greenbrier
Red Maple (Wicomico County)	Trees: American Holly, Sweet Gum, Sweet Bay, Basket Oak Shrubs: Sweet Pepperbush Herbs: False Nettle, Virginia Chain Fern, Net-veined Chain Fern, Rice Cutgrass, Cinnamon Fern, Lizard's Tail (creek)
Red Maple (Wicomico County)	Trees: American Holly, Loblolly Pine, Sweet Bay Shrubs: Sweet Pepperbush, Highbush Blueberry, Fetterbush Herbs: Virginia Chain Fern, Cinnamon Fern Others: Peat Moss, Common Greenbrier
Red Maple (Little Mill Creek, Worcester County)	Trees: Sweet Bay, Loblolly Pine, Willow Oak, Sweet Gum, American Holly, Water Oak Shrubs: Common Winterberry, Highbush Blueberry, Southern Arrowwood, Sweet Pepperbush, Red Chokeberry Herbs: Sedge Others: Japanese Honeysuckle, Laurel-leaved Greenbrier
Red Maple-American Holly (Wicomico State Forest, Wicomico County)	Trees: Sweet Bay, Water Oak (edge), Sassafras (edge) Shrubs: Sweet Pepperbush, Highbush Blueberry, Fetterbush Herbs: Cinnamon Fern, Net-veined Chain Fern Others: Peat Moss, Common Greenbrier
Red Maple-Bald Cypress (Pocomoke River, Worcester County)	Trees/Saplings: Green Ash, Swamp Cottonwood, Water Tupelo Shrubs: Pawpaw, Elderberry, Fetterbush, Silky Dogwood, Smooth Alder, Swamp Rose, Winterberry, Spicebush Herbs: False Nettle, Jewelweed, Bladder Sedge, Lizard's Tail, Beggar-ticks, Wood Reed, Three-way Sedge, Cardinal Flower, Cinnamon Fern, Net-veined Chain Fern, Marsh Blue Violet, Water Horsetail, Arrow Arum, Royal Fern Others: Riverbank Grape
Red Maple-Basket Oak (Dorchester County)	Trees: Sweet Gum, Overcup Oak, Southern Red Oak, Black Gum, Sweet Bay, American Holly Shrubs: Sweet Pepperbush, Highbush Blueberry, Swamp Azalea Herbs: Sedge, Unidentified Grass Others: Common Greenbrier, Poison Ivy, Peat Moss
Red Maple-Basket Oak- Willow Oak (Dorchester County)	Trees: Loblolly Pine, Sweet Gum, White Oak Shrubs: Sweet Pepperbush, Highbush Blueberry Herbs: Slender Spike-grass, Sedge Others: Common Greenbrier, Partridgeberry (high spots), Peat Moss (depressions)

Table 6-13. (continued)

Dominance Type (Location)	Associates
Red Maple-Black Gum (Massey's Crossing, Worcester County)	Trees: Sweet Gum Shrubs: Elderberry, Spicebush Herbs: Pokeweed, False Nettle, Bristlebract Sedge, Spinulose Wood Fern, Hoplike Sedge, Wood Reed Others: Brambles, Japanese Honeysuckle, Poison Ivy
Red Maple-Green Ash (Wicomico River, Wicomico County)	Trees: Swamp Black Gum, Ironwood, Sweet Bay, American Holly, Black Gum, Atlantic White Cedar, Loblolly Pine, Tulip Poplar Shrubs: Spicebush, Sweet Pepperbush, Highbush Blueberry, Winterberry Herbs: Cinnamon Fern, Net-veined Chain Fern, Jack-in-the-pulpit, Royal Fern, Violet, Jewelweed, Wild Yam Others: Grape, Common Greenbrier, Partridgeberry, Poison Ivy
Red Maple-Loblolly Pine- Swamp White Oak (Wicomico County)	Trees: American Holly, Willow Oak, Sweet Bay, Black Gum Shrubs: Sweet Pepperbush, Highbush Blueberry Herbs: Sedges Others: Common Greenbrier, Peat Moss, Partridgeberry
Red Maple-Loblolly Pine- Sweet Gum (Wicomico County)	Trees: Black Gum, American Holly, Sweet Bay Shrubs: Highbush Blueberry, Sweet Pepperbush, Swamp Azalea, Dangleberry, Fetterbush, Winterberry Herbs: Sedge, Cinnamon Fern, Partridgeberry, Slender Spikegrass Others: Peat Moss, Common Greenbrier
Red Maple-Pin Oak (Worcester County)	Trees: American Holly, Sweet Bay, Sweet Gum, Loblolly Pine, Black Gum, Basket Oak, Ironwood, Devil's Walking-stick, Tulip Poplar Shrubs: Highbush Blueberry, Southern Arrowwood, Fetterbush Herbs: Sensitive Fern, Royal Fern, Cinnamon Fern, Jack-in-the-pulpit, Marsh Fern, Bladder Sedge, Lurid Sedge, Goldenrod, False Nettle, Big-leaved Arrowhead, Cardinal Flower, Soft Rush, Virginia Chain Fern, Marsh St. John's wort Others: Common Greenbrier, Peat Moss, Virginia Creeper, Partridgeberry, Blackberry, Hair-cap Moss
Red Maple-Sweet Gum (Winton Crossing, Worcester County)	Trees: American Elm, Ironwood, Sweet Bay, Black Gum, Bald Cypress, Swamp Cottonwood, American Holly, Pin Oak, Basket Oak Shrubs: Virginia Sweet-spires, Sweet Pepperbush, Spicebush (higher spot) Herbs: Sedges, Lizard's Tail, Net-veined Chain Fern, Wood Reed, White Grass, Royal Fern, Three-way Sedge Others: Cross Vine
Red Maple-Sweet Gum- Basket Oak-Overcup Oak- Willow Oak (Dorchester County)	Trees: American Holly, Beech, Loblolly Pine Shrubs: Highbush Blueberry, Sweet Pepperbush, Fetterbush, Red Chokeberry, Swamp Azalea, Huckleberry Herbs: Royal Fern, Wool Grass (low spots), Switchgrass, Unidentified Grass, Common Reed, Soft Rush Others: Peat Moss, Common Greenbrier, Partridgeberry (high spots)
Red Maple-Sweet Gum- Black Gum (Worcester County)	Trees: American Holly, Sweet Bay Shrubs: Highbush Blueberry, Fetterbush, Sweet Pepperbush Herbs: Sensitive Fern Others: Peat Moss, Common Greenbrier
Red Maple-Sweet Gum- Black Gum (Worcester County)	Trees: American Holly, Sweet Bay Shrubs: Highbush Blueberry, Fetterbush, Sweet Pepperbush Herbs: Sensitive Fern Others: Peat Moss, Common Greenbrier
Sweet Gum-Red Maple (Dorchester County)	Trees: American Holly, Sweet Bay, Tulip Poplar, Water Oak, White Oak Shrubs: Swamp Azalea, Southern Arrowwood, Black Haw, Sweet Pepperbush, Spicebush, Fetterbush Herbs: Net-veined Chain Fern, Royal Fern Others: Japanese Honeysuckle

Table 6-14. Examples of seasonally flooded palustrine (nontidal) forested wetland communities observed on the Upper Eastern Shore of Maryland. These communities are typical of the Lower Coastal Plain or the Gulf-Atlantic Coastal Flats of Hammond (1970). Communities marked by an asterisk (*) are pothole forested wetlands, characteristic of Caroline, Kent, and Queen Annes Counties.

Dominance Type (Location)	Associates
Black Gum-Red Maple (Caroline County)	Trees: Ironwood, Tulip Poplar, Sweet Gum, American Holly, Sweet Bay, Loblolly Pine (edge), Green Ash Shrubs: Sweet Pepperbush, Elderberry, Virginia Sweet-spires, Spicebush, Highbush Blueberry, American Strawberrybush Herbs: Skunk Cabbage, Net-veined Chain Fern, Violet, Sedge, Aster, Royal Fern, Cinnamon Fern, Jewelweed Others: Common Greenbrier, Poison Ivy
*Black Gum-Sweet Gum- Basket Oak-Willow Oak (Kent County)	Trees: Sweet Bay Shrubs: Sweet Pepperbush, Highbush Blueberry, Swamp Azalea, Fetterbush Herbs: Sedge Others: Common Greenbrier, Peat Moss
Green Ash (Miles River, Talbot County)	Trees: Sweet Gum, American Elm Shrubs: Silky Dogwood, Spicebush, Smooth Alder Herbs: Unidentified Grass, White Avens, Field Garlic Others: Japanese Honeysuckle, Grape, Common Greenbrier
*Red Maple (Caroline County)	Trees: Persimmon, Sweet Gum, Sweet Bay Shrubs: Highbush Blueberry, Sweet Pepperbush (edge) Herbs: Net-veined Chain Fern, White Grass Others: Common Greenbrier, Peat Moss
Red Maple (Herring Run, Caroline County)	Trees: American Elm, Tulip Poplar, American Holly Shrubs: Southern Arrowwood, Spicebush, Silky Dogwood Herbs: Skunk Cabbage, Field Garlic Others: Japanese Honeysuckle, Poison Ivy
Red Maple (Kent County)	Shrubs: Southern Arrowwood, Silky Dogwood, Common Elderberry, Winterberry Herbs: Unidentified Grass, Jewelweed, Sensitive Fern Others: Common Greenbrier, Japanese Honeysuckle, Brambles
Red Maple (Kent County)	Trees: Ironwood, River Birch, Swamp White or Basket Oak, American Elm, Black Willow (river bank) American Elm, Black Willow (river bank) Herbs: Wood Reed, Sedge, Aster Others: Common Greenbrier, Poison Ivy
Red Maple (Talbot County)	Trees: Sweet Gum, Sweet Bay, American Holly, Basket Oak, Devil's Walking-stick Shrubs: Sweet Pepperbush Herbs: Wood Reed Others: Common Greenbrier, Peat Moss (depressions)
Red Maple-Black Gum- Green Ash-Smooth Alder (Cecil County)	Trees: Sycamore Shrubs: Silky Dogwood Herbs: Swamp Beggar-ticks, Skunk Cabbage, Jewelweed, Joe-Pye-Weed Others: Common Greenbrier, Poison Ivy
*Red Maple-Green Ash (Queen Annes County)	Trees: Sweet Gum Shrubs: Virginia Sweet-spires, Southern Arrowwood, Sweet Pepperbush, Silky Dogwood Herbs: Wood Reed, Virginia Spring Beauty (hummocks), Aster, False Nettle, Violet Others: Common Greenbrier, Poison Ivy, Grape, Virginia Creeper
Red Maple-Green Ash (Talbot County)	Trees: Sweet Bay, American Elm, Sweet Gum Shrubs: Fetterbush, Elderberry, Virginia Sweet-spires, Wild Raisin Herbs: Wood Reed, Goldenrod, False Nettle, Jewelweed Others: Poison Ivy, Common Greenbrier

Table 6-14. (continued)

Dominance Type (Location)	Associates
*Red Maple-Sweet Gum (Queen Annes County)	Trees: Southern Red Oak, River Birch, Willow Oak Shrubs: Highbush Blueberry, Sweet Pepperbush (edge), Fetterbush (edge) Others: Common Greenbrier (edge)
Sweet Gum-Red Maple (Watts Creek, Caroline County)	Trees: Ironwood, Tulip Poplar, River Birch, Sycamore, Beech, American Holly Shrubs: Elderberry, Spicebush, Multiflora Rose, Southern Arrowwood Herbs: Wood Reed, Field Garlic, Sedge, Jewelweed, Skunk Cabbage, Aster Others: Grape, Japanese Honeysuckle, Poison Ivy, Common Greenbrier
*Sweet Gum-Red Maple- Southern Red Oak (Kent County)	Trees: Black Gum, White Oak Shrubs: Highbush Blueberry, Fetterbush, Sweet Pepperbush Others: Common Greenbrier
Sycamore-Red Maple- Green Ash (Mill Creek, Talbot County)	Trees: American Elm, Ironwood Shrubs: Spicebush, Silky Dogwood, Common Winterberry Herbs: Wood Reed, Skunk Cabbage, Christmas Fern, White Avens, Violet, False Nettle Others: Japanese Honeysuckle, Poison Ivy, Grape, Common Greenbrier, Brambles

Table 6-20. Examples of temporarily flooded palustrine (nontidal) forested wetland communities observed on the Lower Eastern Shore of Maryland. These communities are typical of the Lower Coastal Plain or the Gulf-Atlantic Coastal Flats of Hammond (1970). Communities marked by an asterisk (*) were observed by William Sipple.

Dominance Type (Location)	Associates
American Holly-Loblolly Pine-Red Maple (Worcester County)	Trees: Sweet Gum, Sweet Bay Shrubs: Highbush Blueberry, Sweet Pepperbush, Maleberry
Loblolly Pine (Dorchester County)	Trees: Sweet Gum Shrubs: Wax Myrtle Herbs: Switchgrass Others: Poison Ivy, Japanese Honeysuckle
Loblolly Pine (Dorchester County)	Trees: Black Gum, American Holly Shrubs: Wax Myrtle Herbs: Switchgrass Others: Common Greenbrier, Poison Ivy
Loblolly Pine (Wicomico County)	Trees: Red Maple, Sweet Gum, American Holly Shrubs: Poison Ivy
Loblolly Pine-Black Gum (Dorchester County)	Trees: Sweet Gum, Red Maple, Southern Red Oak, Cherry, Tulip Poplar, Swamp White Oak Shrubs: Highbush Blueberry, Wax Myrtle, Sweet Bay, Sweet Pepperbush, Inkberry
Red Maple (Millpond River, Dorchester County)	Trees: Sweet Bay, American Holly, Black Cherry (on ditch berm), Sweet Gum, Willow Oak Shrubs: Sweet Pepperbush, Spicebush, Winterberry, Southern Arrowwood, Fetterbush Herbs: Slender Spike-grass, Lizard's Tail (creek), Bur-reed (creek) Others: Japanese Honeysuckle, Common Greenbrier
Red Maple-American Holly (Tulls Swamp, Somerset County)	Trees: Black Gum, Basket Oak, Sweet Gum, Sweet Bay, White Oak, Cherrybark Oak Shrubs: Sweet Pepperbush, Highbush Blueberry, Fetterbush Others: Common Greenbrier
Red Maple-Black Gum (Worcester County)	Trees: Sweet Gum, Loblolly Pine, Basket Oak, American Holly, Sweet Bay Shrubs: Sweet Pepperbush, Highbush Blueberry, Swamp Azalea, Mountain Laurel Herbs: Sensitive Fern Others: Peat Moss (low spots), Partridgeberry, Common Greenbrier, Wintergreen
* Red Maple-Southern Red Oak-White Oak (Worcester County)	Trees: Sweet Gum, Loblolly Pine, Black Gum Shrubs: Sweet Pepperbush, Highbush Blueberry Herbs: Slender Spike-grass
Red Oak-Southern Red Oak-Loblolly Pine (Dorchester County)	Trees: White Oak, Red Maple, Sweet Gum, Beech, Black Gum, Basket Oak Shrubs: Highbush Blueberry, American Holly, Sweet Pepperbush, Serviceberry Herbs: Slender Spike-grass
Sweet Gum-Red Maple (Worcester County)	Trees: American Holly, White Oak, Sweet Bay, Black Gum, Tulip Poplar, Sassafras, Flowering Dogwood, Loblolly Pine Shrubs: Sweet Pepperbush, Highbush Blueberry, Mountain Laurel Herbs: Sensitive Fern, Cinnamon Fern, Royal Fern Others: Peat Moss (low spots), Wintergreen, Common Greenbrier
* Water Oak-White Oak (Wicomico County)	Trees: Willow Oak, Red Maple, Loblolly Pine, Sweet Gum, Sweet Bay, Black Gum, American Holly, Sassafras Shrubs: Sweet Pepperbush, Highbush Blueberry, Swamp Azalea Herbs: Slender Spike-grass, Netted Chain Fern, Sensitive Fern Others: Common Greenbrier, Partridgeberry

Table 6-13. Examples of seasonally flooded palustrine (nontidal) forested wetland communities observed on the Lower Eastern Shore of Maryland. These communities are typical of the Lower Coastal Plain or the Gulf-Atlantic Coastal Flats of Hammond (1970).

Dominance Type (Location)	Associates
Swamp Black Gum (Wicomico County)	Trees: Red Maple, Sweet Bay, Green Ash, Sweet Gum Shrubs: Sweet Pepperbush, Fetterbush, Southern Wild Raisin Herbs: Bladder Sedge, False Nettle, Net-veined Chain Fern, Manna Grass, Devil's Beggar-ticks, Bugleweed, Long Sedge, Wood Reed, Lizard's Tail, Joe-Pye-weed Vines: Common Greenbrier
Loblolly Pine (Kings Creek, Somerset County)	Trees: Red Maple, Sweet Gum Shrubs: Wax Myrtle, Common Winterberry Herbs: Royal Fern, Sedge, Pennywort
Red Maple (Kentuck Swamp, Dorchester County)	Trees: Black Gum, Swamp Black Gum, Loblolly Pine, Willow Oak, Sweet Gum, Swamp White Oak, Southern Red Oak, Basket Oak Shrubs: Sweet Pepperbush, Common Winterberry, Highbush Blueberry, American Holly, Fetterbush Herbs: Slender Spike-grass, Bladder Sedge, Unidentified Grass, Sedges, White Grass, Panic Grass Others: Common Greenbrier, Grape, Japanese Honeysuckle, Partridgeberry, Poison Ivy
Red Maple (Somerset County)	Trees: Loblolly Pine, Sweet Bay, American Holly, Sweet Gum, Cherrybark Oak Shrubs: Southern Arrowwood, Silky Dogwood, Common Winterberry, Common Elderberry Herbs: Wood Reed, Cinnamon Fern, Net-veined Chain Fern, Sedge, False Nettle Others: Japanese Honeysuckle, Swamp Dewberry, Grape, Common Greenbrier
Red Maple (Wicomico County)	Trees: American Holly, Sweet Gum, Sweet Bay, Basket Oak Shrubs: Sweet Pepperbush Herbs: False Nettle, Virginia Chain Fern, Net-veined Chain Fern, Rice Cutgrass, Cinnamon Fern, Lizard's Tail (creek)
Red Maple (Wicomico County)	Trees: American Holly, Loblolly Pine, Sweet Bay Shrubs: Sweet Pepperbush, Highbush Blueberry, Fetterbush Herbs: Virginia Chain Fern, Cinnamon Fern Others: Peat Moss, Common Greenbrier
Red Maple (Little Mill Creek, Worcester County)	Trees: Sweet Bay, Loblolly Pine, Willow Oak, Sweet Gum, American Holly, Water Oak Shrubs: Common Winterberry, Highbush Blueberry, Southern Arrowwood, Sweet Pepperbush, Red Chokeberry Herbs: Sedge Others: Japanese Honeysuckle, Laurel-leaved Greenbrier
Red Maple-American Holly (Wicomico State Forest, Wicomico County)	Trees: Sweet Bay, Water Oak (edge), Sassafras (edge) Shrubs: Sweet Pepperbush, Highbush Blueberry, Fetterbush Herbs: Cinnamon Fern, Net-veined Chain Fern Others: Peat Moss, Common Greenbrier
Red Maple-Bald Cypress (Pocomoke River, Worcester County)	Trees/Saplings: Green Ash, Swamp Cottonwood, Water Tupelo Shrubs: Pawpaw, Elderberry, Fetterbush, Silky Dogwood, Smooth Alder, Swamp Rose, Winterberry, Spicebush Herbs: False Nettle, Jewelweed, Bladder Sedge, Lizard's Tail, Beggar-ticks, Wood Reed, Three-way Sedge, Cardinal Flower, Cinnamon Fern, Net-veined Chain Fern, Marsh Blue Violet, Water Horsetail, Arrow Arum, Royal Fern Others: Riverbank Grape
Red Maple-Basket Oak (Dorchester County)	Trees: Sweet Gum, Overcup Oak, Southern Red Oak, Black Gum, Sweet Bay, American Holly Shrubs: Sweet Pepperbush, Highbush Blueberry, Swamp Azalea Herbs: Sedge, Unidentified Grass Others: Common Greenbrier, Poison Ivy, Peat Moss
Red Maple-Basket Oak- Willow Oak (Dorchester County)	Trees: Loblolly Pine, Sweet Gum, White Oak Shrubs: Sweet Pepperbush, Highbush Blueberry Herbs: Slender Spike-grass, Sedge Others: Common Greenbrier, Partridgeberry (high spots), Peat Moss (depressions)

Table 6-21. (continued)

Dominance Type (Location)	Associates
Sweet Gum-Red Maple (Caroline County)	Trees: Ironwood, Sweet Bay, Black Gum, Basket Oak, Loblolly Pine, Beech Shrubs: Sweet Pepperbush, Fetterbush, Virginia Sweet-spires, American Strawberrybush Herbs: Skunk Cabbage (low spots) Others: Common Greenbrier
Sweet Gum-Red Maple (tributary of Kings Creek, Talbot County)	Trees: Ironwood, Beech, Basket Oak Shrubs: Spicebush, Elderberry, Wild Raisin Herbs: Virginia Spring Beauty, False Hellebore (low spots), Field Garlic, Bedstraw Others: Japanese Honeysuckle, Common Greenbrier
Sycamore-Black Willow- Sweet Gum (Granny Finley Branch, Queen Annes County)	Shrubs: Multiflora Rose, Smooth Alder, Elderberry, Spicebush Herbs: Jewelweed, Spotted Joe-Pye Weed, Halberd-leaved Tearthumb, Giant Ragweed Others: Poison Ivy, Trumpet Creeper, Japanese Honeysuckle, Dodder
Sycamore-Tulip Poplar- Sweet Gum (Williams Creek, Talbot County)	Trees: American Elm, Red Maple, Pawpaw, Sweet Bay, American Holly, Beech Shrubs: Spicebush, Multiflora Rose Herbs: Field Garlic, Virginia Spring Beauty, Ground Ivy, False Nettle Others: Japanese Honeysuckle, Grape, Common Greenbrier, Poison Ivy
White Oak (Queen Annes County)	Trees: Beech, Loblolly Pine, Sweet Gum, Black Gum, Red Maple Herbs: Slender Spike-grass Others: Common Greenbrier
White Oak (Talbot County)	Trees: Loblolly Pine, Black Gum, Red Maple, Sweet Gum, American Holly Shrubs: Sweet Pepperbush, Highbush Blueberry, Serviceberry, American Strawberry-bush Others: Virginia Creeper, Poison Ivy, Raspberry, Common Greenbrier
*White Oak (Talbot County)	Trees: Loblolly Pine, Red Maple, Willow Oak, Black Gum, Sassafras, Willow Oak, Southern Red Oak, Black Cherry, Eastern Red Cedar Shrubs: Sweet Pepperbush, Highbush Blueberry, Swamp Azalea, Fetterbush, Red Chokeberry, Oblong-leaf Juneberry Herbs: Pink Lady's-slipper Others: Common Greenbrier
White Oak-Red Maple- Black Gum-Loblolly Pine (Talbot County)	Trees: Southern Red Oak, Basket Oak, American Holly, Sweet Gum Shrubs: Highbush Blueberry, Sweet Pepperbush, American Strawberry-bush Others: Common Greenbrier, Poison Ivy
Willow Oak-American Holly-Red Maple (Caroline County)	Trees: White Oak, Sweet Gum, Black Gum, Southern Red Oak, Loblolly Pine, White Oak Shrubs: Sweet Pepperbush, Highbush Blueberry, Swamp Azalea, Fetterbush, Eastern Red Cedar, Dangleberry Herbs: Slender Spike-grass Others: Common Greenbrier, Partridgeberry
Willow Oak-Red Oak (Caroline County)	Trees: Black Gum, Red Maple, Sweet Gum, Loblolly Pine Shrubs: Highbush Blueberry, Fetterbush Others: Common Greenbrier, Peat Moss (depressions)

Table 6-25. Examples of palustrine scrub-shrub wetlands observed in Maryland. Communities marked by an asterisk (*) have limited distributions. All communities represent seasonally flooded types, except for buttonbush which is semipermanently flooded.

Dominance Type (Physiographic Region)	Associates
Buttonbush (Coastal Plain)	None
*Seaside Alder (Lower Coastal Plain)	Herbs: Smartweed, Halberd-leaved Tearthumb, Water Hemlock
Smooth Alder/Swamp Rose (Coastal Plain)	Trees/Saplings: Persimmon, Black Willow Shrubs: Elderberry, Silky Dogwood Herbs: Broad-leaved Cattail, Swamp Aster, Boneset, Big-leaved Arrowhead, Jewelweed, Mint, Dwarf St. John's-wort, Rice Cutgrass, Soft Rush, Seedbox, Dye Bedstraw, Sensitive Fern, Arrow-leaved Tearthumb, Tussock Sedge, Reed Canary Grass, Lurid Sedge, Small Purple-fringed Orchid, Water Pepper, Bugleweed, Skunk Cabbage Others: Virgin's Bower
Black Chokeberry (Appalachian Highlands)	Trees/Saplings: Red Maple Shrubs: Northern Arrowwood Herbs: Sedges, Long Sedge, Soft Rush Others: Big Cranberry, Peat Mosses, Swamp Dewberry
Highbush Blueberry/ Speckled Alder (Appalachian Highlands)	Trees/Saplings: Black Gum, Red Maple, Larch, White Pine, Hemlock Shrubs: Red Chokeberry, Winterberry, Mountain Holly, Arrowwood, Elderberry, Northern Wild Raisin, Swamp Rose, Rosebay Rhododendron Herbs: Wild Calla, Marsh St. John's-wort, Cinnamon Fern, Bugleweed, Jewelweed, Rattlesnake Grass, Skunk Cabbage, Rice Cutgrass, Tussock Sedge, Arrow-leaved Tearthumb Others: Peat Mosses, Blackberry
Narrow-leaved Meadow-sweet (Appalachian Highlands)	Shrubs: Silky Dogwood, Broad-leaved Meadowsweet, Alder, Bushy St. John's-wort Herbs: Bluejoint, Sedges, Wool Grass
Speckled Alder-Emergents (<i>Mixed Shrub Swamp-Wet Meadow</i>) (Appalachian Highlands)	Shrubs: Elderberry, Ninebark, Northern Arrowwood, Winterberry Herbs: Tussock Sedge, Rice Cutgrass, Tall Meadow-rue, Fringed Sedge, Sensitive Fern, Jewelweed, Arrow-leaved Tearthumb, Long Sedge, Skunk Cabbage, Green Bulrush, Fringe-top Closed Gentian, Soft Rush, New England Aster, New York Aster, Square-stemmed Monkeyflower, Northern Willow-herb, Fox Sedge Others: Swamp Dewberry
Speckled Alder-Northern Arrowwood (Appalachian Highlands)	Trees/Saplings: Yellow Birch, Black Gum, Rosebay Rhododendron Shrubs: Common Winterberry Herbs: Sedges, Soft Rush, Rough-stemmed Goldenrod, Rice Cutgrass, Jack-in-the-pulpit, Bugleweed, Arrow-leaved Tearthumb, Sensitive Fern, Cinnamon Fern, New England Aster, Jewelweed, Marsh St. John's-wort, Manna Grass
Speckled Alder-Red Osier Dogwood (Appalachian Highlands)	Shrubs: Elderberry, Northern Wild Raisin, Swamp Rose Herbs: Bluejoint, Goldenrod, Sensitive Fern Shrubs: Arrowwood, Elderberry
Alders (Appalachian Highlands)	Herbs: Bluejoint
Arrowwood-Bluejoint (<i>Mixed Shrub Swamp-Wet Meadow</i>) (Appalachian Highlands)	Trees: White Pine (dying), Hemlock Shrubs: Smooth Winterberry, Swamp Rose, Alder, Meadowsweet Herbs: Rice Cutgrass, Jewelweed, Tussock Sedge, Arrow-leaved Tearthumb

Table 6-26. More abundant species found in six bogs in Anne Arundel County (compiled from Hull and Whigham 1987).

Life Form	Plant Species
Herbs	Giant Cane, False Nettle*, Lurid Sedge*, Twig-rush, Dodder, Spatulate-leaved Sundew, Three-way Sedge, Pine Barren Rush, Soft Rush, White Water Lily, Royal Fern*, Warty Panic Grass (<i>Panicum verrucosum</i>), White Beak-rush, Peat mosses, Marsh Fern*, Marsh St. John's-wort, Fibrous Bladderwort, Virginia Chain Fern*
Shrubs	Leatherleaf, Sweet Pepperbush, Swamp Loosestrife or Water willow, Northern Bayberry, Swamp Azalea, Highbush Blueberry
Woody Vines and Trailing Plants	Poison Ivy, Swamp Dewberry*, Big Cranberry
Trees/Saplings	Red Maple, Atlantic White Cedar*, Sweet Gum, Sweet Bay, Black Gum, Pitch Pine

*Only occurred in one bog.

Table 6-27. Dominance types of tidal fresh marshes and some commonly observed associates in Maryland and other Mid-Atlantic states. (Source: McCormick and Somes 1982)

Dominance Type	Common Associates
Arrowheads	Jewelweed, Spatterdock, Arrow Arum, Tearthumb
Big Cordgrass	
Bulrushes (mostly Common Three-square)	
Bur-marigold	Water Hemp, Jewelweed, Arrow Arum, Tearthumbs, Big Arrowhead, Wild Rice
Cattails	Rose Mallow, Bur-marigold, Jewelweed, Spatterdock, Sensitive Fern, Arrow Arum, Smartweeds, Tearthumbs, Pickerelweed, Big Arrowhead, Sweet Flag
Common Reed	
Giant Ragweed	Rose Mallow, Bindweed, Jewelweed, Arrow Arum, Tearthumbs
Golden Club	Cattails
Pickerelweed/Arrow Arum	Jewelweed, Spatterdock, Big Arrowhead
Purple Loosestrife	
Reed Canary Grass	
Rose Mallow	Arrow Arum, Smartweeds, Cattails
Smartweed/Rice Cutgrass	Rose Mallow, Bur-marigold, Jewelweed, Spatterdock, Arrow Arum, Clearweed, Tearthumbs, Soft-stemmed Bulrush, Wild Rice

Table 6-29. Characteristic plants of Eastern Shore glades. (Compiled from Boone *et al.* 1984, Sipple and Klockner 1984, Tyndall *et al.* 1990, and personal observations.) An asterisk (*) designates a potentially dominant species. An "e" designates species typical of the woodland edges.

Aquatic Herbs

- * Mermaid-weed (*Proserpinaca pectinata*)
- * Water-willow (*Decodon verticillatus*)
- Hidden-fruit Bladderwort (*Utricularia geminiscapa*)
- Purple Bladderwort (*U. purpurea*)
- Featherfoil (*Hottonia inflata*)
- White Water Lily (*Nymphaea odorata*)
- Yellow Water Buttercup (*Ranunculus flabellaris*)

Grasses

- * Giant Beardgrass (*Erianthus giganteus*)
- * Maiden-cane (*Panicum hemitomom*)
- Warty Panic Grass (*Panicum verrucosum*)
- * Fall Panic Grass (*P. dichotomiflorum*)
- Panic Grass (*P. longifolium*)
- * Panic Grass (*P. spretum*)
- Club-head Cutgrass (*Leersia hexandra*)
- Rice Cutgrass (*L. oryzoides*)
- New Jersey Muhly (*Muhlenbergia torreyana*)
- Knotgrass (*Paspalum dissectum*)

Sedges and Rushes

- * Walter's Sedge (*Carex walteriana*)
- Button Sedge (*C. bullata*)
- * Twig-rush (*Cladium mariscoides*)
- Small-fruit Spike-rush (*Eleocharis microcarpa*)
- Black-fruit Spike-rush (*E. melanocarpa*)
- Robbins' Spike-rush (*E. robbinsii*)
- Three-way Sedge (*Dulichium arundinaceum*)
- Autumn Sedge (*Fimbristylis autumnalis*)
- Harper's Fimbry (*F. perpusilla*)
- Long-beak Baldrush (*Psilocarya scirpoides*)
- Thread-leaf Beak-rush (*Rhynchospora filifolia*)
- Loose-head Beak-rush (*R. charalocephala*)

- Tall Beak-rush (*R. macrostachya*)
- Wool Grass (*Scirpus cyperinus*)
- * Netted Nutrush (*Scleria reticularis*)
- Soft Rush (*Juncus effusus*)
- Canada Rush (*J. canadensis*)

Flowering Herbs

- * Smartweeds (*Polygonum* spp.)
- * Globe-fruit Seedbox (*Ludwigia sphaerocarpa*)
- Seedbox (*L. alternifolia*)
- Englemann's Arrowhead (*Sagittaria engelmanniana*)
- Creeping St. John's-wort (*Hypericum adpressum*)
- Coppery St. John's-wort (*H. denticulatum*)
- Marsh St. John's-wort (*Triadenum virginicum*)
- Canby's Lobelia (*Lobelia canbyi*)
- White Boltonia (*Boltonia asteroides*)
- Clustered Bluets (*Oldenlandia uniflora*)
- Canby's Cowbane (*Oxypolis canbyi*)
- Lizard's Tail (*Saururus cernuus*)
- * Virginia Meadow-beauty (*Rhexia virginica*)
- Carolina Redroot (*Lachnanthes caroliniana*)
- Sundews (*Drosera* spp.)
- Lance-leaf Violet (*Viola lanceolata*)
- * Virginia Chain Fern (*Woodwardia virginica*)

Woody Plants

- * Buttonbush (*Cephalanthus occidentalis*)
- ^e Sweet Gum (*Liquidambar styraciflua*)
- ^e Willow Oak (*Quercus phellos*)
- ^e * Fetterbush (*Leucothoe racemosa*)
- ^e Swamp Azalea (*Rhododendron viscosum*)
- ^e Highbush Blueberry (*Vaccinium corymbosum*)
- ^e Common Greenbrier (*Smilax rotundifolia*)

Appendix B. Keys to Waterbody Type and Hydrogeomorphic-type Wetland Descriptors for U.S. Waters and Wetlands (Operational Draft). (Source: Tiner 2000)

**Keys to Waterbody Type and
Hydrogeomorphic-type Wetland Descriptors
for U.S. Waters and Wetlands
(Operational Draft)**

**U.S. Fish and Wildlife Service
National Wetlands Inventory Project
Northeast Region
300 Westgate Center Drive
Hadley, MA 01035**

September 2000

**Keys to Hydrogeomorphic-type Wetland Descriptors
and Waterbody Types for U.S. Wetlands and Waters
(Operational Draft)**

Ralph Tiner, Regional Wetland Coordinator

**U.S. Fish and Wildlife Service
National Wetlands Inventory Project
Northeast Region
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September 2000

Introduction

The U.S. Fish and Wildlife Service's official wetland and deepwater habitat classification emphasizes a host of characteristics associated with these habitats including vegetation, soils, hydrology, salinity, and certain impacts (e.g., beaver, partly drained, and impounded) (Cowardin et al. 1979). These are important characteristics for describing wetlands and for assessing fish and wildlife habitat, but are not adequate for addressing abiotic features important for evaluating other wetland functions (e.g., chemical characteristics of the water, habitat maintenance, and water storage and transport) (Brinson 1993). Moreover, the classification of deepwater habitats is quite limited mainly to general aquatic ecosystem (marine, estuarine, lacustrine, and riverine) and bottom substrate type, with a few subsystems noted for riverine deepwater habitats. There is need for more indepth classifications for both wetlands and waterbodies.

For example, Dr. Mark Brinson created a hydrogeomorphic (HGM) classification system to fill this void (Brinson 1993). The HGM system is actually more of "a generic approach to classification and not a specific one to be used in practice" (p. 2). It is a way of looking at wetlands in a geographic region for assessing ecosystem functions. Current studies are underway in several regions to develop HGM profiles for certain types of wetlands.

To aid in use of HGM data when available and to better describe wetlands from the abiotic standpoint, a set of keys have been developed (Tiner 1997). These keys attempt to bridge the gap between the Service's classification and the HGM system by providing descriptors for landscape position and landform. While more specific than the basic HGM types, the new descriptors can be easily correlated with these types to make use of HGM data when they become available. The landscape position and landform descriptors can be added to existing National Wetlands Inventory maps and digital data or to other wetland maps. These descriptors can also be used to describe wetlands for reports of various kinds including wetland permit reviews, wetland trend reports, and other reports requiring more comprehensive descriptions of individual wetlands. This information can be used to prepare a characterization of the functions performed by similar wetland types. These characterizations may be used to predict the likely functions of individual wetlands or to estimate the capacity of an entire suite of wetlands to perform certain functions in a watershed, for example. These characterizations would be derived from our current knowledge of wetland functions for specific types and be refined in the future, as needed, based on the applicable HGM profiles. Based on experiences over the past 3 years, some revisions to the keys in Tiner 1997 have been made and are included in this document.

For deepwater habitats, additional information is also useful. For example, identification of the extent of dammed rivers and streams in the United States is a valuable statistic, yet according to the Service's classification dammed rivers are classified as Lacustrine deepwater habitats with no provision for separating dammed rivers from natural lakes and large impoundments (e.g., reservoirs). The description of estuarine deepwater habitats is also limited following Cowardin et al. 1979. Information on different types of estuaries would be useful.

Two sets of keys have been developed to enhance the current classification of wetlands and waterbodies. The added features are considered descriptors for application to the existing system or can be used independently to describe a wetland or deepwater habitat.

The first set of keys is for describing wetlands by landscape position, landform, water flow path and other modifiers. It is an update of an earlier set of keys published in 1997 as "Keys to

Landscape Position and Landform Descriptors for U.S. Wetlands (Operational Draft)” (Tiner 1997). Application of these operational keys has revealed the need for minor adjustments and additional modifiers. Pilot studies applying these keys also underscored the need to better describe associated waterbodies. This led to the development of the second set of keys focusing on deepwater habitats and other waterbodies (e.g., ponds). The keys provided are still considered operational draft as they have mainly been used in the Northeastern U.S. and need to be applied to arid, semiarid, and arctic regions for further testing. A glossary of technical terms is provided at the end of this publication.

Wetland Keys

Three keys are provided to identify wetland landscape position and landform for individual wetlands: Key A for classifying the former and Keys B and C for the latter (for inland wetlands and coastal wetlands, respectively). Users should first identify the landscape position associated with the subject wetland following Key A. Afterwards, using Key B for inland wetlands and Key C for salt and brackish wetlands, users will determine the associated landform. The landform keys include provisions for identifying specific regional wetland types such as Carolina bays, pocosins, flatwoods, cypress domes, prairie potholes, playas, woodland vernal pools, West Coast vernal pools, interdunal swales, and salt flats. Various modifiers may also be applied to better describe wetlands, such as inflow, throughflow and outflow types, pond types, headwater areas, and other features of interest.

Key A: Key to Wetland Landscape Position

This key characterizes wetlands based on their location in or along a waterbody, in a drainage way, or in isolation.

- 1. Wetland is located in or along a lake, estuary, ocean, stream, or river and any associated floodplain.....2
- 1. Wetland occurs on a slope, flat, or in a depression (including ponds, potholes, and playas) lacking a stream, but may be ditched*.....**Terrene** (*go to Key B for landform*)
 - *Stream may originate from a terrene wetland, but if a stream enters and exits the wetland even if flow is nonchannelized within, the wetland is lotic and not terrene because the wetland is part of the hydrologic (downstream) flow of the stream system.
 - [Note: *Modifiers* may include Headwater (for first-order streams, possibly second-order streams also; including large wetlands in upper portion of watershed believed to be significant groundwater discharge sites) and for terrene wetlands whose outflow goes directly to an estuary or the ocean: Estuarine Outflow or Marine Outflow, respectively.]
- 2. Wetland is located in or along a salt or brackish waterbody (ocean or estuary).....3
- 2. Wetland is located in or along a fresh waterbody.....4
- 3. Wetland is located along shores of the ocean.....**Marine** (*go to Key C for landform*)
- 3. Wetland is located in or along an estuary (salt or brackish waters).....**Estuarine** (*go to Key C for landform*) (Note: If area was formerly connected to estuary but now is completely cut-off from tidal flow, consider as one of inland landforms - Terrene, Lentic, or

Lotic, depending on current site characteristics. Such areas should be designated with a modifier to identify such wetlands as “former estuarine wetland.”)

4. Wetland is located in or along a lake or reservoir (standing waters).....**Lentic** (*go to Key B for landform*)

[Note: Lentic wetlands consist of all wetlands in a lake basin, including those bordering streams that empty into the lake. The upstream limit of lentic wetlands is defined by the upstream influence of the lake which is usually approximated by the limits of the basin within which the lake occurs. These streamside lentic wetlands are designated as “Throughflow”, thereby emphasizing the stream flow through these wetlands. Other lentic wetlands are typically classified as “Bidirectional Flow” since waters rise and fall with lake levels during the year.]

4. Wetland is located in or along a river or stream (flowing waters).....**Lotic** (*specify whether wetland is associated with a River or Stream - see following note, then go to couplet "a" below; also see note under first couplet #4 re: streamside wetlands in lake basins*)

[Note: A River is a broad channel mapped as a polygon (2-lined watercourse) on a U.S.G.S. topographic map, while a narrower channel mapped as a linear feature is a Stream. Artificial drainageways--ditches--are considered part of the Lotic classification. Modifiers may be applied: Perennial (flowing water year-round), Intermittent (seasonal flow only), Headwater (first order streams, possibly second order streams also; including large wetlands in upper portion of watershed believed to be significant groundwater discharge sites), and Channelization (excavated and/or stream course modified). See Waterbody Key for classification of rivers, streams, canals, and ditches.]

a. Flow of water is bidirectional due to tidal influence (freshwater tidal areas).....**Tidal Gradient** (*go to Key B for landform*)

a. Flow is unidirectional; no tidal influence.....b

b. Water flow is generally rapid due to steep gradient; typically little or no floodplain development; watercourse is generally shallow with rock, cobbles, or gravel bottoms; first and second order "streams"; part of Cowardin's Upper Perennial and Intermittent subsystems.....**High Gradient** (*go to Key B for landform*)

b. Watercourse characteristics are not so; "stream" order greater than 2.....c

c. Water flow is generally slow; typically with extensive floodplain; water course shallow or deep with mud or sand bottoms; typically fifth and higher order "streams", but includes lower order streams in nearly level landscapes such as the Great Lakes Plain (former glacial lakebed) and the Coastal Plain (the latter streams may lack significant floodplain development) and ditches; Cowardin's Lower Perennial subsystem.....**Low Gradient** (*go to Key B for landform*)

c. Water flow is fast to moderate; with little to some floodplain; usually third and fourth order "streams"; part of Cowardin's Upper Perennial subsystem.....**Middle Gradient** (*go to Key B for landform*)

Key B: Key to Inland Landforms

1. Wetland occurs on a noticeable slope (e.g., greater than a 2 percent slope).....**Slope Wetland**

a. Wetland created by paludification processes (where in areas of low evapotranspiration and high rainfall, peat moss moves uphill creating wetlands on hillslopes) which cause wetland to develop upslope of primary water source.....Paludified Slope Wetland

a. Wetland not formed by paludification processes.....b

b. No surface water inflow from a stream or other waterbody, or no suspected significant surface or ground water inflow from nonslope wetland or other waterbody at a higher elevation and no outflow to a stream or no suspected significant surface or ground water flow to a wetland or waterbody at a lower elevation.....Isolated Slope Wetland

b. Wetland not hydrologically isolated.....c

c. Surface water inflow from a stream or other waterbody, or suspected significant surface or ground water inflow from a nonslope wetland or other waterbody at a higher elevation and no observable or known significant outflow of surface or ground water to a stream or a nonslope wetland or waterbody at a lower elevation.....Inflow Slope Wetland

c. Wetland not an inflow wetland, but either throughflow or outflow.....d

d. No surface water inflow from a stream or other waterbody, or no suspected significant surface or ground water inflow from a wetland or other waterbody at a higher elevation, and water is discharged from this wetland to a stream or other waterbody, or there is significant outflow of surface or ground water to a wetland or other waterbody at a lower elevation.....Outflow Slope Wetland

d. Surface water inflow from a stream or other waterbody, or suspected significant surface or ground water inflow from a nonslope wetland or other waterbody at a higher elevation and water passes through the subject wetland to a stream, another wetland, or other waterbody at a lower elevation.....Throughflow Slope Wetland

[*Modifiers* can be applied to Slope Wetlands to designate the type of inflow or outflow as Channelized Inflow or Outflow (intermittent or perennial, stream or river), Nonchannelized Inflow or Outflow (wetland lacking stream, but connected by observable surface seepage flow), or Nonchannelized-Subsurface Inflow or Outflow (suspected subsurface flow from or to a neighboring wetland upslope or downslope, respectively).]

1. Wetland does not occur on a distinct slope.....2

2. Wetland forms an island.....**Island Wetland**

a. Island formed in a delta at the mouth of a river or stream.....Delta Island Wetland

a. Island not formed in a delta.....b

b. Island surrounded by a river or stream...River Island Wetland or Stream Island Wetland

b. Island formed in a lake or pond.....Lake Island Wetland or Pond Island Wetland

[Note: Vegetation class and subclass from Cowardin et al. 1979 should be applied to characterize the vegetation of these wetland islands; vegetation is assumed to be rooted unless designated by a *modifier* (Floating Mat) to indicate a floating island.]

2. Wetland does not form an island.....3

3. Wetland occurs within the banks of a river or stream or along the shores of a pond, lake, or island, or behind a barrier beach or island, and is typically permanently inundated, semipermanently flooded, or otherwise flooded for most of the growing season, or permanently saturated due to this location.....**Fringe Wetland**

a. Wetland forms along the shores of an upland island within a lake, pond, river, or stream.....b

a. Wetland does not form along the shores of an island.....c

b. Wetland forms along an upland island in a river or stream.....River Island Fringe Wetland or Stream Island Fringe Wetland

b. Wetland forms along an upland island in a lake or pond.....Lake Island Fringe Wetland or Pond Island Fringe Wetland

c. Wetland forms in or along a river or stream.....River Fringe Wetland or Stream Fringe Wetland

c. Wetland forms in or along a pond or lake.....d

d. Wetland forms along a pond shore.....Pond Fringe Wetland

d. Wetland forms along a lake.....e

e. Wetland forms behind a barrier island or beach along a lake.....Barrier Island Fringe Wetland or Barrier Beach Fringe Wetland

e. Wetland forms along a lake shore.....Lake Fringe Wetland

[Note: Vegetation is assumed to be rooted unless designated by a *modifier* to indicate a floating mat (Floating Mat).]

3. Wetland does not exist along these shores.....4

4. Wetland occurs on an active or inactive (former) floodplain (alluvial processes dominate currently or did so in the past, historically).....**Floodplain Wetland*** (could specify the river system, if desirable). Sub-landforms are listed below.

a. Wetland occurs on the active floodplain, not separated from the river by dikes or artificial levees.....b

a. Wetland is now isolated from typical floodplain processes, separated by dikes, artificial levees, or road/railroad embankments (former or historic floodplain).....c

b. Wetland forms in a depressional feature on a floodplain.....Floodplain Basin

Wetland or Floodplain Oxbow Wetland (a special type of depression)

b. Wetland forms on a broad nearly level terrace.....Floodplain Flat Wetland

c. Wetland is a depressional feature on an isolated floodplain.....Former Floodplain Basin Wetland or Former Floodplain Oxbow Wetland (a special type of depression)

c. Wetland forms on a broad nearly level terrace.....Former Floodplain Flat Wetland

*[Note: Questionable floodplain areas may be verified by consulting soil surveys and locating the presence of alluvial soils, e.g., Fluvaquents or Fluvents, or soils with Fluvaquentic subgroups. Water flow path for “former floodplain wetlands” may be designated, e.g., Inflow, Outflow, or Isolated.]

[Modifiers: Partly Drained. Confluence wetland - wetland at the intersection of two or more streams. River-mouth or stream-mouth wetland - wetland at point where a river and stream empties into a lake. Meander scar wetland - floodplain basin wetland, the remnant of a former river meander.]

4. Wetland does not occur on a floodplain.....5

5. Wetland occurs on an interstream divide (interfluvium).....**Interfluvium Wetland** or specify *regional types* of interfluvium wetlands, for example: **Carolina Bay Interfluvium Wetland**, **Pocosin Interfluvium Wetland**, and **Flatwood Interfluvium Wetland** (Southeast). Sub-landforms are listed below.

a. Wetland forms in a depressional feature..... Interfluvium Basin Wetland

a. Wetland forms on a broad nearly level terraceInterfluvium Flat Wetland

[Modifiers: Partly Drained. Should designate Water Flow Path: most will be outflow, but other types: throughflow, inflow, and isolated, see couplet #6 below.]

5. Wetland does not occur on an interfluvium.....6

6. Wetland exists in a distinct depression.....**Basin Wetland** or specify *regional types* of basin wetlands, for example: **Carolina Bay Basin Wetland** and **Pocosin Basin Wetland** (Atlantic Coastal Plain), **Cypress Dome Basin Wetland** (Florida), **Prairie Pothole Basin Wetland** (Upper Midwest), **“Salt Flat” Basin Wetland** (arid West), **Playa Basin Wetland** (Southwest), **West Coast Vernal Pool Basin Wetland** (California and Pacific Northwest), **Interdunal Basin Wetland** (sand dunes), **Woodland Vernal Pool Basin Wetland** (forests throughout the country), **Polygonal Basin Wetland** (Alaska), **Sinkhole Basin Wetland** (karst/limestone regions), or **Pond Wetland Basin** (throughout country).

a. No surface water inflow from stream or other waterbody, or no suspected significant surface or ground water inflow from a wetland or other waterbody at a higher elevation and no outflow to stream or no suspected significant surface or ground water flow to a wetland or waterbody at a lower elevationIsolated

Basin Wetland

a. Wetland not hydrologically isolated.....b

b. Surface water inflow from a stream or other waterbody, or suspected significant surface or ground water inflow from a wetland or other waterbody at a higher elevation and no observable or known significant outflow of surface or ground water to a stream or a wetland or waterbody at a lower elevation.....Inflow Basin Wetland

b. Wetland not an inflow wetland.....c

c. Surface water inflow from a stream or other waterbody, or suspected significant surface or ground water inflow from a wetland or other waterbody at a higher elevation and water passes through the subject wetland to a stream, another wetland, or other waterbody at a lower elevation; this includes wetlands along lakes (lentic basin wetlands) which have a stream flowing through them.....Throughflow Basin Wetland

(Note: If wetland is a lentic basin wetland, the directional flow of throughflow should be designated as lake inflow or lake outflow.)

c. Wetland not subjected to throughflow.....d

d. No surface water inflow from a stream or other waterbody, or no suspected significant surface or ground water inflow from a wetland or other waterbody at a higher elevation, and water is discharged from this wetland to a stream or other waterbody, or there is significant outflow of surface or ground water to a wetland or other waterbody at a lower elevation.....Outflow Basin Wetland

d. Along a lake and subjected to fluctuating water levels (including water tables) principally due to changes in lake levels.....Bidirectional Flow Lentic Basin Wetland

[Note: *Modifiers* may be applied to indicate artificially created basins due to beaver activity or human actions or artificially drained basins: Beaver (beaver-created), Human-caused (created for various purposes or unintentionally formed due to human activities; may want to specify purpose), and Partly drained (drainage ditches observed). Other *modifiers* may be applied to designate the type of inflow or outflow as Channelized (intermittent or perennial, stream or river), Nonchannelized-wetland (contiguous wetland lacking stream), or Nonchannelized-subsurface flow (suspected subsurface flow to neighboring wetland), or to identify a headwater basin (Headwater) or a drainage divide wetland that discharges into two or more watershed (Drainage divide), or to denote a spring-fed wetland (Spring-fed), a wetland bordering a pond (Pond border) and a wetland bordering an upland island in a pond (Pond island border). For ponds, may also want to add modifiers that identify the nature of the area surrounding the pond, e.g., farm, residential, commercial, industrial, coal mine, forest, and others - see “Waterbody Keys”. For lotic basin wetlands, consider additional modifiers such as confluence wetland - wetland at the intersection of two or more streams; river-mouth or stream-mouth wetland - wetland at point where a river and a stream empties into a lake.]

6. Wetland exists in a relatively level area.....Flat Wetland
or specify *regional types* of flat wetlands, for example: **Salt Flat Wetland** (in the Great Basin).

a. Wetland created by paludification processes (where in areas of low evapotranspiration and high rainfall, peat moss moves uphill creating wetlands on hillslopes and broad upland flats) which cause wetland to develop upslope of primary water source....Paludified Flat Wetland

a. Wetland not formed by paludification processes.....b

b. No surface water inflow from stream or other waterbody, or no suspected significant surface or ground water inflow from a wetland or other waterbody at a higher elevation and no outflow to stream or no suspected significant surface or ground water flow to a wetland or waterbody at a lower elevation.....Isolated Flat Wetland

b. Wetland not hydrologically isolated.....c

c. Surface water inflow from a stream or other waterbody, or suspected significant surface or ground water inflow from a wetland or other waterbody at a higher elevation and water passes through the subject wetland to a stream, another wetland, or other waterbody at a lower elevation; this includes wetlands along lakes (lentic flat wetlands) which have a stream flowing through them.....Throughflow Flat Wetland
(Note: If wetland is a lentic flat wetland, the directional flow of throughflow should be designated as lake inflow or lake outflow.)

c. Wetland not subjected to throughflow.....d

d. No surface water inflow from a stream or other waterbody, or no suspected significant surface or ground water inflow from a wetland or other waterbody at a higher elevation, and water is discharged from this wetland to a stream or other waterbody, or there is significant outflow of surface or ground water to a wetland or other waterbody at a lower elevation.....Outflow Flat Wetland

d. Along a lake and subjected to fluctuating water levels (including water tables) principally due to changes in lake levels.....Bidirectional Flow Lentic Flat Wetland

[Note: If desirable a *modifier* for drained flats can be applied: Partly drained. Other *modifiers* can be applied to designate the type of inflow or outflow as Channelized (intermittent or perennial, stream or river), Nonchannelized-wetland (contiguous wetland lacking stream), or Nonchannelized-subsurface flow (suspected subsurface flow to neighboring wetland). For lotic flat wetlands, consider additional modifiers such as confluence wetland - wetland at the intersection of two or more streams; river-mouth or stream-mouth wetland - wetland at point where a river and a stream empties into a lake.]

Key C: Key to Coastal Landforms

1. Wetland forms an island.....Island Wetland

a. Occurs in a delta.....Delta Island Wetland

a. Occurs elsewhere either in a river or an embayment.....b

- b. Occurs in a river.....River Island Wetland
- b. Occurs in a coastal embayment.....Bay Island Wetland

1. Wetland does not form an island, but occurs elsewhere.....2

2. Wetland occurs along the shore.....**Fringe Wetland**

a. Occurs behind a barrier island or barrier beach spit.....Barrier Island Fringe Wetland or Barrier Beach Fringe Wetland [*Modifier* for overwash areas....Overwash]

a. Occurs elsewhere.....b

b. Occurs along a coastal embayment or along an island in a bay.....Bay Fringe Wetland or Bay Island Fringe Wetland or Coastal Pond Fringe Wetland (a special type of embayment, typically with periodic connection to the ocean unless artificially connected by a bulkheaded inlet) or Coastal Pond Island Fringe Wetland

b. Occurs elsewhere.....c

c. Occurs along a coastal river or along an island in a river.....River Fringe Wetland or River Island Fringe Wetland

c. Occurs elsewhere.....d

d. Occurs along an oceanic island.....Ocean Island Fringe Wetland

d. Occurs along the shores of exposed rocky mainland.....Headland Fringe Wetland

2. Wetland occurs in an artificial impoundment or behind a road or railroad embankment where tidal flow is at least somewhat restricted.....**Basin Wetland**

[*Modifiers* may be applied to designate created basins: Human-induced (managed fish and wildlife areas; salt hay; tidally restricted-road, tidally restricted-railroad, other road crossing (no significant tidal restriction suspected), other railroad crossing (no significant tidal restriction suspected), and other situations to be determined.)]

Waterbody Keys

These keys are designed to expand the classification of waterbodies beyond the system and subsystem levels in the Service's wetland classification system (Cowardin et al. 1979). Users are advised first to classify the waterbody in one of the five ecosystems: 1) marine (open ocean and associated coastline), 2) estuarine (mixing zone of fresh and ocean-derived salt water), 3) lacustrine (lakes, reservoirs, large impoundments, and dammed rivers), 4) riverine (undammed rivers and tributaries), and 5) palustrine (e.g., nontidal ponds) and then apply the waterbody type descriptors below.

Five sets of keys are given. Key A helps describe the major waterbody type. Key B identifies different stream gradients for rivers and streams. It is similar to the subsystems of Cowardin's Riverine system, but includes provisions for dammed rivers to be identified as well as a middle gradient reach similar to that of Brinson's hydrogeomorphic classification system. The third key, Key C, addresses lake types, while Keys D and E further define ocean and estuary types, respectively. Key F is a key to water flow paths of ponds, lakes, and reservoirs. Keys G and H are for coastal waterbodies: the former is for describing tidal ranges and the latter is for describing general circulation patterns in estuaries. The coastal terminology applies concepts of coastal hydrogeomorphology.

Key A. Key to Major Waterbody Type

1. Waterbody is predominantly flowing water, either unidirectional or tidal.....2
2. Flow is unidirectional and waterbody is a river, stream, or similar channel.....3
3. Waterbody is a polygonal feature on a U.S. Geological Survey map or a National Wetlands Inventory Map (1:24,000/1:25,000).....**River**
3. Waterbody is a linear feature on such maps.....**Stream**

Go to River/Stream Gradient Key and for other modifiers (Key B).

2. Flow is tidal (bidirectional) at least seasonally; waterbody is an ocean, embayment, river, stream, or lake.....4
4. Waterbody is freshwater.....5
5. Waterbody is a polygonal feature on a U.S. Geological Survey map or a National Wetlands Inventory Map (1:24,000/1:25,000).....**River***
5. Waterbody is a linear feature on such maps.....**Stream**

* Note: In rare cases, lakes may be tidal (if so, waterbody is classified as a Tidal Lake).

Go to River/Stream Gradient Key and for other modifiers (Key B).

4. Waterbody is salt or brackish.....6
7. Part of a major ocean or its associated embayment (Marine system of Cowardin et al. 1979)**Ocean**

Go to Ocean Key (Key D).

7. Part of an estuary where fresh water mixes with salt water (Estuarine system of Cowardin et al. 1979).....**Estuary**

Go to Estuary Key (Key E).

1. Waterbody is predominantly standing water or essentially so; not subjected to tides*8

* Note: In rare cases, fresh waterbodies may be tidal (if so, waterbody is classified as a Tidal Lake or Tidal Pond using criteria below to separate lakes from ponds).

8. Waterbody is permanently flooded and deep (>than 6.6 ft at low water).....**Lake**

Go to Lake Key (Key C).

8. Waterbody is shallow (< 6.6 ft at low water).....9

9. Waterbody is small (< 20 acres).....**Pond**

Separate natural from artificial ponds, then add other modifiers like the following. Some *examples* of modifiers for ponds: beaver, alligator, marsh, swamp, vernal, Prairie Pothole, Sandhill, sinkhole/karst, Grady, interdunal, farm-cropland, farm-livestock, golf, industrial, sewage/wastewater treatment, stormwater, aquaculture-catfish, aquaculture-shrimp, aquaculture-crayfish, cranberry, irrigation, aesthetic-business, acid-mine, arctic polygonal, kettle, woodland, borrow pit, Carolina bay, tundra, coastal plain, and in-stream.

(Note: Wetlands associated with ponds are typically either Terrene basin wetlands, such as a Cypress dome or cypress-gum pond, or Terrene pond fringe wetlands, such as semipermanently flooded wetlands along margins of pond.)

9. Waterbody is large (≥20 acres).....**Lake**

Go to Lake Key (Key C).

Key B. River/Stream Gradient and Other Modifiers Key

1. Water flow is under tidal influence.....**Tidal Gradient**

Type of tidal river or stream: 1) natural river, 2) natural stream, 3) channelized river, 4) channelized stream, 5) canal (artificial polygonal lotic feature), 6) ditch (artificial linear lotic feature), 7) restored river segment (part of river where restoration was performed), and 8) restored stream segment (part of stream where restoration was performed).

1. Water flow is not under tidal influence (nontidal).....2

2. Water flow is dammed, yet still free-flowing at least seasonally**Dammed Gradient**

Type of dammed river: 1) lock and dammed (canalized river, a series of locks and dams are present to aid navigation), 2) run-of-river dammed (low dam allowing flow during high water periods; often used for low-head hydropower generation), and 3) other

dammed (unspecified, but not major western hydropower dam as such waterbodies are considered lakes, e.g., Lake Mead and Lake Powell).

- 2. Water flow is unrestricted.....3
- 3. Water flow is perennial (year-round); perennial rivers and streams.....4
 - 4. Water flow is generally rapid due to steep gradient; typically little or no floodplain development; watercourse is generally shallow with rock, cobbles, or gravel bottoms; first and second order "streams"; part of Cowardin's Upper Perennial subsystem.....**High Gradient***
 - 4. Water flow is not so; some to much floodplain development.....5
 - 5. Water flow is generally slow; typically with extensive floodplain; water course shallow or deep with mud or sand bottoms; typically fifth and higher order "streams", but includes lower order streams in nearly level landscapes such as the Great Lakes Plain (former glacial lakebed) and the Coastal Plain (the latter streams may lack significant floodplain development); Cowardin's Lower Perennial subsystem**Low Gradient***
 - 5. Water flow is fast to moderate; with little to some floodplain; usually third and fourth order "streams"; part of Cowardin's Upper Perennial subsystem**Middle Gradient***
- 3. Water flow is seasonal or aperiodic (intermittent); Cowardin's Intermittent subsystem.....**Intermittent Gradient***

*Type of river or stream: 1) natural river- single thread (one channel), 2) natural river - multiple thread (braided) (multiple, wide, shallow channels), 3) natural river-multiple thread (anastomosed) (multiple, deep narrow channels), 4) natural stream-single thread, 5) channelized river (dredged/excavated), 6) channelized stream, 7) canal (artificial polygonal lotic feature), 8) ditch (artificial linear lotic feature), 9) restored river segment (part of river where restoration was performed), and 10) restored stream segment (part of stream where restoration was performed). Other possible descriptors: 1) for perennial rivers and streams can distinguish riffles (shallow, rippling water areas), pools (deeper, quiet water areas), and waterfalls (cascades), 2) deep rivers (≥ 6.6 ft at low water) from shallow rivers (< 6.6 ft at low water), 3) nontidal river or stream segment emptying into an estuary, ocean, or lake (estuary-discharge, ocean-discharge, or lake-discharge), 4) classification by stream order (1st, 2nd, 3rd, etc), and 5) channels patterns (straight, slight meandering, moderate meandering, and high meandering).

Key C. Key to Lakes.

- 1. Waterbody is permanently flooded and deep (>than 6.6 ft at low water).....2
 - 2. Waterbody is not dammed or impounded.....**Natural Lake**

Modifiers for main body, semi-enclosed embayment, and seiche-influenced; also river-fed and stream-fed descriptors.
- 2. Waterbody is dammed or impounded.....3
 - 3. Dammed river valley.....**Dammed Valley Lake**
 - 3. Dammed natural lake.....**Dammed Lake**

Modifiers for main body, semi-enclosed embayment, water-level controlled lake, reservoir (public water supply), high-dam impoundment, other impoundment, and seiche-influenced; also river-fed and stream-fed descriptors.

- 1. Waterbody is shallow (< 6.6 ft at low water).....4
 - 4. Waterbody is essentially permanently flooded.....**Shallow Lake***
 - 4. Waterbody is not permanent, goes dry in most years.....5
 - 5. Waterbody is seasonally flooded in most years.....**Seasonal Lake***
 - 5. Waterbody is flooded intermittently.....**Intermittent Lake***

*Can use additional modifiers listed under Pond (see Key A) and others (e.g., crater, lava flow, aeolian, fjord, oxbow, other floodplain, glacial, alkali, and manmade), as appropriate; also river-fed and stream-fed descriptors. Wetlands associated with these types of lakes are typically considered Terrene basin and flat wetlands.

Key D. Ocean Key.

- 1. Waterbody is completely open, not protected by any feature.....**Open Ocean**
- 1. Waterbody is somewhat protected.....2
 - 2. Associated with coral reef or island3
 - 3. Open but protected by coral reef **Reef-protected Waters**
 - 3. Protected by a coral island..... **Atoll Lagoon**
 - 2. Not associated with coral reef or island.....4
 - 4. Deep embayment cut by glaciers, with an underwater sill at front end, restricting circulation; associated with rocky headlands.....**Fjord**
 - 4. Other semi-protected embayment.....**Semi-protected Oceanic Embayment**

Key E. Estuary Key.

- 1. Estuary is surrounded by rocky headlands and shores.....2
 - 2. Deep embayment cut by glaciers, with an underwater sill at front end, restricting circulation.....**Fjord Estuary**
 - 2. Not so, either open or semi-enclosed.....**Rocky Headland Bay Estuary***

* Modifiers: Open or Semi-enclosed

- 1. Estuary not surrounded by rocky headlands and shores.....3
 - 3. Estuary is a drowned river valley**Drowned River Valley Estuary***

*Modifiers: Open Bay, River Channel, Semi-enclosed Bay

- 3. Estuary is not a drowned river valley.....4
 - 4. Waterbody is behind and protected by barrier islands or barrier beaches.....5
 - 5. Waterbody is behind a barrier island**Barrier Island Back Bay Estuary**
 - 5. Waterbody is behind a barrier beach.....6
 - 6. Waterbody is completely protected by beaches and intermittently connected to

- salt water except where artificially kept open.....7
- 7. Water is brackish to fresh**Coastal Pond Estuary**
- 7. Water is hypersaline.....**Hypersaline Lagoon Estuary**
- 6. Waterbody is protected by beaches, but has free exchange of tidal water due to natural forces.....**Barrier Beach Back Bay Estuary**
- 4. Waterbody is not behind barrier islands or beaches, but is an open or semi-enclosed embayment.....8
- 8. Waterbody is protected by islands.....**Island Protected Bay Estuary**
- 8. Waterbody is not protected by islands.....**Shoreline Bay Estuary**

Modifier: Tidal Inlet (includes any ebb- or flood- deltas that are completely submerged) and Shoals (shallow water areas).

Key F. Key to Water Flow Paths for Ponds, Lakes, and Reservoirs

- 1. Water flow is mainly out of the pond, lake or reservoir via a river, stream, or ditch.....**Outflow***
- 1. Water flow is not so.....2
- 2. Water flow comes in from river, stream, or ditch, goes through and out of the lake or reservoir via a river, stream, or ditch.....**Throughflow***
- 2. Water flow is not throughflow.....3
- 3. Water flow enters via a river, stream, or ditch, but does not exit pond, lake or reservoir; waterbody serves as a sink for water.....**Inflow***
- 3. No apparent channelized inflow, source of water either by precipitation or by underground sources**Isolated**

*Modifier: Ditch (for inflow, outflow, and throughflow via a ditch network).

Key G. Key to Tidal Range Types

- 1. Tide range is greater than 4m (approx. >12 feet)**Macrotidal**
- 1. Tidal range is less than 4m2
- 2. Tidal range is 2-4m (approx. 6-12 feet)**Mesotidal**
- 2. Tidal range is less than 2m (approx. < 6 feet)**Microtidal**

Key H. Key to Estuarine Hydrologic Circulation Types

- 1. Estuary is river-dominated with distinct salt wedge moves seasonally up and down the river; fresh water at surface with most saline waters at bottom; low energy system with silt and clay bottoms**Salt-wedge Estuary**
- 1. Estuary is not river-dominated2
- 2. Estuarine water is well-mixed, no significant salinity stratification, salinity more or less the same from top to bottom of water column; high-energy system with sand bottom**Homogeneous Estuary**
- 2. Estuarine water is partially mixed, salinities different from top to bottom, but not strongly stratified; low energy system**Partially Mixed Estuary**

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Glossary

Barrier Beach -- a coastal peninsular landform extending from the mainland into the ocean or large embayment or large lake (e.g., Great Lakes), typically providing protection to waters on the backside and allowing the establishment of salt marshes; similar to the barrier island, except connected to the mainland

Barrier Island -- a coastal insular landform, an island typically between the ocean (or possibly the Great Lakes) and the mainland; its presence usually promotes the formation of salt marshes on the backside

Basin -- a depressional (concave) landform; various types are further defined by the absence of a stream (isolated), by the presence of a stream and its position relative to a wetland (throughflow, outflow, inflow), or by its occurrence on a floodplain (floodplain basins include ox-bows and sloughs, for example)

Bay -- a coastal embayment of variable size and shape that is always opens to the sea through an inlet or other features

Carolina Bay -- a wetland formed in a semicircular or egg-shaped basin with a northwest to southeast orientation, found along the Atlantic Coastal Plain from southern New Jersey to Florida, and perhaps most common in Horry County, South Carolina

Channelization -- the act or result of excavating a stream or river channel to increase downstream flow of water or to increase depth for navigational purposes

Channelized -- water flow through a conspicuous drainageway, a stream or a river

Cypress Dome -- a wetland dominated by bald cypress growing in a basin that may be formed by the collapse of underlying limestone, forest canopy takes on a domed appearance with tallest trees in center and becoming progressively shorter as move toward margins of basin

Delta -- a typically lobed-shaped or fan-shaped landform formed by sedimentation processes at the mouth of a river carrying heavy sediment loads

Ditch -- a linear, often shallow, artificial channel created by excavation with intent to improve drainage of or to irrigate adjacent lands

Drained, Partly -- condition where a wetland has been ditched or tilled to lower the ground water table, but the area is still wet long enough and often enough to fall within the range of conditions associated with wetland hydrology

Estuarine -- the landscape of estuaries (salt and brackish tidal waterbodies, such as bays and coastal rivers) including associated wetlands, typically occurring in sheltered or protected areas, not exposed to oceanic currents

Flat -- a relatively level landform; may be a component of a floodplain or the landform of an interfluvium

Flatwood -- forest of pines, hardwoods or mixed stands growing on interfluves on the Gulf-Atlantic Coastal Plain, typically with imperfectly drained soils; some flatwoods are wetlands, while others are dryland

Floodplain -- a broad, generally flat landform occurring in a landscape shaped by fluvial or riverine processes; for purposes of this classification limited to the broad plain associated with large river systems subject to periodic flooding (once every 100 years) and typically having alluvial soils; further subdivided into several subcategories: flat (broad, nearly level to gently sloping areas) and basin (depressional features such as ox-bows and sloughs)

Fringe -- a wetland occurring along a flowing or standing waterbody, i.e., a lake, river, stream, estuary, or ocean; note that ponds are excluded

Ground Water -- water below ground, held in the soil or underground aquifers

Headland -- the seaward edge of the major continental land mass (North America), commonly called the mainland; not an island

High Gradient -- the fast-flowing segment of a drainage system, typically with no floodplain development; equivalent to the Upper Perennial and Intermittent Subsystems of the Riverine System in Cowardin et al. 1979

Inflow -- water enters; an inflow wetland is one that receives surface water from a stream or other waterbody or from significant surface or ground water from a wetland or waterbody at a higher elevation and has no significant discharge

Interdunal -- occurring between sand dunes, as in interdunal swale wetlands found in dunefields behind ocean and estuarine beaches and in sand plains like the Nebraska Sandhills

Interfluve -- a broad level to imperceptibly depressional poorly drained landform occurring between two drainage systems, most typical of the Coastal Plain

Island -- a landform completely surrounded by water and not a delta; some islands are entirely wetland, while others are uplands with or without a fringe wetland

Karst -- a limestone region characterized by sinkholes and underground caverns

Lentic -- the landscape position associated with large, deep standing waterbodies (such as lakes and reservoirs) and contiguous wetlands formed in the lake basin (excludes seasonal and shallow lakes which are included in the *Terrene* landscape position).

Lotic -- the landscape position associated with flowing water systems (such as rivers, creeks, perennial streams, intermittent streams, and similar waterbodies) and contiguous wetlands

Low Gradient -- the slow-flowing segment of a drainage system, typically with considerable floodplain development; equivalent to the Lower Perennial Subsystem of the Riverine System in Cowardin et al. 1979 plus contiguous wetlands

Marine -- the landscape position (or seascape) associated with the ocean's shoreline

Middle Gradient -- the segment of a drainage system with characteristic intermediate between the high and low gradient reaches, typically with limited floodplain development; equivalent to areas mapped as Riverine Unknown (R5) in the Northeast Region plus contiguous wetlands

Nonchannelized -- water exits through seepage, not through a river or stream channel or ditch

Outflow -- water exits; an outflow wetland has water leaving via a stream or seepage to a wetland or waterbody at a lower elevation, it lacks an inflow source

Oxbow -- a former mainstem river bend now partly or completely cut off from mainstem

Paludified -- subjected to paludification, the process by which peat moss engulfs terrains of varying elevations due to an excess of water, typically associated with cold, humid climates of northern areas (boreal/arctic regions and fog-shrouded coasts)

Playa -- a type of basin wetland in the Southwest characterized by drastic fluctuations in water levels over the normal wet-dry cycle

Pocosin -- a shrub and/or forested wetland forming on organic soils in interstream divides (interfluves) on the Atlantic Coast Plain from Virginia to Florida, mostly in North Carolina

Pond -- a natural or human-made shallow open waterbody that may be subjected to periodic drawdowns

Prairie Pothole -- a glacially formed basin wetland found in the Upper Midwest especially in the Dakotas, western Minnesota, and Iowa.

Reservoir -- a large, deep waterbody formed by a dike or dam created for a water supply for drinking water or agricultural purposes or for flood control, or similar purposes.

Salt Pond -- a coastal embayment of variable size and shape that is periodically and temporarily cut off from the sea by natural accretion processes; some may be kept permanently open by jetties and periodic maintenance dredging

Salt Flat -- a broad expanse of alkaline wetlands associated with arid regions, especially the Great Basin in the western United States

Sinkhole -- a depression formed by the collapse of underlying limestone deposits; may be wetland or nonwetland depending on drainage characteristics

Slope -- a wetland occurring on a slope; various types include those along a sloping stream (fringe), those (paludified) formed by paludification -- the process of bogging or swamping of uplands by peat moss in northern climes (humid and cold), and those not designated as one of the above and typically called seeps

types: *perennial* where water flows continuously in all years except drought or extremely dry years; intermittent where water flows only seasonally in most years; channelized where stream bed has been excavated or dredged

Subsurface Flow -- water leaves via ground water

Surface Water -- water occurring above the ground as in flooded or ponded conditions

Terrene -- wetlands surrounded or nearly so by uplands and lacking a channelized outlet stream; a stream may enter or exit this type of wetland but it does not flow through it as a channel; includes a variety of wetlands and natural and human-made ponds

Throughflow -- water entering and exiting, passing through; a throughflow wetland receives significant surface or ground water which passes through the wetland and is discharged to a stream, wetland or other waterbody at a lower elevation

Tidal Gradient -- the segment of a drainage basin that is subjected to tidal influence; essentially the freshwater tidal reach of coastal rivers; equivalent to the Tidal Subsystem of the Riverine System in Cowardin et al. 1979 plus contiguous wetlands

Vernal Pool -- a temporarily flooded basin; woodland vernal pools are found in humid temperature regions dominated by trees, these pools are surrounded by upland forests, are usually flooded from winter through mid-summer, and serve as critical breeding grounds for salamanders and woodland frogs; West Coast vernal pools occur in California, Oregon, and Washington on clayey soils, they are important habitats for many rare plants and animals

Appendix C. Wildlife x Freshwater Wetland Type Matrix based on ECOSEARCH models (prepared by Dr. Hank Short, U.S. Fish and Wildlife Service retired). Expected occurrence of certain wildlife in nontidal wetlands in New England; data may have some relevance to Maryland.

Note: Wetland types are NWI types based on a combination of predominant vegetative life form (e.g., broad-leaved deciduous trees and shrubs [PFO1; PSS1], needle-leaved evergreen trees [PFO4], broad-leaved evergreen shrubs [PSS3], persistent emergent herbs [PEM1], and nonpersistent emergent herbs [PEM2]), and water regime (a - temporarily flooded; b - saturated; c - seasonally flooded [including seasonally flooded/saturated - the “E” water regime on NWI maps], and f- semipermanently flooded). Common names are given for animal species. The first three columns address other habitat requirements related to wetlands, namely special requirements (springs, seepage areas, temporary rain pools, ponds, and bogs), lotic (associated with rivers and streams), and lentic (associated with lakes).

MATRIX 332 x
WETLAND TYPE

SPECIES	Special	Lotic	Lentic	PFO 1			PFO 4			PSS 1			PSS 3	PEM 1			PEM 2		
				a	b	c	a	b	c	a	b	c		a	b	c	a	b	c
Blanding's turtle	d,e		X																
Eastern spiny softshell		X																	
Five-lined skink			X																
Northern water snake	d,e	X			X														
Northern brown snake					X														
Northern redbelly snake	e				X														
Eastern garter snake	e	X			X														
Eastern ribbon snake	d,e	X			X														
Eastern hognose snake					X														
Northern ringneck snake					X														
Eastern worm snake					X														
Northern black racer					X														
Eastern smooth green snake					X														
Black rat snake					X														
Eastern milk snake	e	X			X														
Northern copperhead					X														
Timber rattlesnake					X														
Common loon	d	X			X														
Pied-billed grebe	d	X			X														
Double-crested cormorant	d	X			X														
American bittern	d				X														
Least bittern	d,e	X			X														
Great blue heron	d,e	X			X														
Snowy egret	d				X														
Cattle egret					X														
Green heron	d	X			X														
Black-crowned night heron	d	X			X														
Yellow-crowned night heron					X														
Glossy ibis	d	X			X														
Mute swan	d	X			X														
Canada goose		X			X														
Wood duck	d	X			X														

MATRIX 332 X
WETLAND TYPE

SPECIES	Special	Lotic	Lentic	PFO 1			PFO 4			PSS 1			PSS 3	PEM 1			PEM 2		
				a	b	c	a	b	c	a	b	c		a	b	c	a	b	c
Northern saw-whet owl				X	X	X	X	X	X										
Common nighthawk				X	X	X	X	X	X									X	X
Whip-poor-will				X	X	X													
Chimney swift																			
Ruby-throated hummingbird				X	X	X	X	X	X										X
Belted kingfisher	d	X	X																
Red-headed woodpecker				X	X	X													
Red-bellied woodpecker				X	X	X													
Yellow-bellied sapsucker				X	X	X	X	X	X										
Downy woodpecker				X	X	X	X	X	X										
Hairy woodpecker				X	X	X	X	X	X										
Three-toed woodpecker	e			X	X	X	X	X	X										
Black-backed woodpecker	e			X	X	X	X	X	X										
Northern flicker				X	X	X	X	X	X										
Pileated woodpecker				X	X	X	X	X	X										
Olive-sided flycatcher	d,e			X	X	X	X	X	X										
Eastern wood-pewee				X	X	X	X	X	X										
Yellow-bellied flycatcher	e			X	X	X	X	X	X				X						
Acadian flycatcher				X	X	X	X	X	X										
Alder flycatcher	e			X	X	X	X	X	X				X						
Willow flycatcher				X	X	X	X	X	X										
Least flycatcher				X	X	X	X	X	X										
Eastern phoebe				X	X	X	X	X	X										
Great crested flycatcher				X	X	X	X	X	X										
Eastern kingbird				X	X	X	X	X	X										
Horned lark																			
Purple martin	d	X	X	X	X	X	X	X	X										
Tree swallow	d,e	X	X	X	X	X	X	X	X										
Northern rough-winged swallow	d	X	X	X	X	X	X	X	X				X						
Bank swallow	d	X	X	X	X	X	X	X	X										
Cliff swallow	d	X	X	X	X	X	X	X	X										
Barn swallow	d	X	X	X	X	X	X	X	X										

MATRIX 332 x
WETLAND TYPE

SPECIES	Special	Lotic	Lentic	PFO 1			PFO 4			PSS 1			PSS 3	PEM 1				PEM 2	
				a	b	c	a	b	c	a	b	c		a	b	c	f	c	f
Northern waterthrush	e	x		x	x	x	x	x	x	x	x	x	x						
Louisiana waterthrush				x	x	x													
Mourning warbler	e			x	x	x													
Common yellowthroat	d,e			x	x	x	x	x	x	x	x	x	x						
Hooded warbler				x	x	x													
Wilson's warbler	e			x	x	x	x	x	x	x	x	x	x						
Canada warbler	e			x	x	x	x	x	x	x	x	x	x						
Yellow-breasted chat				x	x	x													
Scarlet tanager				x	x	x													
Northern cardinal		x		x	x	x													
Rose-breasted grosbeak				x	x	x													
Indigo bunting				x	x	x													
Rufous-sided towhee				x	x	x													
American tree sparrow				x	x	x	x	x	x	x	x	x	x						
Chipping sparrow				x	x	x													
Field sparrow				x	x	x													
Vesper sparrow																			
Savannah sparrow																			
Grasshopper sparrow																			
Henslow's sparrow																			
Fox sparrow				x	x	x													
Song sparrow				x	x	x													
Lincoln's sparrow	e			x	x	x	x	x	x	x	x	x	x						
Swamp sparrow	d,e			x	x	x	x	x	x	x	x	x	x						
White-throated sparrow				x	x	x	x	x	x	x	x	x	x						
Dark-eyed junco				x	x	x													
Lapland longspur				x	x	x													
Snow bunting																			
Bobolink																			
Red-winged blackbird	d,e			x	x	x													
Eastern meadowlark				x	x	x													
Rusty blackbird	d,e	x		x	x	x	x	x	x	x	x	x	x						

MATRIX 332 x
WETLAND TYPE

SPECIES	Special	Lotic	Lentic	PFO 1			PFO 4			PSS 1			PSS 3	PEM 1			PEM 2		
				a	b	c	a	b	c	a	b	c		a	b	c	a	b	c
Raccoon	e			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Marten																			
Fisher	e			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Ermine	e			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Long-tailed weasel	e			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Mink	d,e	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Striped skunk	e			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
River otter	d,e	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Lynx	e			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Bobcat	e			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
White-tailed deer	e			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Moose	d,e	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Appendix D. List of Area-sensitive or Forest Interior Birds of the Eastern United States.
(Source: Freemark and Collins 1992 as reported in Schroeder 1996)

Table 1
Eastern Forest Birds Classified as Either Area Sensitive or
Forest Interior Occupants (from Freemark and Collins 1992)

Species	Area Sensitive	Forest Interior
Cooper's hawk (<i>Accipiter cooperii</i>)		X
Red-shouldered hawk (<i>Buteo lineatus</i>)	X	
Broad-winged hawk (<i>Buteo platypterus</i>)		X
Barred owl (<i>Strix varia</i>)		X
Red-bellied woodpecker (<i>Melanerpes carolinus</i>)	X	
Hairy woodpecker (<i>Picoides villosus</i>)	X	X
Pileated woodpecker (<i>Dryocopus pileatus</i>)	X	X
Olive-sided flycatcher (<i>Contopus borealis</i>)		X
Acadian flycatcher (<i>Empidonax virescens</i>)	X	X
Least flycatcher (<i>Empidonax minimus</i>)	X	
Great crested flycatcher (<i>Myiarchus crinitus</i>)	X	
American crow (<i>Corvus brachyrhynchos</i>)	X	
Common raven (<i>Corvus corax</i>)		X
Tufted titmouse (<i>Parus bicolor</i>)	X	
Red-breasted nuthatch (<i>Sitta canadensis</i>)		X
White-breasted nuthatch (<i>Sitta carolinensis</i>)	X	X
Brown creeper (<i>Certhia americana</i>)	X	X
Winter wren (<i>Troglodytes troglodytes</i>)		X

(Continued)

Table 1 (Concluded)

Species	Area Sensitive	Forest Interior
Golden-crowned kinglet (<i>Regulus satrapa</i>)		X
Blue-gray gnatcatcher (<i>Polioptila caerulea</i>)	X	
Veery (<i>Catharus fuscescens</i>)	X	X
Swainson's thrush (<i>Catharus ustulatus</i>)		X
Hermit thrush (<i>Catharus guttatus</i>)	X	X
Wood thrush (<i>Hylocichla mustelina</i>)	X	
Yellow-throated vireo (<i>Vireo flavifrons</i>)	X	
Red-eyed vireo (<i>Vireo olivaceus</i>)	X	
Chestnut-sided warbler (<i>Dendroica pensylvanica</i>)	X	
Magnolia warbler (<i>Dendroica magnolia</i>)		X
Black-throated blue warbler (<i>Dendroica caerulescens</i>)	X	X
Yellow-rumped warbler (<i>Dendroica coronata</i>)		X
Black-throated green warbler (<i>Dendroica virens</i>)	X	X
Blackburnian warbler (<i>Dendroica fusca</i>)		X
Yellow-throated warbler (<i>Dendroica dominica</i>)		X
Pine warbler (<i>Dendroica pinus</i>)		X
Cerulean warbler (<i>Dendroica cerulea</i>)	X	X
Black and white warbler (<i>Mniotilta varia</i>)	X	X
American redstart (<i>Setophaga ruticilla</i>)	X	X
Worm-eating warbler (<i>Helminthos vermivorus</i>)	X	X
Ovenbird (<i>Seiurus aurocapilus</i>)	X	X
Northern waterthrush (<i>Seiurus noveboracensis</i>)	X	X
Louisiana waterthrush (<i>Seiurus motacilla</i>)	X	X
Kentucky warbler (<i>Oporornis formosus</i>)	X	X
Mourning warbler (<i>Oporornis philadelphia</i>)	X	
Hooded warbler (<i>Wilsonia citrina</i>)	X	X
Canada warbler (<i>Wilsonia canadensis</i>)	X	X
Summer tanager (<i>Piranga rubra</i>)	X	
Scarlet tanager (<i>Piranga olivacea</i>)	X	X
Rose-breasted grosbeak (<i>Pheucticus ludovicianus</i>)	X	

Appendix E. Information on Fish and Wildlife Uses of Maryland's Wetlands. (Source: Tiner and Burke 1995)

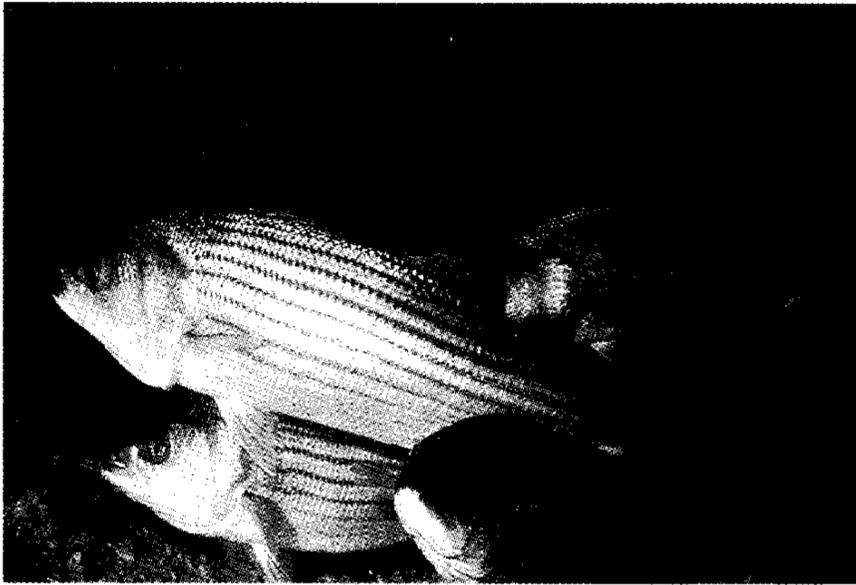


Figure 7-1. Striped bass or rockfish is an important sport fish that spawns in Chesapeake Bay tributaries. (FWS photo)

Fish and Shellfish Habitat

Numerous studies of fish habitat have been conducted, principally along the Atlantic and Gulf Coasts, showing that freshwater, marine and estuarine fish species use or depend upon wetlands for various purposes during their life cycles. Nearly all freshwater finfish and shellfish species that are harvested commercially or for sport require shallow water for various life stages. About two-thirds of the commercial fishery landings in the United States depend on estuaries including deepwater habitats and associated wetlands (McHugh 1966). Even a higher percentage (97%) of the fish harvest in the Chesapeake Bay area is estuarine-dependent (McHugh 1976). Approximately 200 species of fishes frequent or inhabit Chesapeake Bay waters (Figure 7-1).

In Maryland, species such as the American oyster and white perch complete their entire life cycles in estuarine waters (Goodger 1985). Freshwater spawning marine species, such as striped bass and American shad, and many marine spawners, including bluefish and menhaden, depend on wetlands for nursery, feeding and cover areas. Major tributaries of Chesapeake Bay account for approximately 90 percent of the striped bass spawned on the East Coast (Berggren and Lieberman 1977). Metzgar (1973) recognized irregularly flooded salt marsh as a highly valued habitat for fishery resources based on usage by 21 species including prized commercial and sport fish such as bluefish, striped bass and white perch. He documented the usage (spawning, nursery, and adult feeding), season of usage, and abundance of 44 different fish species in an irregularly flooded salt marsh and nearby water at a location in Dorchester County (Table 7-2). Heinle and others (1976) found that in the Patuxent River, most of the tidal marsh detritus input occurs in January and February when ice scouring removes biomass from the

marshes. At such times, estuarine detritivores, such as copepod (*Eurytemora affinis*) and mysid shrimp (*Neomysis americana*), become very abundant. Both of these species are important food for young-of-the-year striped bass.

Menhaden is the most abundant fish species in Chesapeake Bay. More pounds of menhaden are landed annually than all other commercial fish species combined. Menhaden convert planktonic plants and animals dependent on wetlands into an oil-rich protein that is used in cosmetics, paints, and tempering products for steel. It is also used commercially as chicken feed and plant fertilizer. Menhaden is also the principal food of juvenile striped bass. Other common Bay fish species include blueback herring, spot, bay anchovy, Atlantic silverside, white perch, spottail shiner, alewife, bluefish, and mummichog.

Blue crab is the most abundant and valuable shellfish catch in Maryland. Nearly 42 million pounds of blue crab, worth over 20 million dollars, were harvested in 1987.

Approximately 15 species of submerged aquatic vegetation (SAV) commonly occur in the Bay (Hurley 1990). SAV beds provide cover from predators for estuarine-spawning fishes and their offspring including shad, herring and rockfish and many small fish such as minnows and killifish. Highly vulnerable to predation, molting blue crabs hide in SAV beds until their shells harden. Fishes may consume as much as 7.5 percent of the standing crop of rooted aquatics each day (McCormick and Somes 1982). Additionally, a gelatinous film of diatoms covers many SAV species, providing a suitable surface for the attachment of algae, bacteria, protozoans, eggs, and small invertebrates that are eaten by fish.

Although freshwater fish species similarly benefit from the habitat offered by nontidal wetland types, much less is generally known about these relationships. Many of Maryland's wetlands are seasonally flooded palustrine forests. Both seasonally and temporarily flooded wetlands may be critical to the development of some warmwater riverine and palustrine species, which use these areas for spawning, feeding and nursery habitat during flooding periods (Adamus and Stockwell 1983). Similarly, the invertebrate food base of many riverine fisheries is greatest where canopy vegetation permits considerable input of insects, or where aquatic bed or emergent vegetation is present in moderate, interspersed amounts. The state's riverine and palustrine wetlands are important spawning and nursery areas for blueback herring and alewife.

Maryland's freshwater wetlands are usually dominated by forage species, such as shiners (*Cyprinidae*) and sunfish

(*Centrarchidae*) (Pete Jensen, pers. comm.)(Table 7-3). Although freshwater fishes of the Coastal Plain typically inhabit freshwater streams, many species range further downstream into brackish waters up to the limit of their salinity tolerance. A total of 46 freshwater species typically inhabit the Coastal Plain, while an additional 32 species sometimes stray from above the Fall Line (White 1989). Pumpkinseeds are common along all tributaries into brackish waters; black crappies (introduced) are restricted to nontidal and tidal fresh waters; largemouth bass and golden shiners inhabit fresh and slightly brackish streams; and bluespotted sunfish and tadpole madtoms reside in sluggish streams and swamps.

Waterfowl and Other Bird Habitat

Wetlands provide year-round habitats for resident birds and are particularly important breeding grounds, overwintering areas and feeding grounds for migratory waterfowl and numerous other birds (Figure 7-2). Both tidal and nontidal wetlands are valuable bird habitats. For more comprehensive information concerning wetland birds, readers should see Meanley (1975) and Stewart (1949).

The Chesapeake Bay and associated wetlands has been the winter home of approximately one-third of all the waterfowl using the Atlantic Flyway. Prior to the 1950s, the Bay historically attracted about one million waterfowl each year between October and April. Waterfowl populations have declined somewhat since then, and shifts in the relative abundance of specific species have occurred. Among the principal reasons for this decline is the widespread deterioration of shallow water habitats and marshes around the Bay and the significant reduction in valuable food for wintering waterfowl especially submerged aquatic vegetation (Chesapeake Bay Program 1990a).¹

Chesapeake Bay waterfowl include over two dozen species belonging to the taxonomic family of swans, geese and ducks (Anatidae). Two swans, the nonmigratory mute swan and the migratory tundra swan, inhabit the Bay. Tundra swans have historically fed on SAV, but have more recently adapted to feeding on row and grain crops in agricultural fields. Canada geese similarly rely on agricultural food sources and are attracted to ponded areas with easy access to open water. Snow geese winter in Maryland, favoring coastal locations, where they feed extensively on estuarine emergent wetland plants and rootstocks, especially common three-square, smooth cordgrass, and salt marsh bulrush. The Atlantic brant inhabits

shallow, open brackish waters and is primarily an aquatic feeder, eating primarily sea lettuce, followed by eelgrass, widgeongrass, and smooth cordgrass.

Dabbling ducks (surface-feeding ducks, marsh ducks, puddle ducks) use a host of emergent and submergent hydrophytes over a wide range of habitats, including inland ponds, marshes and shallow tributaries of the Bay. Dabblers breeding in Maryland include black duck, mallard, wood duck, gadwall, and blue-winged teal. Black ducks prefer ground nests, free from human disturbances, in well hidden, densely vegetated upland areas next to favored wetland brood areas including tidal marshes, cattail marshes, beaver ponds, SAV beds, and alder-fringed streams. Mallards favor similar nesting habitats but are more tolerant of human presence.

Wood ducks are one of the few locally breeding species of waterfowl common to Chesapeake Bay. They are typically associated with forested wetlands adjacent to rivers, streams and beaver ponds. Wood ducks nest in tree cavities and nest boxes, foraging on the ground or in shallow water for mast and fruits, aquatic plants and seeds, insects, and aquatic invertebrates. Wood ducks are largely summer residents whose major wintering range occurs south of Maryland.

Bay ducks are diving ducks that variously feed on animal life, shellfish, and SAV. Greater scaup prefer SAV where available, but principally consume clams. Lesser scaup frequent diverse habitats of open water at various depths and feed primarily on animal life, but will eat seeds and foliage of pondweeds and widgeongrass. Ring-necked ducks are often associated with tidal freshwater wetlands and impoundments, feeding on coontail, pondweeds, and duckweeds; on seeds of pondweeds, sedges and smartweeds; and on snails. Redhead ducks prefer feeding habitats similar to ring-necked ducks, while canvasbacks primarily feed upon clams. Some sea ducks, including the hooded merganser, common merganser, common goldeneye, and bufflehead, are associated with inland waters to a much greater extent than other sea ducks that prefer marine waters and the open Bay.

Maryland's vast acreage of forested wetlands provide birds shelter, nesting areas, water, and food. Nontidal wetlands are important habitats for many species of birds in Maryland (Table 7-4). There are approximately 348 species of birds that have been recorded in Maryland. Of those species, 129 (37%) regularly use vegetated nontidal wetlands, and 31 (9%) are dependent on wetlands for their survival.

¹Waterfowl information derived from Chesapeake Bay Program (1990a), unless otherwise noted.

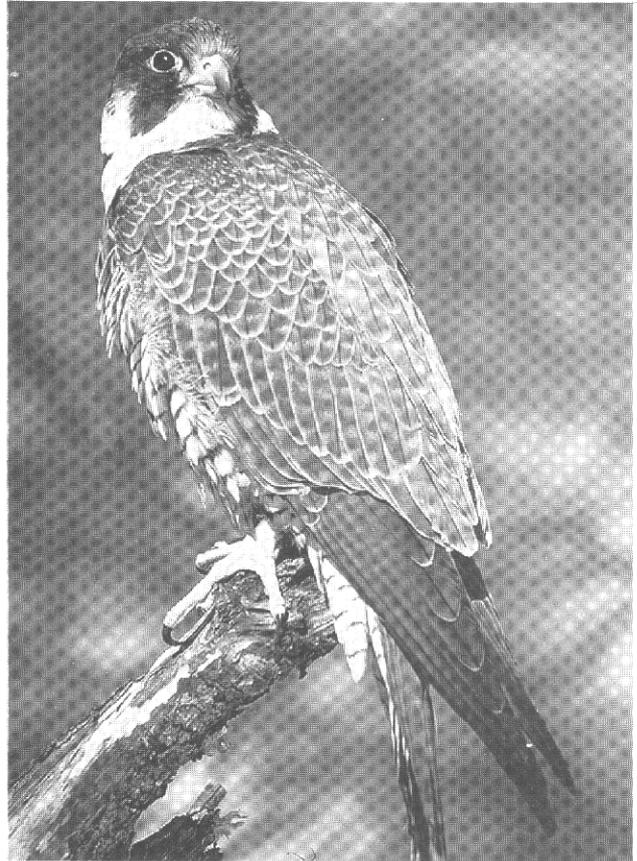
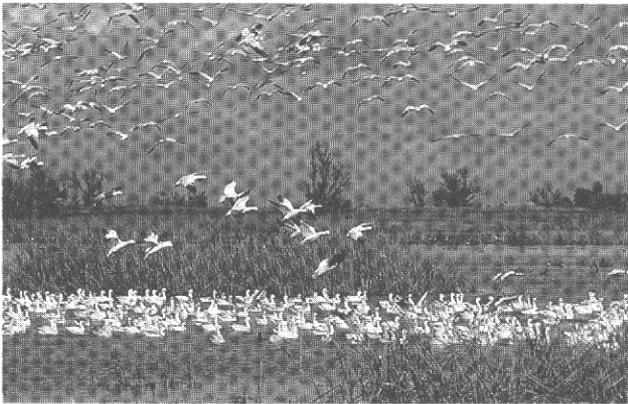
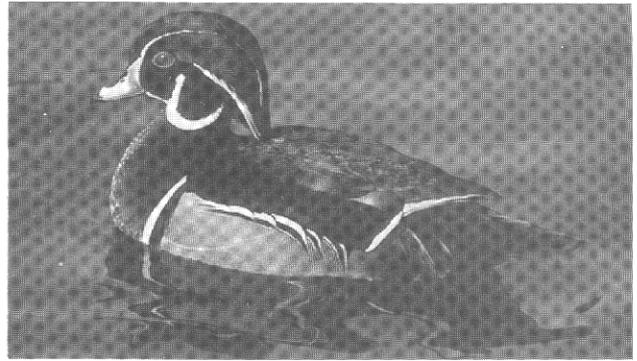
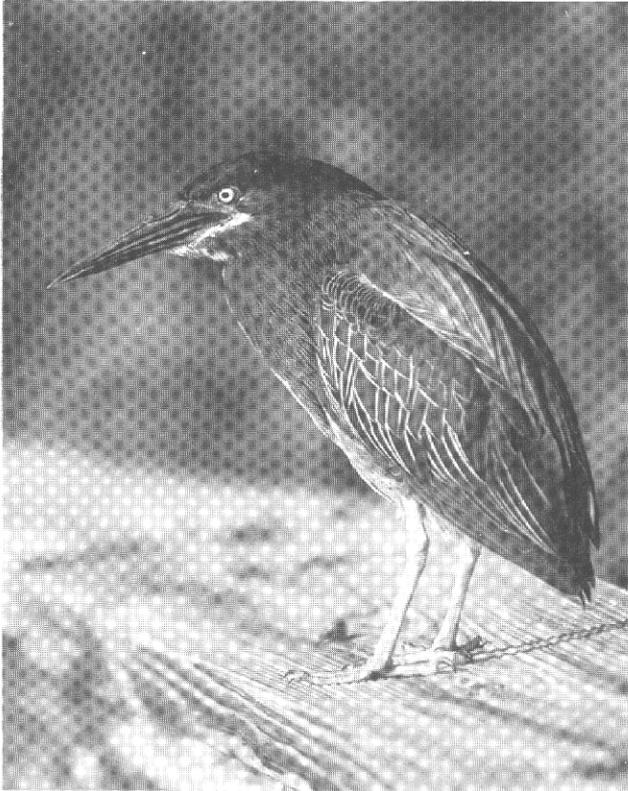


Figure 7-2. Some of the many birds that depend on wetland: green-backed heron (top left), the wood duck (top right), snow geese (center left), endangered peregrine falcon (center right), black duck (bottom left), and Virginia rail (bottom right). (Black duck—FWS photo; Virginia rail photo by Phil Norton).

The prothonotary warbler, Swainson's warbler and northern waterthrush are dependent upon forested wetlands for nesting. Several species of owls and woodpeckers are year-round residents of forested wetlands, including eastern screech-owl, great horned owl, barred owl, red-bellied woodpecker, pileated woodpecker, downy woodpecker, and hairy woodpecker. Migratory species that nest in forested wetlands include yellow-throated vireo, red-eyed vireo, northern parula, yellow-throated warbler, worm-eating warbler, scarlet tanager, eastern wood-pewee, acadian flycatcher, and great crested flycatcher. Migratory species residing in scrub-shrub wetland habitats include alder flycatcher (listed as in need of conservation in Maryland), willow flycatcher and white-eyed vireo. Shorebirds are largely migratory and feed on insects, mosquito and fly larvae and a host of invertebrates occupying beaches, mud flats, emergent wetlands and adjacent shorelines. Representative species include greater yellowlegs, solitary sandpiper, spotted sandpiper, semipalmated plover, and black-bellied plover. Some of the more well known and visible wetland birds are the wading birds including great blue heron, green-backed heron, black-crowned night heron, great egret, and snowy egret. These birds use forested, scrub-shrub, and emergent wetlands and feed on the larger aquatic life forms, including fish, frogs, and snakes. Concerning riparian forests, Keller and others (1993) recommend that riparian forests be at least 300 feet (100 m) wide to provide some nesting habitat for area-sensitive species.

Wetlands are, therefore, crucial for the existence of many birds, ranging from waterfowl and shorebirds to migratory songbirds. Some spend their entire lives in wetland environments, while others primarily use wetlands for breeding, feeding or resting.

Mammal and Other Wildlife Habitat

Many mammals and other wildlife inhabit Maryland wetlands (Table 7-5). Readers may wish to consult Paradiso (1969) for more comprehensive information concerning mammals in Maryland. There are approximately 64 species of mammals that live in Maryland (not including marine mammals), and 38 (60%) of them regularly use vegetated nontidal wetlands. Nine (14%) of these species are dependent on wetlands for their survival. Muskrats are perhaps the most typical and widespread wetland mammal (Figure 7-3). Muskrats are known to feed extensively on the shoots, roots, and rhizomes of three-squares, cattail, sweet flag, arrow arum, and other marsh plants and use parts of these plants to build houses above the marsh floor with hidden, underwater entrances (Department of the Interior 1984). Other common



Figure 7-3. Muskrat and their lodges are common sites in many inland marshes and slightly brackish to fresh tidal marshes. They are trapped for their furs and are also served as a local delicacy at some Eastern Shore restaurants. (Robert Fields photo)

furbearers associated with wetlands include beaver, mink, nutria, otter and raccoon. Nutria are similar to muskrats but do not build houses, preferring shallow burrows in mud banks or sleeping in the open. Nutria were imported to Maryland in the 1940s for breeding on fur farms and apparently escaped or were released into the wild (White 1989). Nutria are now common in Maryland, although less so than muskrats. They are particularly abundant in the marshes of Dorchester and Somerset Counties (Evans 1970). Beavers inhabit scrub-shrub and forested headwater wetlands along small streams and creeks dominated by red maple, willow, alder, willow oak, loblolly and pond pine stands. Once extirpated in Maryland, beavers are now becoming much more common. In fact, recent conflicts with private landowners have become so frequent that the Department of Natural Resources has initiated a relocation program to manage the range of beaver. Mink and river otter are similar species that range seasonally between fresh and brackish tidal marshes in search of food. Mink prey on mice, meadow voles, small birds and occasionally, muskrats. River otter are principally fish eaters. Raccoons are frequent visitors to all types of wetland habitats. They prey upon muskrats in brackish tidal marshes and frequent forested wetlands and streambanks looking for frogs, aquatic insects, crustaceans, wild fruits, and nuts. Other mammals frequenting wetlands include the wild ponies of Assateague Island (Figure 7-4), white-tailed deer, sika deer, red fox, eastern cottontail rabbits, black bear (in western Maryland), and star-nosed mole. Smaller mammals also use wetlands including southern red-backed vole, meadow vole, meadow jumping mouse, marsh rice rat, least shrew, masked shrew, and short-tailed weasel.



Figure 7-4. Wild ponies feed on salt marsh grasses behind Assateague Island. They are a natural attraction for Maryland residents and tourists alike. (Ralph Tiner photo)

Besides mammals and birds, other forms of wildlife make their homes in wetlands. Reptiles (i.e., turtles, lizards and snakes) and amphibians (i.e., toads, frogs, and salamanders) are important residents, principally, of freshwater tidal and nontidal wetlands (Table 7-6). For detailed information regarding amphibians and reptiles in Maryland, readers should see Harris (1975). Reptiles (turtles, lizards, snakes, and crocodilians) have lungs and scaled skin, and either lay shelled eggs or give birth to live young. Amphibians (salamanders, toads, and frogs) have smooth, moist skin, and most go through a gilled, aquatic, juvenile stage after hatching from eggs that are covered by a jelly-like substance and laid in water. There are approximately 40 species of reptiles (not including sea turtles) and 38 species of amphibians that live in Maryland. Of those, 33 (83%) of the reptiles and 32 (84%) of the amphibians regularly use vegetated nontidal wetlands. Ten (25%) of the reptiles and 31 (82%) of the amphibians are dependent on nontidal wetlands. Painted turtles are commonly found in channels, ponds, and along the banks of freshwater wetlands (Figure 7-5). Other species are found in both freshwater and brackish wetlands, including spotted turtle, mud turtle, red-bellied turtle, and snapping turtle (McCormick and Somes 1982). The five-lined skink and broad-headed skink are lizards that occur in Maryland wetlands. Many species of snakes are found in and near wetlands. The northern water snake is a resident of virtually every swamp, stream, river, and marsh in the Bay region (White 1989). Other snakes include northern copperhead, common kingsnake, northern black racer, northern brown snake, black rat snake, and eastern ribbon snake. Toads and frogs are found in great numbers in vernal pools in forested wetlands (Figure 7-6) and along the shorelines of ponds and streams. Common toads include the American toad and Fowler's toad. Southern leopard frog, green frog, pickerel frog,



Figure 7-5. Painted turtles are frequently seen in many freshwater marshes and ponds. (FWS photo)

bull frog, and northern spring peeper are among the most common frogs. Less common frogs include the northern leopard frog and carpenter frog. Adults of the red-spotted newt live in ponds with an abundance of submerged vegetation, while the juveniles are terrestrial. Many salamanders use vernal pools or wetlands for breeding, although they may spend most of their years in upland or streamside habitats. Nearly all of the approximately 190 species of amphibians in North America are wetland-dependent at least for breeding (Clark 1979). Salamanders using Maryland wetlands are numerous including, among others, spotted salamander, mountain dusky salamander, northern dusky salamander, eastern mud salamander, and northern two-lined salamander.

The Role of Wetlands in Preserving Plant and Animal Species Diversity

Oftentimes wetlands possess unique characteristics derived from particular soil, water, and sunlight conditions that interact together to form specialized habitats that certain plant and animal species are especially adapted to or dependent upon. More than half of the fishes and amphibians, 30 percent of the reptiles and birds, and 15 percent of the mammals endangered or threatened in the United States are dependent on wetlands for survival (Williams and Dodd 1979). In Maryland, of the 101 plant species classified as "endangered," about one-half (50 species) are plants that are found only (99% of the time) in wetlands (Tables 7-7 and 7-8). Similarly, of the 28 "threatened" plant species in the state, over one-third are found only in wetlands. Excluding marine mammals, there are 38 species of mammals, birds, reptiles and amphibians that are classified as endangered, threatened or in need of conservation. Of this total, 18 species (47%) use

wetlands, and 11 of these 18 species directly depend on wetlands for their survival (Table 7-9). Norden and others (1984) have prepared a summary of threatened endangered plants and animals for Maryland.

Environmental Quality Values

Besides providing habitat for fish and wildlife, wetlands play a less conspicuous but essential role in maintaining high environmental quality, especially in aquatic habitats. They do this in a number of ways, including purifying natural waters by removing nutrients, chemical and organic pollutants, and sediment, and producing food which supports aquatic life.

Water Quality Improvement

Wetlands help maintain good water quality or improve degraded waters in several ways: (1) nutrient removal and retention, (2) processing chemical and organic wastes, and (3) reducing the sediment load of water. Wetlands are particularly good water filters because of their locations between land and open water (Figure 7-7). Thus, they can

both intercept runoff from land before it reaches the water and help filter nutrients, wastes and sediment from flooding waters. Clean waters are important to humans as well as to aquatic life.

First, wetlands remove nutrients, especially nitrogen and phosphorus, from flooding waters for plant growth and help prevent eutrophication or overenrichment of natural waters. Much of the nutrients are stored in the wetland soil. Although most wetlands have the ability to improve water quality, this function may vary considerably from site to site depending upon hydrological characteristics (especially the turnover rate or contact time of water), type of substrate and plants, seasonal patterns of nutrient immobilization, and the type of wetland. At the Smithsonian Environmental Research Center in Edgewater, Peterjohn and Correll (1982) extensively studied a "riparian forest," later recognized as part of the "wetland continuum" by Whigham and others (1988), for its ability to process nutrients. Their study showed that dissolved nitrogen compounds in surface water runoff declined dramatically after traversing the riparian forest, with the greatest change occurring in the first 63 feet (19 m). A total reduction of 79 percent for nitrate was observed. Similarly, 90 percent and 98 percent total decreases in the mean annual groundwater



Figure 7-6. Vernal pools (temporarily flooded waterbodies in forested wetlands) provide critical breeding areas for many amphibians, including spring peepers and spotted salamanders. (Ralph Tiner photo)

Table 7-2. Survey sample of fishery resource usage and abundance in irregularly flooded salt marshes or nearby waters of Dorchester County, Maryland (Metzgar 1973).

FISH SPECIES PRESENT:

Scientific name	Common name	Spawning	Nursery	Adult Feeding	Spr.	Sum.	Fall	Wntr.	High	Mod.	Low
* <i>Petromyzon marinus</i>	Sea Lamprey	•									
<i>Carcharhinus leucas</i>	Bull Shark			•		•					
<i>Carcharhinus milberti</i>	Sandbar Shark			•		•					
<i>Sphyrna zygaena</i>	Hammerhead Shark			•		•					
<i>Raja eglanteria</i>	Clearnose Skate			•		•					
<i>Rhinoptera bonasus</i>	Cownose Ray			•		•					
* <i>Acipenser oxyrinchus</i>	Atlantic sturgeon	•			•				•		
* <i>Alosa aestivalis</i>	Blueback Herring	•			•				•		
* <i>Alosa mediocris</i>	Hickory Shad	•			•				•		
* <i>Alosa pseudoharengus</i>	Alewife	•			•				•		
* <i>Alosa sapidissima</i>	American (White) Shad	•			•				•		
<i>Brevoortia tyrannus</i>	Atlantic Menhaden		•	•	•	•			•		
<i>Dorosoma cepedianum</i>	Gizzard Shad		•	•		•	•				•
<i>Anchoa mitchilli</i>	Bay Anchovy	•	•	•	•	•	•	•	•		
<i>Cyprinus carpio</i>	Carp			•			•	•			•
<i>Notropis hudsonius</i>	Spottail Shiner			•			•	•			•
<i>Ictalurus catus</i>	White Catfish		•		•						•
<i>Anguilla rostrata</i>	American Eel		•	•	•	•	•	•	•		
<i>Strongylura marina</i>	Atlantic Needlefish	•	•	•	•	•	•	•	•		
<i>Hyporhamphus unifasciatus</i>	Halfbeak		•	•		•	•		•		
<i>Cyprinodon variegatus</i>	Sheepshead Minnow	•	•	•	•	•	•	•	•		
<i>Fundulus heteroclitus</i>	Mummichog	•	•	•	•	•	•	•	•		
<i>Fundulus majalis</i>	Striped Killifish	•	•	•	•	•	•	•	•		
<i>Lucania parva</i>	Rainwater Killifish	•	•	•	•	•	•	•	•		
<i>Syngnathus fuscus</i>	Northern Pipefish	•	•	•	•	•	•	•	•		
* <i>Roccus americanus</i>	White Perch	•	•	•	•	•	•	•	•		
* <i>Roccus saxatilis</i>	Striped Bass	•	•	•	•	•	•	•	•		
<i>Bairdiella chrysura</i>	Mademoiselle		•	•		•	•				•
<i>Cynoscion regalis</i>	Greytrout (Weakfish)		•	•		•	•				•
<i>Cynoscion nebulosus</i>	Spotted Seatrout		•	•		•	•				•
<i>Pomatomus saltatrix</i>	Bluefish		•	•		•	•		•		
<i>Leiostomus xanthurus</i>	Spot		•	•		•	•		•		
<i>Micropogon undulatus</i>	Atlantic Croaker		•	•		•	•				•
<i>Pogonias cromis</i>	Black Drum		•	•		•	•				•
<i>Sciaenops ocellata</i>	Channel Bass (Red Drum)		•	•		•	•				•
<i>Chasmodes bosquianus</i>	Striped Blenny	•	•	•	•	•	•	•			•
<i>Peprilus alepidotus</i>	Butterfish (Southern Harvestfish)		•	•	•	•	•				•
<i>Menidia menidia</i>	Atlantic Silverside	•	•	•	•	•	•	•	•		
<i>Paralichthys dentatus</i>	Summer Flounder		•	•		•					•
<i>Pseudopleuronectes americanus</i>	Winter Flounder		•	•	•			•			•
<i>Trinectes maculatus</i>	Hog Choker	•	•	•	•	•	•	•	•		
<i>Gobiosox strumosus</i>	Clingfish (Skilletfish)	•	•	•	•	•	•	•			•
<i>Opsanus tau</i>	Oyster Toadfish	•	•	•	•	•	•	•		•	
<i>Spharoides maculatus</i>	Northern Puffer		•			•					

* Adults present during spawning migration, but not used as a spawning ground *per se*.

Table 7-3. Freshwater species found in Maryland's inland riverine wetlands (Pete Jensen and Robert Bachman, pers. comm.).

Freshwater Species of Inland Riverine Wetlands

Salmonidae

- Brook Trout (*Salvelinus fontinalis*)
- Brown Trout (*Salmo trutta*)
- Rainbow Trout (*Salmo gairdneri*)

Esocidae

- Northern Pike (*Esox lucius*)
- Chain Pickerel (*Esox niger*)
- Redfin Pickerel (*Esox americanus*)

Cyprinidae

- Stoneroller (*Compostoma ananalum*)
- Rosyside Dace (*Clinostomus funduloides*)
- Carp (*Cyprinus carpio*)
- Cutlips Minnow (*Exoglossum maixillingua*)
- Blacknose Dace (*Rhinichthys atratulus*)
- Longnose Dace (*Rhinichthys cataractae*)
- Creek Chub (*Semotilus atromaculatus*)
- Fallfish (*Semotilus corporalis*)
- River Chub (*Nocomis micropogon*)
- Common Shiner (*Notropis cornutus*)
- Spottail Shiner (*Notropis hudsonius*)
- Rosyface Shiner (*Notropis rubellus*)
- Spotfin Shiner (*Notropis spilopterus*)
- Bluntnose Minnow (*Pimephales notatus*)
- Golden Shiner (*Notemigona crysolencas*)

Catostomidae

- Northern Hogsucker (*Hypentelium nigricans*)
- White Sucker (*Catostomus commersoni*)
- Crack Chubsucker (*Erimyzon oblongers*)

Ictaluridae

- Margined Madtom (*Noturus insignis*)
- Brown Bullhead (*Ictalurus nebulosus*)
- Channel Catfish (*Ictalurus punctatus*)

Gottidae

- Mottled Sculpin (*Cottus bairdi*)

Centrarchidae

- Rock Bass (*Ambloplites rupestris*)
- Pumpkinseed Sunfish (*Lepomis gibbosus*)
- Green Sunfish (*Lepomis cyanellus*)
- Redbreast Sunfish (*Lepomis auritus*)
- Bluegill Sunfish (*Lepomis macrochirus*)
- Smallmouth Bass (*Micropterus dolomieu*)
- Largemouth Bass (*Micropterus salmoides*)

Percidae

- Tessellated Darter (*Etheostoma olmstedii*)
- Glassy Darter (*Etheostoma vitreum*)
- Fantail Darter (*Etheostoma flabellare*)
- Greenside Darter (*Etheostoma blennioides*)
- Walleye (*Stizostedion vitreum*)
- Yellow Perch (*Perca flavescens*)

Table 7-4. Use of nontidal wetlands by birds in Maryland.

This list shows the birds that regularly use three types of vegetated nontidal wetlands: forested, scrub-shrub, and emergent. Information for this list was gathered from Robbins and Bystrack (1977), field guides, and discussions with biologists. For more comprehensive information regarding birds, readers should reference Stewart and Robbins (1958) and McCormick and Somes (1982). The following symbols are used throughout the list:

- W species uses this nontidal wetland type during winter;
- M species uses this nontidal wetland type during spring and fall migration;
- N species nests regularly in this nontidal wetland type or upland habitat adjacent to this nontidal wetland type;
- + species is dependent on these wetland types (some species also use these types of tidal wetlands);
- E species is listed as "Endangered in Maryland" by the Maryland Department of Natural Resources (in 1990);
- I species is listed as "In Need of Conservation in Maryland" by the Maryland Department of Natural Resources (in 1990);
- H locally rare species that is being monitored by the Natural Heritage Program of the Maryland Department of Natural Resources (in 1990);
- * species is a year-round resident and does not migrate.

Species	Wetland Type		
	Forested	Scrub-shrub	Emergent
<i>Grebes</i>			
Pied-billed Grebe—H			WMN+
<i>Wading Birds</i>			
American Bittern—I		WMN	WMN+
Least Bittern—I			MN+
Great Blue Heron	WMN+	WMN+	WM+
Great Egret	M+	M+	M+
Snowy Egret	M+	M+	M+
Little Blue Heron—I		M+	M+
Green-backed Heron	M+	MN+	M+
Black-crowned Night-heron	WMN+	WMN+	WMN+
Yellow-crowned Night-heron	MN	M	M
<i>Waterfowl</i>			
Canada Goose		N+	WMN+
Wood Duck	MN+		
Green-winged Teal			WM+
American Black Duck		WMN+	WMN+
Mallard		WMN+	WMN+
Northern Pintail			WM+
Blue-winged Teal			WMN+
Northern Shoveler			WM+
Gadwall			WM+
American Wigeon			WM+
Ring-necked Duck			WM+
Hooded Merganser—H	M+	M+	M+
<i>Birds of Prey</i>			
Northern Harrier—H			WMN
Red-shouldered Hawk	WMN		

Species	Wetland Type		
	Forested	Scrub-shrub	Emergent
<i>Gallinaceous Game Birds</i>			
Ring-necked Pheasant*		W	W
Ruffed Grouse*	W	W	
<i>Rails</i>			
Virginia Rail		WMN	WMN+
Sora—H			MN+
Black Rail—I		MN+	MN+
Common Moorhen—I			MN+
<i>Shorebirds</i>			
Killdeer			MN
Black-necked Stilt			MN
American Avocet			M
Greater Yellowlegs			M
Lesser Yellowlegs			M
Solitary Sandpiper			M
Spotted Sandpiper			M
Semipalmated Sandpiper			M
Western Sandpiper			M
Least Sandpiper			M
Baird's Sandpiper			M
Pectoral Sandpiper			M
Dunlin			WM
Stilt Sandpiper			M
Short-billed Dowitcher			M
Long-billed Dowitcher			M
Common Snipe		WM	WM
American Woodcock	WMN	WMN	WMN
Wilson's Phalarope			M
Red-necked Phalarope			M
<i>Owls</i>			
Eastern Screech-owl*	WN		
Great Horned Owl*	WN		
Barred Owl*	WN		
Northern Saw-whet Owl—H	WM	WM	
<i>Hummingbirds</i>			
Ruby-throated Hummingbird	M	MN	
<i>Kingfishers</i>			
Belted Kingfisher	WMN		
<i>Woodpeckers</i>			
Red-headed Woodpecker	WMN		
Red-bellied Woodpecker*	WN		
Yellow-bellied Sapsucker—H	WM		
Downy Woodpecker*	WN		
Hairy Woodpecker*	WN		
Common Flicker	WN		
Pileated Woodpecker*	WN		
<i>Perching Birds</i>			
Olive-sided Flycatcher—H	M		
Eastern Wood-pewee	MN		
Acadian Flycatcher	MN		
Alder Flycatcher—H		MN+	
Willow Flycatcher		MN	
Eastern Phoebe	MN		
Great Crested Flycatcher	MN		
Eastern Kingbird	M	M	

Table 7-4. (continued)

Species	Wetland Type			Species	Wetland Type		
	Forested	Scrub-shrub	Emergent		Forested	Scrub-shrub	Emergent
<i>Perching Birds (continued)</i>				<i>Perching Birds (continued)</i>			
Black-capped Chickadee*	WN	WN		Northern Cardinal*	W	WN	
Carolina Chickadee*	WN	WN		Song Sparrow		WMN	
Tufted Titmouse*	WN	WN		Swamp Sparrow	WM	WMN+	WMN+
Red-breasted Nuthatch—H	WMN			White-throated Sparrow	WM	WM	
White-breasted Nuthatch	WM	WM		Red-winged Blackbird	W	WMN	WMN
Brown Creeper	WMN	WM		Rusty Blackbird	WM	WM	WM
Carolina Wren*	WN	WN		Total Species	80	67	57
Winter Wren—H	WMN	WM		Total Dependent Species	10	13	28
Sedge Wren—I		M	MN				
Marsh Wren			MN+				
Golden-crowned Kinglet—H	WM	WM					
Ruby-crowned Kinglet	WM	WM					
Blue-gray Gnatcatcher	MN	MN					
Eastern Bluebird		WM	WM				
Veery	MN	M					
Gray-checked Thrush	M						
Hermit Thrush	WMN	WM					
Wood Thrush	MN						
American Robin	WMN	WM					
Gray Catbird	MN	MN					
Northern Mockingbird		WMN					
Brown Thrasher		WMN					
Water Pipit			M				
White-eyed Vireo		MN					
Yellow-throated Vireo	MN						
Philadelphia Vireo	M	M					
Red-eyed Vireo	MN						
Blue-winged Warbler	M	MN					
Golden-winged Warbler	M	MN					
Nashville Warbler—H	MN	MN					
Northern Parula	MN						
Yellow Warbler	M	MN	M				
Yellow-rumped Warbler—H	WM						
Yellow-throated Warbler	MN						
Palm Warbler	M	M	M				
Cerulean Warbler	MN	M					
Black-and-white Warbler	MN	M					
American Redstart	MN	MN					
Prothonotary Warbler	MN+	M					
Worm-eating Warbler	MN						
Swainson's Warbler—I	MN+						
Northern Waterthrush	MN+	M					
Louisiana Waterthrush	MN	M					
Kentucky Warbler	MN	M					
Connecticut Warbler	M	M					
Mourning Warbler—H	M	M					
Common Yellowthroat	MN	MN	MN				
Hooded Warbler	MN	M					
Wilson's Warbler	M	M					
Canada Warbler	MN	M					
Summer Tanager	MN						
Scarlet Tanager	MN						

Table 7-5. Use of nontidal wetlands by mammals in Maryland.

This list shows the mammals that regularly use three types of vegetated nontidal wetlands: forested, scrub-shrub, and emergent. Information for this list was gathered from Paradiso (1969), field guides and discussions with biologists.

The following symbols are used throughout the list:

- X species occurs in this nontidal wetland habitat;
- + species is dependent on these wetland types (some species also use these types of tidal wetlands);
- E species is listed as "Endangered in Maryland" by the Maryland Department of Natural Resources (in 1990);
- I species is listed as "In Need of Conservation in Maryland" by the Maryland Department of Natural Resources (in 1990);
- H locally rare species that are being monitored by the Natural Heritage Program of the Maryland Department of Natural Resources (in 1990).

Species	Wetland Type		
	Forested	Scrub-shrub	Emergent
<i>Marsupials</i>			
Virginia Opossum	X	X	X
<i>Shrews and Moles</i>			
Masked Shrew	X	X	X
Southeastern Shrew—I	X	X	X
Southern Water Shrew—E	X+	X+	X+
Smoky Shrew—H	X	X	
Pygmy Shrew—H	X	X	X
Short-tailed Shrew	X	X	
Least Shrew	X	X	X
Star-nosed Mole	X+	X+	X+
<i>Rabbits</i>			
Eastern Cottontail	X	X	X
<i>Rodents</i>			
Fox Squirrel—(Delmarva subspecies E)	X		
Southern Flying Squirrel	X		
Beaver	X+	X+	X+
Marsh Rice Rat			X+
Eastern Harvest Mouse			X
Deer Mouse	X	X	
White-footed Mouse	X	X	
Southern Red-backed Vole	X	X	
Meadow Vole		X	X
Southern Rock Vole—H	X		
Muskrat		X+	X+
Southern Bog Lemming—H			X+
Meadow Jumping Mouse		X	X
Woodland Jumping Mouse	X		
Nutria			X+
<i>Carnivores</i>			
Red Fox	X	X	X
Gray Fox	X	X	X
Black Bear	X	X	X
Raccoon	X	X	X
Fisher	X		
Short-tailed Weasel	X	X	X
Least Weasel—I	X	X	
Long-tailed Weasel	X	X	X
Mink	X+	X+	X+
River Otter	X+	X+	X+
Bobcat—I	X	X	
<i>Deer</i>			
Sika Deer	X	X	X
White-tailed Deer	X	X	X
Total Species	30	29	27
Total Dependent Species	5	6	9

Table 7-6. Use of nontidal wetlands by reptiles and amphibians in Maryland.

This list shows the reptiles and amphibians that regularly use three types of vegetated nontidal wetlands: forested, scrub-shrub, and emergent. Information for this list was gathered from Harris (1975), field guides, and discussions with biologists.

The following symbols are used throughout the list:

- X species occurs in this nontidal wetland habitat;
- + species is dependent on these wetland types (some species also use these types of tidal wetlands);
- E species is listed as "Endangered in Maryland" by the Maryland Department of Natural Resources (in 1990);
- I species is listed as "In Need of Conservation in Maryland" by the Maryland Department of Natural Resources (in 1990);
- H locally rare species that are being monitored by the Natural Heritage Program of the Maryland Department of Natural Resources (in 1990).

Species	Wetland Type		
	Forested	Scrub-shrub	Emergent
Amphibians			
<i>Salamanders</i>			
Mudpuppy	X		
Red-spotted Newt	X+	X+	X+
Jefferson Salamander—H	X+	X+	X+
Spotted Salamander	X+	X+	X+
Marbled Salamander	X+	X+	X+
Eastern Tiger Salamander—E	X+	X+	X+
Northern Two-lined Salamander	X+		
Long-tailed Salamander	X+		
Four-toed Salamander	X+	X+	X+
Northern Spring Salamander	X+		
Eastern Mud Salamander	X+	X+	X+
Northern Red Salamander	X+	X+	X+
Northern Dusky Salamander	X+		
Mountain Dusky Salamander	X+		
Appalachian Seal Salamander	X+		
<i>Frogs and Toads</i>			
Eastern Spadefoot	X+	X+	X+
American Toad	X+	X+	X+
Fowler's Toad	X+	X+	X+
Northern Cricket Frog	X+	X+	X+
Green Treefrog	X+	X+	X+
Northern Spring Peeper	X+	X+	X+
Eastern Gray Treefrog	X+	X+	X+
Southern Gray Treefrog	X+	X+	X+
Mountain Chorus Frog—H	X+		
Chorus Frog	X+	X+	X+
Eastern Narrow-mouthed Toad—E	X+	X+	X+
Bullfrog	X+	X+	X+
Carpenter Frog—I	X+	X+	X+
Green Frog	X+	X+	X+
Southern Leopard Frog	X+	X+	X+
Pickerel Frog	X+	X+	X+
Wood Frog	X+	X+	X+
Total Species	31	24	25
Total Dependent Species	31	24	24

Species	Wetland Type		
	Forested	Scrub-shrub	Emergent
Reptiles			
<i>Lizards</i>			
Ground Skink	X		
Northern Coal Skink—E	X	X	X
Five-lined Skink	X		
Broad-headed Skink	X	X	
<i>Snakes</i>			
Eastern Worm Snake	X	X	
Ringneck Snake	X	X	
Rough Green Snake	X	X	
Eastern Smooth Green Snake	X	X	
Northern Black Racer	X	X	X
Black Rat Snake	X	X	X
Corn Snake	X	X	
Common (Eastern) Kingsnake	X	X	X
Milk Snake	X	X	X
Red-bellied Water Snake	X	X	X
Northern Water Snake	X	X	X
Queen Snake	X	X	X
Northern Brown Snake	X	X	X
Northern Red-bellied Snake	X	X	X
Smooth Earth Snake— (Mountain subspecies E)	X	X	X
Eastern Ribbon Snake	X+	X+	X+
Eastern Garter Snake	X	X	X
Northern Copperhead	X	X	X
<i>Turtles</i>			
Stinkpot	X+	X+	X+
Eastern Mud Turtle	X+	X+	X+
Common Snapping Turtle	X+	X+	
Spotted Turtle	X+	X+	X+
Wood Turtle	X+	X+	X+
Bog Turtle—H	X+	X+	
Eastern Box Turtle	X	X	X
Map Turtle—I		X+	
Painted Turtle	X+	X+	X+
Red-bellied Turtle	X+	X+	X+
Red-eared Turtle (feral)	X	X	
Total Species	28	30	26
Total Dependent Species	7	9	10

Appendix F. List of Maryland's Endangered and Threatened Plants. (Source: Tiner and Burke 1995)

Table 7-7. Endangered and threatened plant species of Maryland by wetland plant indicator status. Data compiled in 1990 from Maryland Natural Heritage Program; contact them for updated information.

ENDANGERED PLANT SPECIES

Species	Wetland Plant Indicator Status*
1. Sensitive Joint-Vetch (<i>Aeschynomene virginica</i>)	OBL
2. Sandplain Gerardia (<i>Agalinis acuta</i>)	UPL*
3. Fascicled Gerardia (<i>Agalinis fasciculata</i>)	FAC
4. Thread-Leaved Gerardia (<i>Agalinis setacea</i>)	UPL*
5. Woolly Three-Awn (<i>Aristida lanosa</i>)	UPL*
6. Virginia Heartleaf (<i>Asarum virginicum</i>)	FACU
7. Red Milkweed (<i>Asclepias rubra</i>)	OBL
8. Serpentine Aster (<i>Aster depaupertaus</i>)	UPL*
9. Tickseed Sunflower (<i>Bidens coronata</i>)	OBL
10. Small Beggar-Ticks (<i>Bidens discoidea</i>)	FACW
11. Small-Fruited Beggar-Ticks (<i>Bidens mitis</i>)	OBL
12. Aster-Like Boltonia (<i>Boltonia asteroides</i>)	FACW
13. Grass-Pink (<i>Calopogon tuberosus</i>)	FACW
14. Long's Bittercress (<i>Cardamine longii</i>)	OBL
15. Barratt's Sedge (<i>Carex barrattii</i>)	OBL
16. Buxbaum's Sedge (<i>Carex buxbaumi</i>)	OBL
17. Coast Sedge (<i>Carex exilis</i>)	OBL
18. Giant Sedge (<i>Carex gigantea</i>)	OBL
19. Cypress-Swamp Sedge (<i>Carex jorii</i>)	OBL
20. Dark Green Sedge (<i>Carex venusta</i>)	OBL
21. Marsh Wild Senna (<i>Cassia fasciculata</i> var. <i>macrosperma</i>)	FACU
22. Spreading Pogonia (<i>Cleistes divaricata</i>)	FAC
23. Wrinkled Jointgrass (<i>Ceolorachis rugosa</i>)	OBL
24. Wister's Coralroot (<i>Corallorhiza wisteriana</i>)	FAC
25. Fraser's Sedge (<i>Cymophyllus fraseri</i>)	UPL*
26. Smooth Tick-Trefoil (<i>Desmodium laevigatum</i>)	UPL*
27. Linear-Leaved Tick-Trefoil (<i>Desmodium lineatum</i>)	UPL*
28. Cream-Flowered Tick-Trefoil (<i>Desmodium ochroleucum</i>)	UPL*
29. Rigid Tick-Trefoil (<i>Desmodium rigidum</i>)	UPL*
30. Pineland Tick-Trefoil (<i>Desmodium strictum</i>)	UPL*
31. Pink Sundew (<i>Drosera capillaris</i>)	OBL
32. Long Fern (<i>Dryopteris celsa</i>)	OBL
33. Knotted Spikerush (<i>Eleocharis equisetoides</i>)	OBL
34. Black-Fruited Spikerush (<i>Eleocharis melanocarpa</i>)	FACW
35. Robbins' Spikerush (<i>Eleocharis robbinsii</i>)	OBL
36. Water Horsetail (<i>Equisetum fluviatile</i>)	OBL
37. Bent-Awn Plumegrass (<i>Erianthus contortus</i>)	FAC
38. Parker's Pipewort (<i>Ericaulon parkeri</i>)	OBL
39. White-Bracted Boneset (<i>Eupatorium leucolepis</i>)	FACW
40. Darlington's Spurge (<i>Euphorbia purpurea</i>)	FAC
41. Harper's Fimbristylis (<i>Fimbristylis perpusilla</i>)	FACW
42. Box Huckleberry (<i>Gaylussacia brachycera</i>)	UPL*
43. Swamp-Pink (<i>Helonias bullata</i>)	OBL
44. Featherfoil (<i>Hottonia inflata</i>)	OBL
45. Creeping St. John's-Wort (<i>Hypericum adpressum</i>)	OBL
46. Coppery St. John's-Wort (<i>Hypericum denticulatum</i>)	FACW
47. Dwarf Iris (<i>Iris verna</i>)	UPL*
48. Red-Root (<i>Lachnanthes caroliniana</i>)	OBL
49. Club-Headed Cutgrass (<i>Leersia hexandra</i>)	OBL
50. Star Duckweed (<i>Lemna trisulca</i>)	OBL
51. Downy Bushclover (<i>Lespedeza stuevei</i>)	UPL*

ENDANGERED PLANT SPECIES

Species	Wetland Plant Indicator Status*
52. Mudwort (<i>Limosella subulata</i>)	OBL
53. Sandplain Flax (<i>Linum intercursum</i>)	UPL*
54. Pondspice (<i>Litsea aestivalis</i>)	OBL
55. Canby's Lobelia (<i>Lobelia canbyi</i>)	OBL
56. Cylindric-Fruited Seedbox (<i>Ludwigia glandulosa</i>)	OBL
57. Hairy Ludwigia (<i>Ludwigia hirtella</i>)	OBL
58. Sessile-Leaved Water-Horehound (<i>Lycopus amplexans</i>)	OBL
59. Erect Water-Hyssop (<i>Mecardonia acuminata</i>)	OBL
60. Torrey's Dropseed (<i>Muhlenbergia torreyana</i>)	FACW
61. Low Water-Milfoil (<i>Myriophyllum humile</i>)	OBL
62. Floating-Heart (<i>Nymphoides cordata</i>)	OBL
63. Virginia False-Gromwell (<i>Onosmodium virginianum</i>)	UPL*
64. Canby's Dropwort (<i>Oxypolis canbyi</i>)	OBL
65. Tall Swamp Panicgrass (<i>Panicum scabriusculum</i>)	OBL
66. Wright's Panicgrass (<i>Panicum wrightianum</i>)	FAC
67. Kidneyleaf Grass-of-Parnassus (<i>Parnassia asarifolia</i>)	OBL
68. Yellow Nailwort (<i>Paronychia virginica</i>)	UPL*
69. Walter's Paspalum (<i>Paspalum dissectum</i>)	OBL
70. Canby's Mountain Lover (<i>Paxistima canbyi</i>)	UPL*
71. Blue Scorpion-Weed (<i>Phacelia ranunculacea</i>)	FACW
72. Jacob's Ladder (<i>Polemonium van-bruntiae</i>)	FACW
73. Cross-Leaved Milkwort (<i>Polygala cruciata</i>)	FACW
74. Dense-Flowered Knotweed (<i>Polygonum densiflorum</i>)	OBL
75. Slender Rattlesnake-Root (<i>Prenanthes autumnalis</i>)	FAC
76. Alleghany Plum (<i>Prunus alleghaniensis</i>)	UPL*
77. Short-Beaked Baldrush (<i>Psilocarya nitens</i>)	OBL
78. Long-Beaked Baldrush (<i>Psilocarya scirpoides</i>)	OBL
79. Harperella (<i>Ptilimnium nodosum</i>)	UPL*
80. One-Sided Pyrola (<i>Pyrola secunda</i>)	FAC
81. Yellow Water-Crowfoot (<i>Ranunculus flabellaris</i>)	OBL
82. Hairy Snoutbean (<i>Rhynchosia tomentosa</i>)	UPL*
83. Short-Bristled Hornedrush (<i>Rhynchospora corniculata</i>)	OBL
84. Thread-Leaved Beakrush (<i>Rhynchospora filifolia</i>)	FAC
85. Grass-Like Beakrush (<i>Rhynchospora globularis</i>)	FACW
86. Clustered Beakrush (<i>Rhynchospora glomerata</i>)	OBL
87. Drowned Hornedrush (<i>Rhynchospora inundata</i>)	OBL
88. Torrey's Beakrush (<i>Rhynchospora torreyana</i>)	FACW
89. Sacciolepis (<i>Sacciolepis striata</i>)	OBL
90. Sessile-Fruited Arrowhead (<i>Sagittaria rigida</i>)	OBL
91. Sandbar Willow (<i>Salix exigua</i>)	OBL
92. Canby's Bulrush (<i>Scirpus etuberculatus</i>)	OBL
93. Water Clubrush (<i>Scirpus subterminalis</i>)	OBL
94. Slender Nutrush (<i>Scleria minor</i>)	FACW
95. Pink Bog-Button (<i>Sclerolepis uniflora</i>)	OBL
96. Halberd-Leaved Greenbrier (<i>Smilax pseudo-china</i>)	FAC
97. Red-Berried Greenbrier (<i>Smilax walteri</i>)	OBL
98. Showy Goldenrod (<i>Solidago speciosa</i>)	UPL*
99. Two-Flowered Bladderwort (<i>Utricularia biflora</i>)	OBL
100. Fringed Yelloweyed-Grass (<i>Xyris fimbriata</i>)	OBL
101. Small's Yelloweyed-Grass (<i>Xyris smalliana</i>)	OBL

Table 7-7. (continued)

THREATENED PLANT SPECIES

Species	Wetland Plant Indicator Status*
1. Single-Headed Pussytoes (<i>Antennaria solitaria</i>)	UPL*
2. Giant Cane (<i>Arundinaria gigantea</i>)	FACW
3. Glade Fern (<i>Athyrium pycnocarpon</i>)	FAC
4. Maryland Bur-Marigold (<i>Bidens bidentoides</i>)	FACW
5. Button Sedge (<i>Carex bullata</i>)	OBL
6. Shoreline Sedge (<i>Carex hyalinolepis</i>)	OBL
7. Inflated Sedge (<i>Carex vesicaria</i>)	OBL
8. Leatherleaf (<i>Chamaedaphne calyculata</i>)	OBL
9. Red Turtlehead (<i>Chelone obliqua</i>)	OBL
10. Goldenseal (<i>Hydrastis canadensis</i>)	UPL*
11. Deciduous Holly (<i>Ilex decidua</i>)	FACW
12. Narrow-Leaved Bushclover (<i>Lespedeza augustifolia</i>)	FAC
13. Wild Lupine (<i>Lupinus perennis</i>)	UPL*
14. Climbing Fern (<i>Lygodium palmatum</i>)	FACW
15. American Lotus (<i>Nelumbo lutea</i>)	OBL
16. Red Bay (<i>Persea borbonia</i>)	FACW
17. Pale Green Orchis (<i>Platanthera flava</i>)	FACW
18. Purple Fringeless Orchis (<i>Platanthera peramoena</i>)	FACW
19. Spongy Lophotocarpus (<i>Sagittaria calycina</i>)	OBL
20. Englemann's Arrowhead (<i>Sagittaria engelmanniana</i>)	OBL
21. Northern Pitcher-Plant (<i>Sarracenia purpurea</i>)	OBL
22. Virginia Mallow (<i>Sida hermaphrodita</i>)	FAC
23. Featherbells (<i>Stenanthium gramineum</i>)	FACW
24. Mountain Pimpernel (<i>Taenidia montana</i>)	UPL*
25. Steel's Meadowrue (<i>Thalictrum steeleanum</i>)	FACU
26. Kate's-Mountain Clover (<i>Trifolium virginicum</i>)	FACW
27. Dwarf Trillium (<i>Trillium pusillum</i>)	FACW
28. Purple Bladderwort (<i>Utricularia purpurea</i>)	OBL

*The wetland plant indicator status according to Reed (1988). See Chapter 6 for discussion.

Table 7-8. Numbers and percentages of threatened and endangered plants of Maryland by wetland plant indicator status (according to Reed 1988). Data compiled in 1990 from the Maryland Natural Heritage Program.

Classification	Wetland Indicator Status of Plants	Number of Species	% of Endangered or Threatened Species
Endangered	OBL	54	53.5
	FACW	14	13.9
	FAC	10	9.9
	FACU	2	1.9
	UPL	21	20.8
Total		101	100
Threatened	OBL	10	35.7
	FACW	10	35.7
	FAC	3	10.7
	FACU	1	3.6
	UPL	4	14.3
Total		28	100

Table 7-9. Wildlife species using nontidal wetlands and classified as endangered, threatened, or in need of conservation in Maryland. Data compiled in 1990 from the Maryland Natural Heritage Program.

Group	Total Number of Species	Number of Species Using Nontidal Wetlands
Mammals	8	5 (1 "dependent")*
Birds	17	7 (6 "dependent")
Reptiles	8	3 (1 "dependent")
Amphibians	5	3 (3 "dependent")
38		18

*"Dependent" means that species directly depends upon nontidal wetlands for survival of the species.